

भारतीय मानक

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प्रति इकाई दर का परिकलन — मार्गदर्शी सिद्धान्त  
( पहला पुनरीक्षण )

*Indian Standard*

GUIDELINES FOR WORKING OUT  
UNIT RATE COST OF THE  
CONSTRUCTION EQUIPMENT USED FOR  
RIVER VALLEY PROJECTS  
( *First Revision* )

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## FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Cost Analysis and Cost Estimates Sectional Committee had been approved by the River Valley Division Council.

River valley projects require large quantities of work to be executed. To complete these in reasonable time, construction machinery of various types and sizes is deployed according to the particular needs of the projects.

The capital cost of the machinery is very high. It is important therefore to work out the unit rate cost of deployment of different types of machines so that the optimum size, type and units of construction machinery are selected for the project, keeping in view the resources of the project, economics of operation, the time frame, etc.

The correctness of working out unit rate cost of deployment of machinery is very important in a river valley project and needs to be standardized. This standard deals with the procedure for working out the unit rate cost of owning and operating machinery deployed on river valley projects.

This standard was first published in 1986. This revision has been taken up in light of experience gained in the use of this standard and prevalent practices. The major changes relate to calculation of annual cost and depreciation of machinery and to the life and repair provisions in respect of various equipment as given in Table 2.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2:1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

# Indian Standard

## GUIDELINES FOR WORKING OUT UNIT RATE COST OF THE CONSTRUCTION EQUIPMENT USED FOR RIVER VALLEY PROJECTS

( *First Revision* )

### 1 SCOPE

**1.1** This standard lays down guidelines for working out hourly owning and operating cost of different types of construction equipment used on river valley projects.

**1.2** This standard does not cover hire charges for deployment of machinery.

### 2 OWNING AND OPERATING COST OF EQUIPMENT

**2.1** In case of construction equipment, the owning and operating cost is estimated per hour of operation of equipment, while in case of inspection vehicles and highway transport vehicles it is usually expressed as cost per kilometre. These rates are computed for a period of one year and are reassessed thereafter.

**2.2** The hourly owning and operating cost of equipment comprises the following elements:

a) *Ownership Cost*

- i) Interest on capital investment
- ii) Insurance cost
- iii) Depreciation cost.

b) *Operational Cost*

- i) Fuel/energy and lubricants charges.
- ii) Operation and maintenance crew charges.
- iii) Repair charges.
- iv) Miscellaneous supplies.

The various elements as mentioned above may be evaluated as described in 2.2.1 to 2.2.7

#### 2.2.1 Interest on Capital Investment

The interest charges are to be related to the average annual cost of equipment based on the life of equipment in number of years (see Annex A). The annual cost of equipment is determined as follows:

Average annual cost =

$$\text{Book value of equipment} \times \frac{n+1}{2n}$$

where,  $n$  is number in years of life of the equipment.

NOTE — Book value of equipment will be purchase price plus freight, insurance, all taxes and duties, post clearance charges, erection and commissioning expenses and other incidental charges.

The rate of interest per annum may be taken at prevalent rates.

In case of construction equipment owned by Government departments and deployed for their own works, the interest charges should not normally be included in the hourly owning and operating cost of the equipment.

#### 2.2.2 Insurance Cost

These may be taken as per actual annual charges.

#### 2.2.3 Depreciation Cost

There are several methods of calculation of depreciation cost. However, the simplest of all the methods is the straight line method which may be adopted.

The straight line method depreciates the book value of equipment over its life at a uniform rate till its residual/scrap value which is taken as 10 percent of the book value. Annual depreciation should be calculated with reference to scheduled life in hours and also with reference to scheduled life in years and the actual depreciation should be taken as the average of these two.

#### 2.2.4 Fuel/Energy and Lubricants Charges

The fuel/energy and lubricant charges should be taken as per actuals. However, for the purpose of estimating fuel/energy charges, the following method may be adopted:

i) *For electrically powered equipment*

In case of such equipment the energy charges can be obtained by estimating the energy consumed in kilowatt per hour and multiplying it by the energy rate.

$$\text{Energy consumed} = \frac{\text{BHP} \times 746}{1\,000} \times C_1 \times C_2$$

where

- BHP = Brake Horse Power,
- $C_1$  = factor for category of equipment (Table 1), and
- $C_2$  = duty factor (Table 1).

