
Plant Management

Introduction

Traditionally, especially on housing projects, much of the materials handling is done manually. As labour costs have risen, more plant has been introduced to reduce the labour requirements.

Usually the building company will have a policy on the type and levels of plant needed for site operations. The site agent, therefore, may have little choice in the selection of plant. The main considerations in relation to plant management include :

- Type of plant
- Hire or purchase
- Maintenance
- Costs
- Outputs
- Plant matching

Type of plant

The types of plant employed on low / medium rise domestic, commercial and industrial construction projects include :

➤ **for earth moving and excavation** (can have wheels or caterpillar tracks)

- Combined loading and back actor - JCB type
- General site clearance and grading - bulldozer
- Moving / loading materials on to lorries - loading shovels
- Excavation of trenches and pits - back actors
- Compaction of materials - rollers

➤ **for lifting / moving materials and components**

- Offloading and stacking materials - forklift truck
- Vertical movement of materials / components - hoists
- Vertical / horizontal movement combined - cranes

➤ **for general site use**

- Operation of pneumatic breakers etc. - compressor
- Operation of electrical equipment - generator
- General movement of materials around site - dumpers

In addition, there are a wide variety of power tools used on construction sites.

Hire or purchase

The decision as to whether an item of plant will be hired or purchased for a construction project is complex as there are many factors to be considered. In general terms, if a building company owns its own plant, and it has enough work to keep the plant fully employed, the cost will be less than hiring.

The size of company involved often determines the choice as most small companies will not own large items of plant and so hiring is the only option. They may, of course, purchase smaller items of plant.

In larger companies, some items of plant which are needed on all projects may be purchased, while others which are specialised and needed only rarely will be hired.

The purchase of the plant may be done centrally by the company (or a separate subsidiary plant company could be set up) and hired out to each contract at rates below those offered by other plant hire companies.

Alternatively, the plant could be purchased by 'the contract' and then 'sold' to the company at the end of the project for re-use on future contracts.

In order to determine whether to hire or purchase a particular piece of plant the following factors should be considered :

- What type of machine is required ?
- Does the company already own such plant ?
- If so, is it available ?
- How long will it be needed on site ?
- Is this period continuous or not ?
- If not, how many times must it be moved on and off site ?
- What are the transport costs ?
- What is the purchase price ?
- What is the hire rate ?
- What does the hire rate include ?
- What are the maintenance costs?
- Can the machine be used on other projects ?
- What is the expected life of the plant ?
- Will money have to be borrowed for the purchase ?
- If so what interest will be paid ?
- What value will be allowed if sold to the company when the project ends?

Hire or purchase

Example : Air Compressor

▪ Time required on site (continuous)	20 weeks
▪ Transport costs	£20 each way
▪ Plant not available within the company at this time	
▪ Purchase price	£12000
▪ Hire rate (including maintenance)	£200 / week
▪ There will be use on other sites in future	
▪ Maintenance costs (if purchased)	£10 / week
▪ Fuel cost	£20 / week
▪ Life expectancy	4 years
▪ Resale value to company	£9000

➤ **Cost if hired**

20 weeks @ £200 / week	£ 4000
Transport £20 each way	£ 40
Fuel costs £20 x 20	£ 400
TOTAL	£ 4440

➤ **Cost if purchased**

Purchase price	£12000
Less resale value	£ 9000
	£ 3000
Transport £20 each way	£ 40
Fuel costs £20 x 20	£ 400
Maintenance	£ 200
TOTAL	£ 3640

➤ **Conclusion**

It is better to purchase the air compressor

Maintenance

When plant breaks down it invariably causes delays to the progress of the work.

Irrespective of whether plant is hired or purchased it is important to ensure that it is kept clean and in good working order. This requires regular maintenance which is best achieved by allocating this work to a specific operative for each item of plant who can perform these daily duties.

Most companies will have a fitter whose job it is to service all site plant regularly. On larger jobs there will often be several fitters and a Plant Manager.

The Plant Manager must co-ordinate the servicing of plant with the Site Agent and General Foreman to ensure that the maintenance and servicing of plant is done in a planned way so as not to interfere with the planned programme of work.

It is important that detailed records are kept in order to ensure that the servicing and maintenance are carried out in accordance with the manufacturers recommendations.

