

Management System for Controlling Construction Equipments at Dam Site

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Abstract

This paper report presents the work related to the management of construction equipments at dam site. Dams are very important structures as they deals with the major irrigation projects and water resource planning. The dam site is large and takes much area and also require high endeavour for each of its work packages however most important part then remains as the execution of work and handling of large equipments and machineries. The economic dam site is one which is handled with economy of equipments thus here the part of concern is to have proper planning and management of equipments on dam site. The report mainly focused on the management of construction equipments at dam site.

The presented work consists of two main parts. The first part is related to construction equipments details and its production rate and the second part is associated with combination of various equipments to find out the optimum cost of equipment handling .

Keywords: Ownership cost. Operating cost, maintenance and repairs, equipment life, Production Rate. Combination of various equipments.

I. INTRODUCTION

The management of heavy construction equipment is a difficult task. Equipment managers are often called upon to make typical economic decisions involving the machines in their uses. These papers include those concerning acquisitions, maintenance, repairs, rebuilds, replacements, and retirements. The equipment manager must also be able to forecast internal rental rates for their machinery. Repair and maintenance expenditures can have significant impacts on these economic decisions and forecasts.

It is a management tool for planning and budgeting deferred maintenance capital improvement, equipment repair and replacement, and construction projects The documentation begins at the ground level with identification of deferred maintenance, capital improvement, construction, and equipment replacement and repair needs by field station managers.

The Indian Construction Equipment sector has an estimated market size of 8.4 to 9.4 l Crores for the year 2015. The industry has been growing due to the large investments made by the Government and the private sector infrastructure developments.

II. OWNERSHIP COST

Ownership costs are fixed costs. Almost all of these costs are. annual in nature and include:

- Initial capital cost

- Depreciation
- Investment (or interest) cost
- Insurance cost
- Taxes
- Storage cost

III. COST OF OPERATING CONSTRUCTION EQUIPMENT

The operating costs vary with the amount of equipment used and job-operating conditions. The best basis for estimating the cost of operating construction equipment is the use of historical data from the experience of similar equipment under similar conditions. If such data is not available, recommendations from the equipment manufacturer could be used.

IV. FUEL COST

Fuel consumption is incurred when the equipment is operated. When operating under standard conditions, a gasoline engine will consume approximately 0.06 gal of fuel per flywheel horsepower hour (fw hp-h), while a diesel engine will consume approximately 0.04 gal/fw hp-h. A horsepower hour is a measure of the work performed by an engine. The hourly cost of fuel is estimated by multiplying the hourly fuel consumption by the unit cost of fuel.

V. MAINTENANCE AND REPAIR COSTS

Maintenance and repair costs are the crux of the equipment replacement decision and result from the cost of labor and parts used to maintain and repair the given piece of equipment. This is an incredibly dynamic system and can be affected by the following factors:

- Type of equipment.
- Age of the equipment.
- Operating conditions.
- Operating skill of the operator.
- Daily care by the operator.
- Maintenance department.
- Frequency and level of preventive maintenance.
- As a result, it is very important to keep accurate cost.

VI. OBJECTIVES AND GOALS OF EQUIPMENT

Management Maintenance objectives fall in two categories: the primary objective and the secondary objective. The primary objective of maintenance is the repair and upkeep of production equipment to ensure that it is kept in a safe and effective operating condition so that production targets can be met on time, in budget, and in good quality. The secondary objective of maintenance is to perform approved maintenance and repair work to the extent that such maintenance work does not reduce the planned operating hours per year upon which the equipments' hourly rental rates are predicated. Objectives help to ensure that the intended maintenance program can be carried out effectively. The fundamental objectives of a good planned maintenance program are as follows.

VII. METHODOLOGY

In this chapter, I am collecting the Panchala Dam site data which is situated in Panchala Village in Washim District, and collecting various operations activities and quantity of material which are required for construction of this Dam. and find out the actual requirement of construction equipment on the basis of compares' in between actual rent cost and actual purchasing cost of construction equipments. and find out easy way to make Buy, Rent or Lease decision to manage the construction equipment.

VIII. CONSTRUCTION DETAILS OF PANCHALA DAM

- Length of Dam is 500 M.
- Hight of Dam is 18 M.
- Bottom Width of Dam wall is 88 M
- Top width of Dam wall is 7 M

IX. TYPES OF EQUIPMENT AND ITS USES.

Sr No	Type of Equipment	Use of Equipment
1	Excavator	Excavation for Foundation.
2	Tipper	Convey the excavated Materials.
3	Vibratory Roller	Compaction (Dam Wall).
4	Concrete Mixer	Homogeneously combines cement, aggregate such as sand or gravel, and water to form concrete.
5	Concrete Vibrator	To move and position bulk material or small component parts.
6	Diesel Engine.	For lifting water from excavated pit.

