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EFFECTOF CONSTRUCTION EQUIPMENT ON PRODUCTION IN BUILDING COSTRUCTION PROJECT

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ABSTRACT

The contractor's equipment policy and equipment management system have a great impact on the profitability of a firm, especially for contractors with large investment in equipment. The cost of equipment in civil engineering construction projects can range from 25-40% of the total project cost. In this paper information given about how the planned and proper maintenance is important for construction equipment for better production. The data given is monthly equipment utilization on site & various reasons for losses in construction equipment production. Proper planning, selection, procurement, installation, operation & maintenance of construction equipment play important role in production in construction projects.

KEYWORDS: Construction Equipment Maintenance, Type of Maintenance, Losses due to improper maintenance

INTRODUCTION

Whether a construction contract is unit price, lump sum, or cost-plus; whether the construction project is to be linear (i.e., concept, design, Procurement, construction) or fast-track (i.e., design/build) the cost of construction is a major factor in all projects. The major factors that impact construction costs are materials, labor, equipment, overhead, and profit. The cost of equipment for civil engineering construction projects can range from 25 to 40% of the total project cost.

The purpose of this study is to evaluate the traffic flow of constructionequipment and how it affects the efficiency of constructionoperations. A large construction project requires largequantities of construction equipment. This volume of equipmentcan result in a traffic jam within a construction site, thereby reducingthe overall efficiency of construction operations. It is necessary to evaluate whether a project can be completed in a giventime even if additional construction equipment is brought to theconstruction site. However, to date, limited researches have beenperformed to evaluate these effects in planning for equipmentutilization.

The high failure rate and extreme competitiveness of the construction business demands that contractors continuously look for new ways to reduce costs. Many companies seek to gain competitive advantages by reducing labor and raw material costs or by increasing service andcontrolling losses. One way that companies in the industrial sector have found effective in increasing profit margins is by effective equipment maintenance.

The costs that arise when an item of equipment or a vehicle fails can bedivided into two broad categories. The first of these includes the tangible cost of the labor, materials, and other resources needed to repair the machine. The second category includes all the intangible, or consequential, costs that arise from the failure and that impact the organization as a whole. Tangible costs are fairly easy to record and estimate using normal cost-accounting methods. Consequential costs present an entirely different problem in that they cannot be assessed with any degree of certainty except under very rigid, well-defined circumstances.

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OBJECTIVE

The objective of this study is the various maintenance management practices that are currently being employed by large construction sector and to identify the good practices for effective maintenance management. This study will help to understand the maintenance phenomenon and factors responsible for better efficiency and less operating cost of owning and operating by reducing the downtime of equipment.

- Identify the good practices for effective Equipment maintenance management.
- To maximize availability of machinery and facilities needed for smooth production.
- To minimize downtime due to breakdown of machinery.
- To ensure long life of the machinery to avoid high rate of depreciation of capital.

Study on the maintenance of equipment related to production of construction Equipment and how it is profitable to construction project.

Michael C. Vorster and Jesus M.De La Garza ,in 1990 they states about how the construction equipment cost affect on total project cost because of lack of availability and Downtime of equipment. There are four categories of consequential cost, a) Associated resource impact (ARI) cost, b) Lack of readiness (LOR) costs, c) Service level impact (SLI) Costs, d) Alternative method impact (AMI) costs.

According toSanjivGokhale Vanderbilt University, the proper equipment selection (Size & type) is very important for that for that particular work and utilization of that equipment for the project. The equipment spread selection for a specific construction operation is critical to success the project. While there will be some overlap in equipment utilization each activity must be evaluated carefully to ensure that the equipment selected for each operation is compatible with task to be completed. The intent is not to provide a detailed description of each activity but to illustrate how equipment selection & utilization are function of associated Variables.

As the Govindan Kannan.in 2011, States that how we can manage the equipment schedule for profitable for construction project. Study about how Equipment are more economical and more productive. This paper relates some of the research and makes new observation in three

Areas: repair costs, residual values, and total cost of ownership (TCO) and productivity.
This paper defines operational failure costs (OFCs), presents a method for their development, and examines their usefulness as a means of equipment management. It considers variables related to the projected use of the equipment in the context of the production team and construction site as a whole as well as importance of each piece of equipment.

