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Disrepair of Earth Moving Equipment: Causes and Remedies

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Abstract: *This study examines the causes of earth-moving equipment breakdown in construction sites in Nigeria using Kwara State, Ilorin as a case study. Efforts were put in place to survey the reasons why many earth moving equipment were abandoned in a state of disrepair on sites using questionnaire, interview and physical observation. Five different types of earth movers were studied and relevant data were collected and analyzed. The results of data obtained identified some subsystems of the equipment which are prone to failure leading to quick breakdown of the entire equipment. Among the subsystems, hydraulic and fuel system contributed significantly to incessant breakdown of the equipment examined, while traction, electrical and cooling system showed the least tendency to breakdown. Possible reasons for abandoning the equipment in their states of disrepair include scarcity of faulty part, expensive maintenance cost, lack of proper training of operator, nonchalant attitude among workers and improper handling of the repair processes, while the reasons for equipment malfunctioning include use of wrong tools by technicians, illiteracy amongst operators and technicians and impatience of operators as identified by the research.*

Keywords: *earth-moving equipment, maintenance, repair, sub-systems, operators, technicians.*

I. Introduction

Earth-moving equipment are large engineering vehicles consisting of articulated parts atop an undercarriage with tracks or wheels. They are used in heavy construction, especially civil engineering projects, which often require the moving of millions of cubic meters of earth. Earth-moving equipment comes with different attachments which serve as the major distinguishing factor to the uses to which they can be put to. Some types of earth-moving equipment are Bulldozer, Pay-loader, Motor-grader, Excavator, Paver-Machine, Tractor and Dump truck. In order to ensure the best performance and profitable utilization of the earthmoving equipment, it is essential that adequate maintenance of the equipment be observed.

The biggest distinction from a cost standpoint is classification of repair as major or a minor repair. A major repair can alter the depreciation of equipment value due to an extension in service life while a minor repair is normal maintenance. Many construction and civil engineering companies had experienced problems and invariably folded up due to incessant scarcity of earthmoving equipment spare parts during servicing.

Fig1: Motor Grader in its State of Disrepair (Source: Construction Site, Ilorin)

Fig 2: Backhoe Loader in its State of Disrepair (Source: Construction Site, Ilorin)

According to Beppler and Hummedia (1983), the accumulated repair cost in the United States is as high as 1.6 times of the purchase price with inability of the local equipment assembly plants to produce spare parts. These equipment are not produced in the country (Nigeria), so huge capital investment is needed to purchase them. [1,2]. When considered individually, the various components of earth-moving machines such as links, pins, bushings, sprockets, rollers, idlers, shoes and frames seem relatively simple parts, but when these components are assembled into a system that supports and propels a track-type machine, the equipment becomes a complex mechanism which might account for half (or more) of the equipment's lifetime repair bill. Gene (1983) and Adigun (1987) classified the component systems of earthmoving equipment into 8 sub-systems viz, engine, transmission, hydraulic, cooling, electrical, lubrication, fuel and traction sub-systems. [3]

1.1 Ergonomics

Operator conveniences can have a large impact on the efficiency of a project because, the more comfortable and efficient the operator is, the quicker and better the project will go. Some common ergonomic considerations include air suspension seats, windshield wipers, beverage holders, storage trays, rearview mirrors and other detail. [4]

1.2 Serviceability

Earth moving equipment manufacturers continually strive to make their products easier to service. Some conveniences include such things like air filters on the same side of the engine, rear-tilting engine hoods, and so on. [4]

1.3 Auxiliary systems

Current auxiliary systems on an earth-moving machine such as an air conditioner, cooling fans, or pilot pumps, are powered by the engine of the earth moving machine. The auxiliary systems are belt or gear driven systems which are connected to the engine.

The auxiliary systems are driven at a speed dictated by the speed of the engine. For' example, the speed of the engine can vary between low idle, i.e. 700rpm, and high idle, i.e. 2400rpm. The variance in the engine speed is dependent on the particular work function the machine is performing, as well as the load that the engine is carrying. [4]. The major aim of this work is to survey some heavy-duty automobiles in their states of disrepair in Kwara State for their serviceability situation and make recommendations on how to obtain the best use and maintenance of these machines at the cheapest cost obtainable.

Therefore, the specific objectives include:

1. To identify the nature of premature disrepair and their causes in the selected equipment as to make recommendations that would contribute to the improvement and performance of the equipment.
2. To recommend the best maintenance practices to ensure prolonged useful life of the earth-moving equipment.

II. Methodology

The methodology employed in this work was basically the use of questionnaire and analysis of detailed information obtained on various types of earthmoving equipment. Their usage and maintenance procedures were collected from respondents, also personal observations were made. A survey was carried out on three types of earthmoving equipment in Ilorin, Kwara State, Nigeria. These equipment are:

1. Backhoe Loader
2. Motor Grader
3. Bulldozer

Details of the methodology adopted are highlighted under the following sub-headings.