X. GENERAL MARKET RATE OF EQUIPMENT ON RENT BASIS.

Sr No	Type of Equipment	Current Market Rate on Rent Basis.(including Operator,repair and Maintenance)
1	Excavator	Rs 1000/hr
2	Tipper	Rs 2000/hr
3	Loader	Rs 700/hr
4	Vibratory Roller	Rs 600/hr
5	Plane Roller	Rs 600/hr
6	Dressing Machine	Rs 800/hr
7	Concrete Mixer	Rs 1500/day
8	Concrete Vibrator	Rs 1000/day
9	Diesel Engine.	Rs 800/hr (excluding fuel)

XI. PRODUCTION RATE OF VARIOUS EQUIPMENTS.

Excavator Production Rate :- (For Model EX200LC Super)

Reff By..Book Name :- Construction Planning , Equipment and Methods

Author – Peurifoy , Schexnayder ,Shapira

Page No-263 Edition 2010

Bucket Capacity :-0.50 CUM = 17.65 Cubic ft

- Cycle element time
- Load 20 sec
- Swing Loaded-4 sec
- Dump-4 sec
- Swing empty-4 sec
- **Total Time =32 sec**

Efficiency factor = TBR information, the efficiency would be 30 to 45 working minutes.

Assume 40 min for a conservation time.

$$\frac{2400}{32} \times 17.65 = 1323$$

= **1323 cubic ft/hr.**

a) Deduct Production Rate by 10 % for Hard Murum.

Hence Production Rate for Hard Murum

= **1190 cubic ft / hr**

b) Deduct Production Rate by 20 % for Soft Rock.

Hence Production Rate for Soft rock

= **1058 cubic ft / hr**

c) Deduct Production Rate by 30 % for Hard Rock.

Hence Production Rate for Hard Rock

= **926 cubic ft / hr**

XII. TIPPER PRODUCTION RATE :-

Reff By..Book Name :- Construction Planning , Equipment and Methods

Auther – Peurifoy , Schexnayder ,Shapira

Page No-315 Edition 2010

- Load Time – 3 min
 - Haul time -7 min
 - Return time -6 min
 - Dump time-2 min
 - **Total Time =18 min**
 - Tipper Capacity = 412 cubic fit / trip
 - Hence Production Rate of tipper / hr
- $$= \frac{60}{18} \times 412 = 1373 \text{ cubic ft/hr}$$

Tipper Production Rate :-1373 cubic ft/hr

XIII. VIBRATORY ROLLER PRODUCTION RATE :-

Reff By..Book Name :- Construction Planning , Equipment and Methods

Auther – Peurifoy , Schexnayder ,Shapira

Page No-128 Edition 2010

Compacted cubic yard per hour

$$= \frac{16.30 \times W \times S \times L \times Efficiency}{n}$$

Where, W - Compacted width per roller passes in feet =7 fit

S - Average roller speed in mile /hr =3 mph

L - Compacted lift thickness in inches = 6 inch.

N - No. of roller passes required to achieve the required density=4

One bcy=0.83 ccy

The scraper production, estimated for the production, is 510 bcy/hr.

Assume a 50 min hour efficiency.

Compacted cubic yard per hour

$$= \frac{16.30 \times 7 \times 3 \times 6 \times 50/60}{4}$$

$$= 428 \text{ ccy/hr}$$

$$= \frac{428 \text{ ccy/hr}}{0.83} = 516 \text{ bcy/hr}$$

$$= 516 \times 27 = 13770 \text{ cubic fit/hr}$$

Hence Vibratory Roller Production Rate is 13770 cubic fit /hr.

XIV. ACTUAL QUANTITY OF MATERIALS IN PANCHALA DAM.

Soft Materials :- 14077 Cum.

Hard Murum :- 24956 Cum.

Soft Rock :- 18625 Cum.

Hard Rock :- 15663 Cum.

Total Qty In Cum 73321 Cum.

XV. FIRST CALCULATE COST OF QUANTITY HANDLING CHARGE AS PER MARKET RATE FOR VARIOUS OPERATIONS. (ON RENT BASIS)

Sr no	Use of Equipment	Operating Hours	Amount (Lacks)
1	Excavator	2333.56	23.33
2	Tipper	1884.42	37.68
3	Vibratory Roller	187.89	1.12
4	Concrete Mixer	15 Days	0.225
5	Concrete Vibrator	15 Days	0.15
6	Diesel Engine	52 Days	0.416
	Total Amount :-		62.94

