GOVERNMENT OF INDIA
MINISTRY OF IRRIGATION

REPORT
OF
COMMITTEE ON COST CONTROL
OF
RIVER VALLEY PROJECTS

VOLUME-II

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GOVERNMENT OF INDIA
MINISTRY OF IRRIGATION
CENTRAL WATER COMMISSION

REPORT

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VOLUME II

PREFACE

The report of the Committee on Cost Control of River Valley Project comprises of Five volumes. The report of the Committee on the specific terms of reference and the recommendations are given in Volume I.

The Volume II of the report deals with Analysis of Rates both for manual as well as Machinery works. While framing the rate analysis, the changes in the technology of construction in the past few years have been kept in view as the break up of the operations of various items differ from what is being adopted in the conventional analysis. This volume is further sub-divided in three sections:

Section I:	Criteria for use rate of Machines and Analysis of Rates both for Manual as well as Machinery work.
Section II:	Hourly use Rate of Machine and Equipment.
Section III:	Main items of Universal Nature pertaining to River Valley Project and their analysis of Rates.

The Section III contains the analysis of rate of 49 items only although in all 57 items have been identified under para 3.09 of Volume I. The analysis of the rates of remaining 8 items were not considered necessary as these items are occasionally required for specific Jobs.

This is an attempt to evolve comprehensive standard schedule of Rates, at least for the Major items which largely constitute the major portion of the project estimate. Needless to say that due to diversity of existing construction practices there is bound to be some variations between the prevailing practice and the provisions in the standard schedule of Rates.

SECTION-I

GENERAL CRITERIA FOR

(a) HOURLY USE RATE OF MACHINES/EQUIPMENT

(b) ANALYSIS OF RATES BOTH FOR MANUAL AND MACHINERY WORKING

CONTENTS

CHAPTER-VI

VI. ANALYSIS OF RATES BOTH FOR MANUAL AS WELL AS MACHINERY ETC.
(Reproduced from Chapter VI of Vol.I)

Necessity and Limitations:

6.01 Under the terms of reference-II(d) of Committee on Cost Control of River Valley Projects, it is envisaged to prepare standard formats for analysis of rates of various standard items of universal nature pertaining to river valley projects both for manual and machine working. This is an attempt to evolve comprehensive standard schedule of Rates, at least, for the Major items which largely constitute the major portion of the project estimate etc. Needless to say that due to the diversity of existing construction practices there is bound to be some variation between the prevailing practice and the provisions in the standard schedule of Rates.

6.02 After Independence, the impact of Socio-economic development brought in its wake a certain degree of mechanisation in the developmental activities in the country. The gigantic multi-purpose River Valley Projects, which have been constructed called for deployment of heavy construction equipment on a large scale. Before proceeding for analysis of rate for a unit item by Machine working, it is essential to workout the hourly use rate of Machine/Equipment intended to be deployed in completion of the particular item. For analysis of hourly use rate some 42 Nos., of machines and equipments have been identified which are at present being normally deployed for various types of river valley projects. These machines include the latest type of equipments which are in use now a days. The list of these machines/equipments is enclosed as Annex. VI. There are several methods of determining the probable cost of owing and operating construction equipment. No known method will give exact cost under all operation conditions. At best, the estimate can only be a close approximation of the cost. Carefully kept records for the equipment previously used could perhaps give some informations which can be as a guide for a particular equipment. For working out the hourly use rate of equipments we have drawn materials from the projects of Ganga and Yamuna Valley and the CWC Guide book on transfer of used equipments. The general criteria adopted for analysis of Hourly use Rate of Machine/Equipment is dealt subsequently.

General Criteria:

6.03 The hourly use rate of the equipment comprises of the following elements:

(a) Ownership Cost:

(i) Depreciation;

(b) Operational Cost:

(i) Repair Charges;

(ii) Depreciation and repair of tyres and tubes;

(iii) Operators and maintenance crew charges;

(iv) P.O.L. and Energy charges;

(v) Miscellaneous supplies.

6.04 The various elements as mentioned above may be evaluated as below:

(A) OWNERSHIP COST:

(i) Depreciation:

The depreciation of the Machine ranges from book value to scrap value. The scrap value of the machine shall be 10% of the book value. Depreciation in respect of new machines/equipments chargeable to the work shall be calculated as under:

Hourly depreciation = $\frac{0.9C}{L}$ as shown in fig. 1 below.

Depreciation of used equipment on transfer shall be calculated in proportion to the hours worked to life in hours as also in proportion to the period elapsed since its acquisition till the date of transfer to the life in years and whichever is greater shall be taken as the depreciation of the Machine as shown in fig. 2 below.

The depreciation of the used equipment may be computed by the modified straight line method starting from the acquisition cost till 50% of the cost in 40% of the life and till the residual value of 10% of cost in the remaining 60% of life as shown in fig. 2.

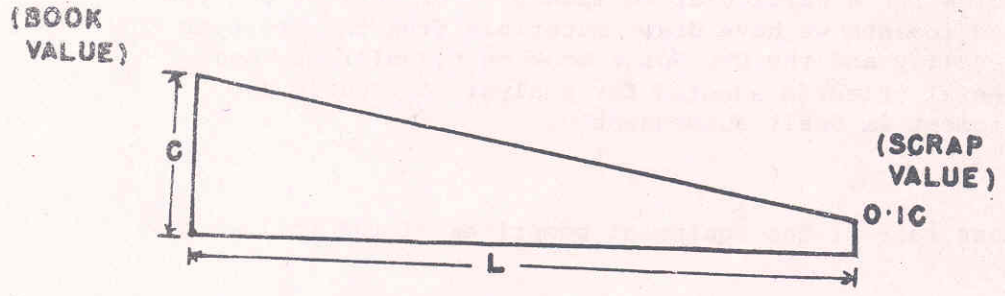


FIG.1. RESIDUAL VALUE DIAGRAM FOR NEW EQUIPMENT.

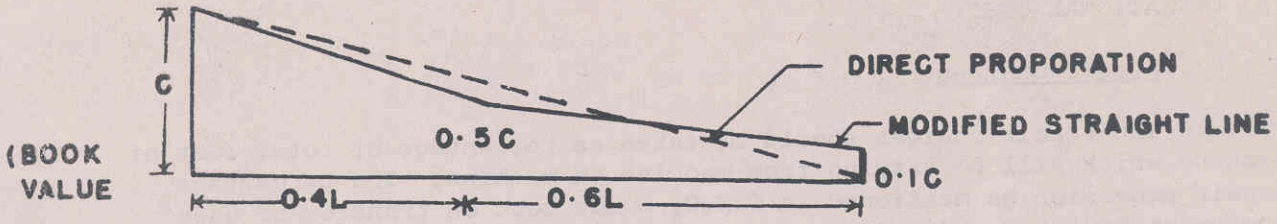


FIG.2. RESIDUAL VALUE DIAGRAM FOR USED EQUIPMENT- ON TRANSFER.

Where 'C' is the book value of the new Machine which includes cost of the equipment, all taxes, Insurance and Carriage charges to the site plus the charges spent on erection and Commissioning of the Machine.

'L' is the life span of the machine in hours which are given in Annex. VII as recommended by C.P.M.C. - 1972 and C.P.M. select group. In case of used equipment/machine the value of 'C' shall be taken as the current market price of the machine on the date of transfer. The depreciated value of the equipment shall then be worked out on the basis of the modified straight line diagram as shown in Fig.2 taking into consideration the market price of the machine.

Fig.2 implies that the rate of depreciation of the machine after 40% of life is more gradual. This looks rather anomalous.

Let

C_o = Original cost of new machine.

C'_o = Present cost of new machine.

Cd = Depreciated cost.

r = Rate of depreciation $\frac{0.90c}{L}$; H = Hours done by machine.

∴ The correct or more rational method of arriving at the present depreciation cost would be

$$Cd = \left[Co - \frac{0.90^{co}}{L} \times H \right] \times \frac{C_{o'}}{C_o}$$

Note: The depreciation of the equipment and tyres shall be calculated separately.

(B) OPERATIONAL COST:

(i) Repair Charges:

The repair charges should be taken as percentage of total cost of machine which will be varying from machine to machine. The percentage repair provision as mentioned in C.W.C. Guide book on transfer of used equipment have been adopted in the analysis of use rates of machines which are reproduced here in Annex. (VII).

(ii) Depreciation and Repair of Tyres and Tubes:

The hourly repair provision may be taken as 15% of the hourly depreciation. Depreciation of tyres and tubes should be calculated on cost of tyres and tubes over the life of tyres and tubes in hours.

(iii) Operators and Maintenance Crew Charges:

Operators and maintenance crew required to handle a particular machine/equipment, as mentioned in Annex. VIII have been adopted in the analysis of hourly use rate. The labour constants for handling of the machines are based mostly on the provisions of similar type of machines being used in the various projects of the State of Uttar Pradesh. The crew charges have been worked out as per actual annual cost over the operational hours during the year. The crew charges have been worked out for various categories as per formula given below:

$$\text{Hourly cost of particular category of worker.} = \frac{\text{Monthly Salary} \times 12}{\text{Annual operational construction hours of the machine.}}$$

The hourly cost of the entire crew deployed on the operation of a particular machine would thus be the sum total of the hourly cost of each labour.

The monthly rate of the various persons in the crew shall be taken as those prevalent in the States at the time of framing the project estimates. The annual operational hour of the machine can be worked out by knowing the total life of the machine in years and the scheduled operational hours.

As regards the quantum of hidden costs of the labour inspite of best effort it has not been possible to get actual details of expenditure on various elements of hidden cost and as such over and above the crew charges to worked out, a provision of 50% has also been made for hidden cost of labour to account for amenities to labour such as camp facilities, leave reserve, hill & hazard allowance and taking into account the non-working period in flood season.

(iv) P.O.L. Charge and Energy Charges:

Optimum fuel consumption per hour may be calculated from the following:

$$\frac{0.5 \times BHP \times c \times 4.5 \text{ litres per hour}}{8.26}$$

Where 0.5 is the specified fuel consumption of HSD and BHP is the rated H.P. of the Engine, 8.26 is the Lbs., to an imperial gallon of HSD.

Equipment used in the construction industry seldom operate at a constant output or at rated output, except for a short periods of time. A tractor engine may operate at maximum power when it is loading a scraper or negotiating an adverse slope. During the balance of its cycle the demand on the engine will be reduced substantially, resulting in decreased consumption of fuel. To allow for this the value of load factor (C) may be taken as follows as recommended by the construction plant and machinery Committee - 1972, taking into consideration the condition also.

		Excellent	Average	Severe
(i)	Wheel type equipment (on road)	0.25	0.30	0.40
(ii)	Wheel type equipment (off road)	0.50	0.55	0.60
(iii)	Truck type Tractors	0.50	0.63	0.75
(iv)	Excavators	0.50	0.55	0.60

Construction equipment is seldom operated the 60 min. in an hour and therefore, the actual fuel consumption has been adopted as 2/3 of the optimum fuel consumption worked out from the above formula.

20 to 25% of the cost of fuel might be provided for the purpose of cost of lubricants depending upon the type of equipment. The electrical energy charges would be as per actuals.

(v) Miscellaneous Supplies

The hourly Miscellaneous provision may be kept at 10% of the hourly repair provision. However, this may be suitably increased for the machine using wire ropes, cuttings edges etc., and in adverse job conditions.

6.05 Based on above, the formats for working out hourly use rate of various equipments deployed in River Valley Projects construction are given in the Volume II.

GENERAL CRITERIA FOR ANALYSIS OF RATES:

6.06 Preparation of Project Estimates for any river valley project requires calculation of the quantities of various items involved, working out their analysis of rates and computations of their cost. While the quantities depend upon the layout and the type of work to be executed, the cost would depend upon the unit rate of items of works involved in the construction of the project. The analysis of rates for various items is worked out taking into consideration the cost of materials, labour and the share of machines involved in executing various items of the work.

6.07 As the Project cost estimates are made before the work is done, the estimate cost is only an indication of the order of the actual cost. The agreement between the estimated and actual cost would depend substantially upon the accuracy with which this analysis is done, which implies the use of precise estimating methods and correct visualisation of the manner in which the work would be executed and the sequence of operation necessary.

6.08 Analysis of rates include assessment of five essential aspects contributing towards the cost of an item of work:

(a)	Criteria:	Estimating various operations involved.
(b)	Material Cost:	Evaluation of material constants, requirement of quantities and costs.
(c)	Labour Cost:	Estimating Labour constants and costs.
(d)	Plant Cost:	Estimating the type & No., of equipment needs to workout hourly use rate of.
(e)	Contractor's Overhead & Profits:	Cost of supervision charges and allocating and reasonable Contractor's profit.

CRITERIA:

6.09 To facilitate the analysis of rate for any particular item of work, the various operations contributing towards the item of work are to be analysed separately. A particular operation in turn involves the application of a group of workers, materials and equipment. A complete analysis of rate, therefore, requires the determination of costs for various operations developing the cost from basic rates of labour, material and machines for the operation.

MATERIAL COST:

6.10 The quantitative assessment of material requirements may be taken as recommended in the report of the rates and cost committee of January

'56. The quantitative assessment in respect of certain item if not available in the report may be adopted from other authoritative books or through independent calculations based on data of the other projects.

6.11 The unit cost of various materials may be taken as those prevalent in the States. The appropriate cost for freight, unloading, cartage, storage, inspection and testing etc., should also be included. The rates of cement, steel explosives, diesel, oil, petrol etc., should be based on the latest circulars, from the office of the Director General of Supplies and Disposal, State Trading Corporation and Indian Iron and Steel Controller respectively. The rates of other items may be adopted as being obtained on the projects of nearby area.

6.12 Over and above the theoretical quantities of materials computed by existing norms and practices there should be an adequate provision for wastage allowance and incidentals to the work in the analysis of rates on all accounts including handling, short weight, losses in storage etc. This allowance or wastage and incidentals to work may be taken upto 5% of quantities in case of cement, while for steel this provisio may be made upto 2½% only as there will be some salvage value of the steel scrap. In the analysis of rates this provision has been mad @ 5% for cement and 2½% for steel reinforcement, and gates etc.

LABOUR COST:

6.13 The time which a labourer takes in performing a unit of work would vary with personal factors such as climatic conditions, job supervision and complexities of operation. The assessment of output of labour should be made as per recommendations contained in the report of Rates and Cost Committee January 1956 (Part-I). The labour constants, required for certain items not covered by the above report; may be taken in consultation with those adopted in the various river valley projects of similar nature.

WAGE RATE AND HIDDEN COST OF LABOUR:

6.14 Daily wage rate structure as given in Table 15.2.1 of the report of rates and cost committee Jan.,'56 need enhancement due to rise in price index. The wages of workers are periodically revised by the State under the statutory Labour Laws and daily wage rates therefore, should be taken as those prevalent in the States at the time of formulation of the projects.

6.15 Apart from the basic wage of a worker, there are other liabilities accrued due to benefits and amenities which are given to workers on river valley projects. These benefits and amenities may be on account of the following items:

(i) Hill compensatory allowance

(ii) Hazard allowance

(iii) Travelling allowance

(iv) Medical expenses or benefits.

(v) Workman compensation.

(vi) Free water supply and Power.

(vii) Subsidized ration.

(viii) Mess Services.

(ix) Other amenities likely free dresses, gum boots, helmets, woollens and mess utensils.

Besides above, in the River Valley Projects, work cannot continue throughout the year as it has to be stopped during the flood season. In some projects casual workers system is not accepted and continuity of the service is given to many workers depending upon the situation at the project and prevalent practices. The effect of this should also have to be considered in the wage rates. The judicious provision of this hidden cost of labour, therefore, has to be made over and above the basic wage rate of the labour for each individual project depending on the Statuary provisions applicable and practices prevalent for benefits and amenities of workers in the project. In the analysis of rates, this hidden cost of labour has been adopted as 50% of the direct labour cost.

PLANT COST:

6.16 The report of the "Construction Plant and Machinery Committee" of 1972 has laid down guide lines for "hourly use rates" of equipments and have made recommendations for life of equipment and repair provision etc. These norms have been adopted for determination of the cost of operations of the plant. The hourly use rate of any equipment comprising of all the charges have already been dealt in the para 6.03.

6.17 Prices of various equipment at project site should be taken on the basis of recent quotations including all taxes and freight etc., where as the life of machines and the charges on account of depreciation, repairs and maintenance should be taken as given in the Para 6.03 General Criteria on hourly use rate of various machines and equipments. The proforma for use rate of 42 machines and equipments as listed in Annex.VII are given separately in Volume II.

CONTRACTOR'S OVERHEAD & PROFITS:

6.18 For any job analysis the following two aspects are to be considered:

(a) Items charged to work.

(b) Managerial charges.

The items, charged to works, are the preliminary and enabling works such as ramps, work sheds, water supply, electrification arrangements, plant foundation and erection etc. Where as the managerial charges which constitute the Contractor's over-head should include (i) Emoluments of managerial and clerical staff (ii) General establishment watch and ward, sanitary and mess etc., (iii) Local conveyance (iv) Travelling expenses (v) medical and sanitation (vi) Social welfare (vii) Office expenses and (viii) share of head office expenses. The interest of all types and Bank Guarantee charges are considered direct charges and rightly debitable to works.

In addition to the contractor over-heads, a reasonable percentage of profit be allowed to the contractor. Since it is difficult to identify over-heads and profits precisely, both those together may be provided at 20% of the prime cost in the analysis of rates.

In case of departmental works, it is expected that the additional departmental charges, which may not include profit, would also be about 20%.

Based on above, the format for analysis of rates of various items as indicated in para 3.09 are dealt in Volume-II.

N.B.: Whenever standard or schedule of rates are revised or there is necessity to do so, the primary guiding principal should be escalation in labour and material cost and not the trend of rates quoted by the Contractors.

6.19 CONCLUSION AND RECOMMENDATIONS:

(i) For fixing the hourly use rate of Machines and Equipments the evaluation of various elements of ownership and operation cost should be done as detailed out.

(ii) Format for working out hourly use rate of various machines and equipment deployed in River Valley Projects construction as given in Volume II be followed.

(iii) Judicious provision of hidden cost of labour has to be made over above the basic wage of the labour depending on statutory provisions applicable and practices prevalent for benefits and amenities to workers in the project. In the format of analysis this hidden cost has been adopted as 50% of the direct cost of labour.

(iv) It is difficult to identify overheads and profits precisely a provision at 20% of prime cost as made in the analysis of rate is recommended.

(v) Format of Analysis of items of Universal Nature as indicated in para 3.09 and as dealt in Volume II is recommended.

(vi) Where standard or schedule of rates are revised or where is necessity to do so, the primary guiding principle should be escalation in Labour and Material Cost and not the trend of rates quoted by contractors.

LIST OF MACHINES/EQUIPMENT

Sl.No.	Name of Machine:
1.	Drill Jumbo
2.	Jack hammer
3.	Wagon drill
4.	Scalling hammer
5.	Drill Steel
	(a) for wagon drill
	(b) for Jack hammer
6.	Locomotive diesel
7.	Locomotive battery
8.	Muck car
9.	Shotcrete machine
10.	Drilling machine
11.	Convey mucker
12.	Overhead Loader
13.	Front end loader
14.	Pusher leg
15.	Auto feed
16.	Pneumatic concrete placer
17.	Grouting machine
18.	Ventilation blower
19.	Agitating car
20.	Diesel shovel(2.0 cum)
21.	Electric shovel
22.	Air Compressor diesel - 210 c.f.m.
23.	Air Compressor diesel - 300 c.f.m.
24.	Air Compressor diesel - 500 c.f.m.
25.	Air Compressor Electrical - 500 c.f.m.
26.	Air Compressor Electrical - 1500 c.f.m.
27.	D-8 class Tractor dozer.

28. D-9 class Tractor dozer
29. 35t rear dumper
30. Hydraulic excavator
31. Dumper (15T)
32. Tipper Truck (7t)
33. Crushing & processing plant
34. Batching & mixing plant
35. Mobile crane 10t
36. Electrical pump-50 H.P.
37. Electrical pump-15 H.P.
38. Shutter - 6.0 m long
39. D-4 Tractor with Turindrum sheep foot roller
40. Ropeway
41. Vibratory rollers
42. Pneumatic tyred rollers.

LIFE & REPAIR PROVISION OF EQUIPMENT

Sl. No.	Equipment		Life of Equipment		Repair provision (%age of cost of Equipment	Remarks
	Category	Capacity	Years	Hours		
1	2	3	4	5	6	7
1.	Excavators	Upto 1.5 cu. yds	10	12,000	150	
	Shovels & Draglines	1.5 to 3.0 cu. yds. (Diesel)	12	15,000	150	
		Above 3.0 cu yds. (Diesel)	15	25,000	150	
		2.5 to 4 cu. yds. (Electric)	15	25,000	150	
		4 cu. yds. & above (Electric)	20	40,000	150	
	Walking Drag-lines.		20	30,000	150	
	Bucket Wheeled Excavators.		20	40,000	150	
	Dredger in Fresh water	Hull	25	-	60	
		Machine	10	-	60	
	Barges	Hull	16	-	60	
		Machine	10	-	60	
	Tugs	Hull	16	-	60	
		Machine	10	-	60	
2.	Dumpers					
	Bottom Dumpers	Upto 20 T	8	10,000	140	
		20 T to 50 T	10	16,000	140	
		Above 50 T	12	20,000	140	
	Rear Dumpers	Upto 15 T	8	10,000	140	
		15 T to 35 T	10	12,000	140	

1	2	3	4	5	6	7
		Above 35 T Upto 50 T	12	15,000	140	
		50 T above	15	20,000	140	
	Highway Dumpers.		8	10,000	140	
3.	Scrapers					
	A. Motorised					
	Push Loaded	Upto 10 cuyds	8	9,000	150	
		Above 10 cuyds	10	10,000	150	
	Elevating and Self-loading		10	10,000	150	
	B. Towed		12	15,000	75	
4.	Tractors					
	Crawler	Upto 100 HP	8	9,000	200	
		Above 100 to 300 HP	10	12,000	240	
		Above 300 HP	12	16,000	240	
	Wheeled	Upto 75 HP	8	12,000	150	
		Above 75 HP	10	15,000	150	
5.	Graders		10	12,000	150	
6.	Loaders					
	Crawler		10	12,000	200	
	Wheeled		10	15,000	150	
	Belt Loaders		16	20,000	70	
	Reclaimers & Stackers		20	30,000	70	
7.	Compactors					
	Self-propelled Sheepsfoot Rollers		10	12,000	80	

1	2	3	4	5	6	7
	Drawn Sheeps-foot Rollers		8	10,000	70	
	Vibratory Rollers		8	8,000	150	
	Smooth drum Rollers		8	10,000	80	
	Smooth drum Vibratory Rollers		8	8,000	150	
	Pneumatic tyred Rollers		8	10,000	80	
	Highspeed Compactors		10	16,000	100	
8.	Water Sprinklers		10	16,000	100	
9.	Canal Trimmer and lining Equipment above 200 cuyds/Hr.		16	20,000	180	
10.	Drills					
	Blast hole drills		10	10,000	80	
	Core Drills		8	8,000	80	
	Wagon Drills		8	8,000	80	
	Tricone rotary Drills		10	10,000	80	
11.	Compressors					
	A. Diesel Compressors.					
	i) Portable upto 300 c.f.m.		8	10,000	100	
	ii) Portable above 300 c.f.m.		10	12,000	100	
	B. Electric Compressors.					
	i) Portable upto 300 c.f.m.		10	16,000	80	

1	2	3	4	5	6	7
	ii) Portable above 300 c.f.m.		12	20,000	80	
	iii) Stationery		20	30,000	80	
12.	Blowers		12	-	80	
13.	Cooling Plants					
	i) Aggregate Cooling plant		20	40,000	75	
	ii) Ice Plant		20	40,000	75	
14.	Batching and Mixing Plant					
	i) Cement handling Batching & Mixing Plant		18	30,000	75	
	ii) Transit Mixers		10	10,000	120	
	iii) Agitating Cars		10	10,000	120	
	iv) Portable Concrete mixers		5	6,000	80	
15.	Pumps					
	i) Diesel Engine		8	10,000	100	
	ii) Electrical		12	20,000	70	
16.	Well Points		12	20,000	100	
17.	Cranes					
	i) Mobile (Pneumatic Wheeled)		12	12,000	120	
	4 to 6 tons		10	12,000	120	
	8 to 12 tons		10	12,000	120	
	15 to 25 tons		12	15,000	120	
	26 tons & above		12	15,000	120	

1	2	3	4	5	6	7
	ii) Crawler Mounted					
		Upto 3 tons	10	12,000	120	
		4 to 10 tons	10	12,000	120	
		Over 10 tons	12	15,000	120	
	iii) Tower Cranes		20	30,000	120	
	iv) Truck mounted		10	16,000	140	
18.	Transport Equipment					
	A. Heavy Transport vehicles.					
		a) Trucks & Highway Dumpers				
		i) Diesel upto 3 T	10	2,00,000 km	140	
		Diesel 3 to 5 T	10	2,00,000 km	140	
		5 T and above	10	2,00,000 km	140	
		b) Tractor Trailers				
		upto 5 T	10	2,50,000 km	140	
		5 T to 10 T	10	2, 50,000 km	140	
		10 T and above	12	20,000 Hrs	140	
	B. Light Transport Vehicles.					
		i) Jeeps		1,60,000 km	140	
		ii) Stations Wagons		1,60,000 km	140	
		iii) Cars		1,60,000 km	140	
		iv) Ambulance cars		1,60,000 km	140	
	C. Ariel Transport					
		i) Ropeways	20	40,000	70	
		ii) Cableways	20	40,000	70	
	D. Rail Transport Locomotives					
		Diesel	10	16,000	120	
		Electrical	22	40,000	100	
		Wagons	20	30,000	70	
		Rail Cars	20	30,000	70	
19.	Diesel Generating Sets					
	Upto 50 KVA		10	20,000	100	
	Above 50 KVA		15	30,000	120	

TABULATION OF OPERATING & MAINTENANCE CREW ADOPTED IN THE HOURLY USE RATE OF EQUIPMENT

Sl. No.	Name of Equipment	Operation & Maintenance crew required for the operational of the M/C									
		Foreman	Operator	Mechanic	Helper	Watchman	Electrician	Supervisor	Driver	Cableman	Beldar
1	2	3	4	5	6	7	8	9	10	11	12
1.	Drill Jumb	1/8	2	1/4	4	1/4	-	-	-	-	-
2.	Jack Hammer (52 Lbs)	-	1	1/8	1/2	1/8	-	1/5	-	-	-
3.	Wagon Drill	1/8	1	1/8	1	1/4	-		-	-	-
4.	Scaling Hammer	-	1	-	1/2	1/10	-	1/8	-	-	-
5.	Drill Steel	-	-	-	-	-	-	-	-	-	-
6.	Locomotive Diesel	1/8	1	1/4	1	1/4	-	-	-	-	-
7.	Locomotive Battery (for 12 Cu.yd.	1/8	1	1/4	1	1/4	-	-	-	-	-
8.	Muck/car) (12 cu. yd.)	-	-	-	-	-	-	-	-	-	-
9.	Shortcrete M/C	1/8	1	1/2	1	1/4	-	-	-	-	-
10.	Drilling Machine	1/8	2	1/4	3	1/4	-	-	-	-	-
11.	Convey mucker (1.5 cu.yd. 42 wide conveyer)	1/8	1	1/6	1	1/4	-	-	-	-	-
12.	Overhead Loader (1 cu.yd.)	1/8	1	1/4	1	1/2	-	-	-	-	-
13.	Front end Loader (2 cu.yd.)	1/8	1	1/4	1	1/6	-	-	-	-	-

1	2	3	4	5	6	7	8	9	10	11	12
14.	Pusher leg	-	-	-	-	-	-	-	-	-	-
15.	Auto feed	-	-	-	-	-	-	-	-	-	-
16.	Pneumatic concrete placer	1/8	1	1/6	1	1/6	-	-	-	-	-
17.	Grouting Machine	1/8	1	1/6	1	1/6	-	-	-	-	-
18.	Ventilation Blower (2000 c.f.m.)	-	1/4	1/4	1/2	-	-	-	-	-	-
19.	Agitating car (4 cu.yd.)	1/8	1/2	1/4	1/2	1/6	-	-	-	-	-
20.	Diesel Shovel 2 cum, 262 HP	1/4	1	1/2	1	1/4	-	1	-	-	-
21.	Electric Shovel 5 cum, 350 HP	1/4	1	1/2	1	1/4	1/2	1	-	2	-
22.	Air Compressor (Diesel) 210 c.f.m., HP 61.5	1/8	1	1/4	1	1/4	-	-	-	-	-
23.	Air Compressor (Diesel 300 cfm HP 94.3	1/8	1	1/4	1	1/4	-	-	-	-	-
24.	Air Compressor (Diesel) 500 cfm 148 HP	1/8	1	1/4	1	1/4	-	-	-	-	-
25.	Air Compressor (Electric, 500 cfm 90 KWH	1/8	1	1/4	1	1/4	1/2	-	-	-	-
26.	Air Compressor (Electric, 1500 cfm 240 KWH	1/8	1	1/3	1	1/4	1/2	-	-	-	-

1	2	3	4	5	6	7	8	9	10	11	12
27.	D-8 class Tractor Dozer (HP270)	1/4	-	1/4	1	1/4	-	-	1	-	-
28.	D-9 class Tractor Dozer (385 HP)	1/4	-	1/4	1	1/4	-	-	1	-	-
29.	Rear Dumper (35 Tonne)	1/4	-	1/4	1	1/4	-	-	1	-	-
30.	Hydraulic Excavater (1.25 cu.yd. HP 103.50)	1/4	1	1/4	1	1/4	-	-	-	-	-
31.	Dumper (15 T)	1/8	1	1/6	1	1/6	-	-	-	-	-
32.	Tipper Truck (7.0 T)	-	-	1/8	1 (Cleaner)	1/6	-	-	1	-	-
33.	Crushing & Processing Plant (220 T)	1	2	1/4	-	1	-	-	-	-	20
34.	Batching & Mixing Plant (35 cu. yd./hr.)	1/2	2	1/2	-	1	-	-	-	-	6
35.	Mobile Crane (10 T)	1/4	1	1/4	2 (1 helper + 1 chargeman)	1/4	1/4	-	-	-	-
36.	Electrical Pump (50 HP)	-	1	1/4	1	-	1/6	-	-	-	-
37.	Electrical Pump (15 HP)	-	1	1/4	-	-	1/8	-	-	-	-
38.	Shutter 6 m long	1/4	2	-	4	1/4	-	-	-	-	-

1	2	3	4	5	6	7	8	9	10	11	12
39.	D-4 Tractor with Turind Sheep Feet Roller.	1/8	1/6	-	1/2	-	-	-	1	-	-
40.	Ropeway	1	-	8 (Fitter)	2 (Greaser)	1	3	-	-	-	24
41.	Vibratory Roller (62 HP)	1/8	1	1/4	1	1/8	-	-	-	-	-
42.	Pneumatic Tyred Roller	1/8	1	1/4	1	1/8	-	-	-	-	-

SECTION - II

HOURLY USE RATE

OF

MACHINERY/EQUIPMENT

ANALYSIS OF HOURLY USE RATE OF EQUIPMENT

1. Drill Jumbo:

a) Depreciation:

i) Cost of drill jumbo at site including all taxes freight and insurance = Rs.