CONSTRUCTION EQUIPMENT MAINTENANCE

In modern industry, equipment and machinery are a very important part of the total productive effort. Therefore, their idleness or downtime becomes very expensive. Hence, it is very important that the plant machinery should be properly maintained.

Maintenance costs are commonly considered the highest percentage of cost related to operating a piece of equipment. It is also referred to by peurify and Schexnayder (2002) as the highest percentage of cost related to the equipment's entire life cycle. The breakdown given was 37% is related to maintenance and repair, 25% to Depreciation, 23% to operating cost and 15% to Overhead. This high percentage of cost due to maintenance is precisely the reason of the research title. As other factors will exits whether the piece is rented, leased or bought, the maintenance cost can shift hands in the process. The secondary impact condition is the level of service to the equipment directly impacts its life and therefore the hourly rate or cost calculation.

Maintenance of a piece of equipment is the operational of keeping its various components in their original form as far as possible with the view to ensure that safety and production in operation do not deteriorate. It includes servicing, inspection and adjustment, small repairs in the field, major repairs and overhaul in main workshop and proper is of laid-up machine.

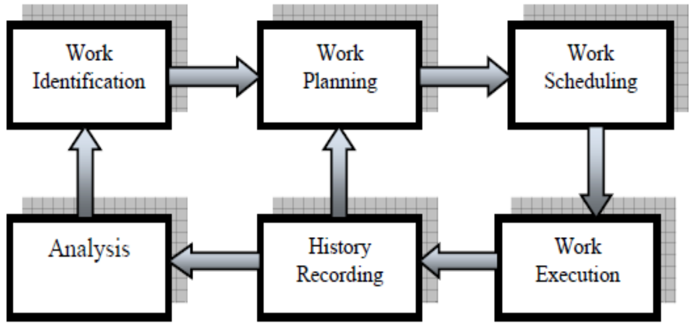

Fig 1. Maintenance Process

MAINTENANCE PROCESS

Fig 1.Shows the process of maintenance. In Work Identification find the work of maintenance of that particular Equipment, Identify the type of Maintenance required then In Work Planning, planning for how to maintenance work going to perform of that particular Equipment, how much time required for maintenance work then proper schedule the work to be performed. After completing all planning and scheduling of work start for actual execution work. Record the work performed for that equipment in Maintenance Record Book. Analysis the all work, check it is performing better or not otherwise again starts from work Identification.

Type of Maintenance

1) Reactive (Corrective) Maintenance – A Reactive maintenance system, characterized by run-to-failure breakdown and repairs after breakdown occurs.
2) Preventive Maintenance – A maintenance system that uses a procedural approach with schedules and guidelines that attempts to prevent breakdown with maintenance procedures.
3) Predictive Maintenance – In predictive maintenance, equipment condition rather than time intervals determine the need for service. Online condition monitoring helps identify when wear-out risk begins to increase and predict when failure is likely to occur.
4) Proactive Maintenance–While predictive maintenance uses online condition monitoring to help predict when a failure will occur, it doesn't always identify the root cause of the failure. That's where proactive maintenance comes in. Proactive maintenance relies on information provided by predictive methods to identify problems and isolated the source of failure.

Maintenance Strategies

Maintenance action can be divided into four general categories or Strategies. The maintenance plan for a company's assets will be a combination of these four strategies shown in fig 2. often they could all be used on the same machine.

