CHARACTERIZATION OF HEAVY CONSTRUCTION EQUIPMENTS IN TRANSPORTATION SECTOR

Keywords: Transportation, Highway, Heavy construction equipments, Road construction machines

Abstract

Along with advancing technology, there seen a rapid development in heavy construction equipment in transportation sector. As a result of coming to the fore of front of concepts in transportation sector such as working capacity, efficiency, time and economical dimension, the increase in variety of heavy construction equipment in sector draws attention. Because of this, the choice of suitable heavy construction equipment in this variety becomes important. With optimum usage level of this heavy construction equipment will contribute to the economy of country in terms of both time and efficiency by providing economical incomes. That is why it is beneficial in transportation sector to make comparison between heavy construction equipment. In this study various heavy construction equipment used in transportation sector were presented and given information about their capacities and their areas of usage.

1. Introduction

Transport can be expressed as all the means and tools that enable people and goods to access. (Eygū, 2016). Transportation activities are directly related to transport costs and the performance of transport activities has a considerable
effect on the formation of transportation costs (Gümüş, 2007). The factors that affect the performance of the enterprises' transportation activities are cost, speed and consistency (Gümüş, 2009).

Highway transportation is the most preferred transportation type in Turkey (Bayraktutan and Özbilgin, 2013). A variety of heavy equipment are used in the construction of a road.

Along with the developing technology, a rapid development is seen in the heavy equipment used in the transportation sector. The increase in diversity in the machines used in the sector is striking because of the concepts such as workforce capacity, efficiency, time and economic dimension in the transportation sector. Therefore, the choice of suitable heavy equipment in this diversity is important.

The economy of the country will be contributed by the optimum use of the heavy equipment to be selected, both in terms of time and in terms of efficiency. For this reason, it is useful to compare heavy equipment in the transportation sector.

The selection of appropriate machines is one of the important decisions that must be made by businesses in the development of an efficient production environment. The machine selection problem is complicated and time-consuming to solve when looking at alternatives such as functional requirements, quality, efficiency, cost and service possibilities of the machines (Ertuğrul, 2014).

Heavy equipment provides economic contribution when used according to their importance and business environment. For this reason, the functions of the machine must be known.

In this study, various heavy equipment used in transportation sector were introduced, and information about their capacities and usage areas was given. It is thought that this work will be beneficial for the companies and employees operating in the transportation sector.

2. Heavy Equipment Used in Transportation Sector

In parallel with the technological developments, the machines used in the transportation sector developed rapidly and many machines according to their genre were developed and started to be used. This section provides information on the introduction, types, tasks and machine functions of the heavy equipment used in the transport sector.

2.1. Kazı makineleri

In the transportation sector, heavy equipment such as excavators for excavation are used. Excavator is heavy equipment that performs excavation, stripping, breaking and loading works. It is widely used in road and railway construction. The excavators are manufactured with 6-100 tones weight and 50-
800 HP engine power. The excavators can be handled in two groups, crawler and wheeled.

Crawler excavators are widely used in excavation, transport and loading since they are effective in excavation, canal opening and loading work on loose ground. It can work on many grounds, including swampy and wet grounds that do not exceed the pallet level. It is being transported by trailer on the construction site. It is capable of maneuvering in narrow spaces and can make point turn around its axis (Figure 1).

Fig.1. Crawler Excavator


The rubber wheeled excavator is a tire wheeled machine that is efficient in jobs such as digging, grooving, transporting and loading in the stiffness and hard ground (Figure 2).

Excavators are preferred because they provide ease of movement, especially on road works.

Fig.2. Rubber wheeled excavator
The connection with the excavator bucket cylinder results in the most efficient digging force when the arm cylinder is 90 degrees in arm angle. The efficient digging range between the lever and the machine is 45 degrees outward and 30 degrees towards the machine. In order to dig high places on the machine, the bucket is shoved in the reverse direction. Different types of excavator attachments are available for different purposes (Figure 3).

Fig.3. Different types of excavator attachments


2.2. Loaders

Loaders are basic machines for digging, handling, loading, paving and loading work. Basic excavation is used for a wide variety of purposes such as road construction, construction works, marble quarries, timber handling and loading. It can work within the capacities of excavating very hard grounds, but it does not have the ability to do work as much as a dozer. The loaders are manufactured with 40-500 HP engine power and 3-100 ton weight. The loader operator is a qualified person who carries out the maintenance and control of the loader, such as loading, carrying, digging, using the loader safely and efficiently. There are two types of loaders, crawler and wheeled.

Crawler loaders are widely used in excavation, transport and loading of foundation excavation since they are convenient for digging and loading works (Figure 4). Crawler loaders are able to work safely and efficiently on all types of floors as they touch the ground on a larger surface. Maneuverability is very high in tight spaces. Due to its assembly, it is able to make point return.
Fig.4. Crawler Loaders


All-wheel bulldozers are suitable for loading and transporting loose material (Figure 5). However, a wide variety of attachments are attached and used extensively in works such as canal excavation, transportation, loading and stacking. It is able to maneuver comfortably on the covered floor. Particularly in articulated machines, the ability to move and work is even higher.