Life of Drill Jumbo = 10 yrs.

Rated life of Drill Jumbo = 12,000 hrs.

Depreciation per hr. = $\frac{0.90 \times \text{Total cost}}{\text{Life hours.}}$ = Rs.

b) Repairs and maintenance charges @ 60% of Depreciation of machine = Rs.

c) P.O.L. Charges:

Fuel = Nil

Sundries & other miscellaneous supplies @ 10% repairs & maintenance (b) above = Rs.

Total P.O.L. Charges = Rs.

d) Labour charges:

Rated life in hrs./yr. = 12000/10 = 1200 hrs.

i) Operators = $\frac{\text{Monthly rate} \times 12 \times 2}{1200}$ = Rs.

ii) Helpers = $\frac{\text{Monthly rate} \times 12 \times 4}{1200}$ = Rs.

iii) Foreman = $\frac{\text{M.R.} \times 12 \times 1}{1200 \times 8}$ = Rs.

iv) Mechanic = $\frac{\text{M.R.} \times 12 \times 1}{1200 \times 4}$ = Rs.

v) Chowkidar = $\frac{\text{M.R.} \times 12 \times 1}{1200 \times 4}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges per hr. = Rs.

Hence Hourly use rate of drill Jumbo (a + b + c + d) = Rs.

2. Jack Hammer (52 Lbs):

a) Depreciation charges:

i) Cost of jack hammer at site including all Taxes freight & Insurance = Rs.

ii) Life of jack hammer in year = 10

iii) Rated life of jack hammer in hours = 10,000

Depreciation per working hr. $\frac{\text{cost x } 0.90}{10,000}$ = Rs.

b) Repairs & Maintenance:

@ 60% of depreciation of M/C (As per table) 3.12.1 page 51 of R&CC report Jan'56 = Rs.

c) P.O.L. Charges:

Compressed air (As per specification) 100 c.f.m. = mm/ = Rs.

i) Cost of compressed air @_____per 100 c.f.m. = Rs.

ii) Lubricants & Grease waste etc. @ 25% of item c(i) above = Rs.

iii) Sundries & miscellaneous supplies at 10% of item (b) above = Rs.

iv) Pneumatic rubber hose pipe 38 mm with fitting 15m @ Rs.../metre per 100 working hrs. = Rs.

Total P.O.L. charges (i+ii+iii+iv) = Rs.

d) Labour Charges:

Rated life in hrs./ry. = $\frac{10000}{10}$ = 1000

i) Operator = $\frac{M.R. \times 12 \times 1}{1000}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 1}{1000 \times 2}$ = Rs.

iii) Supervisor = $\frac{M.R. \times 12 \times 1}{1000 \times 5}$ = Rs.

iv) Mechanic = $\frac{M \times 12 \times 1}{} \times \frac{1}{8} \times \frac{1}{1000}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1000 \times 8}$ = Rs.

Direct labour charges: = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges = Rs.

Hourly use rate of Jack Hammer (a + b + c + d) = Rs.

3. Wagon Drill:

a) Depreciation Charges:

Life of wagon drill in years = 8 yrs.

Cost of wagon drill at site = Rs.

Rated life of wagon drill = 8,000 hrs. (As per C.W.C. Guide book on transfer of used equipments)

(Depreciation per hr. = $\frac{0.90 \times \text{Total cost}}{8,000}$ = Rs.

b) Repairs and maintenance charges (As per C.W.C. Guide book on transfer of used equipment)

Repairs & maintenance charges @ 80% of the depreciation = 0.80 x depreciation = Rs.

c) P.O.L. Charges:

i) Consumption of compressed air for wagon drill = 400 c.f.m.

Cost of compressed air @ Rs.___/100 cfm = Rs.

ii) Cost of lubricants @ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of (b) above = Rs.

Total P.O.L. charges: = Rs.

d) Labour charges:

Rated life in hr./yr. = 8000/8 = 1000

i) Foreman $= \frac{\text{M.R. x 12 x 1}}{} \times \frac{1}{8} \times \frac{1}{1000}$ = Rs.

ii) Operator $= \frac{\text{M.R. x 12 x 1}}{1000}$ = Rs.

iii) Mechanic $= \frac{\text{M.R. x 12 x 1}}{} \times \frac{1}{8} \times \frac{1}{1000}$ = Rs.

iv) Helper $= \frac{\text{M.R. x 12 x 1}}{1000}$ = Rs.

v) Supervisor = (M.R. x 12 x 1)/(1000 x 4) = Rs.

vi) Chowkidar $= \frac{\text{M.R. x 12 x 1}}{1000 \times 4}$ = Rs.

Direct labour charges: = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges per hr. = Rs.

Hourly use rate of wagon drill
(a + b + c + d) = Rs.

4. Scalling Hammer:

a) Depreciation charges:

Cost of hammer at site (including Taxes Insurance & freight) = Rs.

i) Life of scalling hammer in yr. = 10

ii) Rated life in hours = 10000

Depreciation Rate/hr. = $\frac{\text{Cost} \times 0.90}{10{,}000}$ = Rs.

b) Repairs & maintenance charges:

@ 60% of depreciation charges = Rs.

c) P.O.L. Charges:

Compressed air (As per specifications)

i) Cost of .... c.f.m. compressed air @ Rs... per 100 c.f.m. = Rs.

ii) Lubricants & grease etc. @ 25% of item c(i) above = Rs.

iii) Sundaries & miscellaneous supplies @ 10% of item (b) = Rs.

iv) Pneumatic rubber hose pipe 38 m dia with fitting etc. 15m long @ Rs...../metre per 100 hrs. = Rs.

Total P.O.L. charges: = Rs.

d) Labour charges:

Rated life in hrs./yr. = 10,000/10 = 1000

i) Operator = M.R. x 12 x 1/1000 = Rs.

ii) Helper = $\frac{\text{M.R.} \times 12 \times 1}{1000 \times 2}$ = Rs.

iii) Supervisor = $\frac{M.R. \times 12 \times 1}{1000 \times 8}$ = Rs.

iv) Chowkidar = $\frac{M.R. \times 12 \times 1}{1000 \times 10}$ = Rs.

Direct labour charges: = Rs.

Add for hidden cost of labour @ 50% of Direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of scalling hammer (a + b + c + d) = Rs.

5. Drill Steel:

I. Drilling with wagon Drill

The following drill equipments will be required for 10m deep drill holes with one wagon drill.

Shank adopter 1 No. @ Rs.....each = Rs.

Coupling sleeves 4 Nos. @ Rs.....each = Rs.

Extension Rod 3m @ Rs.....each rod = Rs.

Extension Rod 2.5m @ Rs.....each rod = Rs.

Extension Rod 2.0m @ Rs.....each rod = Rs.

Extension Rod 1.5m @ Rs.....each rod = Rs.

Extension Rod 1.0m @ Rs.....each rod = Rs.

Total: = Rs.

(The above costs are inclusive of all Taxes, Insurance, carriage to site and handling charges) = Rs.

Total capital cost: = Rs.

Economic life 460m drilling

= Rs

a) Cost of drill steel per metre of drilling

$$= \frac{\text{Total capital cost}}{460\text{m}} = \text{Rs.}$$

b) Cost of 4 point drill bit at site

Total bit life as specified on page 222 of the book 'Rock Drill data' by Ingersol Rand is 400'-500' Granite i.e. 130m

Cost of bit/m of drilling = $\frac{\text{Cost of bit}}{130}$ = Rs.

c) Sharpening charges @ Rs.0.60 per metre = Rs.

use rate of drill steel/metre

a) Cost of drill rods = Rs.

b) Cost of drill bits = Rs.

c) Cost of sharpening bits = Rs.

Total: = Rs.

II. Drilling with Jack hammer

Cost of ....m drill rod at site (Including cost of bit) = Rs.

Bit life = 130m

a) Rate/m of drill rod & bit = $\frac{\text{cost}}{130}$ = Rs.

b) Sharpening charges of bit L-s = Rs.

use rate of drill rods with bit/metre = (a + b) = Rs.

6. Locomotive Diesel:

a) Depreciation charges:

i) Cost of locomotive at site (including all taxes, Insurance & freight) = Rs.

ii) Life as per C.W.C. Guide book on transfer of used equipment = 16,000 hrs. = Rs.

iii) Life of diesel locomotive = 10 yrs.

Depreciation charges/hr=Cost x 0.90/16000 = Rs.

b) Repairs & maintenance charges:

@ 120% of cost of equipment (as per C.W.C. Guide book on transfer of used equipment) = Rs.

c) P.O.L. Charges:

Rated B.H.P. = 98

Actual fuel consumption/hr.

$$= \frac{0.5 \times 0.6 \times 98 \times 2/3}{8.26} \times 4.546 \text{ litres}$$

= 10.50 litres/hr.

i) Cost of 10.5 litres diesel oil @ Rs.../litre = Rs.

ii) Lubricants and grease etc. @ 25% of c(i) above = Rs.

iii) Miscellaneous supplies etc. @ 10% of Repairs provision at (b) above = Rs.

Total P.O.L. Charges: = Rs.

d) Labour Charges:

Rated life in hrs./yr. = $\frac{16000}{10}$ = 1600

i) Operator = $\frac{M.R. \times 12 \times 1}{1600}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 1}{1600}$ = Rs.

iii) Foreman = $\frac{M.R. \times 12 \times 1}{1600 \times 8}$ = Rs.

iv) Mechanic = $\frac{M.R. \times 12 \times 1 \times 1}{1600 \times 4}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1600 \times 4}$ = Rs.

Direct labour charges: = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of Diesel locomotive (a + b + c + d) = Rs.

7. Locomotive battery (For 12 cubic yard capacity muckcar)

a) Depreciation charges:

i) Total capital cost of locomotive including all taxes freight & insurance = Rs.

ii) Rated Life = 40,000 hrs.

iii) Life in yrs.= 22

Depreciation charges:

$$= \frac{\text{Total capital cost}}{40{,}000} \times .90$$ = Rs.

b) Repairs and maintenance charges:

@ 100% of cost of equipment/hr. (as per C.W.C. Guide book on transfer of used equipment = Rs.

c) P.O.L. Charges:

i) Battery set is charged after every 5 hrs. Electric charges including other Misc. charges/hr. L.S. = Rs.

ii) Battery set:

Cost of 2 sets of batteries = Rs.

Life = 6,000 hrs.

Depreciation charges: $\frac{\text{cost} \times 0.90}{6000}$ = Rs.

Lubricants etc.@ 25% of sub item (i) = Rs.

Sundries & Misc.supplies @ 10% of item (b) = Rs.

Total: = Rs.

d) Labour charges:

(Same as for diesel locomotive) = Rs.

Hourly use rate = (a + b + c + d) = Rs.

8. Muck Car: (12 cubic yard)

a) Depreciation charges:

i) Cost of muck car at site = Rs.

ii) Life of muck car in yrs. = 20

iii) Rated life of muck car in hrs. = 30000

Depreciation charges/hr. = $\frac{0.9 \times \text{cost}}{30,000}$ = Rs.

b) Repairs and maintenance charges:

@ 50% of depreciation = Rs.

c) P.O.L. Charges:

Fuel & Lubricants = Rs. Nil

Sundries etc. @ 10% of (b) above = Rs.

d) Labour charges:

Use rate of muck car/hr. = (a + b + c + d) = Rs.

9. Shotcrete M/C:

a) Depreciation charges:

i) Cost of M/C (Including all taxes, Insurance and freight) = Rs.

ii) Life of machine in yrs. = 10 yrs.

iii) Life of Machine = 15,000 hrs.

Depreciation charges/hr.

$= \frac{\text{Total cost of M/C}}{15,000} \times 0.90$ = Rs.

b) Repairs & maintenance charges:

@ 80% of depreciation (As per report of R & C.C. page 57) = Rs.

c) P.O.L. Charges:

Air consumption = 600 c.f.m.

i) Cost of 600 c.f.m. Compressor air @ Rs...../100 c.f.m./hr. = Rs.

ii) Lubricants and sundries etc. @ 25% of (i) above = Rs.

Total: = Rs.

d) Labour charges:

Rated life in hrs./yr. - 15000/10 = 1500

i) Operator = $\frac{M.R. \times 12 \times 1}{1500}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 1}{1500}$ = Rs.

iii) Mechanic = $\frac{M.R. \times 12 \times 1}{1500 \times 2}$ = Rs.

iv) Foreman = $\frac{M.R. \times 12 \times 1}{1500 \times 8}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1500 \times 4}$ = Rs.

Direct labour charges: = Rs.

Add for hidden cost of labour @ 50% of Direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of shotcrete machine (a + b + c + d) = Rs.

10. Drilling Machine:

a) Depreciation charges:

i) Cost of M/C including all taxes, insurance and carriage to site = Rs.

ii) Life of machine in yrs.

iii) Rated life of M/C = 8000 hrs.
(As per report of R & C.C. page 46 table 3.7.6 (i)

$$\text{Depreciation/hr.} = \frac{\text{Total cost} \times 0.90}{8000} = \text{Rs.}$$

b) Repairs and maintenance charges:

@ 80% of depreciation (As per R & C.C. report page 51 table 3.12.3) = Rs.

c) P.O.L. charges:

H.P. of engine = (As per specification)
H.P. of pump = (As per specification)

Total H.P. = Sum of both

Actual consumption of fuel = 65% or 2/3 of optimum consumption = $\frac{2}{3} \times 0.04 \times (\text{Total H.P.}) \times 4.54$ litres

i) Cost of ..... litres of diesel oil @ Rs..... per litre = Rs.

ii) Cost of lubricants @ 25% c(i) above = Rs.

iii) Cost of sundries and miscellaneous supplies @ 10% of item (b) = Rs.

d) Labour charges:

I - Drilling machine:

Rated life in hrs./yr. = 8000/8 = 1000

i) Operator $= \frac{\text{M.R.} \times 12 \times 2}{1000}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 3}{1000}$ = Rs.

iii) Mechanic = $\frac{M.R. \times 12 \times 1}{1000 \times 4}$ = Rs.

iv) Foreman = $\frac{M.R. \times 12 \times 1}{1000 \times 8}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1000 \times 4}$ = Rs.

Direct labour charges/hr. = Rs.

II - Pump

Rated life in hrs./hr. = 1000

i) Operator = $\frac{M.R. \times 12 \times 1}{1000}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 1}{1000}$ = Rs.

Direct labour charges/hr. = Rs.

Total direct labour charges/hr = I + II = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges = Rs.

Hourly use rate of (a + b + c + d) drilling machine = Rs.

11. Convey Mucker: (1.5 cubic yard 42" wide conveyor)

a) Depreciation Charges:

I. Machine:

i) Cost of M/C = (excluding belt) at site = Rs.

ii) Rated life = 15000 hrs.

iii) Life in yrs. = 10 yrs.

Depreciation charges of M/C/hr.= $\frac{\text{cost} \times 0.90}{15,000}$ = Rs.

II. Belt:

i) Cost of the belt at site = Rs.

ii) Life - 3000 hrs.

iii) Depreciation of belt/hr. = $\frac{\text{cost}}{3000}$ = Rs.

Total depreciation (I + II) = Rs.

b) Repairs & maintenance charges:

i) M/C (excluding belt)
@ 100% of depreciation charges = Rs.

ii) Belt:

@ 45% of depreciation charges = Rs.

Total repairs & maintenance charges
(b) (i) to (ii) = Rs.

c) P.O.L. Charges: (H.P. 165)

Electrical energy required

= 165 x 746 = 123 KEH

i) Charge of electrical energy @ Rs.../unit = Rs.

ii) Lubricants etc. @ 25% of c(i) above = Rs.

iii) Sundries and miscellaneous supplies
@ 10% of (b) = Rs.

Total P.O.L. Charges = Rs.

d) Labour charges:

Rated life in hrs./yr.= $\frac{15000}{10}$ = 1500

i) Operator = $\frac{\text{M.R. x 12 x 1}}{1500}$ = Rs.

ii) Helper = $\frac{\text{M.R. x 12 x 1}}{1500}$ = Rs.

iii) Foreman = $\frac{\text{M.R. x 12 x 1}}{1500 \times 8}$ = Rs.

iv) Mechanic $= \frac{M.R. \times 12 \times 1 \times 1}{6 \times 1500}$ = Rs.

v) Chowkidar $= \frac{M.R. \times 12 \times 1}{1500 \times 4}$ = Rs.

Direct labour charges: = Rs.

Add for hidden cost of labour @ 50% of Direct labour charges = Rs.

Total labour charges: = Rs.

Hourly use rate of convey mucker (a + b + c + d) = Rs.

12. Over Head Loader (1 cu.yd.)

a) Depreciation charges:

i) Cost of Eimco loader at site = Rs.

ii) Rated life = 20,000 hrs.

iii) Life in yrs. = 16

Depreciation charges/hr.

$= \frac{\text{Total cost}}{20,000} = 0.90$ = Rs.

b) Repair and maintenance charges:

@ 70% of cost of equipment/hr. = Rs.

c) P.O.L. Charges:

Rated H.P. = 160 H.P.

Consumption of Energy = 160 x 0.746

= 119.36 KWH

i) Energy charges for 119.36 units @ .....Rs. per unit = Rs.

ii) Lubricants and sundries @ 25% of c(i) above = Rs.

iii) Sundries and miscellaneous supplies @ 10% of (b) = Rs.

Total P.O.L. charges: = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{20000}{16}$ = 1250

i) Operator = $\frac{M.R. \times 12 \times 1}{1250}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 1}{1250}$ = Rs.

iii) Foreman = $\frac{M.R. \times 12 \times 1}{1250 \times 8}$ = Rs.

iv) Mechanic = $\frac{M.R. \times 12 \times 1}{1250 \times 4}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1250 \times 2}$ = Rs.

Direct labour charges: = Rs.

Add for hidden cost of labour @ 50% of Direct labour charges = Rs.

Total labour charges: = Rs.

Hourly use rate of overhead loader (a + b + c + d) = Rs.

13. Front End Loader (2 cy.yd.)

a) Depreciation charges:

Total cost of loader at site (Excluding tyres) = Rs.

Rated life = 15000 hrs.

Life in years = 10

I. Depreciation charges/hr.= $\frac{\text{Total cost} \times 0.90}{15,000}$ = Rs.

II. Total cost of tyres at site = Rs.

Life of tyres = 2800 hrs.

Depreciation charges for tyres

$$= \frac{\text{Total cost}}{2800} = \text{Rs.}$$

Total depreciation charges/hr./Rs. (I + II) = Rs.

b) Repair and Maintenance charges:

I. @ 15% of depreciation charges for loader = Rs.

II. @ 15% of tyre depreciation charges = Rs.

Total Repair and Maintenance charges/hr. = Rs.

c) P.O.L. Charges:

H.P. of equipment = 130 H.P.

Fuel consumption = 0.026 x 130 Gal (U.S)

= 0.026 x 130 x 3.785 litres

= 12.79 litres

i) Cost of 12.79 litres diesel @ Rs..../litre = Rs.

ii) Cost of Lubricants etc. @ 25% of c(i) above = Rs.

iii) Sundries and Miscellaneous supplies @ 10% of (b) = Rs.

Total P.O.L. Charges/hr. = Rs.

d) Labour charges:

Rated life in hrs./yr. $= \frac{15000}{10} = 1500$

i) Operator $= \frac{\text{M.R. x 12 x 1}}{1500}$ = Rs.

ii) Helper $= \frac{\text{M.R. x 12 x 1}}{1500}$ = Rs.

iii) Foreman $= \frac{\text{M.R. x 12 x 1}}{1500 \times 8}$ = Rs.

iv) Chowkidar $= \frac{\text{M.R. x 12 x 1}}{1500 \times 6}$ = Rs.

v) Mechanic $= \frac{\text{M.R. x 12 x 1 x 1}}{1500} \times \frac{1}{4}$ = Rs.

Direct labour charges: = Rs.

Add for hidden cost of labour @ 50% of Direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of Front end loader = (a + b + c + d) = Rs.

14. Pusher Leg:

a) Depreciation charges:

Total cost of equipment at site = Rs.

Rated life = 3000 hrs.

Life in yrs. = 5

Depreciation charges/hr. $= \frac{\text{cost}}{3000} \times 0.99$ = Rs.

b) Repair & maintenance charges:

80% of depreciation = Rs.

c) P.O.L. charges: NIL

d) Labour charges: NIL

e) Miscellaneous charges:

@ 10% of repair and maintenance charges = Rs.

Hourly use rate of pusher leg = (a + b + c + d + e) = Rs.

15. Auto Feed:

a) Depreciation charges:

i) Cost of equipment at site = Rs.

ii) Life in years = 8

iii) Rated life = 8000 hrs.

Depreciation charges/hr. $= \frac{\text{cost}}{8000} \times 0.90$ = Rs.

b) Repair and Maintenance charges:

@ 80% of depreciation = Rs.

c) P.O.L. Charges: = NIL

d) Labour charges: = NIL

e) Misc. charges: = Rs.

@ 10% of repair charges = Rs.

Hourly use rate of Auto feed (a + b + c + d + e)= Rs.

16. Pneumatic Concrete Placer: (1 cubic yard)

a) Depreciation charges:

i) Cost of machine with conveying device pipe & pipe fittings (30m) at site = Rs.

ii) Life in years = 10

iii) Rated life = 10,000

Depreciation charges/hr. $= \frac{\text{cost}}{10000} \times 0.90$ = Rs.

b) Repair and Maintenance charges:

@ 120% of depreciation = Rs.

c) P.O.L. charges:

Specified compressed air consumption = 200 c.f.m. (Refer page 369 of book Construction Equipment-Planning and Application by Dr.Mahesh Varma).

i) Cost of 200 c.f.m. compressed air @ Rs..... per 100 c.f.m. = Rs.

ii) Cost of oils and lubricant @ 25% of c(i) above = Rs.

iii) Sundries and miscellaneous supplies @ 10% of (b) = Rs.

Total P.O.L. charges: = Rs.

d) Labour charges:

Rated life in hrs./hr. = $\frac{10,000}{10}$ = 1000

i) Operator = $\frac{M.R. \times 12 \times 1}{1000}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 1}{1000}$ = Rs.

iii) Foreman = $\frac{M.R. \times 12 \times 1}{1000 \times 8}$ = Rs.

iv) Mechanic = $\frac{M.R. \times 12 \times 1}{1000 \times 6}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1000 \times 6}$ = Rs.

Direct labour charges/hr. = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hence hourly use rate of Pneumatic concrete placer (a + b + c + d) = Rs.

17. Grouting Machine:

a) Depreciation charges:

Cost of machine at site including grouting mixer and grouting agitator = Rs.

Life in years = 10

Rated life = 10,000 hrs.

(As per report of rates and cost committee page 48, the rate of depreciation is 2% per month. Taking 25 working days in a month and 8 working hrs. in a day)

Depreciation charges = $\frac{\text{cost} \times 0.90}{10,000}$ = Rs.

b) Repairs & maintenance charges:

@ 80% of depreciation
(As per R & C.C. Report page 51
Table 3.12.3) = Rs.

c) P.O.L. charges:

(Air requirement for grouting = 200 c.f.m.
(Refer T.M. No. 646 U.S.B.R. for pressure grouting)

i) Cost of 200 c.f.m. compressed air
@ Rs.....% c.f.m. = Rs.

ii) Cost of Lubricants & sundries etc.
@ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies
10% of (b) = Rs.

Total P.O.L. charges/hour = Rs.

d) Labour charges:

Rated life in hrs./yr. = 10000/10 = 1000

i) Operator = $\frac{\text{M.R.} \times 12 \times 1}{1000}$ = Rs.

ii) Helper = $\frac{\text{M.R.} \times 12 \times 1}{1000}$ = Rs.

iii) Foreman = $\frac{\text{M.R.} \times 12 \times 1}{1000 \times 8}$ = Rs.

iv) Mechanic = $\frac{M.R. \times 12 \times 1}{1000 \times 6}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1000 \times 6}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of Grouting machine (a + b + c + d) = Rs.

18. Ventilation Blower: (20,000 c.f.m.)

a) Depreciation charges:

I. Blower:

i) Life in years = 12

ii) Cost at site including erection = Rs.

iii) Rated life - 58,000 hrs.

Depreciation charges of blower/hr.

$= \frac{cost \times 0.90}{58,000}$ = Rs.

II. Air Duct:

Cost of 300 m, 600 mm diameter air dict including fitting at site = Rs.

Rated life = 30,000 hrs.

Depreciation charges of air duct/hr.

$= \frac{cost \times 0.90}{30,000}$ = Rs.

Total depreciation charges/hr. (I + II) = Rs.

b) Repairs & maintenance charges:

i) Blower:

@ 80% of depreciation/hr. = Rs.

ii) Air duct:

@ 10% of depreciation/hr. = Rs.

Total Repair and Maintenance charges/hr. (I + II) = Rs.

c) P.O.L. charges:

H.P. of motor = 20

Energy required/hrs. = 20 x 0.746 KWH
= 14.92 units

i) Cost of electrical energy (14.92 units) @ Rs.....per unit = Rs.

ii) Lubricants @ 25% of c(i) above = Rs.

iii) Sundries and miscellaneous supplies @ 10% of (b) = Rs.

Total P.O.L. charges = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{58000}{12}$ = 4833 = Rs.

i) Mechanic = $\frac{M.R. \times 12 \times 1}{4833 \times 4}$ = Rs.

ii) Operator = $\frac{M.R. \times 12 \times 1}{4833 \times 4}$ = Rs.

iii) Helper = $\frac{M.R. \times 12 \times 1}{4833 \times 2}$ = Rs.

Direct labour charges/hr. = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of Blower (a + b + c + d) = Rs.

19. Agitating Car:

a) Depreciation charges:

i) Cost of Agitating car at site = Rs.

ii) Rated Life = 10,000 hrs.

iii) Life in yrs. = 10

Depreciation charges/hr. = $\frac{\text{cost} \times 0.90}{10,000}$ = Rs.

b) Repair & maintenance charges:

@ 120% of cost of equipment/hr. = Rs.

c) P.O.L. charges:

H.P. of Electric motor = 5 H.P.
The motor would work on batteries and taking efficiency of battery charger as 70%, the electrical energy consumed.

per hour = $\frac{5 \times 0.746}{0.7}$ = 5.33

i) Cost of electrical energy 5.35 units @ Rs.....per unit = Rs.

ii) Lubricants and oils @ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of (b) = Rs.

Total P.O.L. charges: = Rs.

d) Labour charges:

Rated life in hrs/hr. = $\frac{10000}{10}$ = 1000

i) Operator = $\frac{M.R. \times 12 \times 1}{1000 \times 2}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 1}{1000 \times 2}$ = Rs.

iii) Foreman = $\frac{M.R. \times 12 \times 1}{1000 \times 8}$ = Rs.

iv) Mechanic = $\frac{M.R. \times 12 \times 1}{1000 \times 4}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1000 \times 6}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hence hourly use rate of agitating car (a + b + c + d) = Rs.

20. Diesel Shovel: (2.0 cum H.P. 262)

a) Depreciation charges:

Cost of shovel including accessories at site = Rs.

Life in years = 12

Life of machine = 15,000 hrs.
(As per C.W.C. Guide book on transfer of used equipment)

Depreciation per hr. = $\frac{\text{Cost} \times 0.90}{15,000}$ = Rs.

b) Repairs & Maintenance charges:

150% of cost of equipment/hr. = Rs.
(As per C.W.C. Guide book on transfer of used equipment)

c) P.O.L. charges:

Rated H.P. = 262

Actual fuel (diesel) consumption per hr.

$$= \frac{2/3 \times 0.5 \times H.P. \times 6 \times 4.546}{8.26}$$

$$= 0.026 \times H.P. \times 4.546 \text{ litre}$$

(Refer book "construction equipment planning and application" by Dr. Mahesh Varma)

i) Cost of.....litres diesel @ Rs...../litre = Rs.

ii) Cost of lubricants and grease etc. @ 25% of c(i) above = Rs.

iii) Sundries and miscellaneous supplies @ 10% of (b) = Rs.

Total P.O.L. charges = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{15,000}{12}$ = 1250

i) Operator = $\frac{M.R. \times 12 \times 1}{1250}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 1}{1250}$ = Rs.

iii) Foreman = $\frac{M.R. \times 12 \times 1}{1250 \times 4}$ = Rs.

iv) Mechanic = $\frac{M.R. \times 12 \times 1}{1250 \times 2}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1250 \times 4}$ = Rs.

vi) Supervisor = $\frac{M.R. \times 12 \times 1}{1250}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of shovel (a + b + c + d) = Rs.

21. Electric Shovel: (5 cum. 350 H.P.)

a) Depreciation charges:

Cost of machine at site = Rs.

Life of machine = 40,000 hrs.

Life in yrs. = 20

Depreciation charges/hr. = $\frac{\text{cost} \times 0.90}{40,000}$ = Rs.

b) Repairs & maintenance charges:

@ 150% of cost of equipment/hr. = Rs.
(As per C.W.C. Guide book on transfer of used equipment)

c) P.O.L. charges:

H.P. of motor = 350

Electric energy required = 350 x 0.746

= 261 KWH

Electric energy for 40 kV A.C. control @ 0.80 Power factor = 40 x 0.80

= 32 KWH

Total electric energy required

= 261 + 32 = 293 KWH

Assuming diversity factor @ 60% energy required

= 0.6 x 293 = 175.80 KWH

i) Charges for 175.80 units of electric energy @ Rs...../unit = Rs.

ii) Lubricants etc. 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of (b) = Rs.

Total P.O.L. charges/hr. = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{40,000}{20}$ = 2000

i) Operator = $\frac{\text{M.R. x 12 x 1}}{2000}$ = Rs.

ii) Helper = $\frac{\text{M.R. x 12 x 1}}{2000}$ = Rs.

iii) Electrician = $\frac{\text{M.R. x 12 x 1}}{2000 \times 2}$ = Rs.

iv) Cableman = $\frac{\text{M.R. x 12 x 2}}{2000}$ = Rs.

v) Foreman = $\frac{\text{M.R. x 12 x 1}}{2000 \times 4}$ = Rs.

vi) Mechanic = $\frac{\text{M.R. x 12 x 1}}{2000 \times 2}$ = Rs.

vii) Chowkidar = $\frac{\text{M.R. x 12 x 1}}{2000 \times 4}$ = Rs.

viii) Supervisor = $\frac{\text{M.R. x 12 x 1}}{2000}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges = Rs.

Hourly use rate of Electric shovel (a + b + c + d) = Rs.

22. Air Compressor: (Diesel 21.0 C.F.M. HP 61.5)

a) Depreciation charges:

i) Life in yrs. = 8

ii) Cost of compressor at site = Rs.

iii) Life = 10,000 hrs.