1. Questionnaire formation
2. Physical observation
3. Photographic presentation

2.1 Questionnaire

To identify the nature and state of disrepair and causes, a questionnaire was prepared (see appendix) which was administered to the following group of people:

1. Owners of the equipment.
2. Technicians engaged in repair of equipment.
3. Operators of the equipment.

2.2 Physical Observation

Information was also gathered from visual observation of the use of these equipments on site during visits to some construction companies in Ilorin. Inspection and observations were made to consolidate questionnaire information. Interviews were also conducted at sites. Besides the physical observation of the earthmoving machine, photographs of some of the equipment, parts and worksites were taken (see Figures 1 and 2) to properly document the findings.

III. Results and Discussion

It was found out from the questionnaire administered to the owners that all the earth-moving equipment were purchased as fairly used. Most of the equipment (about 70 %) had a few issues at the point of purchase. This complains ranged from bad tackle system to faulty transmission system. They were however purchased by the owners with the intention of putting them in order by buying missing parts and replacing bad ones.

Findings also indicated that some parts are more prone to damage in these equipment thereby causing untimely breakdown of the equipment, the parts include:

1. Transmission pump, hydraulic pump, primer pump
2. Gear
3. Nozzle
4. Nose
5. Radiator
6. Fuel Filter, Oil Filter, Magnetic Strainer
7. Air Cleaner.

The relevance of these parts to the smooth operation of the equipment is discussed below.

Pumps

The transmission, hydraulic and primer pumps are important as they help in coordinating the motions of other parts and sometimes the machine as a whole. Leakages in pumps result in breakdown of the equipments. These leakages result from bad or rusted hose clips or poor clipping of hoses to pipes. This can be corrected by checking hose clips during weekly maintenance and replacing them if they are bad or likely to go bad soon. Leakages can also be caused by high oil level, excessive foaming of lubricant and loose drain plug.

Gear system

The gear system needs maintenance other than periodic oil changes. However, when repair is carried out on a gear system, it is important to examine the whole gear train to locate worn or faulty parts and repair or replace them at that time. This will prevent a breakdown and the need to disassemble the transmission once again.

Therefore, some flaws to look for during maintenance are:

1. Excessive gear tooth wear or broken teeth.
2. Worn-out bearings.
3. Damaged or plugged transmission oil lines or passage in shafts.

Trouble-shooting the gear system

This trouble shooting chart is given as a general guide to common gear system or transmission system failures. They list what the causes might be, and the remedies.

Table 1: Transmission noisy in neutral

S/n	Possible Cause	Remedy
1.	Transmission not aligned with engine	Align
2	Dry, badly worm or broken bearings	Lubricate or replace

Table 2: Transmission noisy while in gear

S/n	Possible Cause	Remedy
1.	Low transmission oil level	Refill
2.	Worn gear-tooth	Replace gear
3.	Defective engine vibration damper	Replace or adjust

Table 3: Transmission ships out of gear

S/n	Possible Cause	Remedy
1	gear loose on shaft	Replace shaft or gear
2.	gear teeth worn	Replace gear

Nozzle

Nozzle heat-up and expand when the engine is running. They expand to cause leakages when they have been in use for a long time. Regular replacement of hoses during maintenance will help prevent breakdown.

Filters and cleaners

Filters and cleaners cannot be prevented from damage but must be replaced at regular intervals.

3.1 Analysis

According to the questionnaire and interviews, equipment owners prefer a cost effective approach in solving problems encountered on the equipment. The issue of buying fairly used parts as against new ones is a common practice. It was also found out from observation of work site areas that some of the equipment were used for jobs way beyond their capacity, and thus resulting in damage of different parts of the machines.

3.2 Reason for Equipment Disrepair

The parts mentioned, are often abandoned when they go bad bringing about equipment being abandoned whenever a fault develops. This is mostly due to scarcity of faulty parts, expensive maintenance cost, inadequate training of operators, nonchalant attitude amongst workers, and improper handling of the repair processes.

3.3 Factors that Led to Equipment Malfunctioning

Some factors were identified as causes of equipment malfunctioning during the cause of the research, they include:

Technicians

Most of the technicians usually make use of wrong tools when repairing or working on faulty equipment. For example, tools like hammer and screwdrivers are used on bolts and nuts as against the

conventional spanner designed for the purpose. More so, their workshops are not arranged to allow systematic, convenient and correct handling of tools, servicing and repair of equipment. Due to the fact that replaceable scraps are not guaranteed in the warehouse, practice of cannibalization has become very necessary.

Illiteracy

It was also observed that one of the reasons for most equipment going into disrepair is as a result of little or no educational background of the operators and technicians. Necessary periodic maintenance in order to prevent the likelihood of equipment not meeting the optimum working condition is not considered important among the operators. At times, wrong practice of cannibalization or economization on equipment repairs result to malfunctioning of equipment.