Table 1 Type and Duty Factors  
( Clause 2.2.4 )

Sl. No.	Category of Equipment	C <sub>1</sub> (Type Factor)	C <sub>2</sub> (Duty Factor)		
			Light Duty	Medium Duty	Heavy Duty
(1)	(2)	(3)	(4)	(5)	(6)
i)	Dump truck	0.30	0.70	1.00	1.40
ii)	Motor grader	0.40	0.67	1.00	1.33
iii)	Hydraulic excavator	0.50	0.80	1.00	1.20
iv)	Wheel loader	0.58	0.70	1.00	1.30
v)	Motorized scraper :				
	a) Single engine	0.62	0.70	1.00	1.30
	b) Twin engine	0.57	0.70	1.00	1.30
vi)	Bulldozer	0.57	0.75	1.00	1.25
vii)	Dozer shovel	0.61	0.75	1.00	1.25
viii)	Diesel generator and air compressors	1.00	0.75	1.00	1.25

ii) *For Diesel Powered Equipment*

Fuel consumed per hour may be estimated from the following relationship:

Fuel consumption in litres  
per hour =  $0.22 \times \text{BHP} \times C_1 \times C_2$

where

BHP = Brake Horse Power,

C<sub>1</sub> = factor for the category of equipment  
(Table 1), and

C<sub>2</sub> = factor for type of duty (Table 1).

iii) *For Pneumatically Operated Equipment*

The cost of compressed air in Rupees per cubic metre per minute can be estimated by first analysing owning and operating cost of air compressor which can then be used. Rated capacity of equipment may be used for obtaining energy charges.

The cost of lubricants can be taken as 25 percent to 30 percent of the cost of fuel/energy depending upon the type of equipment.

2.2.5 *Operation and Maintenance Crew Charges*

Number of crews to be considered while calculating operation and maintenance crew charges may be as per actual deployment. Operation crew charges would include the wages of operators, helpers and share of supervisory staff like chargeman and/or foreman, watch and wardman, etc. Maintenance crew charges would include wages of mechanics, electricians, greasers, helpers, welders, fitters and share of supervisory staff like chargeman and/or foreman, etc.

The wages may be equally divided amongst the group of construction machines to which the crew is attending.

To obtain hourly charges, the annual charges may be divided by the number of scheduled hours for which the equipment is expected to work during the year.

Apart from the salaries of operating and maintenance crew the owner of the equipment has to spend on their housing, reserve leave salary, terminal benefits, medical facilities etc. Therefore, for purpose of hourly charges, the annual cost of operation and maintenance crew distributed over the operational hours during the year can be suitably increased by estimating these benefits.

2.2.6 *Repair Charges*

The provision of repair charges is taken as a percentage of the book value of machine. This provision includes cost of spare parts and wages for all major repairs but does not include normal/routine maintenance. The total repair provision over the scheduled life is given in Annex A (Table 2). This may be scaled into 5 equal stages of the life of machine as under:

Stage	Percentage of Total Repair Provision
First	10
Second	15
Third	25
Fourth	30
Fifth	20

The repair provision could vary to the extent of about 20 percent over and above the indicated provision if severity of job conditions so demand.

The escalation of prices of spares could be provided by increasing the book value nationally on the basis of price index for the machinery issued by Reserve Bank of India or any other authorized agency. Scaled percentage repair provision can then be applied over

this escalated book value to arrive at the repair provision for the stage under consideration.

### 2.2.7 Miscellaneous Supplies

The hourly miscellaneous supplies provision may be kept as 10 percent of the hourly repair provision. This could be suitably increased for machines using wire ropes, cutting edges, etc, and working in adverse job conditions.

## ANNEX A

( *Clauses 2.2.1 and 2.2.6* )

### LIFE AND REPAIR PROVISION OF EQUIPMENT

**A-1** The scheduled operational life of different equipment as years and hours are given in Table 2.

**A-2** The number of hours a machine is expected to work in a year depends on the number of shifts of operation per day and number of days available in a year. Based on 200 working days in a year the number of hours available will be as under:

<i>Number of Shifts per Day</i>	<i>Annual Scheduled Production, Hours</i>
One	1 200
Two	2 200
Three	3 000

NOTE — Where 200 working days are not available because of peculiar situation existing on account of location of sites of work, climatic conditions, the scheduled hours may be reduced proportionately. Similarly, if more than 200 days are available, the number of hours may be increased proportionately.

**Table 2 Life and Repair Provision of Equipment**

( *Foreword and Clauses A-1 and 2.2.6* )

Sl No. (1)	Equipment		Life of Equipment		Repair Provision (Percentage of Cost of Equipment) (6)
	Category (2)	Capacity (3)	Years (4)	Hours (5)	
i) <b>Excavators</b>					
	A) Shovels and draglines :				
	a) Diesel	1) Up to 1.5 m <sup>3</sup>	10	12 000	150
		2) Above 1.5 m <sup>3</sup> and up to 2.50 m <sup>3</sup>	12	15 000	150
		3) Above 2.50 m <sup>3</sup>	15	25 000	150
	b) Electric	1) 1.5 to 3.0 m <sup>3</sup>	15	25 000	150
		2) Above 3 m <sup>3</sup>	20	40 000	150
	B) Walking draglines		20	30 000	150
	C) Hydraulic excavator				
		1) Below 1 m <sup>3</sup> (Diesel)			
		i) Wheeled	10	15 000	100
		ii) Crawler	10	12 000	100
		2) 1 to 3 m <sup>3</sup> (Diesel)			
		i) Wheeled	12	17 500	125
		ii) Crawler	12	15 000	125

Table 2 (Continued)

