

CHAPTER 2 - LITERATURE REVIEW

2.1 Maintenance

Maintenance is a series of activities carried out to maintain, repair, and ensure that a system, equipment, or property remains in good condition and functions optimally. maintenance management is all activities of management that determine maintenance objectives, strategies, and responsibilities, and implement them by means of maintenance planning, control and supervision, improvement methods within the organization, including economic, environmental, and safety aspects (EN 13306: 2010). The main purpose of maintenance is to prevent damage or failure that could compromise the performance, safety and efficiency of whatever is being maintained.

High maintenance performance is still required due to demands for higher product quality, faster production times, and increased operating efficiency in an environment of ever-changing consumer demands. According to Parida and Kumar (2009), maintenance expenditure accounts for 20-50% of production costs for the mining industry depending on the level of the company as indicated in its production volume. Maintenance must begin with the planning of maintenance activities. Better planning can result in efficient maintenance operations.

Based on Duffuaa and Al-Fares (2009), maintenance planning is divided into two types, namely scheduled-based maintenance and unscheduled maintenance damage. One of the objectives of planning is for the company to determine the preparation of its resources to support maintenance. Kinnisson (2012) states that maintenance can be described as a process to ensure that a system continuously performs its intended function at its original level of reliability and safety. Tomlingson (2010) says that preventive maintenance (PM) services must be carried out periodically to prevent premature damage to production equipment and increase the life of the equipment. PM services carried out properly will have the impact of maximizing equipment availability, reducing downtime, increasing equipment life, increasing equipment reliability, and reducing emergency damage. This PM service includes inspection, lubrication, cleaning, adjusting and calibration, replacement of minor components (belts, filters, etc.).

2.2 Overhaul Maintenance

Overhaul Maintenance is a very comprehensive and in-depth type of maintenance on a system, machine, or equipment. The aim is to restore or recover the condition and performance of the equipment to a level close to or equal to its original condition. Overhaul Maintenance involves the inspection, repair, replacement, and renewal of components that may have experienced wear, damage, or decreased performance due to long-term use. Kinnison (2012), MRO (maintenance, repair and overhaul) can be defined as "all actions that have the purpose of maintaining or restoring an item in or to a state where the item can perform its required function. Such actions include a combination of all appropriate technical and administrative, managerial, and supervisory actions. Viles (2007) emphasizes the purpose of maintenance and OVH is not only to reduce repair time but also to improve product reliability, as well as to capture relevant information for analysis.

In the overhaul maintenance process, the equipment or system will be disassembled to a certain degree, and all components that require attention will be thoroughly inspected. If any components are found to be damaged or not functioning properly, they will be repaired or replaced. In addition, overhaul maintenance may also include cleaning, lubrication, recalibration, and testing to ensure that the equipment operates at optimal performance after the maintenance process is complete.

Overhaul maintenance is generally performed on equipment that has a long service life and high complexity, such as industrial machinery, aircraft, heavy vehicles, and other technical systems. The overhaul maintenance process can be time-consuming and costly, but it can extend the life of the equipment and improve its reliability and performance efficiency.

It is important to carry out overhaul maintenance in accordance with the manufacturer's guidelines or applicable industry standards, and perform regular monitoring and maintenance to keep the equipment functioning properly after undergoing the overhaul process.

2.3 LCCA (Life Cycle Cost Analysis)

LCCA is an analytical method used to evaluate the total cost of a project or asset over its entire life cycle, from planning, design, construction, operation, maintenance, to demolition or replacement. In LCCA, various cost components are taken into account, including initial

investment costs, operation and maintenance costs, energy costs, maintenance costs, component replacement costs, final disposal or replacement costs, and other factors related to the asset or project.

The main objective of LCCA is to help make better decisions in terms of resource allocation and investment by considering both short-term and long-term cost aspects. LCCA can provide a basis for evaluating the economic and technical performance of proposed assets, including machinery/equipment and production systems, Diego (2017) life cycle cost equipment has two components, ownership costs and operating costs.