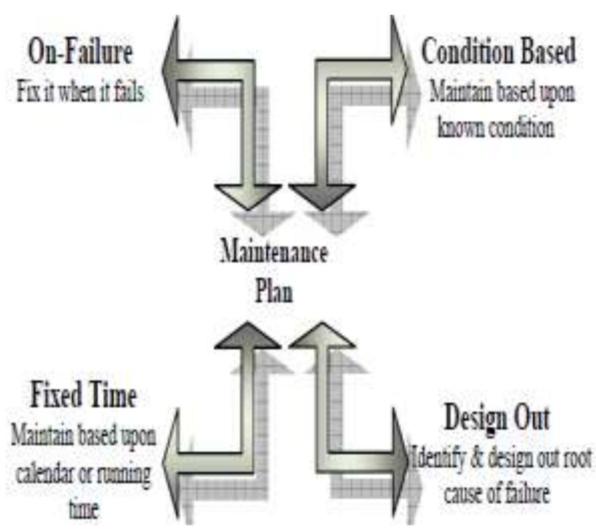

Fig 2. Maintenance strategies

On –Failure-- In maximum time the equipment fails at its running condition then it requires urgent maintenance for proper work perform.

Condition Based-- Maintenance is done as per the condition of equipment. If it is in dangerous condition then it requires earlier maintenance.

Fixed Time-- Maintenance is done in proper time schedule. Some fixed time planned for maintenance work. (Per month, Every 3 months, once in 6 month, yearly)

Design Out-- In maintenance work firstly identifies the main root cause of Failure of that particular Equipment.

DATA COLLECTION

For data collection we have considering a Kalyan Tower, Hadpsar site. which is a residential project site taken as case study. The data collected from site regarding the progress of construction of Future Tower residential building about Equipment information is given below.

The details of Equipment Provided & Used on Kalyan tower ,Hadpsar site where as follows-

Table No 1- Equipment Used On Site

NO.	EQUIPMENT NAME=	COMPANY
1	AUTO LEVEL	
2	BAR BENDING MACHINE	GLOBAL
3	BAR CUTTING MACHINE	HITACHI
4	CONCRETE BATCHING PLANT (30CUM/Hr)	SCHWING STETTER
5	CONCRETE PUMP	KIRLOSKAR
6	CRANE (3 Tonne& 15 Tonne)	POTAIN
7	DUMPER	TATA
8	EARTH COMPACTOR	SALUJA
9	GENERATOR	KIRLOSKAR
10	GRINDER MACHINE	HITACHI
11	JCB	L & T
12	LIFT	UNIVERSAL
13	NEEDLE	SALUJA
14	PLYWOOD CUTTER	GLOBAL
15	PASSANGER LIFT	UNIVERSAL
16	TRANSITE MIXER (6CUM)	ASHOK LEYLAND

Fig no. 3 Equipment Position on construction site, Pune.

•The major reasons of losses in production due to Construction Equipment's Performance-

Table no .2 Losses in production due to Equipment Downtime.

Loss	Category	Loss category example	Comment
1)Breakdown	Downtime losses	Equipment failure Unplanned maintenance Tooling damage	Loss due to Breakdown of Equipment
2)Setup and Adjustment		Setup/changeover Operator shortage	Time lost due to adjustment in the equipment
3)Idling & Minor Stoppage	Speed losses	Components jams	Small stop losses occur when equipment stops for a short time as a result of temporary problem.
4)Reduced Speed		Operator inefficiency Under Design Capacity	Reduced speed refers to the difference between Design speed and actual operating speed.
5)Startup loss	Quality loss	Equipment warm up	Some equipment requires warm up time and certain adjustment to obtain optimum output.

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DATA ANALYSIS

For the data analysis referred the data collected from construction site. In the data analysis the volume of work done by the each equipment is compared with its planned production (volume of work done) and Actual production (Volume of work done).

Work Executed against Planned by construction Equipment Shown below Table no.2.