(As per C.W.C. Guide book on transfer of used equipment)

Depreciation/hr. = $\frac{\text{cost} \times 0.90}{10,000}$ = Rs.

b) Repairs & maintenance charges:

@ 10% of cost of depreciation = Rs.
(As per C.W.C. Guide book on transfer of used equipment)

c) P.O.L. charges:

Rated H.P. = 61.5
(As per criteria of fuel consumption & taking load factor = 0.60)

Actual diesel consumption =

$$= \frac{2/3 \times 0.5 \times BHP \times 0.6 \times 4.5 \text{ litres}}{8.26}$$

$$= \frac{0.26 \times 61.5 \times 4.50 \text{ litres}}{}$$

$$= 7.30 \text{ litres}$$

i) Cost of 7.30 litres diesel @ Rs...../litres = Rs.

ii) Cost of Lubricants, oil @ 25% c(i) above = Rs.

iii) Cost of sundries etc. @ 10% of (b) above = Rs.

Total P.O.L. charges = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{10000}{8}$ = 1250

i) Operator = $\frac{\text{M.R.} \times 12 \times 1}{1250}$ = Rs.

ii) Helper = $\frac{\text{M.R.} \times 12 \times 1}{1250}$ = Rs.

iii) Foreman = $\frac{\text{M.R.} \times 12 \times 1}{1250 \times 8}$ = Rs.

iv) Mechanic = $\frac{M.R. \times 12 \times 1}{1250 \times 4}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1250 \times 4}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of Air compressor 210 c.f.m. (a + b + c + d) = Rs.

23. Air Compressor (Diesel 300 c.f.m. HP 94.3)

a) Depreciation charges/hr.

i) Cost of compressor at site = Rs.

ii) Life of compressor = 10,000 hrs.

iii) Life in years = 10

Depreciation per hr. = $\frac{\text{cost} \times 0.90}{10,000}$ = Rs.

b) Repairs & maintenance charges:

@ 100% of depreciation = Rs.

c) P.O.L. charges:

Rated H.P. = 94.3

Actual Diesel consumption =

0.026 x 94.3 x 4.54 litres

= 11.0 litres

i) Cost of 11 litre diesel @ Rs...../litre = Rs.

ii) Lubricants & oil @ 25% of c(i) above = Rs.

iii) Sundries such as cotton waste etc. @ 10% of (b) above = Rs.

Total P.O.L. charges = Rs.

d) Labour charges:

Rated life hours/year = $\frac{10000}{10}$ = 1000

i) Operator = $\frac{M.R. \times 12 \times 1}{1000}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 1}{1000}$ = Rs.

iii) Foreman = $\frac{M.R. \times 12 \times 1}{1000 \times 8}$ = Rs.

iv) Chowkidar = $\frac{M.R. \times 12 \times 1}{1000 \times 4}$ = Rs.

v) Mechanic = $\frac{M.R. \times 12 \times 1}{1000 \times 4}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of Air compressor 300 c.f.m. (a + b + c + d) = Rs.

24. Air Compressor: (Diesel 500 c.f.m. HP 148)

a) Depreciation charges:

Cost of compressor at site = Rs.

life of compressor = 12,000 hrs.

Life in yrs. = 10
(As per C.W.C. Guide book on transfer of used equipment)

Depreciation/hr. = $\frac{Cost \times 0.90}{12,000}$ = Rs.

b) Repairs and maintenance charges:

@ 100% of depreciation = Rs.

c) P.O.L. charges:

Rated H.P. = 148

Actual fuel consumption = 0.026 x 148 x 4.54

= 175 litres

i) Cost of 17.5 litres diesel @ Rs.../litre = Rs.

ii) Lubricants & other oil @ 25% of c(i) above = Rs.

iii) Sundries such as cotton waste etc. 10% of (b) above = Rs.

Total P.O.L. charges = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{12000}{10}$ = 1200

i) Operator = $\frac{M.R. \times 12 \times 1}{1200}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 1}{1200}$ = Rs.

iii) Foreman = $\frac{M.R. \times 12 \times 1}{1200 \times 8}$ = Rs.

iv) Mechanic = $\frac{M.R. \times 12 \times 1}{1200 \times 4}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1200 \times 4}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of 500 c.f.m. Air compressor (a + b + c + d) = Rs.

25. Air Compressor:(Electric 500 c.f.m. 90 KWH)

a) Depreciation charges:

i) Life in yrs. = 12

ii) Cost of compressor at site. = Rs.

iii) Life of compressor = 20,000 hrs.
(As per C.W.C. Guide book on transfer of used equipment)

Depreciation/hr. = $\frac{\text{cost} \times 0.90}{20.000}$ = Rs.

b) Repairs & maintenance charges:

@ 80% of depreciation = Rs.
(As per C.W.C. Guide book on transfer of used equipment)

c) P.O.L. charges:

Power consumption at full load = 90 KWH

i) Cost of electrical energy 90 KWH @ Rs...../unit = Rs.

ii) Lubricants etc. @ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of (b) = Rs.

Total P.O.L. charges = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{20,000}{12}$ = 1666

i) Operator = $\frac{\text{M.R.} \times 12 \times 1}{1666}$ = Rs.

ii) Helper = $\frac{\text{M.R.} \times 12 \times 1}{1666}$ = Rs.

iii) Electrician = $\frac{\text{M.R.} \times 12 \times 1}{1666 \times 2}$ = Rs.

iv) Chowkidar = $\frac{M.R. \times 12 \times 1}{1666 \times 4}$ = Rs.

v) Mechanic = $\frac{M.R. \times 12 \times 1}{1666 \times 4}$ = Rs.

vi) Foreman = $\frac{M.R. \times 12 \times 1}{1666 \times 8}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of Electric air compressor (a + b + c + d) = Rs.

26. Air Compressor: (Electric 1500 c.f.m. 240 KWH) (Stationery)

a) Depreciation charges:

Life in yrs. = 20

Cost of compressor at site = Rs.

Life of compressor = 30,000 hrs.

Depreciation/hr. = $\frac{Cost \times 0.90}{30.000}$ = Rs.

b) Repairs & maintenance charges:

@ 80% of depreciation = Rs.

c) P.O.L. Charges:

Power consumption at full load = 240 KWH

i) Cost of electrical energy of 240 KWH @ Rs.... per/unit = Rs.

ii) Lubricants etc. @ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of (b) = Rs.

Total P.O.L. charges: = Rs.

d) Labour charges:

Rated life in hrs./yr = $\frac{30,000}{20}$ = 1500

i) Operator = $\frac{M.R. \times 12 \times 1}{1500}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 1}{1500}$ = Rs.

iii) Electrician = $\frac{M.R. \times 12 \times 1}{1500 \times 2}$ = Rs.

iv) Chowkidar = $\frac{M.R. \times 12 \times 1}{1500 \times 4}$ = Rs.

v) Mechanic = $\frac{M.R. \times 12 \times 1}{1500 \times 3}$ = Rs.

vi) Foreman = $\frac{M.R. \times 12 \times 1}{1500 \times 8}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of 1500 c.f.m. electric compressor (a + b + c + d) = Rs.

27. D-8 Class Tractor Dozer: (H.P. 270)

a) Depreciation charges:

i) Cost of machine at site = Rs.

ii) Life of machine = 12000 hrs.

iii) Life in years = 10

Depreciation/hr. = $\frac{Cost \times 0.90}{12,000}$ = Rs.

b) Repairs & maintenance charges:

@ 100% of depreciation charges = Rs.

c) P.O.L. charges:

Rated H.P. = 270

i) Stores:

Consumption of diesel oil

= 0.5 x B.H.P. x 0.6/8.26 Gallons/hr.

= 0.04 BHP Gallons/hr.

Actual consumption adopted

= 65% or 2/3 of above

= 0.026 BHP x 4.546 litres/hr.

= 32 litres/hr.

Cost of 0.25 litre hydraulic oil @ Rs...../litre = Rs.

Cost of 32 litres diesel @ Rs..../litre = Rs.

Cost of 1 litre petrol @ Rs.../litre = Rs.

Cost of 0.75 litre Lubricant oil @ Rs../litre = Rs.

Cost of 0.60 litre filter oil @ Rs.../litre = Rs.

Cost of 0.25 litre Gear oil @ Rs.../litre = Rs.

Cost of ½ kg grease @ Rs...../kg. = Rs.

Cost of 200 gm. cardium compound Rs../kg. = Rs.

Total of stores/hr. = Rs.

ii) Service & miscellaneous charges @ 15% of stores (i) above = Rs.

Total P.O.L. charges = Rs.

d) Labour charges:

Rated life in hr./yr. = $\frac{12,000}{10}$ = 1200

i) Driver = $\frac{M.R. \times 12 \times 1}{1200}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 1}{1200}$ = Rs.

iii) Foreman = $\frac{M.R. \times 12 \times 1}{1200 \times 4}$ = Rs.

iv) Chowkidar = $\frac{M.R. \times 12 \times 1}{1200 \times 4}$ = Rs.

v) Mechanic = $\frac{M.R. \times 12 \times 1}{1200 \times 4}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges .. = Rs.

Total labour charges = Rs.

Hence hourly use rate of D-8 class Tractor Dozer (a + b + c + d) = Rs.

28. D-9 Class Tractor Dozer (H.P. 385):

a) Depreciation charges:

i) Cost of machine at site = Rs.

ii) Life of M/C = 12000 hrs.

iii) Life in yrs. = 10

Depreciation/hr. = $\frac{Cost \times 0.90}{12,000}$ = Rs.

b) Repairs & maintenance charges:

@ 100% of depreciation charges = Rs.

c) P.O.L. charges:

i) Stores:

Rated H.P. = 385

Actual consumption of diesel oil

= 0.026 x 385 x 4.546 litres/hr.

= 46 litres/hr.

Cost of 46 litres of diesel @ Rs.../litre = Rs.

Cost of other oils grease & lubricants same as for D-8 Class Tractor Dozer = Rs.

Total of stores per hour = Rs.

ii) Service & miscellaneous charges:

15% of c(i) above = Rs.

Total P.O.L. charges = Rs.

d) Labour charges:

Same as for D-8 Class Tractor Dozer = Rs.

Hourly use rate of D-9 Class Tractor Dozer (a + b + c + d) = Rs.

29. 35T Rear Dumper:

Capacity - 17 cum H.P. 560

a) Depreciation charges:

i) Cost of Dumper at site (excluding cost of tyres) = Rs.

Life of machine = 12,000 hrs.

Life in yrs. = 10

Depreciation of dumper per hr.= $\frac{\text{Cost x } 0.90}{12.000}$ = Rs.

ii) Cost of Tyres (1 set) at site = Rs.

Life of tyres = 2500 hrs.

Depreciation of tyres/hr. = cost/2500 = Rs.

Total depreciation cost/hr. (i + ii) = Rs.

b) Repairs & maintenance charges:

i) @ 140% of dumper depreciation/hr. = Rs.

ii) 15% of Tyres depreciation/hr. = Rs.

Total Repairs and maintenance charges/hr. b(i) + b(ii) = Rs.

c) P.O.L. charges:

Rated H.P. = 560

Annual diesel consumption/hr.

= 026 x 560 x 4.546 litres
= 66 litres

i) Cost of 66 litres diesel @ Rs.../litre = Rs.

ii) Cost of lubricants other oil etc. @ 25% of (i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of (b) = Rs.

Total P.O.L. charges/hr. = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{12000}{10}$ = 1200

i) Driver = $\frac{\text{M.R. x 12 x 1}}{1200}$ = Rs.

ii) Helper = $\frac{\text{M.R. x 12 x 1}}{1200}$ = Rs.

iii) Foreman = $\frac{\text{M.R. x 12 x 1}}{1200 \text{ x } 4}$ = Rs.

iv) Mechanic = $\frac{\text{M.R. x 12 x 1}}{1200 \text{ x } 4}$ = Rs.

v) Chowkidar = $\frac{\text{M.R. x 12 x 1}}{1200 \text{ x } 4}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of 35T rear Dumper (a + b + c + d) = Rs.

30. Hydraulic Excavator: (1.25 cu.yd.) H.P. 103.5

a) Depreciation charges:

Total cost equipment at site = Rs.

Rated life = 12,000 hrs.

Life in yrs. = 10

Depreciation charges/hr.= $\frac{\text{Total cost} \times 0.90}{12,000}$ = Rs.

b) Repair & maintenance charges:

@ 150% of depreciation = Rs.

c) P.O.L. charges:

H.P. of machine = 103.50

Fuel consumption = .026 x BHP x 4.56 litres/hr.

= litres per hour

i) Cost of .....litres diesel oil @ Rs...../litre = Rs.

ii) Lubricants & grease @ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of item (b) = Rs.

Total P.O.L. charges = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{12000}{10}$ = 1200

i) Operator = $\frac{\text{M.R.} \times 12 \times 1}{1200}$ = Rs.

ii) Helper = $\frac{\text{M.R. x 12 x 1}}{1200}$ = Rs.

iii) Foreman = $\frac{\text{M.R. x 12 x 1}}{1200 \times 4}$ = Rs.

iv) Mechanic = $\frac{\text{M.R. x 12 x 1}}{1200 \times 4}$ = Rs.

v) Chowkidar = $\frac{\text{M.R. x 12 x 1}}{1200 \times 4}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges = Rs.

Hourly use rate of Hydraulic Excavator (a + b + c + d) = Rs.

31. Dumper (15T):

a) Depreciation charges:

i) Total cost at site (excluding tyres) = Rs.

Rated life = 10,000 hrs.

Life in yrs. = 8

Depreciation charges/hr. = $\frac{\text{Total cost x 0.90}}{10,000}$ = Rs.

ii) Depreciation for tyres:

Cost of Tyres at site = Rs.

Life of Tyres for dumper = 2150 hrs.

Depreciation charges of tyres/hr.

= $\frac{\text{Cost of Tyres}}{2150}$ = Rs.

Total depreciation charges (i + ii) = Rs.

b) Repairs & maintenance charges:

i) @ 140% of depreciation of dumper = Rs.

ii) @ 15% of depreciation of Tyres = Rs. _____

Total repairs & maintenance = Rs. _____

c) P.O.L. charges:

Rated H.P. = 200

Actual diesel consumption =

.026 x BHP x 4.546 litres/hr.

i) Cost of ...../litres of diesel @ Rs..../litres = Rs.

ii) Cost of oils & lubricants @ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of item (b) = Rs. _____

Total P.O.L. charges: = Rs. _____

d) Labour charges:

Rated life in hrs./yr. = $\frac{10000}{8}$ = 1250 = Rs.

i) Operator = $\frac{M.R. \times 12 \times 1}{1250}$ = Rs.

ii) Helper = $\frac{M.R. \times 12 \times 1}{1250}$ = Rs.

iii) Foreman = $\frac{M.R. \times 12 \times 1}{1250 \times 8}$ = Rs.

iv) Mechanic = $\frac{M.R. \times 12 \times 1}{1250 \times 6}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1250 \times 6}$ = Rs. _____

Direct labour charges = Rs. _____

Add for hidden cost of labour @ 50% of direct labour charges = Rs. _____

Total labour charges/hr. = Rs.

Hourly use rate of Dumper 15T (a + b + c + d) = Rs.

32. Tipper Truck (7.0):

a) Depreciation charges:

i) Cost of truck at site (excluding tyres) = Rs.

Rated life = 10,000 hrs.

Life in yrs. = 8

Depreciation charges = $\frac{\text{cost} \times 0.90}{10,000}$ = Rs.

ii) For Tyres:

Cost of Tyres at site = Rs.

Rated life for Tyres = 2750 hrs.

Depreciation charges of tyres/hr.

= $\frac{\text{Cost of tyres}}{2750}$ = Rs.

Total depreciation charges/hr. (i + ii) = Rs.

b) P.O.L. charges:

Rated H.P. of truck = 110 H.P.

Actual fuel consumption =.026xBHPx4.546 litres/hr.

i) Cost of ..../litres of diesel @ Rs.../litres = Rs.

ii) Cost of lubricants & oil @ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of item (b) = Rs.

Total P.O.L. charges/hr. = Rs.

c) Labour charges:

Rated life in hrs./yr. = $\frac{10000}{8}$ = 1250 = Rs.

i) Driver = $\frac{\text{M.R. x 12 x 1}}{1250}$ = Rs.

ii) Cleaner = $\frac{\text{M.R. x 12 x 1}}{1250}$ = Rs.

iii) Mechanic = $\frac{\text{M.R. x 12 x 1}}{1250 \times 8}$ = Rs.

iv) Chowkidar = $\frac{\text{M.R. x 12 x 1}}{1250 \times 6}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges = Rs.

Hourly use rate of Tipper Truck (a + b + c + d) = Rs.

33. Crushing & Processing Plant (220 T)

a) Depreciation charges:

i) Cost of crushing and screening plant at site = Rs.

Rated life = 18,000 hrs.
(As per report of R & CC Jan'56 page 220)

Life in yr. = 12

Depreciation charges/hr. = $\frac{\text{Total cost x 0.90}}{18,000}$ = Rs.

ii) Cost of civil works and erection charges = Rs.

Taking life of civil works = 10,000 hrs.

Depreciation charges for civil work

= $\frac{\text{Cost of civil work}}{10.000}$ = Rs.

Total depreciation charges/hr. (i + ii) = Rs.

= Rs.

b) Repair and maintenance charges:

@ 80% of depreciation of plant = Rs.

c) P.O.L. Charges:

Capacity of crushing plant = 220 t

Power requirement = 4 KWH/tonne of aggregate
Electrical energy required/hr. = 220x4 = 880 kwh

i) Cost of 880 Kwh electrical energy @ Rs..../unit = Rs.

ii) Lubricants & grease @ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of (b) = Rs.

Total P.O.L. charges/hr. = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{18000}{12}$ = 1500

i) Operator = $\frac{M.R. \times 12 \times 2}{1500}$ = Rs.

ii) Beldars = $\frac{M.R. \times 12 \times 20}{1500}$ = Rs.

iii) Chowkidar = $\frac{M.R. \times 12 \times 1}{1500}$ = Rs.

iv) Foreman = $\frac{M.R. \times 12 \times 1}{1500}$ = Rs.

v) Mechanic = $\frac{M.R. \times 12 \times 1}{1500 \times 4}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges/hr. = Rs.

Total labour charges/hr. = Rs.

Hourly use rate (a + b + c + d) = Rs.

34. Batching Mixing Plant (35 cu.yd./hr.)

a) Depreciation charges:

Cost of Batching and Mixing plant at site = Rs.

Rated life = 30,000 hrs.

Life in yrs. = 18

Depreciation charges of the plant/hr.

$$= \frac{\text{Cost} \times 0.90}{30.000}$$ = Rs.

Cost of civil works and erection charges = Rs.

Taking life of civil works = 10,000 hrs.

Depreciation charges for civil works/hr. = Rs.

= cost/10,000

Total depreciation charges/hr. (i + ii) = Rs.

b) Repair & maintenance charges:

@ 75% of depreciation of plant

c) P.O.L. charges:

Electrical energy consumption on full load = 60 kWh
(As per experience in Yamuna Hydel Scheme State-II)

i) Cost of 60 kWh Electrical energy @ Rs.../unit = Rs.

ii) Cost of Lubricant & grease @ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of item (b) = Rs.

Total P.O.L. charges/hr. = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{30,000}{18}$ = 1666

i) Operator $= \frac{M.R. \times 12 \times 1}{1666}$ = Rs.

ii) Beldars $= \frac{M.R. \times 12 \times 1}{1666}$ = Rs.

iii) Mechanic $= \frac{M.R. \times 12 \times 1}{1666 \times 2}$ = Rs.

iv) Foreman $= \frac{M.R. \times 12 \times 1}{1666 \times 2}$ = Rs.

v) Chowkidar $= \frac{M.R. \times 12 \times 1}{1666}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate (a + b + c + d) = Rs.

35. Mobile Crane (10 T)

a) Depreciation charges:

Cost of machine at site = Rs.

Rated life = 12,000 hrs.
(As per C.W.C. Guide book on transfer of used equipment)

Life in yrs. = 10

Depreciation charges/hr. $= \frac{Cost \times 0.90}{12,000}$ = Rs.

b) Repairs & maintenance charges:

@ 120% of depreciation = Rs.

c) P.O.L. charges:

8 litres petrol @ Rs.../litre = Rs.

3.5 litres diesel @ Rs..../litre = Rs.

0.75 litre mobil oil @ Rs..../litre = Rs.

0.25 kg. grease @ Rs...../kg. = Rs.

Service charges & sundries etc. @ 10% of repair & maintenance charges = Rs.

Total P.O.L. charges/hr. = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{12,000}{10}$ = 1200

i) Operator = $\frac{M.R. \times 12 \times 1}{1200}$ = Rs.

ii) Electrician = $\frac{M.R. \times 12 \times 1}{1200 \times 4}$ = Rs.

iii) Helper = $\frac{M.R. \times 12 \times 2}{1200}$ = Rs.

iv) Foreman = $\frac{M.R. \times 12 \times 1}{1200 \times 4}$ = Rs.

v) Mechanic = $\frac{M.R. \times 12 \times 1}{1200 \times 4}$ = Rs.

vi) Chowkidar = $\frac{M.R. \times 12 \times 1}{1200 \times 4}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of Crane (a + b + c + d) = Rs.

Electrical Pump (50 H.P.)

a) Depreciation charges:

Cost of pump at site = Rs.

Rated life = 20,000 hrs

Life in yrs. = 12

Depreciation charges/hr. = $\frac{\text{Cost} \times 0.90}{20{,}000}$ = Rs.

b) Repair & maintenance charges:

@ 70% of depreciation = Rs.

c) P.O.L. charges:

H.P. of motor = 50

Energy required/hr.= 50x0.746 = 37.3 kWh

i) Cost of 37.3 kWh electrical energy @ Rs.../unit = Rs.

ii) Lubricants etc. @ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of item (b) = Rs.

Total P.O.L. charges = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{20{,}000}{12}$ = 1666

i) Operator = $\frac{\text{M.R.} \times 12 \times 1}{1666}$ = Rs.

ii) Helper = $\frac{\text{M.R.} \times 12 \times 1}{1666}$ = Rs.

iii) Mechanic = $\frac{\text{M.R.} \times 12 \times 1}{1666 \times 4}$ = Rs.

iv) Electrician = $\frac{\text{M.R.} \times 12 \times 1}{1666 \times 6}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of 50 H.P. Electrical pump (a + b + c + d) = Rs.

37. Electrical Pump (15 H.P.)

a) Depreciation charges:

Life in years = 12

Cost of pump at site = Rs.

Rated life = 20,000 hrs.

Depreciation charges/hr. = $\frac{\text{Cost} \times 0.90}{20,000}$ = Rs.

b) Repair & maintenance charges:

@ 70% of depreciation = Rs.

c) P.O.L. charges:

Energy required for 15 H.P. pump

= 0.746 x 15 = 11.19 Kwh

i) Cost of 11.19 Kwh energy @ Rs.../litre = Rs.

ii) Lubricants & grease @ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of item (b) = Rs.

Total P.O.L. charges = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{20,000}{12}$ = 1666

i) Operator = $\frac{\text{M.R.} \times 12 \times 1}{1666}$ = Rs.

ii) Mechanic = $\frac{\text{M.R.} \times 12 \times 1}{1666 \times 4}$ = Rs.

iii) Electrician = $\frac{\text{M.R.} \times 12 \times 1}{1666 \times 8}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of 15 H.P. Electrical Pump (a + + c + d) = Rs.

38. Shutter 6m Long:

a) Depreciation·

Cost of 6m long Shutter at site = Rs.

Life of Shutter = 12,000 hrs.
(As per R & C C report page 46 table 3.7.6(i)

Life in yrs. = 8

Depreciation/hr. = $\frac{\text{Cost} \times 0.90}{12,000}$ = Rs.

b) Repairs and Maintenance charges:

@ 50% of depreciation = Rs.
(As per R & C C report page 51)

c) P.O.L. charges:

Fuel = NIL

Sundries such as cotton waste petrol etc. = Rs.
@ 10% of item (b)

Total P.O.L. charges = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{12,000}{8}$ = 1500

i) Operator = $\frac{\text{M.R.} \times 12 \times 2}{1500}$ = Rs.

ii) Helper = $\frac{\text{M.R.} \times 12 \times 4}{1500}$ = Rs.

iii) Foreman = $\frac{M.R. \times 12 \times 1}{1500 \times 4}$ = Rs.

iv) Chowkidar = $\frac{M.R. \times 12 \times 1}{1500 \times 4}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of Shutter (a + b + c + d) = Rs.

39. D-4 Tractor with Turnindrum Sheepfoot Roller:

I. Use Rate of D-4 Tractor:

a) Depreciation:

Cost of D-4 Tractor Rs.

Life hrs. = 10,000

Life in yrs. = 8

Depreciation/hr. = $\frac{\text{Cost} \times 0.90}{10,000}$ = Rs.

b) Repairs & maintenance charges:

@ 100% of depreciation = Rs.

c) P.O.L. charges:

i) 6.75 litres HSD oil @ Rs.../litre = Rs.

ii) Lubricants @ 25% of c(i) above = Rs.

iii) Sundries and miscellaneous supplies @ 10% of item (b) = Rs.

Total P.O.L. charges = Rs.

d) Labour charges:

Rated life in hrs. = $\frac{10,000}{8}$ = 1250

i) Driver = $\frac{\text{M.R. x 12 x 1}}{1250}$ = Rs.

ii) Mechanic = $\frac{\text{M.R. x 12 x 1}}{1250 \times 6}$ = Rs.

iii) Helper = $\frac{\text{M.R. x 12 x 1}}{1250 \times 2}$ = Rs.

iv) Foreman = $\frac{\text{M.R. x 12 x 1}}{1250 \times 8}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

I-Use rate of D-4 Tractor (a + b + c + d) = Rs.

II. Use rate of Sheep Foot Roller:

a) Depreciation charges:

Cost = Rs.

Life hrs. = 10,000 hrs.

Depreciation charges/hr. = $\frac{\text{Cost x 0.90}}{10,000}$ = Rs.

b) Repair & maintenance:

@ 70% of depreciation = Rs.

c) P.O.L. charges:

@ 10% of repair and maintenance = Rs.

d) Labour charges:

NIL

II-Hourly use rate of sheep foot roller (a + b + c + d) = Rs.

Hourly use rate of D-4 Tractor with sheep foot roller (I + II) = Rs.

40. Ropeway:

(a) Depreciation charges:

Cost of ropeway at site = Rs.

Life in yrs. = 20

Quantity to be transported (according to project estimate) = cum

Rated life = 40,000 hrs.

Depreciation of cost @ 70% = 0.7 x cost of ropeway at site = Rs.

Depreciation of ropeway/cum

$$= \frac{\text{Depreciated cost}}{\text{Qty. to be Transported}} = \text{Rs.}$$

b) Repairs & maintenance charges:

@ 50% of depreciation (Including change of rope etc.) = Rs.

c) P.O.L. charges:

i) Power per 425 T ropeway required 1716 Kwh @ Rs...../Kwh = Rs.

ii) Routine maintenance (Including consumables & lubricants) = Rs.

@ 67% of c(i) above = Rs.

Total P.O.L. charges/hr. = Rs.

P.O.L. charges/cum

$$= \frac{\text{Total P.O.L. charges/hr.} \times 2}{425} = \text{Rs.}$$

d) Labour charges:

Rated life in hrs./yr. $= \frac{40,000}{20} = 2000$

i) Foreman $= \frac{\text{M.R.} \times 12 \times 1}{2000}$ = Rs.

ii) Mechanic/ Fitter = $\frac{\text{M.R. x 12 x 8}}{2000}$ = Rs.

iii) Helper/ Greaser = $\frac{\text{M.R. x 12 x 2}}{2000}$ = Rs.

iv) Chowkidar = $\frac{\text{M.R. x 12 x 1}}{2000}$ = Rs.

v) Electrician = $\frac{\text{M.R. x 12 x 3}}{2000}$ = Rs.

vi) Beldars = $\frac{\text{M.R. x 12 x 24}}{2000}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Labour charges per cum (assuming 1 cu.m. = 2T) = $\frac{\text{Total labour charges/hr.x2}}{425}$

Use rate/cum = (a + b + c + d) = Rs.

41. Vibratory Roller: (H.P. = 62)

i) Depreciation charges:

Total cost of vibratory roller at site including all taxes, freight & insurance = Rs.

Life in years = 8

Rated life = 8000 hrs.

Depreciation charges/hrs. = Rs.

= 0.90 x $\frac{\text{Total cost of vibratory roller}}{8000}$

b) Repair & maintenance charges:

@ 150% of cost of equipment/hr. = Rs.
(As per Guide book on transfer of used equipment, Govt. of India, Central Water Commission)

c) P.O.L. charges:

Rated BHP = 62

Actual fuel consumption/hr.

$$= \frac{2/3 \times 0.50 \times 0.75 \times 62 \times 4.54}{8.26}$$

(Taking load factor as 0.75) = 8.53 litres
say = 9.00 litres

i) Cost of 9.00 litres Diesel oil @ Rs.../litre = Rs.

ii) Lubricant & grease etc. @ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of sub item (b) above (Repair & maintenance charges) = Rs.

Total P.O.L. charges = Rs.

d) Labour charges:

Rated life in hrs./yr. = $\frac{8000}{8}$ = 1000

i) Foreman = $\frac{M.R. \times 12 \times 1}{1000 \times 8}$ = Rs.

ii) Operator = $\frac{M.R. \times 12 \times 1}{1000}$ = Rs.

iii) Mechanic = $\frac{M.R. \times 12 \times 1}{1000 \times 4}$ = Rs.

iv) Helper = $\frac{M.R. \times 12 \times 1}{1000}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1000 \times 8}$ = Rs.

Direct labour charges = Rs. _____

Add for hidden cost of labour @ 50% of direct labour charges = Rs. _____

Total labour charges/hr. = Rs. _____

Hourly use rate of Vibratory Roller (a + b + c + d) = Rs.

42. Pneumatic Tyred Roller: (H.P. - 60 (Say)

a) Depreciation charges:

I. Roller:

Total cost of pneumatic Tyred Roller excluding cost of tyres & tubes at site including all taxes, freight and insurance = Rs.

Life in yrs. = 8

Rated life = 10,000 hrs.

Depreciation charges

$$= \frac{0.90 \times \text{Total cost of roller}}{10,000} = \text{Rs.}$$

II. Tyres:

Total cost of tyres including freight etc. at site = Rs.

Life of tyres = 2500 hrs.

$$\text{Depreciation of Tyres/hr.} = \frac{\text{cost of Tyres}}{2500} = \text{Rs.}$$

Total depreciation charges/hr. = (I + II) = Rs.

b) Repair and maintenance charges:

I. Roller:

@ 80% of depreciation (As per Guide book on transfer of used equipment) = Rs.

II. Tyres:

@ 15% of depreciation = Rs.

Total Repair & Maintenance charges (I + II) = Rs.

c) P.O.L. charges:

Rated H.P. = 60

Actual fuel consumption/hr. = $\frac{2/3 \times 0.5 \times 0.60 \times 60 \times 4.54}{8.26}$
(Taking load factor 0.60)

i) Cost of 6.60 litre diesel @ Rs.../litre = Rs.

ii) Cost of lubricants and grease etc. @ 25% of c(i) above = Rs.

iii) Sundries & miscellaneous supplies @ 10% of (b) above = Rs.