Ownership costs will include initial costs, depreciation, insurance, taxes, storage, and investment costs, Peurifoy and Schexnayder (2002). Operating costs include repair and maintenance, tires, tire repair, fuel, operator, and other consumable equipment costs (Gransberg et al. 2006). Life cycle costing analysis can be conducted at any phase of its life cycle. It can be used to provide input into decisions about asset design, manufacture, installation, operation, maintenance, renewal/repair, and disposal, Kumar (2017). The life cycle cost of an asset can be expressed by a simple formula: Life cycle cost = Initial projected capital costs + projected life time operating costs + projected lifetime maintenance costs + projected rehabilitation costs + projected disposal costs - projected residual value.

2.4 Komatsu Hydraulic Excavator PC1250-8

An excavator is a type of heavy machinery used for digging, transporting, and loading materials such as soil, rock, or sand. It uses a diesel engine to power all these parts with hydraulic power. The various advantages of this machine make it versatile and capable of doing various types of heavy work. The higher the grade of an excavator, the more weight it can lift or work it can do. To lift coal and blasted topsoil, excavators are an essential equipment in the mining industry.

The heavy equipment chosen in this study is a Komatsu PC1250-8 excavator unit. Excavators are specially designed for excavating and moving large amounts of material. Komatsu PC1250-8 is a type or model of excavator manufactured by a Japanese construction and mining company. In the PC1250-8 code, PC has the standard meaning of power control or programmed control, indicating that this excavator is equipped with a sophisticated electronic control system to optimize its performance and operational efficiency. The 1250 refers to the excavator's

operational weight or lifting capacity of 125 tons. The -8 is a number that refers to the generation or series of the excavator. In this case, -8 indicates that this excavator is part of the 8th generation or 8th series of the model. Each new generation often includes updated technology, efficiency and safety features compared to the previous generation.

In Figure 2. 1 Komatsu PC1250-8 and Figure 2. 2 PC1250-8 Parts is a visualization of the PC1250-8 excavator consisting of its parts.