Impatience

This was inferred from the information collected. Some technicians/operators, in order to hasten their work do not bother to follow manufacturers' specification and correct order to routing maintenance and repairs.

Overuse and wrong use of equipment

Overuse of equipment and nonchalant attitude towards the equipment capacity and flywheel power results to untimely breakdown of equipment. Wrong use of equipment for a particular job can also result in its malfunctioning. For instance, the use of a pay-loader to dig instead of an excavator will bring about its untimely breakdown.

3.4 Precautions to Reduce Disrepair and Scrap Items

1. During servicing and repairs, it is very important that the established equipment guidelines for part replacement or repair are followed. Operators and technicians should be made to undergo proper training. This will reduce nonchalant attitude towards their work
2. Proper inventory must be done, since its shortage results to wrong practice or cannibalization, which may not be economical.
3. Routine maintenance and repair policy should be implemented to suit manufacturers' specification

IV. Conclusions and Recommendations

4.1 Conclusions

The present study examined the causes of earth-moving equipment breakdown in Kwara state. Five (5) different types of earth movers were observed and relevant data were collected. The result of data obtained on the vehicles indicated that hydraulic and fuel system contributed significantly to incessant breakdown of the equipment examined. The results also indicated that traction, electrical and cooling system showed the least tendency to breakdown.

Possible reasons for abandoning the equipments in their states of disrepair include scarcity of faulty part, expensive maintenance cost, lack of proper training of operator, nonchalant attitude among workers and improper handling of the repair processes while the reasons for equipment malfunctioning include use of wrong tools by technicians, illiteracy among operator and technician and impatience of operators during operations as identified by the research.

4.2 Recommendations

The following recommendations can be made:

a) **Maintenance:** In order to prolong the life span of the machine, it is necessary that some preventive and corrective maintenance procedures are adhered to. These include daily checking of the machine's engine oil, transmission oil, hydraulic oil as well as water in the radiator before stating and operating the machine. Apart from regular check, maintenance such as servicing, lubrication and repairs should also be performed.
b) **Servicing:** These involve changing of filters and draining of oil from either engine, transmission or hydraulic depending on the period the machine had worked. It should be divided into:
   1. 250 hrs service: involves changing engine oil and filters.
   2. 500 hrs service: involves changing engine oil and filters.
   3. 750 hrs service: involves changing engine oil and filter.
   4. 1000 hrs service: involves changing engine, transmission and hydraulic oil and filters.

A proper inventory of spare parts must be maintained for effective maintenance. Service and operators manuals should be constantly used by operators and maintenance personnel. This is in agreement with conclusion in an earlier research reported [5].

c) **Lubrication:** Proper and regular lubrication must be ensured. This must entail the changing of oil and greasing of movable parts of the machine with correct amount of oil. Also, the use of correct type of oil for the engine, transmission and greasing of movable part to prevent rubbing of metals in order to ensure proper meshing of the gears and to reduce heat and friction.

d) **Repair:** regular check up should be done on the equipment to notice any damage or imperfection in the machines .Examples include leakage of hydraulic boost while machine is at work and not noticed in time, this may lead to total damage of the pump.

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APPENDIX I Questionnaire

Department of Mechanical Engineering, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. Sample of a Filled Questionnaire on State Of Disrepair of Earth Moving Equipment In Ilorin, Kwara State.

SECTION A

NAME OF COMPANY	Bulletin Construction Company Ilorin
DATE OF VISIT	13th August 2008
NAME OF EQUIPMENT	Loader/ Backhoe
DATE OF PURCHASE	2007
DATE OF MANUFACTURE	2004
NAME OF MANUFACTURER	ALLMAND
MODEL NAME	2004 ALLMAND 235
CAPACITY	1.3 TON (Mini- Loader)
NATURE OF WORK DONE BY EQUIPMENT	Digging holes, landscaping, breaking asphalt, paving roads, small demolition amongst others.
NATURE OF LOCATION OF WORK	Dry land
LEVEL OF EXPERIENCE OF OPERATOR	2-3 years
AVERAGE NUMBER OF HOURS OF USE PER WEEK	36 hours
AVERAGE NUMBER OF HOURS OF USE BEFORE SERVICING	250 hours
MAINTENANCE CARRIED OUT ON MACHINE	Deferred Maintenance
MOST FREQUENT REASON FOR BREAKDOWN	Hydraulic problems

SECTION B

NAMES OF PARTS AND PROBLEMS OF MAINTENANCE

NAME OF PART	FUNCTION	AVERAGE NUMBER OF HOURS OF USAGE BEFORE CHANGE	MOST FREQUENT REASON FOR CHANGE
Back hoe	It is used to dig up hard compact material usually earth	2,200 hours	Hydraulic problems
Bucket	It operates from the rear. It is used to pick up large amount of waste material.	1,400 hours	Wear of Bucket blade
Loader	It is used to pick up large amount of waste material. e.g sand.	-	-