Total P.O.L. charges/hr. = Rs.

d) Labour charges:

Rated life in hrs./yrs = $\frac{10000}{8}$ = 1250

i) Foreman = $\frac{M.R. \times 12 \times 1}{1250 \times 8}$ = Rs.

ii) Operator = $\frac{M.R. \times 12 \times 1}{1250}$ = Rs.

iii) Mechanic = $\frac{M.R. \times 12 \times 1}{1250 \times 4}$ = Rs.

iv) Helper = $\frac{M.R. \times 12 \times 1}{1250}$ = Rs.

v) Chowkidar = $\frac{M.R. \times 12 \times 1}{1250 \times 8}$ = Rs.

Direct labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges/hr. = Rs.

Hourly use rate of Pneumatic Tyred Roller (a + b + c + d) = Rs.

SECTION - III

ANALYSIS OF RATES BOTH

FOR

MANUAL AS WELL AS MACHINERY

MAIN ITEMS OF UNIVERSAL NATURE IDENTIFIED FOR ANALYSIS

Sl. No.	Item No. (From the list of items of Universal Nature) Chapter No. III.	Name of Items	Rationalised Unit
1.	1.	Rock Excavation in foundations	Per Cum
2.	2.	Common Excavation in dams and barrages	Per Cum
3.	3.	Earth fill in Dam	Per Cum
4.	4.	Rock fill in Dam	Per Cum
5.	5.	Inverted filter	Per Cum
6.	6.	Stone riprap or pitching	Per Cum
7.	7.	Stone masonary in hearting of dam	Per Cum
8.	8.	Face masonary 1:4 in dams	Per Cum
9.	9.	Mass concrete in dams (M-100)	Per Cum
10.	10. (i)	Concrete M-150 in spillways, dams, bridge piers and intake.	Per Cum
	(ii)	Concrete M-200 in dams and spillways	Per Cum
	(iii)	Concrete M-250 in dams, spillways and head works.	Per Cum
11.	11.	Mild steel reinforcement	Per tonne
12.	12.	Seals:	
	(a)	Furnishing and installing copper seal	Per Kg.
	(b)	Furnishing and installing asphalt seal	Per R.M.
	(c)	Furnishing and installing monel seal	Per Kg.
13.	13.	Rock bolt in tunnels	Per R.M.
14.	14.	Pen stocks liners	Per Tonne
15.	15.	Rock excavation in tunnels	Per Cum
16.	16.	Fabrication and erection of steel supports for ground excavation.	Per Tonne
17.	17.	Shotcreting	Per Bag of 50 Kg Cement
18.	18.	Dewatering of foundations	Per KWH
19.	19.	Earth work in lip cutting in bed and slope in all types of soils	Per Cum

20.	20. Drilling Grout holes	Per R.M.
	(a) upto 5.0 M depth	
	(b) more than 5.0 M depth	
21.	21. Grouting in dam/barrage foundation	Per bag of 50 Kg Cement
22.	22. Grouting in tunnels	Per bag of 50 Kg Cement
23.	23. Granite set	Per Cum
24.	24. Boulder set	Per Cum
25.	25. Pumped concrete (Grade M-200) in pen stocks and surge shaft.	Per Cum
26.	26. Coarse Aggregates	Per Cum
27.	27. Sand (crushed)	Per Cum
28.	28. Concrete in Power House (Sub-structure)	Per Cum
29.	29. Concrete in Power House (Super Structure)	Per Cum
30.	31. Sheet piling	Per Tonne
31.	32. Shaft excavation	Per Cum
32.	33. Canal excavation	Per Cum
33.	34. Tile lining in canals	Per Sq. M
34.	35. Concrete lining of canals	Per Sq. m
35.	39. Rock toe	Per Cum
36.	40. From work and shuttering	Per Sq. m
37.	41. Radial gates for spillway	Per Tonne
38.	42. Sluice Gates for irrigation Outlets	Per Tonne
39.	44. Barrage Gates	Per Tonne
40.	45. Stop log gates	Per Tonne
41.	46. Trash Racks	Per Tonne
42.	48. Water Courses	Per Km
43.	49. Distributaries	Per Km
44.	52. Construction of haul roads	Per Km
45.	53. Construction of 6.1 m wide roads	Per Km
46.	54. Painting of liners	Per Sq.m
47.	55. False ceiling	Per Sq.m
48.	56. Concrete pretrench for diaphragm wall	Per R.M.
49.	57. Plastic concrete for diaphragm wall	Per Cum.

1. ROCK EXCAVATION IN FOUNDATION (per cum.) Lead = 1 Km

(A) Drilling and Blasting:

(a) Drilling charges:

Rock drilling for excavation will be carried out by the jack hammers on the basis of Table 11.7 construction, planning, equipment and methods by R.L. peurifoy page 259 drilling and blasting data are as follow:considering 1 ft hole sufficient for blasting 0.92 cu.yd.(0.92 cum) of rock.

Size of hole in mm.	Hole pattern meter	Area per hole cum.	Quantity of Rock per liner meter of hole cum.	Kg. of explosives per liner m. of hole	Kg. of Explosive per cum. of Rock (% of hole filled) 100	75	50
1	2	3	4	5	6	7	8
38	1.52x1.52	2.31	2.31	1.34	0.58	0.43	0.28

Depth of drilling per 100 cum. of Rock = $\frac{100}{2.31}$ = 43.29

Horizontal drilling and pull effect @ 50%

= 43.29 x 0.50 = 21.64

Total drilling per 100 cum. or Rock = 43.29 + 21.64 = 64.93

Say = 65 M

Cost of Drilling:

Rate of drilling per hour 2.3 metre: (Refer page 260 of construction planning, Equipment & methods)

Cost of drilling by Jack hammer = $\frac{65.0 \times \text{use rate of jack hummer}}{2.3}$ -Rs.

(b) 1. Cost of drill steel

Cost of drill steel per metre

2. Cost of drill rod for 65 meter drilling

= 65 x cost of drill rod per metre) Rs.

Blasting:

(c) (i) Cost of Gelatine:

Assuming that the drill holes can be filled with dynamite upto 75% of their capacity. The quantity of explosives required per 100 cum of Rock = 0.43 x 100 = 43 Kgms.

Cost of 43 Kgs Gelating @ Rs.

(ii) Cost of electric Detonators:

Average depth of hole = 1.75 metre
Quantity of Rock per linear metre of hole = 2.31 cum.
Quantity of Rock per 1.75 m deep hole = 2.31 x 1.75=4.04 cum.

No. of holes per 100 cum. = $\frac{100}{4.04}$ = say 25 Nos.

Using one detonator per hole
Then No. of detonators per 100 cum. of Rock = 25 Nos.

Cost of 25 Nos. electric detonators @ Rs. _____ = Rs.

(iii) Blasting batteries, primer, primac rd and loading wires etc per 100 cum. @ 50% of the cost of detonators = Rs.

(iv) Stemming @ 40% of the cost of detonators =Rs.
Total charges for blasting = (i) to (iv) =Rs.

Total charges for drilling and balsting including cost of drill rod = a + b + c =Rs.

Add for secondary drillings and blasting @ 10% of (a + b + c) =Rs.

Total Rs.

say Rs.....

Hence rate for drilling and balsting per 100 cum =Rs.

(B) Carriage of blasted Rock upto 1 Km lead/Diesel shovel capacity = 2 cum.

Output = 100 cum per hour
Dumper = 15 T

Capacity 8.33 cum
Swell factor = 0.67 (for hard Rock)

Machinery charges:

(i) Shovel 2 cum.

Use rate of shovel per working hour output per working hour = 100 cum.

Rate per cum. = $\frac{\text{use rate}}{100}$

Rs.

(ii) 15 T Dumper:

Lead = 1.00 Km.
Body capacity = capacity x swell factor
= 8.33 x 0.67 = 5.58 cum.

Loading time = $\frac{\text{Body capacity}}{\text{Shovel output/mm.}} = \frac{5.58 \times 60}{100}$ = 3.35 min.
Spotting time = 0.30 min.

Loaded Haul @ 20 kms/Hr = $\frac{1 \times 60}{20}$ = 3.00 min.
Turning & dumping time = 2.0 min.

Empty haul @ 25 Kms. per hour $\frac{1 \times 60}{20}$ = 2.4 min.

Total cycle Time 11.05

No. of trips per working hour of 50 min. = $\frac{50}{11.05}$ = 4.52

Output of dumper per working hour
= 5.58 x 4.52
= 25.22 cum.

Use rate of dumper per working hours

Rs.

Rate per Cum. = $\frac{\text{use rate of Dumper}}{25.22}$

Rs.

(iii) Tractor Dozer at site of excavation:

Assuming that one dozer will work with one shovel output of Tractor Dozer = output of shovel = 100 cum.

Use rate of Dozer per working hour

Rate per cum. = $\frac{\text{use rate of Tractor Dozer}}{100}$ =Rs.

Total machinery charges per cum-(i) + (ii) +(iii) -Rs.
Hence carriage rate per 100 cum.
=Total machinery charges per cum x 100 =Rs.
Total rate per 100 cum. – A+B =Rs.

Add for:

(i) Construction and maintenance of haul road @ 5% of (A + B) =Rs.
(ii) Electric energy charges @ 2% of (A + B) =Rs.
(iii) Levelling and trimming of waste piles 3% of (A + B) =Rs.

Prime Cost =Rs.

Add overhead charges and contractor's profit @ Rs. 20 of Prime Cost =Rs.

Grand total=Rs.

Rate of Excavation per 100 cum.=Say Rs.....

Rate of Excavation per cum. = $\frac{\text{Rate of Excavation per 100 cum.}}{100}$

Say =Rs.
=Rs.

Hence Rate of Excavation per cum =Rs.

2. COMMON EXCAVATION IN DAMS & BARRAGES:

Average lead = 1.00 Km.

Diesel shovel capacity = 2.0 cum.
Ideal Production per hour 196 cum. (Bank volume)

(Taking depth of cut and angle of swing factor as 0.88 vide page 513 of book "Construction Equipment and its planning and application by Dr. Mahesh Verma" Third Edition 1979).

Production per hour = 196 x .88
= 172.48 cum.

Now Taking Efficiency and job management factor as 0.88 and 0.69 vide page 436 and 437 of above referred book
Output of shovel per hour 172.48 x .69 x .88
-104.72 Say 100 cum.

Dumper: 15 T Dumper

Capacity = 8.33 cum.
Swell factor = 0.75

(A) Machinery Charges:

(i) Shovel

Use rate per working hour Rs.
Output per working hour = 100 cum.
Rate per cum. = $\frac{\text{use rate of shovel}}{100}$ Rs.

(ii) Dumper:

Average lead-1.00 Km.
Swell factor = 0.75 (as per RCC report Jan'1956)
Body capacity = 8.33 x swell factor
= 8.33 x .75 (Bank volume)
= 6.25 cum.

Handling cycle time

(i) Loading time = $\frac{\text{Body capacity}}{\text{Shoved out put per min.}}$

= $\frac{6.25 \times 60}{100}$

= 3.750 min.

(ii) Spotting time 0.30 mon:: (Table 6.8.6, R.C.C. report page 119)

(iii) Turning and dumping time = 2.00 min.

(iv) Empty haul @ 25 Kms per hour 1 x 60/25 = 2.40 min.

(v) Loaded haul @ 20 Kms/hr, 1x60/20 - 3.00 min. cont

Total cycle time = 11.45 min.

No. of dumper trips in 50 min. working hour

= $\frac{50}{11.45}$ = 4.36

Output of dumper per working hour 6.25 x 4.36 = 27.25 cum.

Use rate of 15 T Dumper per working hour = Rs.
Hence rate per cum = $\frac{\text{Use rate of dumper}}{27.25}$

(iii) D-8 Tractor Dozer at site of excavation:

Assuming that one shovel will work at one place and one Tractor Dozer will be enough for one shovel output of Tractor Dozer = out put of shovel = 100 cum.

Use rate of D-8 Tractor Dozer per working hour = Rs.

Rate per cum. = $\frac{\text{use rate}}{100}$ = Rs.

Total machinery charges i+ ii + iii = Rs.

(B) Add for:

(i) Construction and maintenance of haul Roads @ 5% of machinery charges (A) = Rs.

(ii) Electric energy charges @ 2% of machinery charges =Rs.

(iii) Levelling and trimming of waste piles etc. @ 5% of machinry charges (A) = Rs.

Total (B) = Rs.

Prime Cost = Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost = Rs.

Grand Total=Rs.

Say Rs.....

Rate per cum Rs.....

3. EARTHFILL IN DAM:

Average lead = 1 Km.

It is proposed to use ripper with D-9 Tractor Dozer and Diesel shovel (2 cum) at quarry, hauling by 7 T Tipper and D-8 Tractor Dozer at placement site.

(A) Clearing and grubbing of borrow area L.S. = Rs. 0.50/cum.

(B) Ripper with D-9 Tractor Dozer

Output per working hour = 150 cum.

Use rate per working hour = Rs.

Cost of ripping per cum. = $\frac{\text{use rate}}{\text{out put}}$ = Rs.

(C) Shovel:

Capacity = 2 cum.
= 60 cum. per dipper cum per hour

Out put @ 88% efficiency = 60 x 2 x .88 = 105.60 cum.

Say - 100.00 cum per hour

Use rate per working hour = Rs.

Rate per cum. = $\frac{\text{Use rate of shovel}}{\text{out put}}$ = Rs.

(D) Carriage by 7 T. Tipper:

Capacity = T
vol. of earth = 7 x 1/1.67
(Taking density of earth as 1.67) = 4.19 cum.

Swell factor = 0.80 As per RCC report Jan, 56
(for common earth) table 6.6.9 page 113
body capacity = 4.19 x 0.80
= 3.35 cum.

Cycle time

(i) Loading Time = $\frac{\text{Body capacity}}{\text{Shovel output per min.}}$

$= \frac{3.35 \times 60}{100}$

= 2.01 mm.

(ii) Loaded haul
@ 30 Kms per hour = $\frac{1 \times 60}{30}$ = 2.00 min.

(iii) Empty haul
@ 40 Kms per hour = $\frac{1 \times 60}{40}$ = 1.50 Min.

(iv) Unloading, turning, dumping and spotting

(Table 6.8.6. R & C.C. report Jan'56 page 119 for "constructed spaced manouvering to dump required"

= 0.30 + 2.50 + 0.50
= 3.30 min.

Total hauling cycle time = 1 + ii + iii + iv
= 2.01 +2.00 + 1.50 + 3.30
= 8.81 min.

No. of Trips per working hour of 50 min.
= 50/8 81 = 5.67

Materials carried @ 80% efficiency
= 5.67 x 3.35 x 0.8
= 15.20 cum per hour

Hourly use rate of 7 T Tipper Rs.

Rate per cum. = $\frac{\text{use rate of tipper}}{15.20}$ = Rs.

(E) Spreading charges at placement by D-8 Tractor Dozer:

Output per working hour = 300 cum. = Rs.
use rate of D-8 Tractor Dozer

Rate per cum = $\frac{\text{use rate}}{300}$ = Rs.

Total charges = A + B + C + D + E = Rs.

Add for:

(i) Processing @ 5% of Total charges = Rs.....
(ii) Wetting @ 5% of Total charges = Rs.....
(iii) Compaction @ 7% of Total charges = Rs.....

Total

Total Rs.

Add for:

(i) Construction & maintenance of haul roads @ 5% of total above = Rs.

(ii) Electric charges @ 2% of Total = Rs.

(iii) Extra labour etc., at site @ 2% of total = Rs.

Prime Cost = Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost = Rs.

Add = Rs.

Say = Rs.

Hence rate per cum., of earth fill in Dam = Rs.

Note:- The average speeds of the hauling equipment to be adopted for working out the cycle time shall be determined for each project site taking into consideration the type of hauling equipment and the distances to be traversed from borrow area to dam toe, along the ramps and that traversed at the top of dam.

The average speed of the hauling equipment shall be worked out as detailed below:

Average speed $= \frac{\text{lead}}{T_1}$

Average speed for empty haulage $= \frac{\text{lead}}{T_2}$

Where T_1 and T_2 are total time taken for traversing the lead with loaded and empty haulage respectively.

Further:-

$$T_1 = \left(\frac{D_1}{S_1} + \frac{D_2}{S_2}\right)$$

$$T_2 = \left(\frac{D_1}{S_3} + \frac{D_2}{S_4}\right)$$

Where D_1 is the distance from borrow area to toe of dam.

D_2 is the distance traversed along the ramp and that at the top of dam.

S1 and S2 are the speeds in Km. per hour of the loaded haulage for D1 or D2 respectively.

S3 and S4 are the speeds in Km per hour of the empty haulage for D1 and D2, respectively.

In the above sample calculation for item No. 3 - the average speeds for the total distance (D1+D2) have been assumed.

4. ROCK FILL IN DAMS

(i) From quarry (Average lead = 1 Km.)

a. Rate of common excavation = Rs.
(Same as in item No. 2 excluding overhead expenses)

b. Compaction and dressing etc. L.S. = Rs.

Prime Cost = Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost = Rs.

Total Rs.

Say Rs.

Hence Rate per cum. = Rs.

(ii) From Excavated material (Lead upto 1 Km.)

(a) Rate of material @ 50% of (i) (a) above = Rs.
(b) Compaction and dressing etc. L.S. = Rs.
Add overhead charges and contractor's profit @ 20% of Prime cost Rs.

Say Rs.....

Hence Rate per cum. = Rs.

5. INVERTED FILTER:

(A) Materials (For 3 cum.)

(i) 1.65 cum. boulders at site of work @ Rs._____ = Rs.
(ii) 0.825 cum shingle at site of work @ Rs. _____ = Rs.
(iii) 0.825 cum. peagravel at site of work @ Rs._____ = Rs.

Total

Rate per cum = $\frac{\text{Total cost of materials}}{3}$

Add extra charges for selection and screening of filter material @ 50% of total material charges per cum.

= Rs. _____

Total _____

(B) Labour (for 100 cft)

(i) ¼ No. mason Ist class @ Rs. _____ per day per shift Rs.
(ii) 3½ No. Beldars @ Rs. _____ - do - = Rs. _____

Sub total of labour charges = Rs.

Assuming work will be done on 25 days only in a month

Average daily wages = $\frac{\text{Sub total of labour charges} \times 30}{25}$

= Rs.

Add for hidden cost of labour @ 50% of direct labour charges

= Rs. _____

_____

Grand total of labour charges = Rs.

Labour charges per cum. = $\frac{\text{Grand total of labour charges} \times 35.31}{100}$

= Rs.

Prime Cost per cum = (A + B) = Rs.

Add for over head charges and contractor's profit @ 20% of Prime Cost

= Rs. _____

Total = Rs. _____

Say Rs.....

Hence Rate per Cum. = Rs.

.6. STONE RIPRAP OR PITCHING:

Brief Specifications Hand packed

(A) Materials: per cum.

(i) 1.15 cum. Rubble stone at quarry including spalls @ Rs. _____ per cum = Rs.

(ii) 1.15 cum. carriage of Rubble stone and spalls from quarry to work site @ Rs._____per cum. = Rs.

(B) Labour:(For 100 cft)

½ mason IInd class @ Rs. _____ per day per shift = Rs.
3 nos. Beldars @ Rs. _____ - do - = Rs.

Sub total of labour = Rs.

Assumming work to be done on 25 days in a month

Average daily wages = $\frac{\text{Sub total of labour} \times 30}{25}$ = Rs.

Add for hidden cost of labour @ 50% of direct labour charges. = Rs.

Total labour charges = Rs.

Labour rate per cum. = $\frac{\text{Total labour charges} \times 35.31}{100}$ = Rs.

Total Prime Cost = (A+B) = Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost. Total = Rs.

Say Rs.....

Hence Rate per cum. of riprap = Rs.

7. STONE MASONRY IN 1:4 C.M. IN HERTING OF DAM:

(A) Materials: per cum.

(i) 1.00 cym. Quarrying and transportation of rubble stone to site @ Rs._____ per cum. = Rs.

(ii) 0.54 cum. Quarrying or manufacturing of sand including storage & handling carriage to site @ Rs.___= Rs.

(iii) 3.00 Nos. Cement cost including transportation storage and handling charges @ Rs. ____ per bag. = Rs.

(iv) Water charges @ L.S. = Rs.

(v) Admixtures @ L.S. (With transportation to site and storage and handling) = Rs.

Total = Rs.

(B) Labour Per 100 cft.

Mixing of mortar laying and handling

1 No. Dressing mason @ Rs._____ per day per shift = Rs.
1 No. mason Ist class @ Rs._____ - do - = Rs.
1 No. mason IInd class @ Rs._____ - do - = Rs.
3½ Nos. Beldars @ Rs._____ - do - = Rs.
½ No. Bhisti or water carrier @ Rs.__ do - = Rs._____

Sub total of labour = Rs._____

Add for hidden cost of labour @ 50% of direct labour charges = Rs._____

Total = Rs._____

Prime Cost (A+B) = Rs.

Add overhead expenses and contractor's profit @ 20% of Prime Cost. = Rs._____

Total = Rs._____

Say Rs.....

Hence Rate per cum. =

8. FACE STONE MASONRY (1:4) IN DAMS:
Unit.....per m^3

(A) Materials:

(i) 1.00 cum. collection and carriage of STONE to site @ Rs..... per cum. = Rs.

(ii) 1.00 cum. Dressing charges @ Rs. 3.2 x 1.05 Nos* = Rs.

(iii) 3.2 x 1.05 Nos* cement bags at site of work including carriage charges @ Rs. = Rs.

(iv) 0.45 cum. cost of sand at site for work including carriage @ Rs._____ per cum. = Rs._____

Total (A) = Rs._____

* 5% wastage and incidentals to work

(B) Labour : For 100 cu-ft.

1 No. mason Ist class @ Rs._____ per day per shift = Rs.
2 Nos. Beldars @ Rs._____ - do - = Rs.
1 No. Bhisti @ Rs._____ - do - = Rs.

Total _____

Assuming work will be done on 25 days in a month
average daily wages = Total wages X 30 / 25 = Rs.

Add for hidden cost of labour @ 50% direct labour charges = Rs.

Total Rs.

Therefore labour rate per cum = Total x 35.31 / 100 = Rs.

Prime cost of material and labour = (A+B) = Rs.

Add contractor's profit and overhead charges @ 20% of Prime Cost = Rs._____

Grand Total _____

Say Rs.....

Hence rate per cum. = Rs.....

9. MASS CONCRETE IN DAMS (M-100)

Rate per cum. Average lead = 1 Km.

(A) Materials:

Sl. No.	Item	Quantities	Unit	Rate	per	Amount
1.	Cement	4.6x1.05*	Bags	Rs.	bag	Rs.
2.	Sand	0.45	Cum.	Rs.	cum.	Rs.
3.	Coarse Aggregates	0.90	Cum.	Rs.	cum.	Rs.
4.	Water	-	-	L.S.	-	2.00
5.	Admixtures	-	-	L.S.	-	1.00

Total _____

* 5% wastage and incidentals to work

(B) Batching, mixing & Laying of Concrete:

(a) Batching & mixing charges use rate of 35 cum. yd. = Rs.
Batching & mixing plant
(Refer item 3-4 of)use rate vol.
Rate per cum. = $\frac{\text{use rate}}{35 \times .764 \times 0.69}$ = Rs.
(Taking Job management factor as 0.69)

(b) Transport of concrete by 4 cu. yd. buckets hauled by 5 T Diesel Locomotive from batching and mixing plant to pick up poing

Average lead = 1.00 Km.

Hauling cycle Time:

Ideal production at Batching plant = 75 cu. yd.
Actual production with 0.69 x 75 = 51.75 cu. yd.

Loading Time of a train = $\frac{4 \times 2 \times 60}{51.75}$ = 9.28 Min.

Spotting & waiting Time = 1.50 "
Loaded haul @ 6.0 K.M.P.H = $\frac{1 \times 60}{6}$ = 10.00 "

Turning and unloading Time = 9.28 "

Empty haul @ 6.00 Km.P.H. = $\frac{1 \times 60}{6}$ =10.00 "

Total cycle time = 40.06 Minutes.

No. of trips in a 50 min. working hour = $\frac{50}{40.06}$

= 1.25

Output of one train with 2 Buckets
per hour = 2 x 4 x 1.25 = 10 cu. yd = 7.6 cum.

Use rate of Diesel Locomotive ....)Rs.
Use Rate of 2 concrete Buckets ....)Rs.

Total use rate = Rs.

Transport Rate per cum. = $\frac{\text{Total use rate}}{7.6}$ = Rs.

(c) Placement of concrete by hammerhead Crane

Use Rate of crane = Rs.

Output of crane/hour using 2 No. Buckets of 4 cu. yd. capacity each.

= 75.00 x 0.69 x 0.76 = 39.33 cum.

Rate per cum = $\frac{\text{Use Rate of crane}}{39.33}$ = Rs.

Labour for placement L.S. = Rs.

Total (C) Rs.

(d) Vibrating the concrete:

(i)	Vibrators	L.S.	= Rs.
(ii)	Labour	L.S.	= Rs.
		Total	

(e) Cleaning, slurry, curing and finishing:

(i)	Sand blasting	L.S.	= Rs.
(ii)	Cement for slurry mortar	L.S.	= Rs.
(iii)	Cleaning and washing	L.S	= Rs.
(iv)	Curing and finishing	L.S.	= Rs.
		Total (e)	= Rs.

(f) Catwalks and other aids for concreting: = Rs.

(g) Other charges:

(i)	Electric Energy	L.S.	= Rs.
(ii)	Compressed air	L.S.	= Rs.
(iii)	Work shop	L.S.	= Rs.
(iv)	Track charges	L.S.	= Rs.
		Total (g)	= Rs.

(h) Mise supplies such as hose pipes Gumboots and small tools etc

Total charges for item (B) - items a to h = Rs.

(i) Shuttering charges @ Rs. 50.00 per cum. = Rs. 50.00

Abstract of Charges — Rate in Rs. per cum.

(A) Materials = Rs.
(B) Batching, mixing and laying = Rs.
(C) Shuttering @ Rs. 50 per cum. charges =Rs. 50.00

Prime Cost

Add overhead charges and contractor's profit @ 20% of Prime cost = Rs.

Grand total = Rs.

Say Rs.....

Hence Rate per cum. = Rs.

10(i). CONCRETE M-150 IN SPILLWAYS, DAMS, BRIDGE PIERS @ INTAKE

Rate per cum. Average lead = 1 Km.

(A) Materials:

Sl.No.	Item	Quantity	Unit	Rate in Rs,	Amount
1.	Cement	6.00 x 1.05*	Bags	Rs.....	Rs.....
2.	Sand	0.45	Cum.	Rs.....	Rs.....
3.	Coarse Aggregates	0.90	Cum.	Rs.....	Rs.....
4.	Water	-	-	L.S.	=Rs. 2.00
5.	Admixtures	-	-	L.S.	=Rs. 1.00
				Total(A)	

5% Wastage and incidentals to work

(B) Batching, Mixing & Laying:

Same as for mass concrete M-100 (Total of part B of item No. 9) =Rs.

Rate per cum. =Rs.

(C) Shuttering charges @ Rs. 90 per cum. =Rs. 90.00

Total Prime cost per cum. = (A + B + C) =Rs.

Add overhead charges and contracter's profit @ 20% Prime cost =Rs.

Grand total =Rs.

Say Rs.

Hence Rate per cum. of M-150
Grade concrete = Rs._____

10(ii). CONCRETE M-200 IN DAMS & SPILLWAYS (AVERAGE LEAD 1 Km.)

Rate per cum.

(A) Materials:

Sl. No.	Item	Qty	Unit	Rate in Rs. per	Amount.
1.	Cement	8.00 x 1.05*	bags	Rs.... Each	Rs.....
2.	Sand	0.43	cum.	Rs.... -do-	Rs.....
3.	Coarse Aggregates	0.86	-	Rs.... -do-	Rs.....
4.	Water	-	-	L.S. -	Rs. 2.00
5.	Admixtures	-	-	L.S. -	Rs. 1.00

Total(A) =Rs.

(* 5% wastage and incidentals to work)

(B) Batching, mixing and laying etc.

Same as for mass concrete M-100
Total of sub-item B of item No. 9 =Rs.

(C) Shuttering charges @ Rs. 90 per cum

Prime Cost (A + B + C) =Rs.
Add overhead charges and contractor's profit @ 20% of Prime cost =Rs.

Grand total =Rs.

Say Rs._____

Hence Rate per cum. = Rs._____

10(iii). CONCRETE M-250 IN DAMS, SPILLWAYS & HEAD WORKS:
Rate per cum; average lead = 1Km.

(A) Materials:

Sl. No.	Item	Qty.	Unit	Rate in Rs. per	Amount
1.	Cement	11.00 x 1.05*	Bags	Rs...	each Rs....
2.	Sand	0.42	Cum.	Rs...	-do- Rs....
3.	Coarse Aggregates	0.84	Cum.	Rs...	-do- Rs....
4.	Water	-	-	L.S.	- Rs.2.00
5.	Admixtures	-	-	L.S.	- Rs.1.00

(*5% wastage and incidentals to work) Total (A) = Rs.

(B) Batching mixing and laying etc.

(a) Batching & mixing charages same as in item No. 9 of mass concrete M-100 =Rs.....

(b) Transport of concrete same as in item No. 9 of mass concrete M-100 =Rs.....

(c) Placement of concrete

(i) Labour for placing into Pneumatic concrete placer =Rs.....

(ii) Hourly use Rate of pneumatic concrete placer =Rs.....

Capacity of machine per hour = 25 cu.yd.
Output of machine at 69% efficiency

0.69 x 25 cu.yd. = 17.25 cu.yd.
= 13.18 cum.

Rate per cum = $\frac{\text{Hourly use rate of concrete Placer}}{13.18}$ =Rs.....

(iii) Labour for placement into Forms =Rs.....

Total (c) = (i) + (ii) + (iii) =Rs.....

(d) Vibration charges: =Rs.....

(e) Cleaning, curing and finishing:

(i) Sand blasting =Rs.....
(ii) Cement for slurry mortar =Rs.....
(iii) Cleaning & Washing =Rs.....
(iv) Curing and finishing =Rs.....
Total: =Rs.

(f) Catwalk and other aids for concreting
..... =Rs.....

(g) Other charges:

Same as in item No. 9
of mass concrete M-100 = Rs. 14.00

(h) Misc.-supplies

Same as in item No. 9
of mass concrete M-100 = Rs. 8.00

Total charges for item (B) =Rs.

(C) Shuttering charges @ Rs. 90 per cu, = Rs. 90.00

Abstract of charges:

A.	Materials.	= Rs.
B.	Batching mixing and laying	= Rs.
C.	Shuttering	= Rs.
	Prime Cost	= Rs.
	Add for overhead charges and contractor's Profit @ 20% of Prime cost	= Rs.
	Grand Total	= Rs.