Costs

The cost of using items of plant owned by the construction company must take into consideration many factors, including :

- Purchase price of the plant
- Interest on loans required for purchase
- Residual value of plant
- Life expectancy
- Licences
- Insurances
- Maintenance and servicing
- Repairs
- Operator wages
- Fuel and oil
- General overheads
- Required profit

Some of these items vary for different items of plant, while others can be gained from previous experience on other projects. The required profit level will vary with the prevailing economic conditions at the time of tender.

Outputs

When selecting plant it is necessary to ensure that the output is adequate to perform the relevant operations in the planned duration so that programme targets are achieved.

It should be noted that the outputs specified by manufacturers are for machines working under ideal conditions. These optimum outputs are affected by various factors including :

- **Level of supervision** (can affect the output by up to 10 %)
 - experienced staff for a particular type of work
 - staff supply plentiful
- **Labour** (can affect the output by up to 7 %)
 - operatives can handle the plant efficiently
 - operatives satisfied with job conditions - E.g. site facilities and pay
- **Project conditions** (can affect the output by up to 8 %)
 - adequate programme time allowed for efficient working
 - site working conditions are good
- **Equipment** (can affect the output by up to 8 %)
 - condition of the plant to be used
 - plant output varies with depth of dig
 - availability and standard of maintenance and repair facilities
- **Weather** (can affect the output by up to 10 %)
 - check past weather records for the site area
 - could affect choice of wheeled or tracked machines
- **Soil type** (for excavation plant)
 - light soils - E.g. sands and gravels needs less effort to remove
 - medium soils - E.g. topsoil, soft clays - no excessive effort needed
 - heavy soils - E.g. stiff clays - heavy soil needs more effort to remove
 - rock - soft E.g. shales - needs ripping prior to excavation
hard E.g. sandstone -needs blasting prior to excavation

The output of excavation plant is also affected by the relative positions of the excavator and the point of dumping - either on to a stockpile or into a haulage vehicle. The output rate decreases as the angle of rotation increases.

Using plant improperly not only results in lower outputs but can also result in damage to the machine and put the safety of the operator and other site operatives at risk. It is, therefore, imperative that operators receive sufficient and appropriate training to ensure correct plant usage.

Plant Matching

Care must be taken when selecting plant to ensure that the selected machine is of such a size that it can gain access to its intended working place at any particular stage of the construction programme. There must also be enough room at this work place to allow it to operate safely and efficiently.

In addition, different types of plant are used in conjunction with each other. E.g. an excavator loads material on to trucks for disposal.

After loading a truck, there is inevitably a short delay while the next truck moves into place. The overall waiting time is reduced as the truck size increases.

It is important that the excavator keeps working all the time and does not have to wait for trucks to arrive. In order to ensure that this happens the different types of plant should be considered together.

This is known as plant matching.

➤ Example : matching trucks to excavators

As a rough guide the truck capacity can be taken as 5 x the excavator bucket size.

To determine the required number of trucks :

- **Loading time** =
$$\frac{\text{volume of truck}}{\text{production rate of the excavator}}$$
- **Travel time** =
$$\frac{\text{distance to tip (there and back)}}{\text{average truck speed}}$$
- **Dumping time** = between 3 and 5 minutes, say

The number of trucks required to service an excavator is then given by :

$$\text{Number of trucks} = 1 + \frac{(\text{travel time} + \text{dumping time})}{\text{loading time}}$$

Assessment - Plant Management

1. Determine whether to hire or purchase the item of plant detailed below :

Excavator

▪ length of time required on site	60 weeks (continuous)
▪ transport cost	£180 each way
▪ purchase price	£34000
▪ hire rate	£460 / week including driver and maintenance
▪ Life expectancy	5 years
▪ Maintenance (if purchased)	£50 / week
▪ Wages for driver (if purchased)	£260 / week
▪ Fuel cost	£80 / week
▪ Value of excavator at end of project	£24000
▪ Interest on loan (if purchased)	£5000

2. A project requires a contractor to remove a stockpile of 59,000 m³ of common earth over several weeks during the summer months. A wheeled loading shovel, with a bucket capacity of 3 cubic metres, will be used.

Assumptions :

- 10 hour working day
- 6 day week
- actual output of excavator is 165 m³ / hour
- distance to tip = 1.5 km
- average truck speed = 15 km/hr
- dumping time 4 minutes

Determine :

1. How long will the job take, in weeks
2. The number of trucks required

Comment on the factors that could affect the choice of truck size.