XVI. CURRENT MARKET PRICE OF VARIOUS EQUIPMENTS ON SITE.(INCLUDING FUEL AND MAINTENANCE AND OPERATOR CHARGES)

Sr no	Type of Equipment	Price (Lacks)	Fuel & Maintance cost	Total Cost (Lacks)
1	Excavator	22	4.43	26.43
2	Tipper	8	2.85	10.85
3	Vibratory Roller	28	0.72	28.72
4	Conc. Mixer	0.58	0.102	0.68
5	Conc Vibrator	0.25	0.045	0.30
6	Diesel Engine	0.3	0.206	0.51

XVII. Comparison of Cost In Between Rent Amount and Purchasing Amount.

Sr no	Type of Equipment	Rent Amount (Lacks)	Purchasing Amount (Lacks)	Difference (Lacks)
1	Excavator	23.34	52.86	29.53
2	Tipper	37.69	21.69	-16.00
3	Vibratory Roller	1.13	28.72	27.59
4	Conc. Mixer	0.23	0.68	0.45
5	Conc Vibrator	0.15	0.30	0.15
6	Diesel Engine	0.42	0.51	0.09

Case -4

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	On Rent	37.69	75.38
3	Vibratory Roller	On Rent	1.13	1.13
4	Conc. Mixer	Purchase	0.68	0.68
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	On Rent	0.42	0.42
			Total Cost	124.42

XVIII. Combinations of various equipment to find out optimum cost for equipment handling.

Case-I

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	Purchase	26.43	52.86
2	Tipper	On Rent	37.69	75.38
3	Roller	On Rent	1.13	1.13
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	On Rent	0.42	0.42
			Total Cost	130.16

Case -5

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	On Rent	37.69	75.38
3	Vibratory Roller	On Rent	1.13	1.13
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	Purchase	0.30	0.30
6	Diesel Engine	On Rent	0.42	0.42
			Total Cost	124.12

Case -2

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	Purchase	10.85	21.69
3	Roller	On Rent	1.13	1.13
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	On Rent	0.42	0.42
			Total Cost	130.16

Case -6

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	On Rent	37.69	75.38
3	Vibratory Roller	On Rent	1.13	1.13
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	Purchase	0.51	0.51
			Total Cost	124.06

Case -3

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	On Rent	37.69	75.38
3	Vibratory Roller	Purchase	28.72	28.72
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	On Rent	0.42	0.42
			Total Cost	151.56

Case -7

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	Purchase	26.43	52.86
2	Tipper	Purchase	10.85	21.69
3	Vibratory Roller	On Rent	1.13	1.13
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	On Rent	0.42	0.42
			Total Cost	76.47

Case -8

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	Purchase	10.85	21.69
3	Vibratory Roller	Purchase	28.72	28.72
4	Conc. Mixer	On Rent	0.68	0.68
5	Conc Vibrator	On Rent	0.30	0.30
6	Diesel Engine	On Rent	0.51	0.51
Total Cost				98.57

Case -12

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	Purchase	26.43	52.86
2	Tipper	On Rent	37.69	75.38
3	Vibratory Roller	Purchase	28.72	28.72
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	On Rent	0.42	0.42
Total Cost				157.75

Case -9

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	On Rent	37.69	75.38
3	Vibratory Roller	Purchase	28.72	28.72
4	Conc. Mixer	Purchase	0.68	0.68
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	On Rent	0.42	0.42
Total Cost				152.01

Case -13

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	Purchase	26.43	52.86
2	Tipper	On Rent	37.69	75.38
3	Vibratory Roller	On Rent	1.13	1.13
4	Conc. Mixer	Purchase	0.68	0.68
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	On Rent	0.42	0.42
Total Cost				130.61

Case -10

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	On Rent	37.69	75.38
3	Vibratory Roller	On Rent	1.13	1.13
4	Conc. Mixer	Purchase	0.68	0.68
5	Conc Vibrator	Purchase	0.30	0.30
6	Diesel Engine	On Rent	0.42	0.42
Total Cost				124.57

Case -14

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	Purchase	26.43	52.86
2	Tipper	On Rent	37.69	75.38
3	Vibratory Roller	On Rent	1.13	1.13
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	Purchase	0.30	0.30
6	Diesel Engine	On Rent	0.42	0.42
Total Cost				130.31

Case -11

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	On Rent	37.69	75.38
3	Vibratory Roller	On Rent	1.13	1.13
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	Purchase	0.30	0.30
6	Diesel Engine	Purchase	0.51	0.51
Total Cost				124.21

Case -15

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	Purchase	26.43	52.86
2	Tipper	On Rent	37.69	75.38
3	Vibratory Roller	On Rent	1.13	1.13
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	Purchase	0.51	0.51
Total Cost				130.25

Case -16

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	Purchase	10.85	21.69
3	Vibratory Roller	On Rent	1.13	1.13
4	Conc. Mixer	Purchase	0.68	0.68
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	On Rent	0.42	0.42
Total Cost				70.73

