

## ***Bulldozer Performance and Productivity***

### ***Bulldozers and their description:***

- It is an earthmoving machine designed to push large quantities of rubble, soil, sand and other loose materials.
- **It also runs mostly on diesel fuel.**
- It is characterized by a large flat blade on the front that can be moved and lifted with hydraulic arms, and by the tracks that it runs on.
- **Bulldozers in many cases have ripper at the back.**
- Further, it is equipped with a sturdy cab over the driver's seat to prevent work injuries.
- There are two types of Bulldozers: Crawler and Tier (wheel-mounted).

### ***The suitable works for bulldozer:***

***Bulldozer can be used to various purposes as listed below:***

#### ***1. Earthmoving operations:***

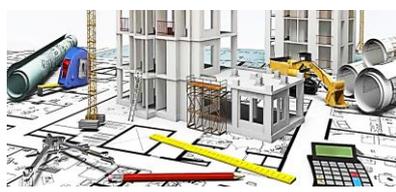
- The most common use for a bulldozer is moving large amounts of earth materials where it can push/spread material piles in front of it using its blade for haul distance upto 100 m.
- Also, construction sometimes used in conjunction with other equipment such as backhoes and other digging machines.

#### ***2. Road building:***

- It is a primary tool used in the building of roads where it is used to push away the topsoil that needs to be removed.
- Also, Clearing different layers of old roads.

#### ***3. Construction processes:***

- It can strip off surface vegetation in preparation for the digging of foundation holes.



- It can also push waste, trash and other materials into one location for burning or disposal.

4. Demolition activities:

- A large bulldozer can knock a house over, saving the trouble of having to deconstruct it piece by piece.
- A bulldozer has been knocked down an old structure, and then can be used to push all of the debris into a single pile and clean up the surrounding area.

**Operating options for both types of bulldozers:**

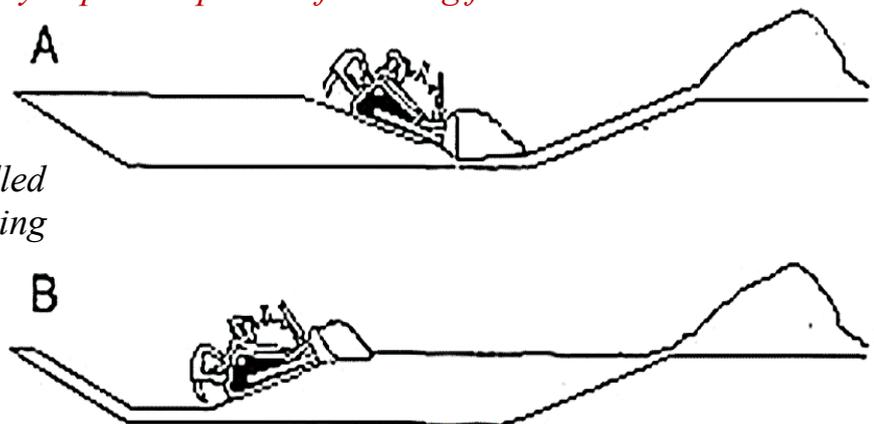
The main operational characteristics for two types of bulldozers are listed below:

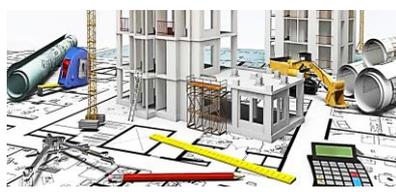
| Crawler  | Wheel mounted   |
|--|---|
| <ul style="list-style-type: none"> <li>• Ability to deliver greater tractive force.</li> </ul>             | <ul style="list-style-type: none"> <li>• Higher travel speed.</li> </ul>  |
| <ul style="list-style-type: none"> <li>• Ability to travel over muddy surface.</li> </ul>                  | <ul style="list-style-type: none"> <li>• Elimination of hauling equipment to transport the bulldozer to job.</li> </ul> |
| <ul style="list-style-type: none"> <li>• Ability to operate in rocky formation.</li> </ul>                 | <ul style="list-style-type: none"> <li>• Greater output.</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Greater flotation because lower pressure under tracks.</li> </ul> | <ul style="list-style-type: none"> <li>• Ability to travel on paved highways.</li> </ul>                                |

**Factors Affecting Bulldozer Productivity:**

The production of Bulldozer mainly depends upon the following factors:

- Size and condition of the dozer
- Distance traveled by the dozer
- Speed of operation
- Characteristic of soil being handled
- Surface on which dozer is operating
- Efficiency
- Blade type
- Cycle time