Figure 2. 1 Komatsu PC1250-8

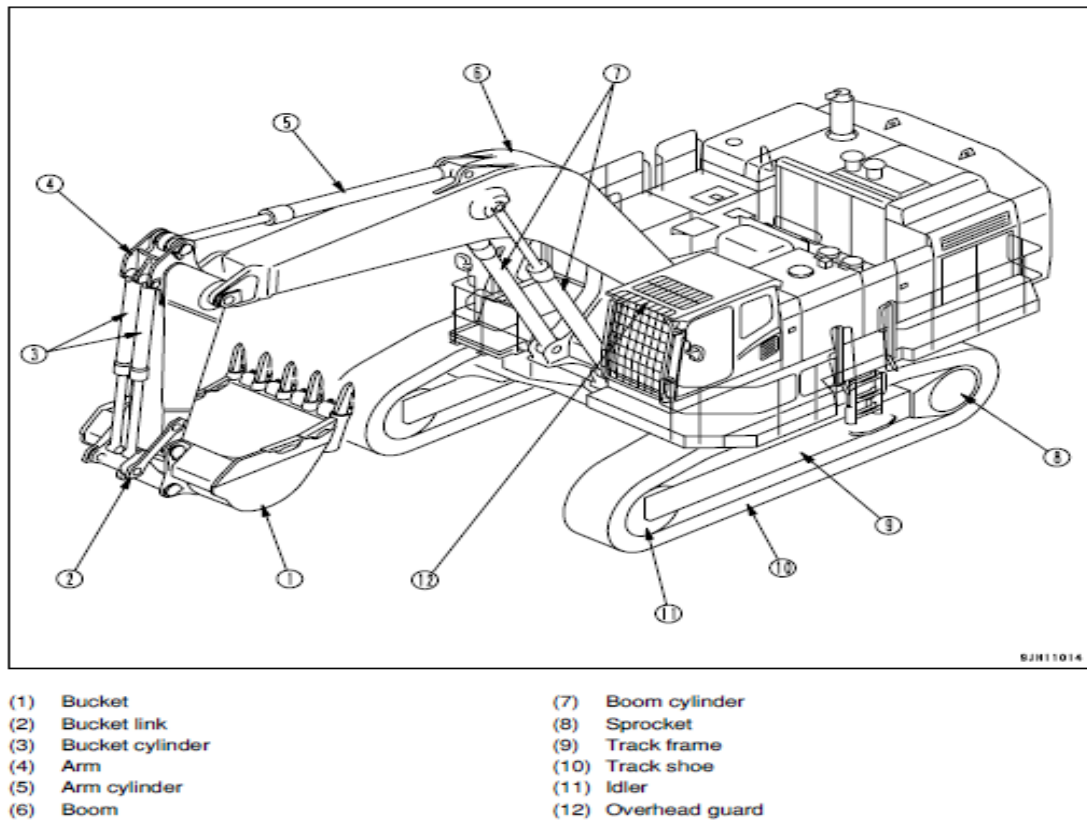


Figure 2. 2 Parts of PC1250-8

Referring to the shop manual book komatstu PC1250-8, the production calculation for mining excavators (new products) can be calculated based on the truck load per hour as follows:

Table 2. 1 General specification of operating parameter

Unit	PC-1250SP-8
Bucket Capacity (q) (lcm)	6.50
Fill Factor (k)	90%
Swell Fact	1.30
Cycle Time (cm) (sec)	25.00
Job Efficiency (E) (%)	83%
Productivity (Q) (BCM)	553

$$Q = q \times \frac{3600}{Cm} \times E$$

where Q : Hourly production (m³ /hr; yd³ /hr) q : Production per cycle (m³; yd³)
Cm : Cycle time (sec.) E : Job efficiency

$$q = q_1 \times K$$

where q₁ : Bucket capacity (heaped) (m³; yd³)

K : Bucket fill factor

Dimensionally the PC1250-8 excavator has a total length of 15,840 mm and a width of 5,355 mm which can be seen in detail in Figure 2. 3 PC1250-8 Dimension.

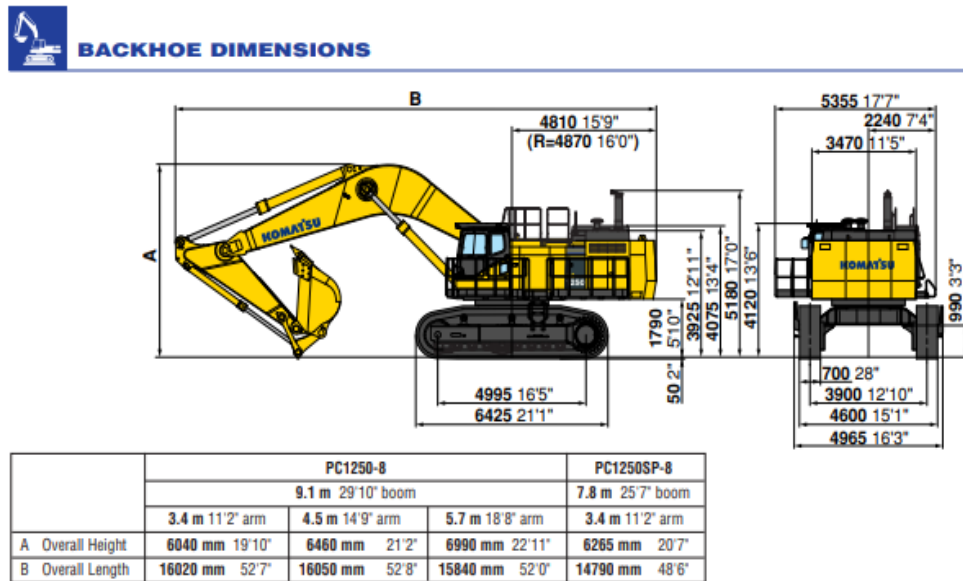


Figure 2. 3 PC1250-8 Dimension