Say Rs.....

Hence Rate per cum = Rs.

11. MILD STEEL REINFORCEMENT

Unit = 1 tonne.

(A) Material:

(i) Cost of mild steel bars at stores = Rs.
(ii) Add for wastage and incidentals to work @ 2.5% of (i) above = Rs.

Total of item (A) Rs.

(B) Handling & placing:

(i) Bending and cutting @ 6% of (A) above = Rs.

(ii) Handling @ 5% of (A) above = Rs.
(iii) Placing, and welding @ 5% of (A) above = Rs.
(iv) Binding wire and other materials @ 5% of (A) above = Rs.

Total of item (B) = Rs.

Abstract of charges:

(A) Material = Rs.
(B) Handling & Placing = Rs.

Prime cost = Rs.

Add overhead charges and contractor's profit @ 20% of Prime cost = Rs.

Grand total = Rs.

Hence rate per tonne = Rs_____ = Rs.

12. SEALS

(A) Furnishing & Installing copper seal : (Unit-1 kg.)

A. Cost of copper seal and accessories:

Size of copper seal 250 mm. x 0.8 mm. weight per Sq. metre = 7.35 Kg.

Weight of strips per linear metre = 0.20 x 1 X 7.35 x 1.025* = 1.50 Kg.

(*Allowing 2.5% for wastage and incidentals to work)

(i) Cost per linear metre @ Rs._____ per Kg. including furnishing, storing, handling and cutting etc. = Rs.

(ii) Cost of bracing, washers and nails etc. per running metre @ 3% of item (i) above = Rs.

Total of item (A) above = Rs.

(B) Labour Charges:

Taking that ½ mason and 1 helper can place the seal in one lift of 1.5 m. in one shift the cost of labour is

½ mason @ Rs._____per day per shift = Rs._____
1 helper @ Rs._____ per day per shift = Rs._____

Sub Total of Labour charges = Rs._____

Add for hidden cost of labour @ 50% of direct labour charges = Rs._____

Total Labour Charges per shift = Rs._____

Labour charges per metre = $\frac{\text{Total Labour charges/shift}}{1.5}$ = Rs._____

Abstract of charges per metre:

A. Cost of copper seal and accessories = Rs._____
B. Cost of Labour = Rs._____

Prime Cost = Rs._____

Add overhead charges and contractor's profit @ 20% of Prime cost = Rs._____

Grand Total = Rs._____

Hence rate per Kg. of copper seal

= $\frac{\text{Grand total per metre}}{\text{wt of seal per metre}}$ = Rs._____

(B) Furnishing and Installing Asphalt Seal (Unit per m.)

(A) Cost of Asphalt:

Size of seal = 135 mm. x 135 mm.

Volume of asphalt required per linear = 0.018 cum.
Weight of asphalt per cum.. = 1365 Kg.
Weight of 0.018 cum. a sphalt = 24.57 Kg.

Cost of asphalt @ Rs. _____per Kg. including carriage and handling = Rs._____

(B) Cost of steam Pipe:

Size of pipe = 12 mm diameter

Quantity required per linear m = 2 m.

Cost of pipe including carriage and handling @ Rs._____per metre = Rs._____

(C) Cost of other accessories:

The accessories include pipe fittings, 24 cm. long and 1.25 cm. diametre bolts with clamps, metal plates, frames for recesses and wire etc. for support of pipes. The cost of these accessories can be taken @ 50% of the cost of pipe

The cost of above accessories = Rs._____

(D) Cost of Steam:

The steam shall be required for melting the asphalt: in the seal

Cost per linear metre @ 25% of the cost of pipe = Rs. = Rs._____

(E) Labour charges:

Following labour will be required for placing that a sphalt seal in one lift, 1.5 m. of block per shift.

½ No. pipe fitter @ Rs._____per day per shift = Rs._____
¼ No. mason @ Rs._____per day per shift = Rs._____
½ No. helper @ Rs._____per day per shift = Rs._____

Sub total labour charges = Rs._____

Add for hidden cost of labout @ 50% of direct labour charges = Rs._____

Total labour charges = Rs._____

Progress per shift = 1.5 m

Cost of Labour per linear metre = $\frac{\text{Total Labour charges}}{1.5}$ = Rs._____

Abstract of cost:

(A) Cost of asphalt	= Rs._____
(B) Cost of Steam pipe	= Rs._____
(C) Cost of accessories	= Rs._____
(D) Cost of steam	= Rs._____
(E) Cost of Labour	= Rs._____
Prime cost	= Rs._____
Add for over head charges and contractor's profit @ 20% of Prime cost	= Rs._____
Total cost of seal per meter	= Rs.

(C) Furnishing and installing Monel seal: (Unit 1 Kg.)

(A) Supply:

Cost of 1.025 Tonne* monel strip including all taxes and carriage to the site per tonne	= Rs._____
(* Including 2.5% wastage and incidentals to work)	= Rs._____

(B) Installation:

(i) Cutting & binding L.S.	= Rs. 150.00
(ii) Fixing L.S.	= Rs. 100.00
(iii) Brazing L.S.	= Rs. 150.00
(iv) Miscellaneous work including nailing and supporting forms L.S.	= Rs. 200.00
Total:	= Rs. 600.00

Abstract of charges:

(A) Supply	= Rs._____
(B) Installation	= Rs. 600.00
Prime cost	= Rs._____
Add for over head charges and contractor's profit @ 20% of Prime cost	= Rs._____
Grand Total: (Rate per tonne)	= Rs._____

Rate per Kg. = $\frac{\text{Rate per Tonne}}{1000}$ = Rs._____

13. ROCK BOLT:

(A) Drilling:

(i) Cost of drilling use rate of Jack hammer = Rs._____
Average rate of drilling 35 mm dia holes per hour = 2.3 meter

Hence rate of drilling/meter = $\frac{\text{Use rate of Jack hammer}}{2.3}$ = Rs._____

(ii) Cost of drill rod per meter of drilling = Rs._____

(iii) Labour, lighting and scaffolding etc. per meter L.S. = Rs. 2.00

(iv) Ventilation & workshops charges L.S. = Rs. 1.50

Total: = Rs._____

Say = Rs._____

(B) Supply and making the bolts:

(i) Rock bolts 25 mm dia @ Rs.....per meter = Rs._____
(Issue rate or purchase rate)

(ii) Wastage in cutting 2.5% of B(i) = Rs._____

(iii) Cutting & making tip L.S. = Rs. 2.00

(iv) Threading L.S. = Rs. 3.00

(v) Cost of nut & plate L.S. = Rs. 6.00

Total: = Rs.

(C) Installation:

(i) Placing rock bolt in position using rock bolting machine L.S. = Rs. 4.00

(ii) Grouting Rock bolt L.S. = Rs. 4.00

(iii) Miscellaneous work L.S. = Rs. 2.00

Total: = Rs.10.00

Abstract of charges:

(A) Drilling = Rs._____
(B) Supply of bolts = Rs._____

(C) Installation = Rs. 10.00

Prime Cost = Rs. _____

Add overhead charges and contractor's profit @ 20% of Prime cost = Rs. _____

Grand Total: = Rs. _____

Say = Rs. _____

Hence rate per meter = Rs..... = Rs. _____

14. PENSTOCK LINERS: (Per M.T.)

(A) Material:

1. Steel fire Box quality including imported steel at stores = Rs. _____

2. Add for wastage and incidentals to work @ 2.5% of steel = Rs. _____

Total: = Rs. _____

(B) Fabrication:

(Rate as per experience at Rihand and Yamuna Hydel scheme stage-II)

The rate of items on lump sum basis given below may vary from place to place depending upon site conditions and they should be carefully adopted or suitably changed.

1.	Straightening	L.S.	= Rs. 50.00
2.	Marking	L.S.	= Rs. 40.00
3.	Cutting	L.S.	= Rs. 60.00
4.	Rolling	L.S.	= Rs. 100.00
5.	Welding	L.S.	= Rs. 500.00
6.	Radiographic testing of welds	L.S.	= Rs. 150.00
7.	Handling of materials during intershop operations	L.S.	= Rs. 130.00
8.	Temporary fixtures	L.S.	= Rs. 130.00
		Total:	= Rs. 1160.00

(C) Erection:

Handling, assembling, final matching field welding and painting L.S. =Rs.900.00

Prime Cost of steel liner=(A+B+C) =Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost of liner =Rs.

Grand total =Rs.

Say =Rs.

Hence Rate of penstock liner is Rs._____per ton.

15. ROCK EXCAVATION IN TUNNELS:

Format for tunnel of diameter = 7.00 meter
Thickness of lining = 0.5 meter
Length of Tunnel = As per requirement

Excavated diameter of tunnel -Finished dia of tunnel + 2 x Thickness of lining + Distance of pay lines
=7.00 + 2 x 0.5 + 2 x 0.15
=8.3 meter

Gross sectional area of Tunnel=3.14 $\frac{d^2}{4}$

$$=\frac{3.14}{4}(8.3)^2$$

=54.11 SQM

Add for over break @ 20% =10.82 SQM

Gross sectional area = 64.93 SQM

Quantity of excavation per meter length of tunnel = 64.93 x 1.00
= 64.93 cum.
Say = 65 cum.

Assumed progress per face This includes drilling blasting, mucking, ribbing and packing etc. = 3 m per day

Hence Quantity of Excavation per day = 65 x 3
= 195 cum.

No. of working shifts of 8 hours each = 3 Nos.

Quantity of Excavation per shift = 195/3
= 65 cum.

(Borrow measure)

Cycle of operations:

Sl.No.	item of operation	No.of working hours
1.	Drilling and shifting working plateform	6.00 hours
2.	Charging and blasting	1.00 hours
3.	Defuming	1.00 hours
4.	Mucking	4.00 hours
5.	Rock bolting, Rib erection and Concreting	12.00 hours
		24.00 hours

1. Direct Labour

1 No. Foreman special drilling @ Rs._____per day/shift =Rs.

1 No.Assistant Foreman Special drilling @ Rs._____per day/per shift. =Rs.

1 No. Explosive Inspector Rs._____ per day per shift =Rs.

1 No. Electrician @ Rs._____ per day per shift =Rs.

1 No. Explosive @ Rs._____ per day per shift =Rs.

2 Nos. Hole cleaners @ Rs._____ per day per shift =Rs.

1 No. Helper to Electrician @ Rs._____ per day per shift =Rs.

12 Nos. Muckers @ Rs._____ per day (for 2 shift) =Rs.

12 Nos. Beldars @ Rs._____ per day(for 2 shift) =Rs.

1 No. wireman for blasting @ Rs._____per shift =Rs.

2 Nos. Explosive chargeman @ Rs._____per shift =Rs.

Total wages =Rs.

Add for hidden cost of labour @ 50% of direct labour charges =Rs.

Total direct labour =Rs.

Rate of labour per cum.= $\frac{\text{Total direct labour}}{195}$ =Rs.

2. Machinery charges:

Sl.No.	Equipments	Nos.	Working hrs. per-day	Total work-ing hours perday	Use rate per hour in Rs.	Amount in Rs.
1.	Drill Jumbo	1	6.00	6.00		Rs.
2.	Trolleys	16	4.00	64.00		Rs.
3.	Jack Hummers(48 No)	10	5.00	50.00		Rs.
4.	Scaling	2	4.00	8.00		Rs.
5.	Drill Extractors	2	1.00	2.00		Rs.
6.	Grinders	2	1.00	2.00		Rs.
7.	Convey Muckers (1 cu.yd)	1	5.00	5.00		Rs.
8.	Battery Loco	4	5.00	20.00		Rs.
9.	D-8 Tractor Dozer	1	6.00	6.00		Rs.

Total Machinery Charges=Rs.

Note:

Use rate of machines are to be calculated on the basis of item No. given in the column.

Total machinery charges =Rs.

Quantity of Rock Excavated = 195 cum.

Rate per cum.= $\frac{\text{Total machinery charges}}{195}$ =Rs.

3. Material charges:

(A) Drilling and Blasting:

a). It is proposed that to attain 3 m progress per day

per face 3.3 m deep holes will be drilled

Cross-sectional area of Tunnel - 54.11 SQM
Assumming average spacing of holes=0.75 m c/c
Area of rock cross section per hole=$(0.75)^2$-0.562 SQM
No. of holes required per face= $\frac{54.11}{0.562}$=96 Nos.

Total Depth of drilling=96x3.3=316.80 m.

Cost of drill steel=3168xcost of drill steel per meter Rs.
Quantity of rock Excavated=195 cum.

Rate for drill steel per cum.=$\frac{\text{Total cost of drill steel}}{195}$ =Rs.

b) Explosives:

i) Gelatine required per cum = 1.00 Kg.
Cost of gelatine per Kg. =Rs.
(To be taken equal to issue rate of the gelatine)

Rate per cum= 1 x cost of gelatine per Kg. =Rs.

ii) Detonators and fuse coils

No. of detonators and fuse coils @ one per hole per face= 96 Nos.

Cost of 96 Nos. detonators and fuse coil @ Rs._____each(Fill Issue rate) =Rs.

Quantity of rock excavated = 195 cum.

Hence rate of explosives per cum, =Rs.

iii) Other consumable petty stores such as blasting batteries, galvanometers and blasting wires etc. @ 50% of item(i) =Rs.

Total Explosive charges per cum(i+ii+iii) =Rs.
Total Drilling and blasting charges=(a+b) =Rs.

(B) Provision of pipe lines for air and water for wet drilling

Rate per cum. L.S. =Rs.3.00

(C) Timber for supports packing
Rate per cum____L.S._____ =Rs.3.00

(D) Miscellaneous supplies such as safety hats, gumboots, rain coats, wire ropes, manila ropes, v-clamps, rubber gloves, shackles and artificial respirators etc.

Rate per cum. L.S. =Rs.3.00

Total material charges per cum
= (A+B+C+D)
= Rs.+Rs.+Rs.+Rs. =Rs.

4. Charges for ventilation blowers:

a) Depreciation charges:

Total cost of blowers including cost of accessories such as air ducts =Rs.

Rated life=15000 Hrs.

Depreciation charges per hour. $= \text{Rs.} \frac{\text{cost of blower with accessories}}{15000}$ = Rs.

b) Repair and maintenance charges @ 100% of depreciation =Rs.

c) P.O.L.Charges:

Horse power of blowers = 100 H.P.
Energy required = 100 x 0.746
= 74.6 KWH

Say = 75 KWH

Cost of 75 KWH energy @ Rs._____KWH =Rs.
Sundaries and other items L.S. =Rs.1.00

Total P.O.L.charges=Rs.....

d) Labour charges:

1 No. operator @ Rs._____per day per shift. =Rs.
1 No. helper @ Rs._____ -do- =Rs.
Sub-Total of wages =Rs.

Add for hidden cost of labour @ 50% of direct labour charges =Rs.

Total labour charges =Rs.

No. of working hours per shift = 8

Labour charges per hour = $\frac{\text{Grand Total of wages}}{8}$ =Rs.

Total charges=(a+b+c+d) =Rs.

Per working hour
No. of working hours of blowers per shift=8

Total charges of blowers per shift
=8 x Total blower charges/hr. =Rs.

Rock Excavated per shift= 65 cum.

Hence Rate per cum.= $\frac{\text{Total blower charges/shift}}{65}$ =Rs.

5. Shop charges:

i) Machine shop including foundary and smithy L.S. =Rs.6.00
ii) Structural shop L.S. =Rs.8.00
iii) Steel metal shop L.S. =Rs.6.00
iv) Air and water pipe shop L.S. =Rs.5.00
v) Carpentary shop L.S. =Rs.5.00

Total shop charges per cum. =Rs.30.00

6. Electrical material charges per cum. L.S. =Rs.5.00
7. Jumbo track charges per cum L.S. =Rs.6.00
8. Compressed air charges per cum. L.S. =Rs.10.00
9. Water charges per cum. L.S. =Rs.5.00

ABSTRACT OF CHARGES

1. Direct Labour charges =Rs.
2. Machinery charges =Rs.
3. Material charges =Rs.
4. Ventilation blower charges =Rs.
5. Shop charges =Rs.30.00

6. Electric materials =Rs. 6.00
7. Jumbo Track =Rs. 6.00
8. Compressed air =Rs.10.00
9. Water charges =Rs. 5.00

Total charges =Rs._____

Note:

The lump sum rates of various items have been adopted as prevalent in Ganga & Yamuna River Valley projects.

Add for construction and maintenance of haul Road @ 5% of Total charges =Rs.

Add for Electric Energy charges @ 20% of Total charges =Rs._____

Prime Cost =Rs._____

Add overhead charges and contractor's profit @ 20% of Prime Cost =Rs._____

Grand Total =Rs._____

Say Rs.....

Hence Rate per cum.=Rs._____.

16. FABRICATION AND ERECTION OF STEEL SUPPORTS FOR UNDER GROUND EXCAVATION

A. Materials

1.025 M.T. Cost of structural steel at project store
2.5% Wastage and incidentals to work. =Rs.

B. Fabrication

i) Marking rolled sections @ 2½% of the cost of stock (A) above. =Rs.

ii) Cutting @ 3% of (A) above =Rs.

iii) Bending of rolled sections @ 6% of (A) above =Rs.

iv) Welding:

a) Cost of electrodes including 20% rejects @ 8% of (A) above =Rs.

b) Labour and electric charges @ 10% of (A) above =Rs.

c) Handling of material during Fabrication @ 5% of (A) above =Rs.

d) Temporary fixtures @ 8% of (A) above =Rs.

Total welding charges =Rs.

Total of Fabrication (i to iv) =Rs.

C. Erection

Transport of material out of workshop, operation, handling final matching and field welding etc.

@ 12% of (A) above =Rs.

Prime Cost Erection Charges (A+B+C) =Rs.

Add for over-head charges and contractor's profit @ 20% of Prime Cost =Rs.

Total =Rs.

Rate per tonne =Rs.

17. SHOT CRETING

Unit - per bag of cement consumption

A. Materials

S.No.	Item	Qty.	Unit	Rate in Rs.	Per	Amount in Rs.
1.	Cement	1x1.05*			bag	Rs.
2.	Coarse aggregate	.033	cum	Rs.	cum	Rs.
3.	Sand	0.10	cum	Rs.	cum	Rs.
4.	Admixture	-		L.s.	-	Rs.5.00
5.	Water	-		L.s.	-	Rs.2.00

*(5% wastage and incidentals to work) Total of materials =Rs.

B. Charges for mixing of Materials per bag:

Same as for mass concrete per cum 7.5 =Rs.

C. Transport of mix to site per bag:

Same as for pneumatically placed concrete/cum. 7.5 =Rs.

D. Placement Charges

Use rate of shot crete machine Rs.

Capacity = 1 cum

Considering No. of shots by shotcreting machine per hour - 6

out put per hour = 6 cum

Use rate of shotcrete Machine per bag of Cement consumption with 80% efficiency = $\frac{\text{Use rate of shotcrete machine/hr.}}{0.8 \times 6 \times 7.5}$

=Rs.

E. Lighting, Workshop Charges and other miscellaneous Items @ 100% of use rate of shotcrete machine per bag =Rs.

Prime Cost = Total of items (A to E) =Rs.

Add over head charges and contractor's profit
@ 20% of prime cost . = Rs.

Grand Total = Rs.

Hence Rate of shotcreting per bag of cement consumption = Rs.

18. DEWATERING OF FOUNDATION

A. Pump Charges

Use rate of 50 H.P. Pump per hour = Rs.
Therefore pump charges per hour = Rs.

B. Pipes and Accessories

a) Depreciation charges

i) 300 mms. pipe 250 mm, dia @ Rs._____ per meter =Rs.
ii) 5 Nos. M.S. Bends 250 mm. dia @ Rs._____per E =Rs.
iii) 1 No. foot valve @ Rs. _____/E =Rs.
iv) 1 No. sluice valve @ Rs._____/E =Rs.
v) 1 No. Vacuum Pumping set 5 H.P. @ Rs._____/ =Rs.
iv) 1 No. Reflex Valve @ Rs._____/E =Rs.
iiv) Spare items L.S. =Rs.

Total Rs.

Rates life = 20,000 hours Depreciation charges per hour.

$$= \frac{0.734 \times \text{Total Cost of Materials}}{0.75 \times 20,000}$$ =Rs.

b) Repair and Maintenance Charges:

Total repair provision = 50% of total cost of equipment

Repair and maintenance charges per hour

$$= \frac{0,5 \times 0,725 \times \text{Total cost}}{0.75 \times 20,000}$$ =Rs.

c) P.O.L. Charges:

Energy consumed in 5 H.P. vacuum pumping set
= 5 x 0.746 = 3.73 KW H Cost of 3.73 KW H @_____Paise per unit

Lubricants and grease with white paint and jute etc.

L.S. =Rs.2

Total Rs. _____

d) Labour Charges:

1 No. plumber @ Rs._____per month =Rs.
1 No. helper @ Rs. _____per month =Rs.
½ No. mechanic @ Rs._____per month =Rs.

Direct Labour charges =Rs.

Total Rs. _____

Add for hidden cost of labour @ 50% of direct Labour charges =Rs.

Total Labour charges =Rs.

Average No. of working hours per months = 150

Labour charges per hour = $\frac{\text{Total Labour Charges}}{150}$ = $\frac{\text{Total labour charges}}{150}$ = Rs.

e) Misc. Charges:

Mise charges @ 10% of repair charges: = Rs.
Total charges for pipes and accessories a to e = Rs.

C. Making sumps for placing of pipes

Labour:

4 Nos. Beldars @ Rs. _____per month (direct labour)

= Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total labour charges = Rs.

Average No. of working hours per month = 150

Labour charges per hour = $\frac{\text{Grand total of wages}}{150}$ = Rs

D. Misc Charges and Making Plateform etc. for Pumps @ 25% of Total Charges per hour. + Rs.

Abstract of Charges:

A. Pump charges = Rs.
B. Pipe and accessories = Rs.
C. Making sumps for placing pipes = Rs.
D. Mise charges and making Plateform for pumps/Prime Cost = Rs.

= Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost Grand Total. = Rs.

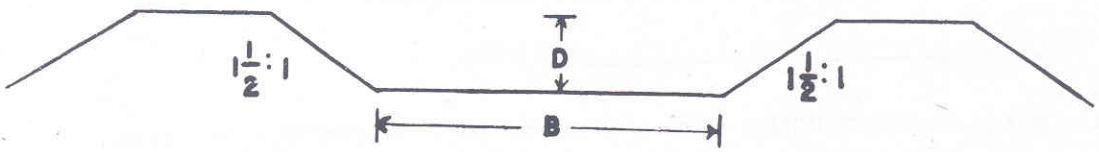
Energy consumed by 50 H.P. per hour
= 50 x 0.746 KWH = 37.30 KWH
Rate per KWH = Grand Total / 37.30

=Rs.

Say Rs. _____

Hence rate per KWH =Rs.

19. EARTH WORK IN LIP CUTTING IN BED & SLOPE IN ALL TYPES OF SOILS (1 Cum.)



For analysis of rate of this item it is assumed that the earth of lip cutting of slopes will fall down in bed and the lift will be considered from bed and the earth will become moist and saturated.

0.50 cum. Earth work ordinary @ Rs._____per cum = Rs.
(As per schedule of rates of the organisation concerned)

0.25 cum. Saturated Earthwork @ Rs._____per cum.
(As per schedule of rates)
= Rs.

0.25 cum. Moist earthwork @ Rs. _____ per cum. = Rs.
(As per schedule of rates)

1.00 cum. (i) Extra for earth mixed with shingle and boulder in the range _____ @ Rs._____per cum. (As per schedule of rates) =Rs.

(ii) Extra for lifts = $\frac{D-1.5}{0.5}$ = _____Nos. @ Rs. _____per each. =Rs.

(iii) Extra for _____Nos. leads beyond initial lead of 30 M. @ Rs._____/lead =Rs.

(iv) Extra for fine dressing for preparation of subgrade @ 25% of sub item No. 1. =Rs._____

Total Rs. = _____

Add

i) For hidden cost of labour @ 50% of direct labour charges Prime cost. =Rs.

ii) For overhead charges and contractor's profit @ 20% of Prime Cost Total =Rs.

Note:- The rates of schedule adopted in the Rate Analysis should be inclusive of hidden cost of labour @ 50% of direct labour charges and 20% overhead charges and contractor's Profit on Prime Cost.

Hence Rate of lip cutting in bed and side slopes

= Rs._____per cum.

20. (a) DRILLING GROUT HOLES UPTO 5 M DEPTH (M)(FOR CONTACT GROUTING)

i) Cost of Drilling

Use rate of Jack hammer =Rs.

Average rate of drilling 35 mm. dia. Holes per hour 2.3 M.

Hence rate of drilling per meter = $\frac{\text{Use rate of Jack hammer}}{2.3}$ =Rs.

ii) Cost of drill rod per meter of drilling = Use rate of drill steel with Jack hammer = Rs.

iii) Labour, lighting & scaffolding, etc @ 60% of sub-item-ii = Rs.

IV) Ventilation and workshop charges @ 40% of sub-item (ii) Prime Cost = Rs.

Add overhead charges and contractor's profit @ 2% of Prime Cost = Rs.

Grand Total =Rs.

Say = Rs. =Rs.

Hence rate per meters = Rs.

20. (b) DRILLING GROUT HOLES OF MORE THAN 5 M DEPTH = M (FOR CONSOLIDATION GROUTING)

i) Cost of drilling
Use rate of wagon drill per hour = Rs.

Assuming the average rate of drilling 35 mm. dia holes per hour to be 6 meter and considering 50% progress due to space limitations etc. the rate of drilling per hour = 0.50 x 6 = 3 meter

Hence rate for per meter drilling = $\frac{\text{Use rate of Wagon drill}}{3}$ = Rs.

ii) Cost of drill steel per meter of drilling
= Use rate of drill steel with wagon drill = Rs.

iii) Cost of shifting of wagon drill @ 40% of item (ii) + Rs.

iv) Lightening ventilation and workshop charges @ 40% of item (ii) = Rs.

Prime Cost = Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost = Rs.

Total= Rs.

Say Rs.

Hence Rate per meter = Rs.

21. GROUTING FOR DAM/BARRAGE FOUNDATION UNIT = PER BAG OF CEMENT

1. Cement and Sand:

i) Cost of 1.05 bag of cement at site including 5% wastage and incidentals to work @ = Rs. Rs. _____ per bag = Rs.

ii) Cost of sand in 1:2 mix for one bag i.e. 0.071 cum. @ Rs. _____ /cum. = Rs.

Total = Rs.

2. Washing the hole:

i) Cost of equipment L.S. = Rs.
ii) Cost of labour L.S. = Rs.

Total = Rs.

3. Grouting:

i) Grouting machine charges:
Use rate of grouting machine = Rs.

Taking 8 bags progress of machine per hour = Rs.

Grouting charges per bag = $\frac{\text{Use rate of grouting machine}}{8}$ = Rs.

ii) Cost of Labour L.S. = Rs.

Total = Rs.

4. Other Misc, items such as G.1 pipe fittings and pressure testing etc. L.S. = Rs. 5.00

Prime Cost (1 + 2 + 3 + 4) = Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost Total = Rs.

Say = Rs.

Hence Rate of grouting per bag of 50 Kg. = Rs.

22. GROUTING IN TUNNEL (PER BAG OF CEMENT CONSUMPTION)

1. Cement and Sand

i) Cost of 1.05 bag of cement at site including 5% wastage and incidentals to work @ Rs._____per bag = Rs.

ii) Cost of sand: Cost of sand in 1 : 2 c.m. per bag (0.071 cum. @ Rs._____per cum. =Rs.

Total =Rs.

2. Washing the Hole:

i)	Cost of equipment	L.S.	=Rs.2.00
ii)	Cost of Labour	L.S.	=Rs.3.00
		Total	=Rs.5.00

3. Grouting:

i) Grouting machine charges
Use rate of grouting machine per hour =Rs.

Taking progress of grouting 6 bag per hour

$$\text{Cost of Grouting} = \frac{\text{Use rate of grouting machine per hour}}{6} = \text{Rs.}$$

ii) Cost of Labour L.S. Total=Rs.

4. Other misc. items such as pipe, fittings and pressure testing etc. L.S. =Rs.5.00

Prime Cost of grouting = 1 - 2 - 3 - 4 =Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost = Rs.

Grand Total =Rs.

Say = Rs.

Hence rate of Grouting per bag of cement consumption =Rs._____

Note: The above format of Grouting can be used in contact grouting as well as consolidation grouting with proportionate variations in sub-item 2, 3 & 4, being on the higher side for consolidation grouting as the drill holes are done above 5 M depth by wagon drill.

23. GRANITE SETS (cum)

1. Material:

A. Cost of 1.00 cum. granite stone

i) Cost of 1.0 cum. granite stone at quarry including royalty charges @ Rs.. _____ per cum. =Rs.

ii) Carriage of 1.0 cum. material from quarry to site @ Rs. _____ per cum. =Rs.

Total =Rs.

Note: The carriage charges shall be calculated on the basis of schedule of rates or powered vehicles as in case of Rock excavation.

B. 0.20 cum. M-200 concerete @ Rs. _____ per cum. (Refer item of Analysis of rates concrete M-200)=Rs.

Total = Rs. A + B)

2. Labour for setting final dressing and local carriage (per cum)

i) ½ No. mason I class @ Rs._____ per day per shift= Rs.
ii) 1 No. stone cutter @ Rs. _____ -do- = Rs.
iii) 4 Nos. beldars @ Rs. _____ -do- = Rs.

= Rs.

Direct Labour/cum.

Assuming work will be done on 25 days in a month effective direct labour/cum = Director Labour/cum x 30 / 25

Add for hidden cost of labour @ 50% of effective direct labour charges =Rs.

Total = Rs.

Abstract of Charges:

1. Material = Rs.
2. Labour = Rs.

Prime Cost = Rs.

Add overhead charges and contractor's profit @ 20% of Prime cost = Rs.

Grand Total = Rs.

Hence rate per cum = Rs. Say = Rs.

24. BOULDER SETTS (cum)

A. Materials:

i) 1.0 cum. Boulder @ Rs._____per cum. including carriage charges and royality chargess =Rs.

ii) 0.40 cum. M-200 concrete @ Rs._____per cum. (Refer Analysis of rates of M-200 concrete) =Rs.

Total Rs.

B. Labour charges for (100 cft.)

i) 1 No. mason @ Rs. _____per day per shift =Rs.
ii) 2 Nos. stone cutter @ Rs. _____-do- = Rs.
iii) 3 Nos. Beldars @ Rs. _____per day per shift

Direct labour % cft.

Assuming work will be done on 25 days in a month
Effective Direct labour % cft.= $\frac{\text{Direct labour \% cft.} \times 30}{25}$

Add for hidden cost of labour @ 50% of effective direct labour charges =Rs.

Total wages = Rs.

Labour charges per cum.=$\frac{\text{Total wages} \times 35.31}{100}$ = Rs.

Prime Cost per cum.= (A + B) =Rs.

Add overhead charges and contractor's profit @ 20% of prime cost =Rs.

Grand Total=Rs.