Sl No.	Equipment		Life of Equipment		Repair Provision (Percentage of Cost of Equipment) (6)
	Category (2)	Capacity (3)	Years (4)	Hours (5)	
(1)		3) Over 3 m <sup>3</sup> :			
		i) Diesel	12	20 000	150
		ii) Electric	15	25 000	125
		D) Bucket wheeled excavators	20	40 000	150
		E) Dredger in fresh water	Hull 25 Machine 10	— —	60 60
		F) Barges	Hull 16 Machine 10	— —	60 60
		G) Tugs	Hull 16 Machine 10	— —	60 60
		ii) Dumpers			
		A) Bottom dumpers	1) Up to 20 MT 8 2) Above 20 MT and up to 50 MT 10 3) Above 50 MT 12	10 000 16 000 20 000	175 175 175
		B) Rear dumpers	1) Up to 15 MT 8 2) Above 15 MT and up to 35 MT 10 3) Above 35 MT and up to 50 MT 12 4) Above 50 MT 15	10 000 12 000 15 000 20 000	175 175 175 175
		C) Highway dumpers	8	10 000	175
(1)		iii) Scrapers			
		A) Motorised			
		a) Push loaded	1) Up to 8 m <sup>3</sup> struck 8 2) Above 8 m <sup>3</sup> struck 10	9 000 10 000	200 200
		b) Elevating and self-loading	10	10 000	200
		B) Towed	12	15 000	100
		iv) Tractors			
(1)		A) Crawler	1) Up to 100 hp 8 2) Above 100 to 300 hp 10 3) Above 300 hp 12	9 000 12 000 16 000	200 240 240
		B) Wheeled	1) Up to 75 hp 8 2) Above 75 hp 10	12 000 15 000	200 200
		v) Graders	10	12 000	200
		vi) Loaders			
		A) Crawler	10	12 000	200
		B) Wheeled	10	15 000	200
(1)		C) Belt loaders	16	20 000	100
		D) Reclaimers and stackers	20	30 000	100

Table 2 (Continued)

Sl No.	Equipment		Life of Equipment		Repair Provision (Percentage of Cost of Equipment)
(1)	Category (2)	Capacity (3)	Years (4)	Hours (5)	(6)
vii)	<b>Compactors</b>				
	A) Self-propelled sheepsfoot roller		10	12 000	100
	B) Drawn sheepsfoot rollers		8	10 000	70
	C) Vibratory rollers		8	8 000	200
	D) Smooth drum rollers		8	10 000	80
	E) Smooth drum vibratory rollers		8	8 000	200
	F) Pneumatic tyred rollers		8	10 000	100
	G) High speed compactors		10	16 000	100
viii)	<b>Water Sprinklers</b>		10	16 000	120
ix)	<b>Canal Trimmer and Lining Equipment</b>		16	20 000	100
x)	<b>Drilling Equipment</b>				
	A) Drilling jumbo :				
	a) Pneumatic		8	12 000	100
	b) Hydraulic		10	15 000	120
	B) Rock bolting jumbo :				
	a) Pneumatic		8	12 000	100
	b) Hydraulic		10	15 000	120
	C) Air Tracks/Drilling equipment		8	8 000	80
	D) Drills :				
	a) Blast hole drills		10	10 000	80
	b) Core drills		8	8 000	80
	c) Wagon drills		8	8 000	80
	d) Tricone rotary drills		10	10 000	80
xi)	<b>Compressors</b>				
	A) Diesel	1) Portable up to 8.5 m <sup>3</sup> /min	8	10 000	100
		2) Portable above 8.5 m <sup>3</sup> /min	10	12 000	100
	B) Electric	1) Portable up to 8.5 m <sup>3</sup> /min	10	16 000	80
		2) Portable above 8.5 m <sup>3</sup> /min	12	20 000	80
		3) Stationary	20	30 000	80
xii)	<b>Blowers</b>		12	—	80
xiii)	<b>Cooling Plants</b>				
	A) Aggregate cooling plant	}	20	40 000	75
	B) Ice plant				
xiv)	<b>Batching and Mixing Plant</b>				
	A) Cement handling and batching and mixing plant		18	30 000	75
	B) Transit mixers	}	10	10 000	120
	C) Agitating cars				

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Table 2 (Concluded)

Sl No.	Equipment		Life of Equipment		Repair Provision (Percentage of Cost of Equipment)
(1)	Category (2)	Capacity (3)	Years (4)	Hours (5)	(6)
C)	Aerial transport :				
	a) Ropeways	}	20	40 000	70
	b) Cableways				
D)	Rail transport :				
	a) Locomotives				
	i) Diesel		10	16 000	120
	ii) Electrical		22	40 000	100
	b) Wagons	}	20	30 000	70
	c) Rail cars				
xix)	Diesel Generating Sets				
		1) Up to 50 kVA	10	20 000	100
		2) Above 50 kVA	15	30 000	120
xx)	Welding Sets				
	A) Diesel Engine Driven		10	—	100
	B) Motor generator (M-G) set		12	—	70
	C) Transformer type		5	—	50
xxi)	Machine Tools		15	—	50
xxii)	Mobile Workshop Van		15	—	70
xxiii)	Mobile Service Van		15	—	70

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