

Analyzing the Aspects that are Impacting the Functioning of Excavatory Equipments

Saurabh Deepak Wadurkar¹, Vaibhav Dhawale²

¹M.E Student, Dept. of Civil Engineering, Prof. Ram Meghe College of Engineering and Management, Maharashtra, India

²Assistant Professor, Dept. of Civil Engineering, Prof. Ram Meghe College of Engineering and Management, Maharashtra, India.

Abstract - Excavating equipments performs significant contribution for completion of construction task timely and successfully. The dependence and need for heavy construction equipment have grown with the size and complexity of construction projects. Today contractors undertake many types of construction activities that require different types, size and groupings of equipment for earthmoving, excavating and lifting. Every construction project includes earthmoving and then excavating operations. Excavators are one of the most commonly used heavy equipments in construction sector. These excavators should give their best performance at job site but in actual condition, they fail to provide desired output. Various factors might be responsible in such cases. This study aims to identify and assess such factors. Total 20 factors were identified and a questionnaire was prepared. Questionnaire and field survey has been carried out in this study by visiting different construction site with ongoing excavation work. The field survey included time-motion study and observation of some field parameters. The collected data from questionnaire survey was analyzed by Relative Importance Index technique and ranking was done. On analysis, it is found that, operator skill is a factor which is found to be most important from both surveys. Apart from this, the effects of other factors is described and concluded in this study.

Key Words: Excavating equipment, Productivity, Performance Factors, Construction Equipment, Excavator Performance

1. INTRODUCTION

Construction Industry is one of the most growing industries in the whole world. Today Indian sub continent is the second fastest-growing economy in the World. The Indian construction industry has been playing a vital role in overall economic development of the country. The construction sector is also the biggest employer in the country following agriculture, employing 18 million people directly and 14 million indirectly. (Dr.Pa.Kaja Mohideen, 2015) Today contractors undertake many types of construction activities that require different types, size and groupings of equipment for earthmoving, excavating and lifting. The Indian Excavating equipment industry is a fraction of the global market, whose size is over US\$ 75 billion, it has been growing at an average of 30 per cent annually compared to

the total growth of 7 per cent. The earthmoving equipment market in India is estimated at about US\$ 6.5 billion and projected to be US\$ 160.83 by 2027. The predominant sub-segment in this is excavators, which account for just over half the market (A report by KPMG for IBEF). The dependence and need for heavy construction equipment have grown with the size and complexity of construction projects. The development of automated heavy construction equipment for earthmoving, excavating and lifting occurred in last two centuries. Today, it is assumed that if equipment does not exist to perform a necessary task, it can be designed and built.

1.1 Need of Study

Machinery and equipment play a pivotal role in completion of any construction project successfully. The need for mechanization arises due to the reasons such as, magnitude & shortage of skilled and efficient manpower, optimum use of material, manpower and finance, importance of keeping the time schedules, high quality standards, complexity of projects, projects involving large quantities of material handling. Right employment of equipment contributes to economy, quality, safety, speed and timely completion of the project. Finalizing equipment is a critical factor in the execution of many construction projects. This is to be much more critical in heavy construction projects where the earthmoving equipment plays a vital role in performing the work (Remon F. Aziz et al. 2015). Numerous factors are involved in fair performance of equipment. Such factor must be identified so as to achieve good command over that equipment. This study aims to study and identify factors influencing performance of excavating equipment.

1.2 Methodology

The research methodology consists of two different surveys. One is the questionnaire survey whereas other is a field survey. These surveys were carried out in Amravati and Pune cities from Maharashtra state. Total 32 different sites were visited for this study where excavation work was in progress. The literature review was conducted through books, internet and various international journals to identify various factors that influence performance of excavating equipments.

2. Aspects Impacting Functioning of Equipments

Based on the literature review, total 22 factors were selected for this study which affects excavator’s performances. Some of the selected factors are equipment related, some are human related and some are site related. These factors are represented in table 2.1 The prepared questionnaire was filled by different authorized persons such as, Engineer, Manager, Site In charge ,Supervisor and operator etc. whoever is present on site during excavation execution. The respondents were asked to indicate, based on their local experience and level of importance of each one of the identified factor of performance on five-point Likert scale as; not important, slightly, moderately, very and extremely important. The analysis was then carried out.

Table -1: Sample Table format

Sr. No.	Factors
1	Measuring Productivity of Excavator
2	Proper Site Investigation
3	Proper Selection of Equipment
4	Repairs and Maintenance of Equipment
5	Experience of Contractor
6	Experience of Machine Operator
7	Presence of Site Engineer
8	Type of Equipment
9	Proper Handling of Equipment
10	Sufficient Knowledge about Machine
11	Condition at Site
12	Type of Soil
13	Condition of Equipment
14	Operator’s Skill
15	Bucket Capacity
16	Bucket Teeth
17	Cycle Time
18	Angle of Swing
19	Height of Cut
20	Availability of Hauling Unit
21	Capacity of Hauling Unit
22	Temperature Factors

This study was conducted at 32 job site with total 32 piece of back hoe excavating equipment individually. The actual job operating condition which might affect the productivity were identified and recorded accurately for each individual piece of equipment in the study. These operating conditions include Type of Soil, Bucket Capacity, Operator’s Skill, Angle of Swing, Depth of Cut, Condition of Equipment and Capacity of Hauling Unit. Time-Motion Studies were conducted for piece of excavating equipment. These are the operating piece of equipment that was encountered on site visit. The total cycle time including time for its element was recorded with stopwatch. Several cycle times were measured on site and

average value of them was considered for calculation. The productivity for each of equipment was then estimated. Formula to find out the productivity of a hydraulic excavator as given by Peurifoy and Schexnayder (2008) is as follows:

$$\text{Hoe Production (cum. Per Hr)} = \frac{3600 \times Q \times F}{t} \times \frac{E}{60 - \text{Min Hr}} \times \frac{1}{\text{Volume Correction}}$$

Where,

Q = Heaped bucket capacity in cubic meter

F = bucket fill factor for hoe buckets

t = cycle time in seconds

E = efficiency in minutes per hour

Volume Correction = for loose volume to bank volume, $1/(1+\text{Swell Factor})$

3. Consequence And Reaction.

In this study, total 15 sites were visited in Amravati and Akola. Total 32 questionnaires were filled and collected from respondents. The most commonly used excavator was found to be Hyundai which was found on 40% of construction sites. Whereas 25% were L&T Komat-su, 20% were JCB, and remaining 15% were others like (Volvo, Kobalco ,Sany ,Cat).





3. CONCLUSIONS

Every construction project includes earthmoving operations and use of equipments to perform some tasks. Excavators are primary earthmoving equipments used to excavate earth material. The equipment are expected to give their best performance on field but in actual job site, contractors fails to achieve the desired output from excavator. Various factors might be responsible in such cases. This study has focused on such factor to identify and assess them.

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No. Of Sites	Hoe Production Cum
Site 1	40
Site 2	95
Site 3	70
Site 4	50
Site 5	105
Site 6	80
Site 7	68
Site 8	55
Site 9	88
Site 10	74
Site 11	95
Site 12	81
Site 13	63
Site 14	59
Site 15	112