Say Rs. _____

Hence rate per cum Rs._____

25. PUMPED CONCRETE M-200 IN PENSTOCK AND SURGE SHAFTS RATE PER CUM.

A. Materials:

Sl. No.	Item	Qty.	Unit	Rate	Per	Amount
1.	Cement	8.00 x 1.05*	Bags	Rs.	Each	Rs.
2.	Sand	0.43	Cum.	Rs.	cum.	Rs.
3.	Coarse Aggregates	0.86	Cum	Rs.	Cum.	Rs.
4.	Water					
5.	Admixtures -	-	L.S	-		Rs.2.00
			L.S.	-		Rs.1.00
				(A) Total =		Rs.

(*5% Wastage and incidentals to work)

B. Batching, Mixing and Laying of Concrete:

a) Batching and mixing charges as per mass concrete M-200 Rate per cum.

b) Transportation of concrete by 4 cu. yd. Agitating cars from batching and mixing Plant to placement site (Lead 3.00 Kms.) one Locomotive will haul 4 cars.

Hauling Cycle Time:

Spotting, waiting and loading time = 30 min.
Loaded haul @ 6 Kms/hr. = 3/6 x 60 = 30 min.

Turning and unloading time = 8 min.
Empty haul @ 6 Kms/hr. = 3/6 x 60 = 30 min.

Total Cycle time = 98 min.

No. of Trips in 50 minutes working hour = $\frac{50}{98}$ = 0.51

Output of one Train of 4 agitating cars per hour = 0.51 x 4 x 4 = 8.16 cu.yd.
= 8.16 cu.yd.
= 6.23 cum.

Use rate of 4 agitating cars per working hour = Rs.
= 4 x use rate of one agitating car per hour

(Refer item No. 19 of use rate Sec. I)

Use rate of 10 T Locomotive per hour = Rs.
(Refer item No.6 of use rate Sec.I) Total = Rs.

Rate per cum= Total of use rates of 4 agitating cars and 10 T Locomotive per hour / output (6.23) = Rs.

C. Placement of Concrete:

i) Labour for placing into pneumatic concrete placer L.S. = Rs.6.00

ii) Use rate of pneumatic concrete placer/hr (Refer item No. 16 of use rate vol.) =Rs.

Capacity of machine per hour =25 cu. yd.
output of machine at 69% of efficiency
= 0.69 x 25 cu. yd. = 17.25 cu.yd.
=13.13 cum.

Rate per cum.= Use rate of pneumatic concrete placer per hour / output (13.13) = Rs.

iii) Labour for placement into forms L.S. =Rs.6.00

Total of item (c) = (i + ii + iii) =Rs.

d) Vibration charges @ 5% of total Labour charges for placement into forms =Rs.

e) Clearing, curing, and finishing

i)	Sand blasting	L.S.	=Rs.
ii)	Cement for slurry mortar	L.S.	=Rs.
iii)	Clearing and washing	L.S.	=Rs.
iv)	Curing and finishing	L.S.	=Rs.
		Total	= Rs.

f) Catwalks and other aids for concreting L.S. =Rs.

g) Other charges:

i)	Electrical energy	-do-	=Rs.
ii)	compressed air	-do-	=Rs.
iii)	Workshop charges	-do-	=Rs.
iv)	Track charges	-do-	=Rs.
		Total	= Rs.

h) Misc-supplies as hose pipes, safety hats Gumboots and small tools etc L.S. =Rs. 10.00

i) Ventilation charges L.S. =Rs. 3.00

Total charges for item B= a+b+c+d+e+f+g+h+i =Rs.

D. Shuttering charges @ Rs.90 per cum =Rs.90/cum.

Prime cost of pumped = **A** + B + C =Rs.
concrete M-200 per cum.

Add overhead charges and contractor's profit
@ 20% of prime cost =Rs.

Grand Total=Rs.

Say Rs.

Hence Rate per cum = Rs.

26. COARSE AGGREGATES (Cum)

(A) Drilling & Blasting:

Rock drilling at quarry site is proposed to be carried out by Jack hammers.

On the basis of Table 11.7 of construction planning, equipment and methods by R.L. Pourify (Page 259) one foot drilling is sufficient for blasting 0.59 cu.yd. of Rock

Depth of drilling per 100 cum. of Rock

$$= \frac{100}{0.59 \times 764} = 221.85 \text{ ft.} = 67.64 \text{ meter}$$

Add for horizontal drilling and pull effect @ 50% of above
Total drilling = 67.64 x 1.5 = 101.46 M. = Say 102 M

a) Jack hammer charges:

$$\text{Cost of drilling} = \frac{102 \times \text{use rate of Jack Hammer}}{2.3} = \text{Rs.}$$

Taking rate of drilling as 2.3 meter per hour as per book referred above page 260.

b) Drill Rod Charges:

Cost of drill rods for 102 M.
= 102 x cost of drill rod per meter = Rs.

c) Blasting:

i) Assumming that drill holes can be filled with dynamite upto 75% of their capacity

Then quantity of explosive required for 100 cum. of rock =0.43 x 100 = 43 Kg.

Coast of 43 Kg. Gelatine @ Rs._____, per Kg. = Rs.

ii) Cost of electric detonators Average depth of holes = 1.75 M.

No. of holes = $\frac{102}{1.75}$ = 58.28

Say 59 Holes

Using one detonator per hole, the No. of detonators per 100 cum. of rock = 59

Cost of 59 Nos. detonators @ Rs._____per each =Rs.

iii) Blasting batteries, primer, primacord and loading wires etc.@ 15% of the cost of Gelatine =Rs.

iv) Stemming @ 7% cost of gelatine =Rs.

Total charges for blasting
= i + ii + iii + iv =Rs.

Total charges for drilling and blasting including cost of drill rods

= a + b + c =Rs.

Say = Rs.

Hence rate of drilling and blasting per 100 cum. =Rs.

Assuming that:

1- 30% material will be available for blasted rock for works Rate per 100 cum. (Borrow measure)
=Rate at A. x 0.7 =Rs.

2- Losses for 100 cum. aggregates as below:

i) 3% in transit from processing plant to Batching and mixing plant

ii) 10% process reject

iii) 5% in transit from quarry to processing plant

iv) 20% rejection at quarry

Rate after adding for rejection and losses
= Rate per 100 cum. of drilling & blasting x 1.38
(Borrow measure) = Rs.

swell factor for hard rock = 0.67
Rate per 100 cum. (Bulk volume) of Aggregate
= 0.67 x Rate after adding for rejection & losses =Rs.
Rate per cum=$\frac{\text{Rate per 100 cum. of Aggregates}}{100}$ = Rs.

(B) Carriage of Blasted Rock upto Crushing Plant:

Average lead = 1.00 Km.
Diesel shovel:
Capacity - 2.0 cum.
Ideal production = 275 cu.yd. per hour
out put = 275 x .88 x 0.69 x .83
From Book of Dr. Mahesh Verma
= 138.59 cu.yd.
= 106.00 cum.

Dumper : 15T
Capacity 5.58 cum.

MACHINERY CHARGES

i) Shovel

Use rate per working hour (Refer item No.20 of use Rate volume)
Out put per working hour = 100 cum. = Rs.
Rate per cum. = $\frac{\text{Use rate of shovel per hour}}{100}$ =Rs.

ii) Dumper:

Lead = 1.00 Km.
Body capacity - 5.58 cum.

Hauling Cycle Time

Loading Time= $\frac{\text{Body capacity}}{\text{Shovel output/min.}} = \frac{5.58 \times 60}{100}$ = 3.35 Min.

Spotting Time (Table 6.8.6 R.C.C. Report Page 119) = 0.30 Min.

Turning and dumping time (Table 6.8.6 R.C.C. Report Page 119) = 2.00 Min.

Loaded haul @ 20 Kms. per hour = $\frac{1 \times 60}{20}$ = 3.00 Min.

Empty haul @ 25 Kms per hour = $\frac{1 \times 60}{25}$ = 2.40 Min.

Total Cycle Time = 11.05 Min.

No. of dumper trips in 50 minutes

Working hour = $\frac{50}{11.05}$ = 4.52 Nos.

Output of dumper per working hour = 4.52 x 5.58 = 25.22 cum.

Use rate of Dumper (15T) per working hour (Refer item No.31 of use rate Sec. I = Rs.

Rate per cum = $\frac{\text{Use rate of Dumper per hour}}{25.22}$ = Rs.

iii) D - 8 Tractor Dozer at site of Excavation

Assuming that one shovel will work for one tractor Dozer

Out put of Tractor Dozer = output of shovel = 100 cum

Use rate of Tractor Dozer/working hours =Rs.

Rate per cum = $\frac{\text{Use rate of D-8 Tractor Dozer}}{100}$ =Rs.

Total machinery charges (I+II+III) =Rs.

Rate per cum (Borrow measure)

=Total machinery charges above=Rs.

Rate per cum. (Bulk. Vol.)=0.67 x Rate/cum. =Rs.

Rate per cum after adding for rejection and transit losses = Rate per cum (Bulk.vol.)x1.03 x 1-10 x 1.05 = Rs.

(C) Crushing and Processing of Aggregates:

Use rate of crushing plant per hour
(Refer item No.33 of use rate vol.)
Capacity of crushing plant =220 Tons per hour

Production per hour $= \frac{220}{0.67 \times 2.8} = 117.27$ cum.

Output per hour with 60% Job management factor = 117.27 x 0.69 = 80.92 cum.

Rate per cum. = $\frac{\text{Use rate of crushing Plant}}{80.92}$ = Rs.
(Bulk volume)

Rate per cum. after adding rejection and transit losses = Rate per cum. x1.03 x 1.1 (Bulk vol.) = Rs.

(D) Carriage of crushed Aggregates upto stock piles at Batching and mixing plant.

i) Loading charges into Dumper by Front end loader (2 cu.yd.)

Use rate of Front end loader per working ~~per~~ hour = Rs.
(Refer item 13 of use rate vol.)

Basic cycle time for front end loader = 0.4 min.
Refer page 61 of Art. of Earth moving by Jagmohan Singh
Correcting this cycle time for mixed material and stock piles height upto 10 ft. or less cycle time
= 0.4 + 0.02 + 0.01(Refer page 61 of above book)
= 0.43 min.

No. of cycles in 50 minutes working hour = $\frac{50}{0.43}$ 116.28

Therefore production of 2 cu.yd. front end loader per hour = 116.28 x 2 x 0.85 x 0.69

(Taking Job management factor as 0.69 and carry factor as 0.85)

= 136.40 cu.yd.
= 104.28 cum.

Hence output of loader per working hour =104.28 cum.

Rate per cum = $\frac{\text{Use rate of Front end loader}}{104.28}$

ii) 7T Tipper truck Charges:

Body capacity = 3.00 cum.
Average lead =10.00 Kms.

Hauling Cycle Time

Loading Time = $\frac{\text{Body capacity}}{\text{Output of front end loader/min.}}$

= $\frac{3.0 \times 60}{104.28}$ = 1.73 Min.

Spotting Time = 0.30 min.
Turning and dumping time = 2.00 min.
Loaded haul @ 20 Kms/hr. = $\frac{10 \times 60}{20}$ = 30.00 min.

Empty haul @ 25 Kms/hr. $\frac{10 \times 60}{25}$ =24.00 min.

Total cycle time 58.03 min.

No. of truck trips in 50 min, working hour = $\frac{50}{58.03}$ =0.86 No.

Output of truck per working hour =0.86 x 3 =2.58 cum.

Use rate of 7T Tipper truck
(Refer item No.32 of use rate vol.)

Rate per cum = $\frac{\text{Use rate of 7 T. Tipper truck/hr.}}{2.58}$ =Rs.

iii) Cost storage time @ 10% of the Transportation charges by Tipper truck per cum. given above =Rs.

iv) Conveyance to Batching and mixing plant @ 10% of the transportation charges of Tipper truck per cum. = Rs.

Carriage charges per cum.=(I + II + III + IV) = Rs.

Adding 3% for transportation losses, Rate per cum
= 1.03 x Total carriage charges (I to IV)

(E) Miscellaneous Supplies: L.S. =Rs. 3.50

Abstract of Charges

A) Drilling and blasting =Rs.
B) Carriage upto crushing plant =Rs.
C) Crushing and processing of Aggregates =Rs
D) Carriage of crushed aggregate upto stock piles at Batching plant =Rs.
E) Miscellaneous supplies =Rs.

Sub-Total = Rs.

Add for:

I) Construction and maintenance of haul roads @ 5% of above total =Rs.

II) Electric energy charges @ 2% of the above Total =Rs.

Prime Cost =Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost =Rs.

Grand Total = Rs.

Say Rs.....

Rate per cum. = Rs._____per cum.

27. SAND (CRUSHED): Per Cum

Rate of course aggregates (sub total) per cum =Rs.
(Refer Analysis of rate of coarse aggregates at item No. 26)

Add Extra charges for secondary crushing, screening, washing and wastage during sand processing @ 50% of primary crushing = 0.50 x Primary crushing =Rs.

Rate of primary crushing is to be taken from sub-item (e) of coarse Aggregates analysis of rates

Total =Rs.

Add for:

i) Construction and maintenance of haul roads @ 5% of Total = Rs.

ii) Electrical Energy Charges @ 2% of Total =Rs.

Prime Cost =Rs.

Add overhead expenses and contractor's profit @ 20% of Prime Cost =Rs.

Grand Total=Rs.

Hence Rate per cum = Rs._____

28. CONCRETE IN POWER HOUSE SUB-STRUCTURE M-200 (Cum).

A. Material: Per Cum.

Sl.No.	Item	Qty.	Unit	Rate in Rs.	Per	Amount
1.	Cement	8.00x1.05*	Bags	Rs._____	each	Rs.
2.	Sand	0.43	CU.M.	Rs._____	CU.M.	Rs.
3.	Coarse Aggregates	0.86	CU.M.	Rs._____	CU.M.	Rs.
4.	Water	-	-	L.S.	-	Rs. 2.00
5.	Admix-tures	-	-	L.S.	-	Rs. 1.00

*(5% wastage and incidentals to work) Total = Rs.

B. Batching Mixing and Laying

a) Batching and mixing

"As in item No.9 of mass concrete (M-100)"

Rate per CU.M. = Rs.

b) Transportation of concrete by 15 Tonne dumper from Batching and mixing plant to placement site having a lead of 2 Kms. = Rs.

Hauling Cycle Time:

Loading Time = $\frac{\text{Body capacity X swell factor}}{\text{output of Batching and mixing plant per min.}}$

Body capacity of 15 T dumper = 8.33 CU.M.
swell factor = 0.75
output of 35 Cu. Yd. Batching and mixing Plant per min.

$= \frac{35 \times .76 \times 0.69}{60}$

(Taking job management factor as 0.69)

Loading Time = $\frac{8.33 \times 0.75 \times 60}{35 \times 0.76 \times 0.69}$ = 20.47 min.

Turning and unloading Time = 2.30 min.

Loaded haul @ 20 Kms/hour = $\frac{2.0 \times 60}{20}$ = 6.00 min.

Empty haul @ 25 Kms/hour = $\frac{2 \times 60}{25 \text{ mm}}$ = 4.80 min.

Total Cycle Time = 33.57 Min.

No. of trips in a 50 min. working hour = $\frac{50.00}{33.57}$ = 1.49

Output of 15 T dumper per hour = 6.25 x 1.49 = 9.31 CU.M.

Use rate of 15T dumper per hour =Rs.

Transportation Rate per CU.M.

$= \frac{\text{Use rate of 15T dumper per hr.}}{\text{Output 15T dumper per hour}}$ =Rs.

c) Placement of concrete L.S. =Rs.

d) Vibrating the concrete L.S. =Rs.

e) Cleaning, Slurry, Curing and finishing.

i)	Sand blasting	L.S.	=Rs.
ii)	Cement for slurry mortar	L.S.	=Rs.
iii)	Cleaning	L.S.	=Rs.
iv)	Curing and finishing	L.S.	=Rs.
		Total (e)	=Rs.

f) Catwalks and other aids for concreting. L.S. =Rs.

g) Other charges.

i)	Electric energy	L.S.	=Rs.
ii)	Compressed air	L.S.	=Rs.
iii)	Workshop	L.S.	=Rs.
iv)	Haul Roads	L.S.	=Rs.
		Total(g)	=Rs.

h) Misc-supplies such as gumboots, safety hats, hose pipes etc, L.S. =Rs. 10.00

i) Ventilation charges L.S. =Rs. 3.00

Total charges for B = Sum of sub-items (a) to (i) =Rs.

C. Shuttering Charges

Rate per CU.M. =Rs.90.00

Abstract of Charges:

A)	Material	=Rs.
B)	Batching, mixing and laying	=Rs.
C)	Shuttering	=Rs.90.00
	Prime Cost (Total)	=Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost = Rs.

Grand Total = Rs.

Hence Rate per Cu.M. of concrete = Rs.

29. CONCRETE IN POWER HOUSE SUPER-STRUCTURE M-200

A. Materials: (Per CU.M.)

S.No.	Item	Qty.	Unit	Rate in Rs.	Each	Amount
1.	Cement	8.00x1.05*	Bags	Rs.	Each	Rs.
2.	Sand	0.43	CU.M.	Rs.	CU.M.	Rs.
3.	Coarse Aggregates	0.86	Cu.M.	Rs.	CU.M.	Rs.
4.	Water	-	-	L.S.	-	Rs.2.00.
5.	Admixtures	-	-	L.S.	-	Rs.1.00
	(* 5% wastage and incidentals to work)				Total =Rs.	

B. Batching Mixing and Laying:

a) Batching and mixing Rate per CU.M. = Rs.
(Same as in item No. 9 of mass concrete)

b) Transportation of concrete by 15T dumpers
(same as in item No.28 of concrete in Power House sub-structure M-200)

Rate per CU.M. =Rs.

c) Placement of concrete by pneumatic placer
(Same as in item No.25 of pumped concrete)

Rate per CU.M. =Rs.

d) Vibration charges L.S. =Rs.

e) Cleaning, Slurry, Curing and finishing

i)	Sand blasting	L.S.	=Rs.
ii)	Cement for slurry mortar	L.S.	=Rs.
iii)	Cleaning	L.S.	=Rs.
iv)	Curing and finishing	L.S.	=Rs.
		Total(e)	=Rs.

f) Catwalks and other aids for concreting =Rs.

g) Electric Energy and work-shop charges

i)	Electric energy charges	L.S.	=Rs
ii)	Compressed air charges	L.S.	=Rs.
iii)	Workshop charges	L.S.	=Rs.
		Total (g)	=Rs.

h) Misc-supplies such as Hose Pipe, gumboots and safety hats etc. L.S. = Rs. 10

i) Ventilation charges L.S. = Rs. 3

Total charges Sum of sub items (a) to (i) for item B. =Rs.

C. Shuttering Charges:

Rate per CU.M. =Rs.130.00

(On the basis of Field statistics and practical experience)

Abstract of Charges:

(A) Material =Rs.

(B) Batching, mixing and laying =Rs.

(C) Shuttering =Rs.130.00

Prime cost Total =Rs.

Add overhead charges and contractor's profit @ 20 of Prime Cost = Rs.

Grand Total =Rs.

Say =Rs.

Hence Rate per CU.M. = Rs.

31. Sheet Piling (Per Ton):

A. Material:

Choose suitable steel section for the job

i) Cost of steel section per Ton at site =Rs.

ii) Cost of clutches per Ton at site 30% of cost of steel at (i) above =Rs.

Total =Rs.

iii) Add for wastage on steel and clutches @ 2.5% of above total. =Rs.

Total = Rs.

B. Labour:

i) Cutting and making holes @ 3% of the cost of steel at (A) above =Rs.

ii) Driving charges @ 30% of the cost of steel at (A) above =Rs.

Total= Rs.

Prime Cost of sheet piling (A + B)

=Rs. + Rs. =Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost =Rs.

Grand Total =Rs.

Say = Rs.

Hence Rate of sheet piling per Ton =Rs.

32. ROCK EXCAVATION IN SURGE SHAFT (Per m^3)

Finished diameter of surge shaft =13.00 M (say)

Average thickness of lining (taking 1.5 m at bottom and 0.5 m at top as thickness of lining) including pay line of 0.15 m. = 1.15 M.

Excavated diameter of vertical shaft =13.00x1.2x1.15=15.3M.

(i.e.finished dia of shaft & thickness of lining)

Cross-sectional area of surge shaft $= \frac{\pi}{4} (15.30)^2$

= 183.80 X Sq.M.

Quantity of excavation per meter height of shaft = 183.80 x 1
=183.80 Cum.

Add for over-break @ 10% = 0.10 X 183.80
= 18.38 Cum.

Total quantity of excavation per m. height of shaft =183.8 X 18.38
=202.18 Cum.

Say =202.00 Cum.

Assumed progress per day in all three shifts = 1.0 M

(This includes drilling, blasting and concreting etc.)

Quantity of excavation per day (three shifts) = 1.00 X 202 Cum.
= 202 Cum.

No. of working shifts of 8 hours each = 3

Quantity of excavation per shift =67.33 Cum.

Cycle of Operations:

Sl.No.	Item of Operation	No.of Working hr.
1.	Drilling	2.50
2.	Charging and blasting	0.50
3.	Defuming	0.50
4.	Mucking	3.00
5.	Rock bolting and concreting	1.50
	Total:=	8.00 hrs.

1. Direct Labour Charges:

1	No. foreman special drilling @ Rs._____	per day per shift	= Rs.
2	Nos. Electrician @ Rs._____	-do-	=Rs.
1	No. Explosive Inspector @ Rs._____	-do-	=Rs.
3	Nos. Explosive chargeman @ Rs._____	-do-	=Rs.
2	Nos. Explosive storeman @ Rs._____	-do-	=Rs.
5	Wireman for blasting @ Rs._____	-do-	=Rs.
25	Nos. Muckers @ Rs._____	-do-	=Rs.
25	Nos. Beldars @ Rs._____	-do-	=Rs.
3	Nos. Helper to Electrician @ Rs._____	-do-	=Rs.
5	Nos. Hole cleaners @ Rs._____	-do-	=Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Total Labour Charges =Rs.

Labour rate per Cum. of excavation = $\frac{\text{Total Labour charges in Rs.}}{67.33}$ =Rs.

2. Machinery Charges:

Sl. No.	Equipment	Nos.	Working hrs.per shift	Total No. of work-ing. hrs.	Use Rate per hr. in Rs.	Amount in Rs.
1	2	3	4	5	6	7
1.	Jack hammers(68 lbs)	24	2.50	60.00	-	-
2.	Scaling hammers	3	1.00	3.00	-	-
3.	Drill Extractors	2	½	1.00	-	-
4.	Grinder	1	1	1.00	-	-
5.	Loader	1	3	3.00	-	-
6.	Trolleys	20	3	60.00	-	-
7.	30 T Hoist	1	3	3.00	-	-
8.	D-8 Tractor Dozer	1	1	1.00	-	-

Total machinery charges =Rs.

Quantity of rock excavated =67.33 Cum.

Machinery charges per cubic metre $= \frac{\text{Total machinery charges}}{67.33}$ =Rs.

3. Material Charges:

A. Drilling and Blasting:

It is proposed that to attain 1.0 m.

Progress per day, 1.25m deep holes will be drilled

X-Sectional area of surge shaft $= \frac{\pi}{4}(13 + 2X1)^2$

$= 177.00$ Sqm.

Assuming average spacing of holes @ 0.80 M C/C area of cross section per hole $=0.80 \times 0.80$

$=0.64$ Sqm.

No. of holes required $= \frac{177.00}{0.64}$

$=273.5$ Nos.

Say = 274 Nos.

Total depth of drilling = 274 x 1 .25

= 342.5 M.

a) Cost of drill steel:

Cost of drill steel per metre =Rs.

Total cost of drill steel = 342.5 x cost of drill steel per metre in Rs.

= Rs.

Quantity of rock excavated per day =202.00 cum.

Cost of drill steel/cum. = $\frac{\text{Total cost of drill steel}}{202}$ =Rs.

b) Explosives:

i) Gelatine required per cum = 1.00 Kg.

Cost of gelatine per Kg. =Rs.

Rate per cum = 1 x cost of gelatine per Kg. =Rs.

ii) Detonators and fuse coils:

No. of detonators and fuse coils @ one per hole = 274 Nos.

Unit cost of detonator and fuse coils =Rs.

Total cost of detonators and fuse coils = (Unit cost of detonator and fuse coil) x 274 =Rs.

Quantity of rock excavated = 202 cum.

Rate per cum = $\frac{\text{Cost of detonators and fuse coils}}{202}$ = Rs.

iii) Other consumable petty stores such as blasting batteries, galvanometers and blasting

wires etc.@ 50% of item b (i) above : Rate per cum. = 0.50 x item (b)(i)=Rs.

Total explosive charges per cum (b) = (i) + (ii) + (iii)=Rs.

A. Total drilling and blasting charges = (a) + (b) =Rs.

B. Provision of pipe lines for air and water for wet drilling =Rs.

Rate per cum. @ 4% of (A) above =Rs.

C. Timbers for temporary Supports and packing

Rate per cum. 5% of (A) above =Rs.

D. Miscellaneous supplies such as safety hats, gumboots, raincoats, wire ropes, manila ropes, U-clamps, rubber, gloves, shackles and artificial respirator etc. =Rs.

Rate per cum. @ 4% of (A) above =Rs.

Total material charges per cum. (A + B + C + D) =Rs.

4. Charges for ventilation blowers:

Use rate of blowers per working hour =Rs.

No. of working hours of blowers per shift = 8 hrs.

Total charges of blower per shift = 8 x rate of blowers per working hour =Rs.

Quantity of excavation per shift = 67.33 cum.

Charges per cum. $= \frac{\text{Total charges of blowers per shift}}{67.33} = \text{Rs.}$

5. Shop Charges:

Machine shop including foundary and smithy @ 40% of machinery charges item (2) above =Rs.

6. Electrical material charges per cum @ 10% of item (3) =Rs.

7. Trolley Track charges per cum. @ 5% of item (3) =Rs.

8. Compressed air charges per cum.@ 20% of item (3) =Rs.

9. Water charges per cum @ 4% of item (3) =Rs.

Abstract of Charges: Rate in Rs. per cum.

1. Direct labour charges =Rs.

2. Machinery charges =Rs.

3. Material charges =Rs.

4. Ventilation blowers charges =Rs.

5. Shop charges =Rs.

6. Electric material charges =Rs.

7. Trolley Track charges =Rs.

8. Compressed air charges =Rs.

9. Water charges =Rs.

Total = Rs.

Add for construction and maintenance of haul roads @ 5% of above total =Rs.

Add for electric energy charges @ 2% of above total =Rs.

Prime Cost = Rs.

Add over head charges and contractor's profit @ 20% of prime cost =Rs.

Grand Toral=Rs.

Say =Rs.

Hence Rate of excavation shaft per cubic metre =Rs.

33. CANAL EXCAVATION (PER CUBIC METRE) BY MACHINES

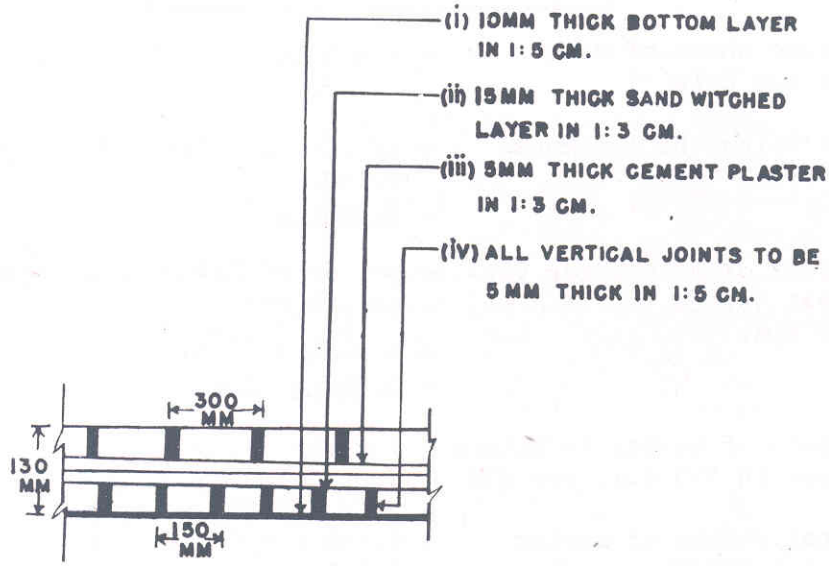
Excavation for canals in all kinds of soil ordinary soils, black cotton soil loam clay, soft murram and hard soils.

Average lead	900 m
haul cycle	2.25 km.
Av. speed	15 kms/hour
Travelling time	$\frac{2.25}{15} \times 60$
Fixed time for loading and unloading	= 9 minutes (say) = 2 minutes (say)
Time per cycle	= (9 + 2) minutes = 11 minutes.
No. of trips in 50 minutes per hr.	$= \frac{50}{11} = 4.55$ Say 4.6.
Taking capacity as 11 M^3 per trip, Earth work per hour	= 11 x 4.6 = 50.6 m^3 Say 51 m^3
(a) hourly use rate of scraper	= Rs._____
(b) hourly use rate of dozer	= Rs._____
(c) Expenditure for running one	= Rs. $(a + \frac{b}{3})$
Scraper + 1/3 dozer	= Rs._____
Prime cost of E.W. in canal excavation	= Rs. $\frac{c}{51}$
Add overhead charges and contractor's Profit @ 20% of Prime cost	= Rs._____
Grand Total	= Rs._____
Hence Rate of canal excavation	= Rs._____

34. TILE LINING IN CANALS (PER SQM.)

Brief Specifications:

1.	Tile size	= 300 x 150 x 50 m.m.
2.	Types of Tiles	= Precast c.c. Tiles
3.	Types of Tile lining	= Double layer Tile lining in bed and slopes.
4.	Thickness of lining	= 130 m.m.
5.	Details of mortar layers and vertical joints.	



(TYPICAL SKETCH OF DOUBLE TILE LINING)

A. Materials: (Per Sqm)

(i) Tiles Requirement:

No. of Tiles for Double layer with 3% breakage per SQM of Lining. $= \frac{2 \times 1 \times 1.03}{(L+t)(B+t)}$

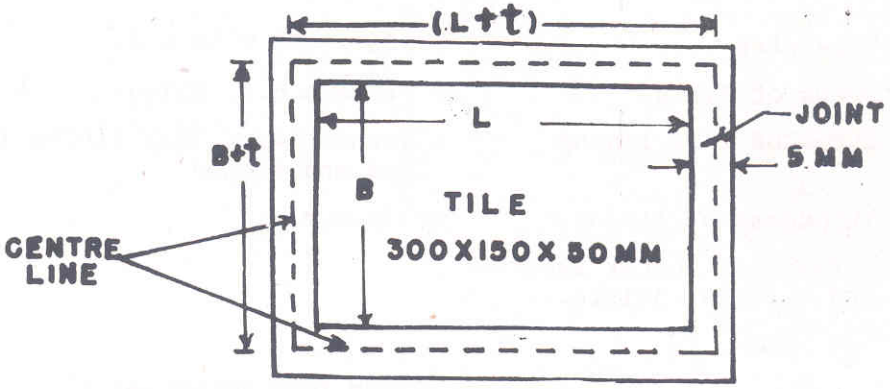
Where L = Length of Tile in metres
B = Width of Tile in metres
t = thickness of joints in meters.