**Bulldozer productivity calculation:**

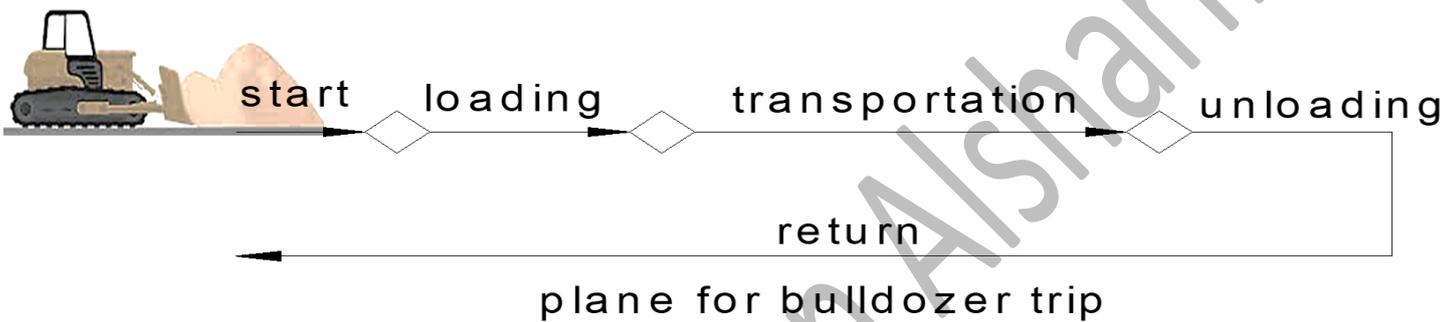
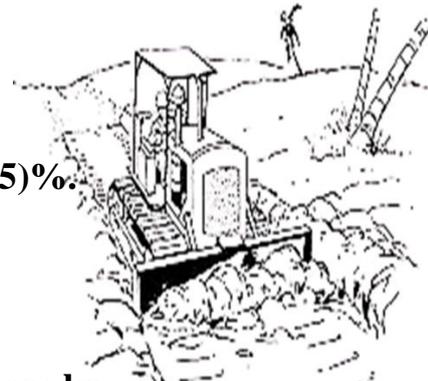
✓ Output is affected by:

1. **Swelling of soil:** Coefficient of Swelling range between (15-25)%.

$$\text{Embankment volume} = \frac{\text{Loose volume}}{1 + \text{Coefficient of Swelling}}$$

2. **Operating Time** is also called “Time factor”: **45-50 minutes per hours**

3. **Operation trip** of bulldozer is called as **cycle time** of bulldozer that consist of:



✓ Important Notes:

- ✓ The sum of time required to **push, backtrack, and maneuver** into position to push represents the complete bulldozer cycle.
- ✓ Bulldozer trip is generally performed at slow speed around **1.5-2.0** mph.
- ✓ Return speed is **usually the maximum** that can be performed in the distance available.

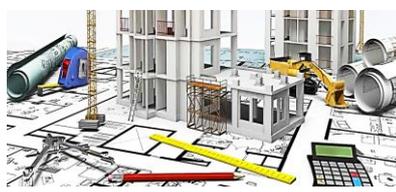
$$\text{Output (m}^3\text{/hr)} = \text{Volume of pushed material (m}^3\text{)} \times \text{No. of trips per hour}$$

$$\text{No. of trips per hour} = \frac{\text{The actual time of operating machine in one hour}}{\text{Cycle time of machine}}$$

$$\text{Cycle time of machine (min)} = \text{Push time} + \text{Return time} + \text{Maneuver time}$$

$$\text{Volume of pushed material (m}^3\text{)}$$

$$= \text{Volume of material formed in front of the machine blade}$$

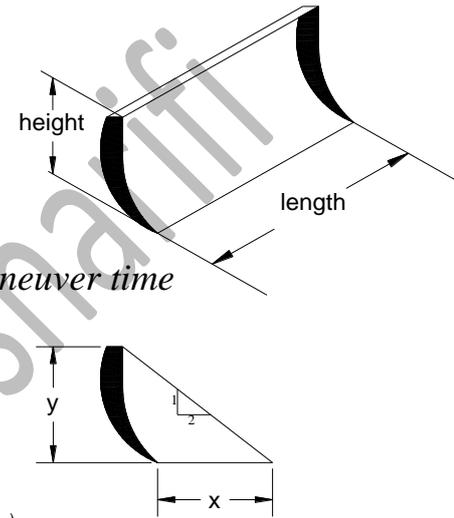


**Case Study No. 6-1:**

Calculate the output of Bulldozer operating to cut and push a clayey soil that have a swelling factor of **25%**, using the following information: Pushing distance **45m**, the blade dimensions are **3m** length and **1m** height, Operating factor **50 min/hr**, Pushing velocity **3 km/hr**, return velocity **6 km/hr**, Maneuver time **0.4 min**, Side slop of pushed soil material is **2:1**.

**Solution:**

| Type of soil | x | y |
|--------------|---|---|
| Sandy soil   | 1 | 1 |
| Clay soil    | 2 | 1 |



*Cycle time of machine (min) = Push time + Return time + Maneuver time*

$$Cycle\ time = \frac{45}{3 * \frac{1000}{60}} + \frac{45}{6 * \frac{1000}{60}} + 0.4 = 1.75\ min.$$

$$\therefore No.\ of\ trip\ per\ hour = \frac{50}{1.75} = 28.57\ trip/hr\ (or\ cycle/hr)$$

$$\therefore Output\ (or\ productivity)\ per\ day = Volume\ of\ pushed\ materials * No.\ of\ trip\ per\ hour * No.\ of\ hours\ per\ day$$

$$\therefore Output\ (loose\ volume)\ per\ day = \frac{2 * 1}{2} * 3 * 28.57 * 8$$

$$= 685.7\ m^3/day\ Output\ (embank\ volume) = \frac{685.7}{1 + 0.25}$$

$$= 548.5\ m^3/day$$