TABLE No.4 EXECUTEDAGAINSTPLANNED WORK DONE BY THE CONSTRUTION EQUIPMENTS

2014	March		April		May		June		July		August	
work done	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
	Cum	cum	cum	cum	cum	cum	Cum	Cum	cum	cum	cum	Cum
Concrete pump 7 (Kirloskar)	1368	962	1125	650	250	245	820	455	912	525	807.5	797.5
Concrete pump 9 (Kirloskar)	880	870	1125	640	1000	780	1100	700	1150	923	550	542
Concrete pump11 (Kirloskar)	932	915	1035	595	975	580	1000	540	1080	624	888	872
JCB 235 (L&T)	2770	2200	852	836	1727	1100	1265	792	1680	1122	-	-
JCB 9859 (L&T)	1470	726	1113	1100	2268	1452	1890	1188	1974	1474	1743	1122
Transit Mixer 7466 (Ashok Leyland)	440.5	370	538	360.5	378.5	322.5	433	338	418	252	335	240
Transit Mixer 7467 (Ashok Leyland)	369	253	290	283	60	52.5	419	244	370.5	205	339	218
Transit Mixer 7463 (Ashok Leyland)	448.5	340	482	262	344	326	332.5	222.8	434.5	224.6	438	249.5
Transit Mixer 4384 (Ashok Leyland)	406	356	412	219	327	235	330.2	285.8	421.7	336.7	306.7	231.2
Transit Mixer 276 (Ashok Leyland)	367	313	383.2	236	268.2	226	432.1	275.5	420.4	272.9	292.9	239.9
Transit Mixer 277 (Ashok Leyland)	449.5	336	318.7	225.2	298.5	230.2	490.1	330.9	288.9	208.3	369.7	239.2
Transit Mixer 4479 (Ashok Leyland)	326.1	315.6	349.3	216.3	150.2	60	316.2	246.2	30.5	216	302	205
Transit Mixer 4487 (Ashok Leyland)	410.2	338.2	483.3	345.8	398.5	326.5	347.7	338.2	478.3	338.3	465	312.5

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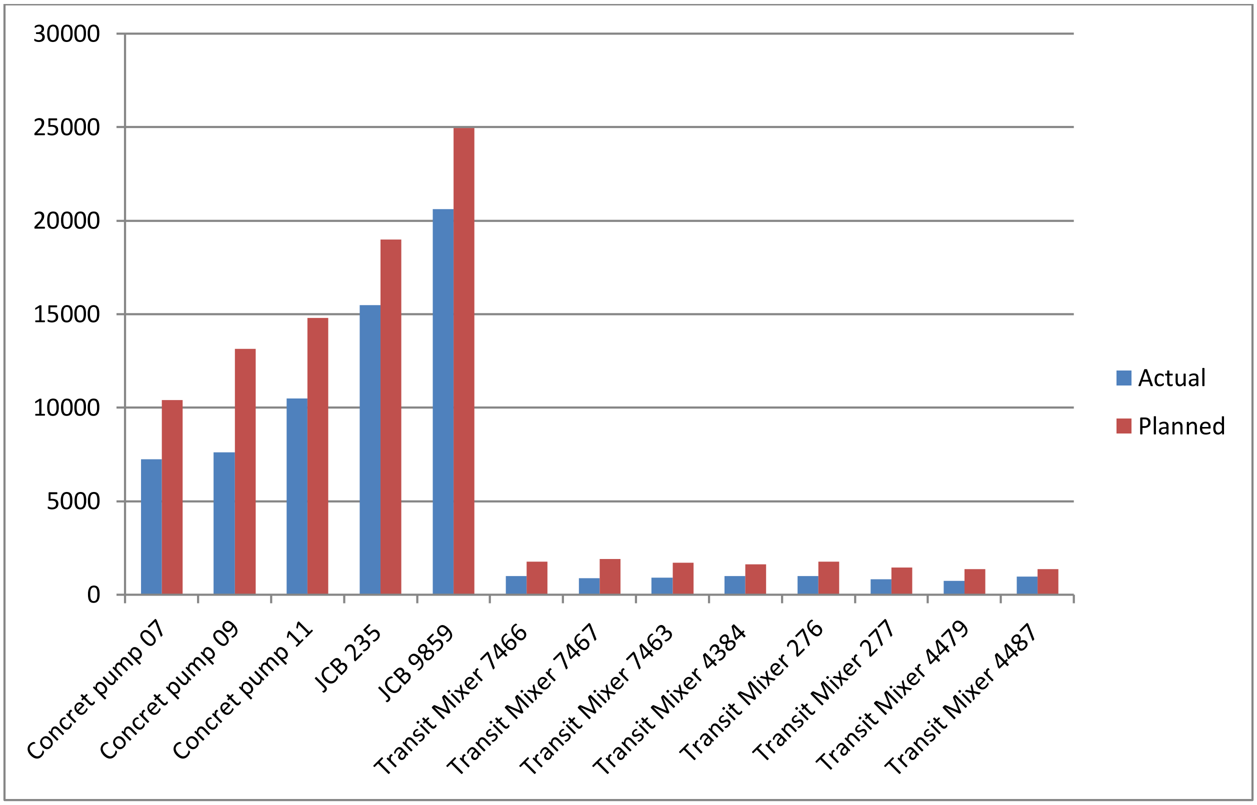