$= \frac{2 \times 1 \times 1.03}{(0.3 + .005)\ (0.15 + 0.005)}$

$= \frac{02.06}{0.305 \times 0.155} = 43.57$ Nos.

Adopted No. of Tiles per SQM. = 44 Nos.

(ii) Sand Requirement:



Volume share of mortar for one tile = ½ x 2 (L + B + 2t) x h x t

('h'being the thickness of tile) = (0.3 + 0.15x2x0.005)x 0.05 x 0.005
= 0.000115

Volume of mortar for vertical joints in 1:5 c.m. per SQM. = No. of tiles/SQM x 0.000115
= 44 x 0.000115
= 5.06×10^{-3} Cum.
= 0.00506 Cum.

Volume of mortar in bottom layer in 1:5 c.m. per SQM. = 1 x .01
= 0.01 Cu.m.

Total volume of mortar in 1:5 CM/SQM = 0.005 + 0.01
= 0.015 Cu.M.

Volume of mortar in sand witched layer and plaster layer in 1:3 C.M. per SQM. = 1 x (0.015 + 0.005)
= 0.02 CU.M.

Volume of sand in 1:5 C.M. per SQM. Taking sand requirement for 12.5 m.m. thick cement plaster layer as 0.0165 cum. per SQM. $= \frac{0.0165 \times 0.015}{0.0125}$
= 0.0198

Adopted from drill of U.P. Irrigation Deptt.

Volume of sand in 1:3 C.M. per SQM. $= \frac{0.015 \times 0.02}{0.0125}$

Taking sand requirement for 12.5 m.m. thick cement plaster layer in 1:3 C.M. as 0.015 Cu.M./SQM. = 0.024 Cu.M.

Now Total Quantity of sand Per SQM of Tile lining =0.0198 +0.024
=0.0438 CUM.

Adopted sand =0.044 Cum.

(iii) Cement Requirement:

No. of cement bags in 1:5 C.M. per SQM. $= \frac{0.095 \times 0.15}{0.0125}$

Taking cement requirement for 12.5 mm thick cement plaster layer in 1:5 C.M. as 0.095 bags/ SQM. = 0.114 bags

No. of cement bags in 1:3 C.M. per SQM. $= \frac{0.14 \times 0.02}{0.0125}$

Taking cement requirement for 12.5 mm thick cement plaster layer in 1:3C.M. as 0.14 bags/ SQM. =0.224 bags

Total cement requirement per SQM of lining =0.114 + 0.224

=0.338 Bags x 1.05* = 0.355 Bags

Adopted cement =0.35 Bags

(*Including 5% wastage and incidentals to work)

Note:

Similary the requirement of materials for any size of tile, mix and specifications can be computed.

Abstract of Materials (Per S.Q.M.)

44 Nos. C.C. Tiles including 3% breakage at site of works @ ;_____ per each =Rs.

0.044 Cum. Sand at site of works @ Rs.____/CU.M. =Rs.
0.34 Nos. cement bags at site of work @ Rs.____/bags =Rs.

Total = Rs.

B. Labour (per 100 S.Q.M.)

i) 18 Nos. Masons Ist class @ Rs._____/day =Rs.

ii) 22 Nos. Beldars for mixing of mortar cleaning, raking, soaking, laying and handling @ Rs. _____/day =Rs.

iii) 6 Nos. Bhisti or water carrier @ Rs._____/day =Rs.

(Labour constants adopted from R&C Report Vol.- I of 1956)

Sub Total Labour Charges =Rs.

Add for hidden cost of labour @ 50% of direct labour charges =Rs.

Total labour charges% SQM =Rs.

Hence labour charges/SQM = $\frac{\text{Total labour \% SQM.}}{100}$ =Rs.

Prime Cost of lining/SQM = (A + B) =Rs.

Add overhead charges and contractor's profit @ 20% of prime cost =Rs.

Grand Total: =Rs.

Say =Rs.

Hence Rate of Tile lining/SQM

35. CONCRETE LINING OF CANALS (per SQM)

Brief Specifications: (i) The proposed thickness of concrete lining for the purpose of Rate Analysis, is 12.5 cums both in bed and slopes. It is mainly carried out by manual labour with concrete mixer at site of work.

(ii) Grade of concrete M-100.

(A) Materials (Per CU.M.)

Sl.No.	Item	Quantities	Unit	Rate	Per	Amount
1.	Cement	4.6x1.05*	Bags	Rs..	Bag	Rs...
2.	Sand	0.45	CU.M.	Rs..	CU.M.	Rs...
3.	Coarse Aggregates	0.90	CU.M.	Rs..	CU.M.	Rs...
4.	Water	-	-	L.S.	-	Rs.2.00
5.	Admixtures	-	-	L.S.	-	Rs.1.00
					Total	Rs.

Total cost of materials per SQM=0.125xcost of materials per Cum. =Rs.....

(* Including 5% wastage and incidentals to work)

(B) Labour (Per CU.M.)

(i) Direct Labour:

¼ No. mason Ist class @ Rs...../each = Rs.
3 Nos. Beldars - @ Rs..../each = Rs.
¼ No. Bhisti or water carrier @ Rs.../each = Rs.

Direct Labour charges = Rs.

Add for hidden cost of labour @ 50% of direct labour charges = Rs.

Add extra for mechanical mixing @ Rs...../CU.M. = Rs.

Total labour charges = Rs.

(ii) Compaction of the concrete lining:

The concrete lining shall be vibrated by surface vibrators, whose per cu.m. charges based on practical experience, are as below.

Vibration charges/cu.m. including labour and cost of vibrators — L.S. = Rs. 8.00

Total= Rs. 8.00

(iii) Cleaning slurry, curing and finishing

Cement for slurry mortar — L.S. = Rs.

Cleaning and washing — L.S. = Rs.

Curing and finishing — L.S. = Rs.

Total= Rs.

Total charges for item(B)/CU.M.=Sum of sub-items (i) to (iii) = Rs.

Hence Total labour charges/SQM= 0.125xTotal labour charges/cum= Rs.

(C) Shuttering charges/S.Q.M.

Shuttering charges/SQM
(on the basis of practical experience) = Rs. 25.00

Abstract of charges per SQM

(A) Materials = Rs.

(B) Labour charges = Rs.

(C) Shuttering charges = Rs.

Prime Cost = Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost = Rs.

Total = Rs.

Say = Rs.

Hence Rate of Concrete Lining per SQM = Rs.

Note: The analysis for the cost of concrete Linning is exclusive of any sub-surface drainage arrangements.

39. ROCK TOE(PER CU.M.)

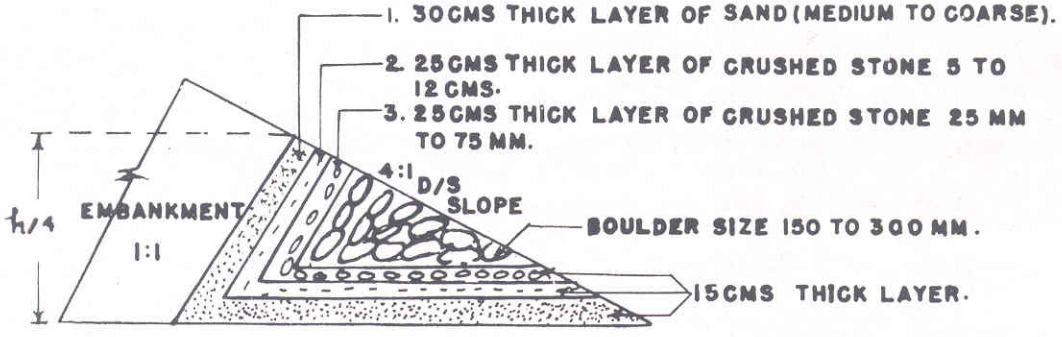
Brief specifications: The Rock Toe is surrounded by transition fitter on its both inner faces. The inclined inner faces or discharge face is laid at 1:1 slope while the outer face is made in continuation of D/S slope of dam say 4:1. The details of transition filter are given in the figure below.

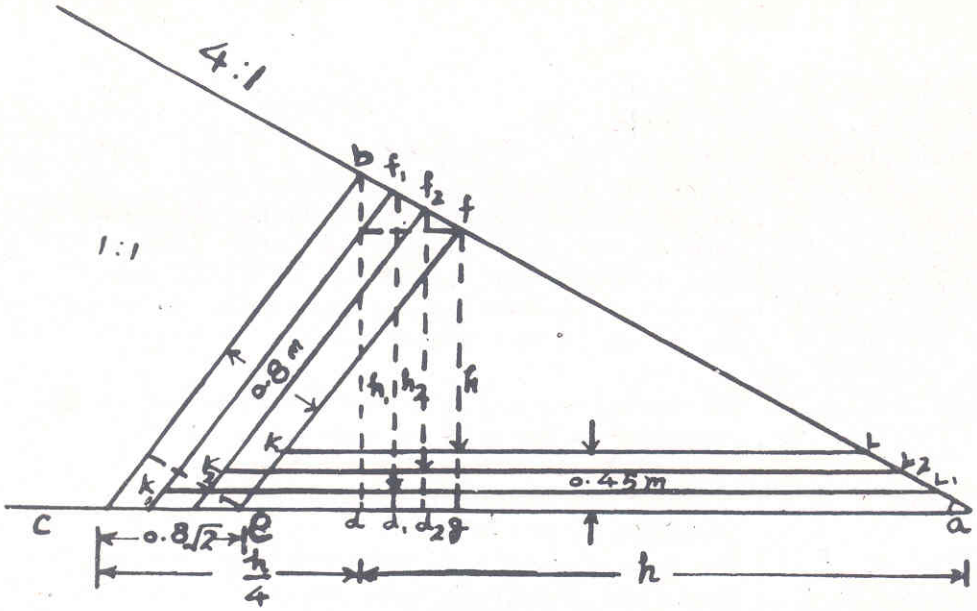
Procedure of working:1. The Rock Toe, being gigantic work, is proposed to be laid by machines and the rate analysis has to be arrived at through use rates of various machines involved in the process.

2. The rate analysis is based on the assumption that the transition materials are not available at site and are to be manufactured by crushing of stones.

DETAILS OF TRANSITION FILTER:

1. 30 cms thick layer of sand(medium to coarse)
2. 25 cms thick layer of crushed stone 5 to 12 mm.
3. 25 cms thick layer of crushed stone 25mm to 75mm.





Area of Triangle a b c $= \frac{1}{2}(h+\frac{h}{4}) \times \frac{h}{4}$

$= \frac{5}{32} h^2$ .....(1)

In triangle a b d

$\sin \alpha = \frac{bd}{ab} = \frac{h}{4\ ab}$

$ab = \frac{h}{4} \cdot \frac{}{\sin \alpha}$

In triangle b c d

$bc = \frac{h}{4}\sqrt{2}$

$\triangle$ abc and $\triangle$ afe are symmetrical.

$\frac{b\ c}{f\ e} = \frac{a\ c}{a\ e}$

$\frac{h/4\sqrt{2}}{f\ e} = \frac{5h/4}{5h/4 - t1\sqrt{2}}$ Where t1 = thickness of layer discharge face.

$f\ e = \frac{\sqrt{2}}{5}(\frac{5h}{4} - t1\sqrt{2})$

$$fg = \frac{ef}{\sqrt{2}}$$

$$= 1/5(5h/4-t_1\sqrt{2})$$

$$fh = 1/5(5h/4-t_1\sqrt{2})-t_2$$

Where t_2 is the thickness of horizontal drainage mm filter.

In Δ f k l

$$\text{Area} = 1/2 \times kl \times fh$$

$$= 1/2 \times (4\,fh + 1\,fh) \times fh.$$

$$= 5/2\ fh^2$$

Taking height of the dam as 200 meters

$$fh = 1/5\ (5/4h-t_1\sqrt{2})-t_2$$

$$= 1/5(5 \times 200/4-0.8\sqrt{2})-0.45$$

$$= 49.32\ M.$$

$$\text{Rock Toe Area} = 5/2 \times 49.32^2$$

$$= \underline{6081.16\ SQM}$$

$$\text{Area of } \Delta abc = 5/32\ h^2$$

$$= 5/32 \times 200^2$$

$$= \underline{6250\ SQM}$$

Area of $\Delta\ f_1k_1l\ \ l_1$

$$= 5/2\ f_1h_1^2$$

$$f_1h_1 = 1/5(5/4\ h-t_1\sqrt{2})-t_2$$

$$= 1/5(5/4 \times 200-0.3\sqrt{2})-0.15$$

$$= \underline{49.76\ M}$$

Area of $\Delta\ f_1k_1l$

$$= 5/2\ f_1h_1^2$$

$$= 5/2 \times 49.76^2$$

$$= \underline{6190.14\ SQM}$$

$\Delta \frac{f_2 k_2 l}{}$

Area $= 5/2\ f_2 h_2^2$

$f_2 h_2 = 1/5(5/4h - t_1\sqrt{2}) - t_2$

$= 1/5(5x200/4 - 0.55\sqrt{2}) - 0.30$

$= 1/5(250 - 0.78) - 0.30$

$= 249.22/5 - 0.30$

$= \underline{49.54\ M}$

Area $= 5/2\ f_2 h_2^2$

$= 5/2 \times 49.54^2$

$= \underline{6136.52\ S.Q.M.}$

i) Percentage Area of sand $= \frac{6250 - 6190.14}{6081.16} \times 100$

$= 0.98\%$ Say 1.0%

ii) Percentage area of crushed per gravel 5 to 12 mm

$= \frac{6190.14 - 6136.52}{6081.16} \times 100$

$= 0.88\%$ Say 1%

iii) Percentage area of crushed stone 25mm to 75mm.

$= \frac{6136.52 - 6081.16}{6081.16} \times 100$

$= 0.91\%$ Say 1%

iv) Boulders in the rock toe $= 100 - (1+1+1) = 97\%$

ANALYSIS OF RATE :

Diesel shovel (2 Cum capacity):

Output of Diesel shovel per hour= 82.00 CU.M.
(For poorly blasted rock)
As per R.&C.C. Report part-1
of Jan. 1956, Table 6.3.4(i) page 104

(A) Machinery charges:

Following set of machines will work with 2 Cu.M Diesel shovel and the equipment cost per hour output of shovel in blasted rock will be as given below:

Sl.No.	Name of machine	No. reqd.	Use Rate per hr.	Amount
1.	Shovel 2 Cu.M.	1 No.	Rs.... (Refer item No.-20)	Rs....
2.	Rear Dumper 35T capacity	4 Nos.	Rs.... (Refer item No.29)	Rs....
3.	D-8 Tractor Dozer	2/3 No.	Rs.... (Refer item No.27)	Rs....
4.	Motor Grader 115 H.P.	¼ No.	Rs.... (Refer annexure-B)	Rs....
5.	Water Tanker		L.S.	Rs.15.00
			Total machinery charges/hr.	Rs.....

Rate per Cu.M. = $\frac{\text{Total machinery charges/hr.}}{82}$ = Rs.....

(B) Materials (Per cum of Rock toe):

Transition and horizontal filter aggregates of size 0.02 Cu.M. of crushed/size 5mm to 75mm @ Rs...../Cum. = Rs.....

(As per item No.26 of Rate analysis)

0.01 Cu.M. of crushed gravel @ Rs...../Cu.M. = Rs.....
(As per item No.27 of Rate analysis)

Total Rs.

(C) Royalty charges (Per Cu.M. of Rock toe)

0.97 Cu.M. Royalty charges of stone boulders as per District Authorities/Forest authorities @ Rs...../Cu.M.

0.03 Cu. M. Royalty of stone boulders for manufacture of course aggregates and sand @ Rs...../Cu.M. = Rs.....

Total Rs.

Abstract of charges (per Cu. m)

(A)	Total machinery charges	=Rs.
(B)	Materials	=Rs.
(C)	Royalty	=Rs.
	Prime Cost	=Rs.
	Add overhead charges and contractor's profit @ 20% of Prime Cost	=Rs.
	Grand Total	=Rs.
	Say	=Rs.

Hence Rate of Rock toe/Cu.M.=Rs.....

Use Rate of motor Grader(115 H.P.)

(A) Depereciation:

(i) Cost of machine excluding tyres at site =Rs.....
Life of machine =12000 Hrs.

(ii) Salvage Value =10%

Depreciation per hour $0.9 \times \frac{\text{Cost of machine}}{12000}$ =Rs.

(iii) Cost of tyres =Rs.
Life of tyres =2500 Hrs.

Depreciation of tyres/hrs. $= \frac{\text{Cost of tyres}}{2500}$ =Rs.

Total Depreciation/hr. =a(i)+(ii) =Rs.

(B) Repairs and maintenance:

(i) of the machine @ 80% of Depreciation =Rs.
(ii) of the tyres @ 55% of Depreciation =Rs.

Total =Rs.

(C) P.O.L.Charges:

H.P.of machine = 115 H.P.

Fuel consumption/hr $= \frac{0.5 \times 0.6 \times \text{B.H.P.} \times .65}{8.26} \times 4.546$ Litres

$= \frac{0.50 \times 115 \times 0.6 \times .65 \times 4.546}{8.26}$ Litres

$= 12.36$ Litres

Fuel consumption/50 minutes working hr. $= \frac{12.36 \times 50}{60}$

$= 10.25$ Litres

(i) Cost of 10.25 Litres fuel @ Rs...../litre =Rs.....
(ii) Lubricants & Grease, @ 25% of fuel charges =Rs.....
(iii) Sundries and cotton waste @ 50% of fuel charges =Rs.....

Total Rs.....

(D) Labour(Per working hour)

1 No. Driver @ Rs.....per day per shift	=Rs.
1 No, helper @ Rs.....per day per shift	=Rs.
1/8 No. foreman @ Rs....per day shift	=Rs.
½No. chowkidar @ Rs....per day per shift	=Rs.
Direct Labour charges	=Rs.
Add for hidden cost of labour @ 50% of direct Labour Charges	=Rs.
Total	=Rs.
Labour charges/hrs.= Total labour charges/shift / 8	=Rs.

Hence Hourly use rate of (A+B+C+D)
115 H.P. Motor Grader =Rs. =Rs.

40. SHUTTERING (PER Sq.m)

Brief Specifications:

1. Heavier type steel shuttering for use in Dams.
2. Working with 35 T(P&H) crane.
3. Shuttering once manufactured shall be used eight times.
4. The Rate analysis is based on the Field data of konar Dam reproduced from R&CC Report, Vol-I of Jan'1956 at para 14.6.1.and it is inclusive of labour or erection and stripping.

(A) Materials(For 100 S.Q.M.)

Sl.No.	Name of structurals/Materials	Quantity in Kgs.	Rate per MT Ex. work-shop	Amount
1	2	3	4	5
1.	M.S.plates 3 mm thick	57.00	Rs...	Rs...
2.	M.S.plates 2mm thick	23.00	Rs...	Rs...
3.	M.S angles 60x60x10m.m.	47.00	Rs...	Rs...

1	2	3	4	5
4	M.S.angles 65x45x8mm	20.00	Rs...	Rs...
5.	M.S.Channel 125x50mm	82.00	Rs...	Rs...
6.	M.S.Channel 150x55mm	42.00	Rs...	Rs...
7.	M.S.Channel 100x45mm	30.00	Rs...	Rs...
8.	M.S.Flats 63x6.00mm	22.00	Rs...	Rs...
9.	G.I.Pipe 50mm dia	3.50	Rs...	Rs...
10.	Nuts and bolts 31 Nos. 10mm dia and 85 mm long	4.50	Rs...	Rs...
11.	Slotted Pins and wedges 30 Nos., 10mm dia and 60 mm long	---	Rs.../E	Rs...
12.	Tube and nuts 26 Nos.,25mm dia and above	---	Rs.../E	Rs...
	Sub-total of materials	331.00	Rs...	Rs...

Sub-Total of materials cost =Rs...
Deduct salvage @ 20% of the above Sub-Total =Rs...
Net Sub-Total of materials cost =Rs...

Additional Materials (Per % sq.m.)

13. M.S. rods 16 mm and 25 mm dia for 240Kg. @Rs../MT =Rs.
for anchorage

14. Linseed oil @ 8 litres % SQM 8 Litres @Rs../Litre =Rs..
Total cost of materials % SQM =Rs..

(B) Transportation and Fabrication (% sqm);

i) Transportation of shuttering from workshop to site including loading,unloading and rehandling for lead below 5 Kms @ 5% of sub-Total of materials cost at Sl. (A) =Rs.

ii) Fabrication Charges including cutting,welding, marking and all other operations @ 90% of the Sub-Total of materials cost =Rs.

Total Transportation and Fabrication charges %S.Q.M. =Rs.

(C) Machinery Charges:

35 T(P&H) crane
Out put of 35 T(P&H) crane/hr.=8.35 SQM
Hourly use rate of 35 T(P&H) crane =Rs.

Machinery charges% SQM=$\frac{\text{Use rate of 35 T crane x 100}}{8.35}$ =Rs.

(D) Labour charges:

¼ Forman @ Rs...../each	=Rs.
10 Khalasis @ Rs.../each	=Rs.
10 Beldars @ Rs..../each	=Rs.
4 Carpenters @ Rs..../each	=Rs.
Sub-Total of Labour charges	=Rs.
Add for hidden cost of Labour @ 50% of direct labour charges	=Rs.
Total labour charges %SQM	=Rs.

Abstract of charges (Per 100 sq.m)

A. Materials	=Rs.
B. Transportation and Fabrication	=Rs.
C. Machinery charges	=Rs.
D. Labour charges	=Rs.
Prime Cost	=Rs.
Add contractor's profit and overhead expenses @ 20% of Prime Cost	=Rs.
Grand Total	=Rs.
Say	=Rs.

Hence Rate of shuttering = $\frac{\text{Grand Total of Abstract of charges per 100 SQM}}{100}$

=Rs..... Say =Rs.

Hence Rate of heavier type of steel shuttering per SQM. =Rs.....

41. Radial Gates for spillway(Per Tonne):

(A) Materials:

i)	Cost of 1.025 M.T. mild steel plates at site stores including 25% wastage and incidentals to work	=Rs.
ii)	Special steel @ 40% of cost of mild steel	=Rs.
iii)	Rubber seal @ 8% of cost of mild steel	=Rs.
iv)	Miscellaneous purchases @ 25% of the cost of of mild steel	=Rs.
v)	Bearings @ 25% of the cost of mild steel	=Rs.
vi)	Forged and cost steel items @ 25% of cost of mild steel	=Rs.
	Total	=Rs.

(B) Fabrication:

i)	Straightening @ 5% of the cost of mild steel	=Rs.
ii)	Marking @ 5% of the cost of mild steel	=Rs.
iii)	Cutting @ 10% of the cost of mild steel	=Rs.
iv)	Drilling and machining etc. @ 30% of the cost of mild steel	=Rs.
v)	Welding @ 70% of the cost of mild steel	=Rs.
vi)	Handling of materials during fabrication @ 25% of cost of mild steel	=Rs.
vii)	Temporary jigs and fixtures @ 25% of cost of mild steel	=Rs.
	Total	=Rs.

(C) Erection:

Erection charges @ 70% of cost of mild steel =Rs.

Abstract of Charges:

A)	Materials	=Rs.
B)	Fabrication	=Rs.
C)	Erection	=Rs.
	Prime Cost	=Rs.
		=Rs.
	Add overhead charges and contractor's profit @ 20% of Prime Cost	=Rs.
	Grand Total	=Rs.
	Say	=Rs.
	Hence Rate per Tonne	=Rs.

42. SLUICE GATE FOR IRRIGATION OUTLETS (per m)

Guidelines for Rate analysis of sluice Gates are based on a sluice gate of size 1830 x 1830 mm manufactured by U.P. Government work-shop at Roorkee.

The rate analysis includes the provision for sluice gate side channels, lifting and lowering Device and operating plat-form structure but excludes the allied civil-works.

(A) Materials (per m)

i) 1.0 M.T. Mild steel in shape of rolled steel channels plates, flats and rods @ rods @ Rs..../m =Rs.

(Adopt average unit effective rate for all structurals given in the drawing)

Add wastage @ 25% of sub-item (i) during various operations and handling =Rs.

ii) 0.6 M.T. Pig iron-----@ Rs...../M.T. =Rs.
iii) 450 Nos. M.S.Electrodes @ Rs..../E =Rs.
iv) 1.8 Cu.M. Acetylene-....@ Rs...../Cu.M. =Rs.
v) 13.5 Cu.M Oxygen.....@ Rs...../Cu.M. =Rs.
vi) 13.5 Kg. Gun metal @ Rs...../Kg. =Rs.
vii) 4.0 M. Rubber seal @ Rs...../M. =Rs.
viii) Job Miscellaneous materials like nuts and bolts, oil, paints, hard coke, pattern wood, grease nipples and thrust bearing etc @ 35% of sub-item-(i) above. =Rs.

Total cost of materials =Rs.

(B) Labour charges (Per m.)

i) Fabrication including cutting, straightening marking and welding @ 60% of cost of mild steel at sub-item A(i) =Rs.

ii) Machining including turning, drilling, threading, boring, teeth cutting and painting @ 100% of cost of mild steel at sub-item A(i) =Rs.

iii) Casting @ 20% of cost of steel at sub-item A(i) =Rs.

iv) Black smithy and forging charges @ 15% of cost of steel at sub-item A(i) =Rs.

v) Temporary jig & fixture and miscellaneous labour charges in handling of job to different shops @ 10% of cost of steel at sub-item A(i) =Rs.

Total labour charges =Rs.

(C) Transportation & Erection charges (Per m):

i) Transportation of sluice gates and guides to site of work @ 10% of cost of steel at sub-item A(i) =Rs.
(Subject to suitable minimum and maximum charges which are actually required on the basis of weight of the sluice gate and Lead) =Rs.

ii) Erection charges of sluice gate and guides @ 50% of cost of mild steel cost at sub-item A(i) =Rs.

Total transportation and Erection charges =Rs.

Abstract of charges (Per m.)

A) Materials =Rs.

B) Labour =Rs.

C) Transportation and erection charges =Rs.

Prime Cost =Rs.

=Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost =Rs.

Total =Rs.

Say =Rs.

Hence Rate of sluice gate per M.T. =Rs.

44. BARRAGE GATES (M.T.)

(Based on Field statistics and practical experience).

Rs. Per Tonne @ Rs..../M.T.

(A) Materials:

i) Cost of 1.025*M.T. mild steel plates at site stores =Rs.

ii) Special steel @ 30% of cost of mild steel plates =Rs.

iii) Rubber seal @ 10% of cost of mild steel plates =Rs.

iv) Miscellaneous purchases @ 20% of cost of mild steel plates =Rs.

v) Bearings @ 20% of cost of mild steel plates =Rs.

vi) Forged and cost steel items @ 15% of cost of mild steel plates. =Rs.

Total =Rs.

(* Including 2.5% wastage and incidentals to work)

(B) Fabrication:

i) Straightening @ 3% of cost of mild steel plates =Rs.

ii) Marking @ 3% of cost of mild steel plates =Rs.

iii) Cutting @ 6% of cost of mild steel plates =Rs.

iv) Drilling and machining etc @ 20% of cost of of mild steel plates =Rs.

v) Welding @ 50% of cost of mild steel plates =Rs.

vi) Handling of materials during Fabrication @ 20% of cost of mild steel plates =Rs.

vii) Temporary jigs and fixtures @ 15% of cost of mild steel plates =Rs.

Total =Rs.

(C) Erection:

Erection charges including painting @ 60% of cost of mild steel plates =Rs.

Abstract of charges: Rate in Rs.per Tonne

A) Materials =Rs.

B) Fabrication =Rs.

C) Erection =Rs.

Prime Cost =Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost Rs._____

Grand Total =Rs._____

Hence Rate per Tonne= =Rs.

45. STOP LOG GATES (PER M.T.)

Guidelines of Rate Analysis are based on Intake stop log Gates of Chilla Power House at Rishikesh(Hardwar) which were manufactured by U.P.Government work-shop at Roorkee.

One complete unit consists of Embedded parts, 2 Nos. top and 2 Nos. bottom stop log gates meant for one bay weighing about 30 M.Tons.

Size of stoplog Gates = 6000 x 8300 m.m.

Materials (Per M.T.)

	1.0 M.T.	mild steel in shape of structurals such as beams, angles, flats, rods and plates @ Rs...../M.T.	=Rs.
		Add wastage @ 2.5% of sub item (i) during various operations and handling.	=Rs.
2.	1.5 CU.M.	Acetylene @ Rs...../CU.M.	=Rs.
3.	7.5 CU.M.	oxygen @ Rs..../CU.M.	=Rs.
4.	200 Nos.	M.S.Electrodes @ Rs..../Each	=Rs.
5.	12 Kg	Gun-metal Ingots @ Rs..../Kg	=Rs.
6.	2.5 metre	Rubber seal @ Rs..../metre	=Rs.
7.	Miscellaneous materials e.g. screws bolts, paints, blackleads, crucible patternwood and hard coke @ 5% of sub-item-(i) above		=Rs.
		Sub cost of materials	=Rs.

(B) Labour charges (Per M.T.)

i) Fabrication including cutting, welding and marking @ 30% of cost of mild steel/M.T.(item A-1 above) =Rs.

ii) Machining including turning, drilling,threading, boring and teeth cutting @ 20% of cost of steel per M.T. =Rs.

iii) Casting @ 20% of cost of steel/M.T. =Rs.

iv) Black smithy and forging charges @ 15% of cost of steel/M.T. =Rs.

v) Miscellaneous Labour charges in handling of job to different shops @ 5% of cost of steel/M.T. =Rs.

Total labour charges =Rs.

(C) Transportation and Erection charges(Per M.T.)

i) Transportation of stoplog gates to the site of works @ 10% of cost of steel i.e. item A(1)above =Rs.

ii) Erection of embeded parts & Positioning of stop log gates @ 15% of the cost steel i.e. item A(1) above =Rs.

Total transportation and erection charges per M.T. =Rs.

Abstract of charges:

A) Materials/M.T. =Rs.
B) Labour/M.T. =Rs.
C) Transportation and Erection/M.T. =Rs.
Prime Cost =Rs.

Add overhead charges and contractor's profit 20% of Prime Cost =Rs.

Total =Rs.
Say =Rs.

Hence Rate of stop log gates/M.T. =Rs.

46. TRASHRACK (PER m)

The Rate Analysis of the item is based on the manufacturing of the Trashracks for Head Regulator of Virbhadra Barrage at Rishikesh by U.P. Government Workshop at Roorkee.