Case -17

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	Purchase	10.85	21.69
3	Vibratory Roller	On Rent	1.13	1.13
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	Purchase	0.30	0.30
6	Diesel Engine	On Rent	0.42	0.42
Total Cost				70.43

Case -18

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	Purchase	10.85	21.69
3	Vibratory Roller	On Rent	1.13	1.13
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	Purchase	0.51	0.51
Total Cost				70.37

Case -19

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	On Rent	37.69	75.38
3	Vibratory Roller	Purchase	28.72	28.72
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	Purchase	0.30	0.30
6	Diesel Engine	On Rent	0.42	0.42
Total Cost				70.37

Case -20

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	On Rent	37.69	75.38
3	Roller	Purchase	28.72	28.72
4	Conc. Mixer	On Rent	0.23	0.23
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	Purchase	0.51	0.51
Total Cost				151.65

Case -21

Sr no	Type of Equipment	Mode of procurement	Amount (Lacks)	Total Amount
1	Excavator	On Rent	23.34	46.67
2	Tipper	On Rent	37.69	75.38
3	Vibratory Roller	On Rent	1.13	1.13
4	Conc. Mixer	Purchase	0.68	0.68
5	Conc Vibrator	On Rent	0.15	0.15
6	Diesel Engine	Purchase	0.51	0.51
Total Cost				124.51

Observations

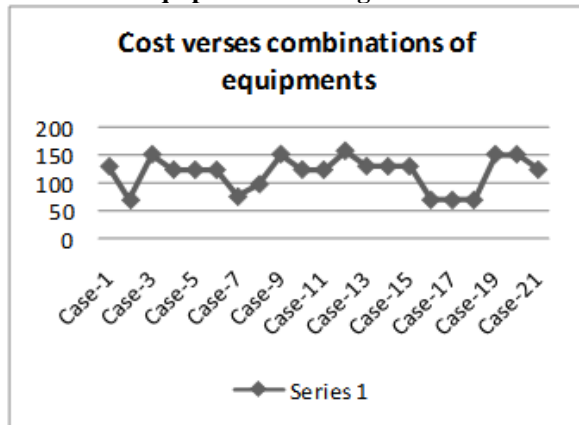
Considering with combinations of Equipments.

- For combination (Case -1) equipment handling cost is 130.16 lacks.
- (Case -2) equipment handling cost is 70.28 lacks.
- (Case -3) equipment handling cost is 151.56 lacks.
- (Case -4) equipment handling cost is 124.42 lacks.
- (Case -5) equipment handling cost is 124.12 lacks.
- (Case -6) equipment handling cost is 124.06 lacks.
- (Case -7) equipment handling cost is 76.47 lacks.
- (Case -8) equipment handling cost is 98.57 lacks.
- (Case -9) equipment handling cost is 152.01 lacks.
- (Case -10) equipment handling cost is 124.57 lacks.
- (Case -11) equipment handling cost is 124.21 lacks.
- (Case -12) equipment handling cost is 157.75 lacks.
- (Case -13) equipment handling cost is 130.61 lacks.

- (Case -14) equipment handling cost is 130.31 lacks.
- (Case -15) equipment handling cost is 130.25 lacks.
- (Case -16) equipment handling cost is 70.73 lacks.
- Case -17) equipment handling cost is 70.43 lacks.
- (Case -18) equipment handling cost is 70.37 lacks.
- (Case -19) equipment handling cost is 151.71 lacks.
- Case -20) equipment handling cost is 151.65 lacks.
- (Case -21) equipment handling cost is 124.51 lacks.

- 6) Third option is to select case no 17. In this combination total cost of equipment handling is 70.43 lacks which is slightly more than case no 18. In this case Tipper and concrete vibrator are purchase and other equipments are use on rent,
- 7) Fourth option is to select case no 16. In this case total cost of the equipment handling is 70.73 lacks, which is slightly more than case no 17. and combination is tipper and concrete mixer are purchased and other equipments are use on rent.

Graph shows the combination of Equipments and total cost of equipment handling.



XIX. Concluding Remark

From above observation it is conclude that:

- 1) Handling cost of various construction equipment on rent basis is low as compare with the purchasing cost of equipment.
- 2) Only tipper rent cost is more than the purchasing cost ie. Rs. 16 lacks so in this case purchasing a new tipper is convenient. But after completion of project there is no balance of any type of equipment as compare to purchasing new equipment.
- 3) So combinations of various equipments are find out and cost is also calculate to achieve the optimum cost of project.
- 4) From above combinations the cost of equipment handling is less ie 70.28 lacks, in case no 2. In this combination only Tipper are purchase and other all equipments are use on rent.
- 5) Second option is to select case no 18. In this combination total cost is 70.37 lacks. In this case Tipper and Diesel engine are purchased and other equipments are used on rent,

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