Chart 1- Actual vsPlanned production of various Equipment.

PLANT PRODUCTION REPORT MARCH 2014

Sr.No.	Equipment Description	Production In Cum		Hours Worked		Prod/ Hour Actual	Prod/ Hour Planned	Break Down Hours	Loss In Production Due To Breakdown	Remark
		PLANNED	ACTUAL	PLANNED	ACTUAL	IN CUM	IN CUM		IN CUM	
1	Concrete Pump 07(1400 HP Kirloskar)	1398	962	105	74	13.3	13	31	342	Total Actual working hour is less. So prod/hour actual is more, for achieving target of production.
2	Concrete Pump 09(1800 HP Kirloskar)	880	870	71	71	12.4	12.2	-	-	Prod/ hour actual & planned is nearly same. less networking hour effect on total production.
3	Concrete Pump 11(1400 HP Kirloskar)	932	915	76	76	12.1	12	-	-	No breakdown so production is near about same
4	JCB 235 (L&T)	2770	2200	132	100	21	22	32	556	Efficiency is less as per planned prod/hour.
5	JCB 9859 (L&T)	1470	726	70	33	21	22	37	722	Less working hour effect on total production.
6	Transit Mixer 7466(6cum Ashok leyland)	440.5	370		462			18	32	

7	Transit Mixer 7467(6 cum Ashok Leyland)	369	253		328			32	51	
8	Transit Mixer 7463(6 cum Ashok Leyland)	448.5	340		415			31	48	
9	Transit Mixer 4384(6 cum Ashok Leyland)	406	356		466			14	28	
10	Transit Mixer 276 (6 cum Ashok Leyland)	367	313		380			16	29	
11	Transit Mixer 277 (6 cum Ashok Leyland)	449.5	336		441			31	43	
12	Transit Mixer 4479(6 cum Ashok Leyland)	326.1	315.6		398			-	-	
13	Transit Mixer 4487(6 cum Ashok Leyland)	410.2	338.2		435			18	34	
14	Conc. Batching Plant	3210	2747	208	189	15	16	-	-	

Operating time against loss time

A Details study to be carried out of operating time against loss time of different equipment's which consist of following,

- Planned Operating Time = Fully productive time + Quality loss + Speed Losses + Downtime Losses + Planned Shutdown
- Planned Shutdown = Tea Break +Lunch/Dinner/Super Break.
- Downtime = Waiting time for Operator + Setup & Changeover Time + Meeting time
- Production Data:
- Shift Length (Operating Time)
- Tea Breaks
- Meals Break
- Down Time
- Idle (Design) Run Rate
- Total number of Production QuantitySupport Variable:
- Planned Production Time = Shift Length – Break
- Operating Time = Planned Production Time – Downtimes

The details for the above against important major equipment will be studied in working out the loss of efficiency of equipment's in an execution of a project.

CONCLUSION

It is essential for a construction industry to improve the production rate of equipment. In order to achieve this, the overall Equipment Effectiveness was improved with low machine breakdown, less idling and minor stops time, reduced accident in plants, increased the productivity rate, optimized process parameter, improved profits though cost saving method.

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Proper planning, selection, procurement, installation, operation, maintenance and equipment replacement policy plays important role in equipment management for successful completion of project.

From data collected it is seen that equipment utilization on site has to be studied in details. There can be various reasons which ultimately affect the overall productivity in construction activity on the project. The downtime and idle run rate of equipment play important rolein production of equipment. These downtime & idle run rate factor also effect on total cost of project.

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