Brief details of Trashrack:

i)	Size of Head Regulator bay	=	11.00 x 7.2 M
ii)	Size of Trashrack	=	1625 x 10875 mm
iii)	Mesh size	=	75 x 400 mm
iv)	Size of flats used	=	(H) 175 x 20 mm (V) 115 x 10 mm 75 x 10 mm
v)	Wt. of one complete set of Trashrack including embeded parts	=	50 t
vi)	No. of Trashrack units in one bay	=	8 Nos.
vii)	Thickness of Pier	=	2000 mm

(A) Materials (Per m):

1.	1.0 M.T.	Mild steel in shape of structurals such as beams, Angles, flats, rods and plates @ Rs...../M.T.	=Rs.
		(Adopt average effective Rate of all structurals)	
		Add wastage @ 2.5% of sub-item (1) during various operations and handling.	=Rs.
2.	3.8 CU.M.	Acetylene @ Rs:...../CU.M.	=Rs.
3.	16.00 CU.M.	Oxygen @ Rs..../ CU.M.	=Rs.
4.	330 Nos.	M.S.Electrodes @ Rs..../CU.M.	=Rs.
5.	Job.	Miscellaneous items like oil and paints @ 2% of the cost of mild steel/M.T.	=Rs.
		Total cost of Materials	=Rs.

(B) Labour (Per m)

1.	Fabrication including cutting welding and marking @ 40% of cost of Mild Steel/M.T.	=Rs.
2.	Straightening and black smithy charges @15% of cost of mild steel/M.T.	=Rs.
3.	Miscellaneous labour charges i.e. handling of job to different shops @ 3% of cost of steel/M.T.	=Rs.
	Total Labour charges	=Rs.

(C) Transportation and Erection charges:

i) Transportation and positioning of the trashrack at site of work @ 10% of cost of mild steel/M.T. = Rs.

ii) Erection of Embeded parts and Trashrack @ 40% of cost of mild steel/M.T. =Rs.

Total Transportation Erection charges = Rs.

Abstract of charges

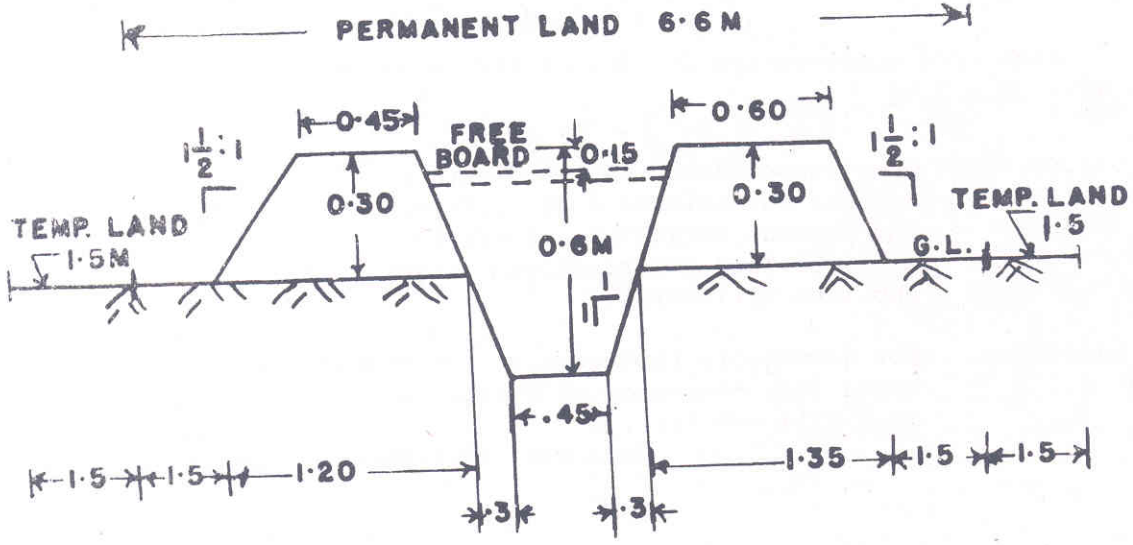
A)	Materials/M.T.	=Rs.
B)	Labour/M.T.	=Rs.
C)	Transportation and erection/M.T.	=Rs.
	Prime Cost	=Rs.
	Add overhead and contractor's profit @ 20% of Prime Cost	=Rs.
	Total	=Rs.
	Say,	=Rs.

Hence Rate of Trashracks/M.T. =Rs.

48. WATER-COURSES (1 km):
(Unlined)

TYPICAL CROSS-SECTION OF WATER COURSE.

(PARTLY IN CUTTING AND PARTLY IN FILLING)



(A) Surveying and Dagbelling (1Km):

20 Nos. Beldars for levelling, chaining, dagbelling and Jungle clearance etc. @ Rs...../each =Rs.

15 Survey pegs @ Rs...../each =Rs.

Sub-Total of item A =Rs.

(B) Land Charges (1 Km.):

i) Permanent land.

Area of 6.6 M wide strip/Km. $= \frac{6.6 \times 1000}{100 \times 100}$

$= \underline{0.66 \text{ Hec.}}$

0.66 Hectares land compensation as per District Revenue authorities @ Rs...../Hec. =Rs.

ii) Temporary Land.

Taking 1.5 M wide strip beyond permanent land on both sides.

Area of Temporary Land/Km.$= \frac{3 \times 1000}{100 \times 100} = \underline{0.3 \text{ Hec.}}$

0.3 Hec. Land compensation as per District Revenue Authtorities @ Rs...../Hec. =Rs.

Total land to be acquired/Km = Sum of sub items(i + ii)

$= 0.66 + 0.30$

$= \underline{0.96 \text{ Hec.}}$

Provide crop compensation for 30% of the total land

i.e. $\frac{30 \times 0.96}{100} = .288$ Hec.

0.288 Hec. Crop compensation as per district Revenue Authorities @ Rs..../Hec. =Rs.

Add 6¼% for Revenue establishment charges on total land compensation charges (i.e. sub item B(i)+B(ii). =Rs.

Add 15% for compulsory Land acquisition charges on total land compensation charges i.e. sub-item B(i) + B (ii). =Rs.

Sub-Total of item(B) =Rs.

(C) Masonry Works (1 Km.):

Taking 2 Nos. masonry works (Gul culverts, syphons etc) in 1 Km. on the average.

Cost of 2 Nos. masonry works; @ Rs...../each =Rs.

(Rate of masonry works is to be separately calculated as per schedule of Rates of the organisation concerned)

(D) Earthwork (1 Km.):

Cross-sectional Area of Gulsection

$$= \frac{0.45 + 1.20}{2} \times 0.30 + \frac{0.60 + 1.35}{2} \times 0.30$$

$$= 0.2475 + 0.2925$$

$$= 0.54 \text{ SQM.}$$

Quantity of Earthwork/Km. length of Gul

= 0.54 x 1000 Cum.

= 540 Cum.

Labour Requirement:

Sl.No.	Category of labour	No. of labourers for 100 Cu.m.	Rate	Labour charges for 100 Cum. E.W.
1.	Beldars	25 Nos.	Rs ... each	
2.	Mates	3/4 Nos.	Rs.. each	

Direct Labour C... =Rs

Add for hidden cost of labour @ 50% of direct labou charges =Rs.

Total labour charge Rs.

Hence Earthwork charges/Km.

$$= \frac{540}{100} \times \text{Total labour charges \% Cu.m.}$$

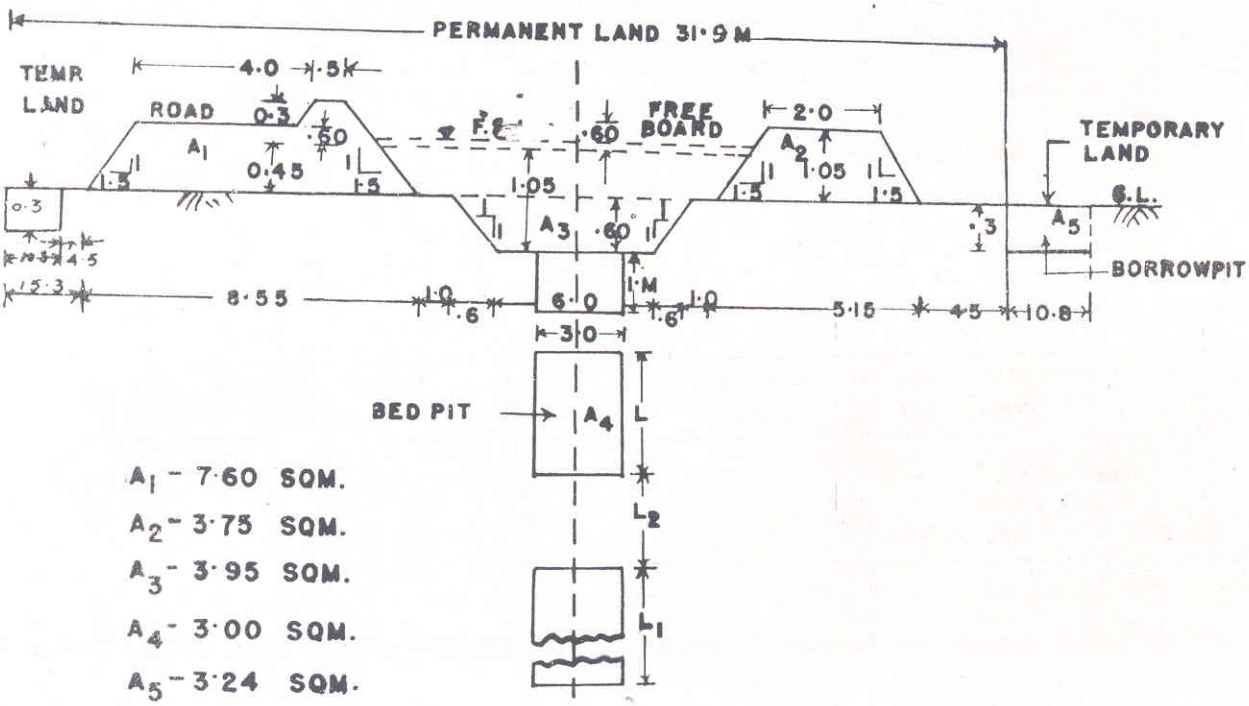
Abstract of charges(Per Km.):

A)	Surveying Dagbelling	=Rs.
B)	Land charges	=Rs.
C)	Masonry works	=Rs.
D)	Earthwork	=Rs.
		=Rs.
	Prime Cost	=Rs.
	Add overhead charges and contractor's profit @ 20% of Prime Cost	=Rs.
	Grand total	=Rs.
	Say	=Rs.
	Hence Rate of water courses/Km.	=Rs.

49. DISTRIBUTARIES (Per sqm)

TYPICAL CROSS-SECTION OF DISTRIBUTORY.

(PARTLY IN CUTTING AND PARTLY IN FILLING)



(A) Surveying and Dagbelling (1 Km.):

35 Nos. Beldars for levelling, chaining dagbelling and jungle clearance @ Rs...../each =Rs.

45 Nos. Survey pegs @ Rs...../each =Rs.

Sub-Total of item A =Rs.

(B) Land charges (1 Km.):

i) Permanent land:

Area of permanent land/Km. $= \frac{31.90 \times 1000}{100 \times 100}$

$= 3.19$ Hec.

Compensation charges of 3.19 Hec. as per rates of District Revenue Authorities/Forest Authorities of Rs...../Hec. =Rs.

ii) Temporary Land:

Area of temporary Land/Km. $= \frac{2 \times 10.8 \times 1000}{100 \times 100}$ -2.15 hec.

(for requirement of temporary land in borrow pits refer sub item E-Earth work.) =Rs.

Compensation charges for 2.15 hec temporary land as per rates of District Revenue Authorities/Forest Authorities @ Rs..../hec. =Rs.

iii) Crop compensation:

Total land to be acquired = 3.19 +2.15 hec
= 5.34 hec.

Crop compensation on 30% of 5.34 Hec. i.e. on 1.60mm land as per rates of District Revenue Authorities @ Rs...../Hec. =Rs.

Total compensation charges = B(i) + B(ii)+ B(iii) =Rs.

Add Revenue establishment charges @ 6¼% on sub item B(i) & B(ii) =Rs.

Add compulsory Land acquisition charges @ 15% on sub items B(i) & B(ii) =Rs.

Total of sub-item(B) =Rs.

(C) Masonry Works (1 km):

As per field statistics the number of masonry works required for km length of a distributary comes to be 2.

2 Nos. Cost of canal works like V.R.B., D.R.B., P.R.B., Falls etc. @ Rs...../each =Rs.

(The cost of each masonry work is to be separately calculated as per schedule of rates of the organisation concerned)

Total of sub-item(C) =Rs.

(D) Miscellaneous Fixtures (Per km):

1 No. Providing and fixing kilometer stones including painting and writing @ Rs..../each =Rs.

4 Nos. Providing & fixing hectometer stones @ 200 m including painting and writing @ Rs..../each =Rs.

10 Nos. Providing & fixing boundary stones including painting @ Rs...../each =Rs.

10 Nos. Providing and fixing of outlets of sizes 15 cms and 10 cms dia for taking out a discharge of 0.1 to 0.15 @ Rs...../each Cumecs/Kms. =Rs.

Total of sub-item(D) =Rs.

(E) Earthwork (Per km):

The area of banks in filling:

i) Left bank $A_1 = \frac{5.4 + 8.55}{2} \times 1.05 = \frac{0.5 + 1.4}{2} \times 0.30$

$= 7.60$ SQM.

ii) Right bank $A_2 = \frac{2.0 + 5.15}{2} \times 1.05 =$ 3.75 SQM

Total filling section= 11.35 SQM

Area of cutting section:

i) Channel section $= \frac{6.00 + 7.20}{2} \times 0.60 = 3.95$ SQM

ii) Area of unbalanced earth = 11.35 - 3.95 Cub.m/m

= 7.40 SQM

This earth is first proposed to be taken from the bed pits & the rest from borrow pits.

Area of central bed pits/m = $\frac{2}{3}$ x 3 x 1

(With regular loft = over-strips of half the length of borrow pit) = 2.0 Cum.

Additional Quantity of earth from each borrow pits = $\frac{1}{2}$ x (7.40-2)

= 2.70 Cub.m.

Giving an allowance of 20% in length for left over pattis, the effective volume of earth = 1.20 x 2.70

= 3.24 Cub.m.

Assuming max. depth of borrow pit to be 0.3 m the width of the Temporary land on either side = $\frac{3.24}{0.30}$

= 10.8 meters.

Quantity of E.W./Km = 11.35 x 1000

= 11350 Cu.m.

Labour Requirement (without lift) for 100 cum. E.W.

Sl. No.	Category of labour	No. of labourers per 100 Cu.m.	Rate/each	Labour charges per 100 cu.	Remarks
1.	Beldars	33 Nos.	Rs.....	Rs.....	
2.	Mate	1 No.	Rs.....	Rs.....	

Direct labour charges per 1000 Cum. = Rs.....

Add for hidden cost of labour @ 50% of direct labour charges =Rs.

Total labour charges % CUM =Rs.

Earthwork charges/Km-113.50 x Total labour charges % CUM =Rs.

Abstract of charges (1 km):

A)	Surveying and dagbelling	=Rs.
B)	Land charges	=Rs.
C)	Masonry works	=Rs.
D)	Miscellaneous fixtures	=Rs.
E)	Earthwork	=Rs.
	Prime Cost	=Rs.

Add overhead expenses and contractor's profit @ 20% of Prime Cost =Rs.

Grand Total =Rs.

Say Rs. =Rs.

Hence rate of Distributary/Km = Rs. = Rs.

52. Construction of haul Roads (per km.)

Brief specifications-17 meter wide haul Roads with gravel topping. The haul road, in general, shall be constructed by the disposed material of excavation. To start with pioneer Roads (7.5 meter wide) shall be made by dozers which will be mostly in-cutting and the widening of these roads to full width of 17 meters, shall be done by the fill material. The haul road shall be provided with 0.5 meter thick gravel topping at the surface.

(A) Excavation:

i) Adopted Data:

Slope of the fill material = 1.5:1
Excavation slope = ½:1
Maximum depth of cutting = 6 meter
Earthwork in excavation of 7.5 meter pioneer Road per Km. = $\frac{7.5 \times 6}{2} \times 1000$
= 22500 CU.M.

Using C-6 crawler tractor
for construction of the haul roads

Hourly use rate of C-6 crawler tractor =Rs.

Output of C-6 crawler tractor per hr. = ___CU.M.

Rate of dozing per CU.M. = Use rate of C-6 crawler tractor / output of c-6 crawler tractor =Rs.

Cost of earthwork per km. length = 22500 x Dozing rate of c-6 crawler tractor per cum. = Rs.

ii) Widening:

No. extra cost shall be debitted to haul roads (based on the assumption that the quantity in excavation is the same as that for fill required for widening).

(B) Gravel Spreading (in 1 Km. length):

i) Material:

Cost of 1 Cu.M. gravel at site of works =Rs.

ii) Labour:

Thickness of gravel	= 0.50 Meter
Machine used	= C-6 dozer
Width of blade	= 3.56 meter
No. of passes required	= 4 for each layer
Average speed	= 53.6 meter/min.
Swell factor	= 0.86
Output of C-6 dozer per hr. (Bank measure)	= $\frac{53.6 \times 3.56 \times 0.50 \times .86 \times 50}{4 \times 2}$
	= 513 Cu.M.
Use rate of C-6 dozer	=Rs.
Rate of spreading gravel/cum	= use rate of C-6 dozer / output of C-6 dozer =Rs.

Total Rate of spreading gravel/Cu.M = item (i) + item (ii) =Rs.

Now quantity of gravel/Km. = 17x0.5x1000

= 8500 Cu.M.

Cost of spreading gravel per Km. = 8500 x spreading rate of gravel =Rs.

(C) Masonry Works:

i) Cost of 2 Nos. drainage crossing/Km. =Rs.
@ Rs._____/each

ii) Cost of Retaining walls and breast walls =Rs.
@ Rs._____/Km.

Total =Rs._____

Prime Cost of haul Roads(A+B+C)Per Km. =Rs.

Add overhead charges and contractor's Profit @ 20% of Prime Cost =Rs._____

Grand Total =Rs._____

Hence Cost of haul Roads/Km. =Rs.

(2) CONSTRUCTION OF 6.1 METER WIDE METALLED ROAD(per km.)

Brief specifications:

Load classification	Class AA Loading
Formation width	=12 M
Metalled width	=6.1 M.
Soling Coat(Consolidated)	=15 Cms.
Inter coat (Consolidated)	=8 Cms.
Top coat (Consolidated)	=8 Cms.
Premix Coat	=2 Cms.
Seal Coat	=Paint thickness.

1. Earthwork

Assuming maximum depth of cutting 2 M. and the section to be fully in cutting.

Earthwork per Km. = ½ x 12 x 2 x 1000 = 12,000 Cu.M. =Rs.

Rate of Earthwork per Cum. =Rs.
(As per schedule of rate applicable)

Cost of Earthwork per Km. = Rate of per cum. EW x 12000 =Rs.

2. Masonry Works

(a) 4 Nos cum ways and culverts per Km. @ Rs._____per each. =Rs.

(b) ___M. high retaining wall and Breadth walls @ Rs._____per Km. =Rs.

Total =Rs.

3. Hill side drain 1 Km. @ Rs._____per km. =Rs.

4. Cost of kilometer and Hectometer stones per km (L.S. on the basis of local inquiry) =Rs.

5. Metalling

(a) Soling Coat (15 cms Thick)

i) Materials (% SQM)

17.5 Cu.M. split boulder 100 mm to 150 mm @ Rs._____per cum. =Rs.

3.5 Cum. stone ballast 40 mm to 90 mm @ Rs. _____per Cum. =Rs.

Total =Rs.

Rate per Cu.M. = Total cost of materials / 100 x 0.15 =Rs.

ii) Labour:

Labour charges per CUM including watering and consolidation (schedule of rate) =Rs.

Rate of soling coat per cu.m.

=Sub item a(i) + a(ii) =Rs.

Cubical contents of soling coat per km (finished thickness 15 cms)

=6.1x1000x.15

=915 Cum.

Cost of soling per Km.=915 x cost of soling coat/cum. =Rs.

(b) Inter and Top Coat(each coat 8 cms thick)

i) Materials:(Per % SQM)

12 cu.m. stone ballast 40 mm to 63 mm @ Rs._____per cum. for inter coat =Rs.

12 Cu m stone ballast 25 mm to 50 mm for top coat____@ Rs._____per cum =Rs._____

Total =Rs._____

Rate per Cu.M.= Total cost of materials / 100 x .16 =Rs.

ii) Labour charges

Labour charges per Cu.M. including watering and consolidation (As per schedule of rate) =Rs.

Total Rate of Inter Coat and top coat per Cum. b (i) + b (ii) =Rs.

Cubical contents of Inter Coat and top coat per km. =6.1x1000x0.16

=976 Cum.

Cost of Inter coat and top coat per km. =976xcoat of Inter and top coat per cum.

=Rs.

(c) Premix coat (2 Cms thick)

i) Materials.(per 100 SQM)
(For fresh water bound surface)

2 Cu.M. stone gritt of 12 mm gauge at site of work @ Rs._____per cu.m. =Rs.

1 cu.m. stone gritt of 10 mm gauge at site of work @ Rs.____per cu.m. =Rs.

0.26 M.T. maxphalt 80/100 at site of work @ Rs._____per M.T. =Rs.

0.26 M.T. Fire wood for heating stone gritt and maxphalt at site of work @ Rs. _____per M.T. =Rs._____

Total =Rs._____

ii) Labour(Per 100 SQM)

Labour charges for spreading and consolidation of premix coat(As per schedule of rate) =Rs.

Total rate of premix coat%SQM = Subitem C(i)+ C(ii) =Rs.

Hence Rate for 1 km length of premix-coat. =6.1x1000xRate of premix coat / 100

=Rs.

(d) Seal coat (Minimum paint thickness)

i) Materials:(Per 100 SQM)

0.70 cum	Coarse sand at site of work @ Rs._____per cum.	=Rs.
0.05 M.T.	Maxphalt 80/100 at site of work @ Rs._____per M.T.	=Rs.
0.03 M.T.	Firewood at site of work @ Rs._____per M.T.	=Rs._____
	Total	=Rs._____

ii) Labour (Per 100 SQM)

Labour charges for heating and spreading the seal coat @ Rs. _____%SQM (As per schedule of rate) =Rs.

Total rate of seal coat%SQM = Sub-item d(i) +d(ii) =Rs.

(e) Ist class Bricks for edging (Per km)

i) Materials:(per km.)

17850 Nos. Ist class Bricks mm at site of work @ Rs.____% Nos. =Rs.

ii) Labour (per km)

Labour charges in digging trench & fixing bricks for edging @ Rs.____per km. (As per schedule of rate) =Rs.

Total rate of Bricks for edging per km. = Sum of sub-items e (i) + e(ii) =Rs.

Cost of metalling per km = Sum of item a to e =Rs.

Hence Prime Cost of 6.1 meter wide metalled Road = Sum of item (1 to 5) =Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost =Rs.

Grand Total = Rs.

Say = Rs.

Hence Rate of 6.1 M wide METALLED Road per km. =Rs.

Note:

1. For class A loading omit Inter coat only and the rest of the procedure will be fully applicable to this loading classification also.

2. Overhead charges and contractor's profit @ 20% on Labour charges has not to be added if the provision of the same is already done in the schedules of the organisations.

54. PAINTING OF LINER (Per sqm.)

A. Material Charges:

i) Covering capacity of 1 litre of paint=5.5 SQM
(Taking 2 coats for painting of liner)
Cost of Anti-corrosive paint including taxes per litre =Rs.

Cost per Sq.m. of area = $\frac{\text{Cost of paint per litre}}{5.5}$ =Rs.

ii) Covering capacity of one litre of primer=11 SQ.M.
(Taking one coat of painting)
Cost of primer paint including Taxes per litre =Rs.

Cost of primer per SQ.M. = $\frac{\text{Cost of primer per litre}}{11}$ =Rs.

Total cost of materials = I + II =Rs.
Rs.+ Rs.

B. Labour charges:

¼ No. painter @ Rs_____per day =Rs.
¼ No. helper @ Rs._____per day =Rs.

Sub total of labour charges =Rs.

Assuming that work will be done for 25 days only in a month.

Average daily wages = $\frac{\text{Sub-Total of labour charges} \times 30}{25}$ =Rs.

Add for hidden cost of labour @ 50% of direct labour charges =Rs.

Grand Total =Rs.

C. Miscellaneous Charges:

i) Labour for cleaning the surface L.S. =Rs.1.5
ii) Cost of Brush, Jute and lighting etc L.S. =Rs.2.5
=Rs.4.0

Abstract of Charges:

A. Material charges =Rs.
B. Labour charges =Rs.
C. Misc. charges =Rs.
Prime Cost =Rs.

Add overhead charges and contractor's profit @ 20% of Prime Cost =Rs.

Grand Total =Rs.

Say Rs.....

Hence rate per SQM=Rs. =Rs.

55. FALSE CEILING (Per sq.m.)

The analysis of rate is based on "All India Standard schedule of Rates, Vol.-I of 1977".

Brief Specifications:-

I. Thickness of False ceiling = 12 m.m.
II. Type of False ceiling = False ceiling with tounged and grooved jointing and wooden screws
III. Type of timber used = 12 mm thick, Indian Teak wood, Ist grade

(The rate analysed, does not include the cost of frame work and cover fillets which are measured and paid for separately).

(A) Materials (Per 10 S.Q.M.):

0.12 Cu.M.	Cost of Ist grade Teak wood planks at site @ Rs...../Cu.M.	=Rs.
0.012 Cu.M.	Extra for 10% wastage of Teak wood planks over the above at site @ Rs...../Cu.M.	=Rs.
160 Nos.	Screws at site of work @ Rs..% Nos	=Rs.
	Total cost of materials per 10 S.Q.M.	=Rs.

Hence cost of materials/SQM = $\frac{\text{Total cost of materials per 10 SQM}}{10}$ = Rs.

(B) Labour (Per 10 SQM):

1.75 Nos.	Carpenters Ist class @ Rs.../Each	=Rs.
1.25 Nos.	Carpenters IInd class @ Rs../Each	=Rs.
1.25 Nos.	Beldars @ Rs.../Each	=Rs.
	Direct Labour charges per 10 SQM.	=Rs.
	Add for hidden Cost of Labour @ 50% of direct labour charges	=Rs.
	Total Labour charges 10 SQM.	=Rs.

Hence Labour charges per SQM = $\frac{\text{Total labour charges per 10 SQM.}}{10}$ =Rs.

(C) Scaffolding and Sundries (Per SQM):

Scaffolding and sundries charges @ 15% of labour charges per SQM at sub-item (B) =Rs.

ABSTRACT (PER SQM.)

1.	Materials	=Rs.
2.	Labour	=Rs.
3.	Scaffolding & Sundries	=Rs.
	Prime Cost	=Rs.

Add overhead charges and contractor's Profit @ 20% of Prime Cost =Rs.

Grand Total =Rs.

Say =Rs.

Hence Rate of False Ceiling per SQM. =Rs.

56. CONCRETE PRETRENCH FOR DIAPHRAGM WALL (Per R.M.)

Brief Specifications:

i) 'L' shaped pre-cast frame of Reinforced concrete Grade M-150.

ii) 1 R.M. of Pretrench will require 0.40 Cu.M. of concrete and 20 Kg. of mild steel reinforcement.

(The quantity of concrete and steel given here are of a key trench for a diaphragm wall of 0.60 meter thick. These quantities will be altered according to the variation in the thickness of the wall)

(A) Concrete:

0.40 Cu.M. of M-150 grade concrete @ Rs.... per cum.=Rs.
(Unit rate of M-150 grade concrete to be adopted same as given under item 10 (1) of chapter on Analysis of rates Vol.-I)
=Rs.

(B) Steel

20 Kg of mild steel @ Rs.....per M.T. =Rs.

(Unit rate of mild steel reinforcement to be adopted same as given under item No. 11 of chapter Analysis of rates Vol.-I)

Hence Prime Cost of concrete pretrench Diaphragm wall /RM = (A+B) =Rs.

Add overhead charges and contractor's Profit @ 20% of Prime Cost =Rs.

Grand Total =Rs.

Say =Rs.

Hence rate of concrete pretrench Diaphragm wall/ RM =Rs.

57. PLASTIC CONCRETE FOR DIAPHRAGM WALL (Per cum.)

Format for Rate analysis of this item is based on the Data supplied by the Chief Engineer, Irrigation Andhra Pradesh, Hyderabad.

(A) Boring for Diaphragm wall (Trenching) (Per cu.m.):

Width of Trench = 0.6 M.

Unit area considered = 1.00 SQM

* Hence multiplying factor = $\frac{1.00}{0.60}$

= 1.67

i) Cost of Boring per metre depth:

Use rate of boring machine (Rig)per hour =Rs.

Output of boring machine/hour=....meter

Hence rate of boring/meter depth = $\frac{\text{use rate of boring machine/hour}}{\text{output of boring machine/hour}}$ =Rs.

ii) Cost of shifting boring machine @ 40% of sub-item A(i) above =Rs.

Rate/SQM = Total rate of boring per meter depth i.e. (i) + (ii) =Rs.

Hence Rate of boring for laying 1 Cu.M. of concrete = Rate of boring SQM x 1.67 =Rs.

(B) Chiselling for Diaphragm wall (Per Cu.M.):

i) Cost of chiselling use rate of Rig with chisel/hour =Rs.

ii) Cost of shifting rig with chisel @ 40% of sub-item B (i) above =Rs.

Rate of Rig with chisel per Rig hour Total =Rs.

Output of Rig with chisel/Rig hour = 0.06 Cu.M.

Rig hours/cu.m. of concrete $= \frac{1.00}{0.06}$ hrs.

$= 16.67$ hrs.

Hence Rate of chiselling/cum of concrete
= Rate of Rig with chisel/Rig hour x 16.67 =Rs.

(C) Placing Plastic Concrete for Diaphragm wall (Per Cum)

i) Material (Per Cu.M.)

Sl.No.	Item	Qty.	Unit	Rate	Per	Amount
1.	Cement	150x1.05*	Kgs.	Rs..	E.	Rs....
2.	Bentonite	6	Kgs.	Rs..	E.	Rs....
3.	Treated clay	178	Kgs.	Rs..	E.	Rs....
4.	Treated sand	564	Kgs.	Rs..	E.	Rs....
5.	20mm H.B. Granite metal	596	Kgs.	Rs..	E.	Rs....
6.	12mm H.B. Granite metal	596	Kgs.	Rs..	E.	Rs....
7.	Water	268	Kgs.	Rs..	E.	Rs....

(* Including 5% wastage and incidentals to work)

ii) Batching mixing and laying same as for mass concrete (M-100) (Total of Part B of item No. 9 of draft chapter on analysis of rates vide terms of reference II(d) =Rs.

Hence rate of laying plastic concrete/Cum. = Sum of sub-items C(i) and (ii) =Rs.

Hence Prime Cost of plastic concrete for diaphragm wall. = Sum of sub-items (A+B+C) =Rs.

Add for overhead charges and contractor's Profit @ 20% of Prime Cost =Rs.

Grand Total =Rs.

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* The multiplying factor will get suitably altered depending on the width of the trench.