Fig.5. All-wheel Bulldozer


In the filling work the scoop is set on the floor to be filled or slightly above it, so as to be parallel to the scoop mouth rim. After it is decided that it is full,
the loader is withdrawn a little and the bucket is tilted back and the load is taken to the bucket.

2.3. Dozers

Dozers are used for such purposes as road cleaning, road opening, paving, trench filling, paving, ground loosening and rock removal, as well as road and dam construction. Dozers are 4-80 tons in weight and 40-700 HP in engine power.

Dozers are divided into flat and triangular according to the pallet shape. Flat pelletized dozers and triangular pelletized dozers have a higher efficiency of doing work in the loose ground and in deep pitched ground, respectively.

Dozers are divided into two types according to the power transmission scheme: wheeled and crawler machines. Crawler dozers have a higher maneuverability especially in tight spaces, although the maneuvering speeds are low (Figure 6). Due to the assembly nature of the machine it is possible to make a point turn.

Fig.6. Crawler dozer


Rubber roller dozers are generally used for laying and pushing because of their higher maneuverability and speed compared to crawler dozers (Figure 7).

Bulgers, angle dozers and tilt dozers are assigned to the dozer according to the blade position. The bulldozer is attached with a plain blade in front of the machine and is also used when the material is being dragged and transported.
Fig. 7. All-wheel bulldozer


In bulldozers, the blade is placed perpendicular to the machine axis (Figure 8). The blade can only be lifted at about the same angle. The blade can also sink into the soil at a certain amount. In bulldozers, the blade can be tilted forward or backward to easily carry out excavation, laying and leveling operations in the working field.

Fig. 8. Bulldozer


In angle dozer the blade is placed perpendicular to the machine axis and can move right or left at a specific angle on the machine axis. The amount of this movement is mostly mechanically adjusted but can also be adjusted with hydraulic assistance on some machines.
In tilt dozer, the blade is placed perpendicular to the machine axis and it can move up and down vertically and at the same time it can be moved horizontally at a certain angle with respect to the other end of the blade. It can be lowered and raised at about the same angle. The blade can also sink into the soil at a certain amount.

In tilt dozer, the blade can be tilted to the front or back so that excavation, laying and leveling operations can be done easily. Tilting the blade to the right or left can also be used for slitting, trenching and slope excavations. The blade is placed perpendicular to the machine axis and can move right or left at a certain angle on the machine axis. This amount of motion is mostly mechanically adjusted, but in some machines, it is also adjusted by hydraulic assistance.

Fig.9. Angle dozer and tilt dozer


Angle dozers can do all the work bulldozers and tilt dozers do.

**Conclusion and Recommendations**

In this section; suggestions have been presented to ensure optimum efficiency from the heavy equipment used in the transportation sector.

During the operation of the excavator, the machine must be run in parallel to the machine axis as far as possible, and it should not be forced while working perpendicular to the axis. The digger must be selected according to the characteristic of the ground to be excavated. Before the excavation work, a ground survey should be done. The truck and excavator should be in the proper position when loading for fuel economy and efficient operation. For crawler excavators, the appropriate pallet tension should be adjusted to the ground to be worked on. The excavator should not be operated for a long time. The work machine should not be operated without support when on its own tires. When working on the construction site, the support feet of the work machine and the
blade should be pressed onto ground. When loading, make sure that the excavation is started from the front of the truck damper and poured.

While working on the hard ground with the loader, the digger nails must be absolutely attached. The loader should be submerged slowly until it reaches the desired depth. It requires less power to dig or drag the material down the ramp. In the work of correcting using loader, the bucket filled with soil is pushed backwards. The material pushed backwards is smoothed as the digger fingers touch the soil. In loading and unloading work, when you are in a loaded condition, you have to go back in the direction of a steep incline and go forward when going uphill. Care should be taken to avoid sudden turn and stop when the bucket is loaded. When loading from sloping ground or pile, the loader position should be taken as the wind will be behind. When approaching the truck, the bucket should be lifted up the truck level and the load speed must be reduced and the load discharged. When the material is empty, it must be lifted so as to free the bucket from the truck chassis. While the bucket digging teeth are in the soil, the loader should not be turned. At the dismantling of large rocks buried in the ground, the under of the rocks must be excavated first, then the rock should be removed.

In the dosing process, if the land is soft, the blade must be brought straight and upright and care must be taken to ensure that the material stacked on the edge of the blade is uniform on both sides. Sloping landing should be done downhill to take advantage of machine weight. In one-sided dosing, the blade should be angled. The blade should be tilted on the hard ground.

REFERENCES


