Tractor equipped with a front mounted earthmoving blade is known as bulldozer or dozer.

Blade is lowered to cut the soil and push the soil in front of blade.

It unloads the soil by pushing it over a cliff or into a hopper or by raising the blade.
Bulldozers are used for:

- stripping topsoil and clearing vegetation
- shallow excavating
- maintaining haul roads
- opening up pilot roads
- spreading and grading
- pushing scraper
- ripping
- touring some equipment, such as compactors
Dozers are normally **crawler mounted** and rarely used **wheel mounted**.

**Crawler dozers** can operate on steeper side slopes, climb greater grades than can wheel mounted dozers, and can operate in rough terrain. Apply low ground pressure, 6-9 lb/in² so good in low trafficable areas.

On the other hand, **wheel dozers** can move faster than crawler dozer and move on paved roads without damaging its surface.
Dozer blades

Straight blades
The section perpendicular to line of push is straight.
The curvature causes to roll the material forward.
The driver controls the depth of cut during pushing action by feel.
When rear of the dozer is felt to rise, the blade is starting to dig in.
Universal Blade (U-Blade)

The blade in cross section has a much deeper curvature, almost approaching a "U" shape.

In addition the outer edges are angled slightly inwards.

U-Blades can carry larger volumes of soil.
Angle Blade

The blade in plan view is angled up to 25° and cast material to one side. This blade is mostly used in backfilling along a trench and operating a pilot road in hilly terrain.
Cushion Blade

Especially larger machine bulldozers (300 hp or more) are used to push scrapers while loading. The blade used in this case is usually fitted with a shock absorbers and the blade is much more stronger than the other blades.
Estimating Dozer Production

**Production = Volume per cycle × cycles per hour**

**Estimation of blade volume:**
Doze a full blade load, then lift the blade while moving forward on a level surface until an even pile is formed:
- Measure the width (W) of the pile
- Measure the height (H) of the pile
- Measure the length (L) on the pile

\[
\text{Blade Load (Lm}^3) = H(m) \times W(m) \times L(m)
\]

Dozer cycle time = fixed cycle time + variable cycle time
Estimating Dozer Production

- Fixed cycle time represents time for manoeuvring, changing gears, start loading and dump.
- Variable cycle time is the time required to doze and return.
## Typical dozer fixed cycle times

Table 4-4 p.96

<table>
<thead>
<tr>
<th>Operating Conditions</th>
<th>Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power-shift transmission</td>
<td>0.05</td>
</tr>
<tr>
<td>Direct-drive transmission</td>
<td>0.10</td>
</tr>
<tr>
<td>Hard digging</td>
<td>0.15</td>
</tr>
</tbody>
</table>
## Typical dozer operating speeds

Table 4-5 p.97

<table>
<thead>
<tr>
<th>Operating Conditions</th>
<th>Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dozing</strong></td>
<td></td>
</tr>
<tr>
<td>Hard materials, haul 100 ft (30 m) or less</td>
<td>1.5 mi/hr (2.4 km/hr)</td>
</tr>
<tr>
<td>Hard materials, haul over 100 ft (30 m)</td>
<td>2.0 mi/hr (3.2 km/hr)</td>
</tr>
<tr>
<td>Loose materials, haul 100 ft (30 m) or less</td>
<td>2.0 mi/hr (3.2 km/hr)</td>
</tr>
<tr>
<td>Loose materials, haul over 100 ft (30 m)</td>
<td>2.5 mi/hr (4.0 km/hr)</td>
</tr>
<tr>
<td><strong>Returning</strong></td>
<td></td>
</tr>
<tr>
<td>100 ft (30 m) or less</td>
<td>Maximum reverse speed in second range (power shift) or reverse speed in gear used for dozing (direct drive)</td>
</tr>
<tr>
<td>Over 100 ft (30 m)</td>
<td>Maximum reverse speed in third range (power shift) or highest reverse speed (direct drive)</td>
</tr>
</tbody>
</table>
A power-shift crawler tractor has a rated blade capacity of 10 LCY (7.65 Lm³). The dozer is excavating loose common earth and pushing it a distance of 200 ft (61 m). Maximum reverse speed in third range is 5 mi/h.
Solution

Fixed time = 0.05 min

Dozing speed = 2.5 mi/hr (4.0 km/hr)

Dozing time = \( \frac{200}{2.5 \times 88} \) = 0.91 min

\[
\left[ \frac{61}{4 \times 16.7} = 0.91 \text{ min} \right]
\]

- Note: 1 mi/hr = 88 ft/min; 1 km/hr = 16.7 m/min
Solution

Return time = \( \frac{200}{5 \times 88} = 0.45 \text{ min} \)

\[
\left[ \frac{61}{8 \times 16.7} = 0.45 \text{ min} \right]
\]

Cycle time = 0.05 + 0.91 + 0.45 = 1.41 min

Production = \( 10 \times \frac{50}{1.41} = 355 \text{ LCY / hr} \)

\[
\left[ \frac{7.65 \times 50}{1.41} = 271 \text{ Lm}^3 / \text{ hr} \right]
\]
A tractor equipped with a front end bucket, called a loader, front end loader or bucket loader. Both wheel loaders and track loaders are available.
Loaders are used:

- to excavate soft to medium hard material
- loading haul units and hoppers
- stockpiling material
- backfilling ditches
- moving concrete and other construction materials
Wheel Loaders

- higher speed (25 mil/hr or more)

- good job mobility

- articulated (hinged between front and rear axles to provide great manoeuvrability)
Track Loaders

- overcoming steeper grades
- operating in areas of higher side slopes
- low ground pressure and high tractive effect
- lower speed than has wheel loaders
Production \( (m^3) = \text{bucket load} \times \text{cycles per hour} \)

Basic loader cycle times (Table 4-6 p.103):

<table>
<thead>
<tr>
<th>Loading conditions</th>
<th>Basic Cycle Time (min)</th>
<th>Articulated wheel loader</th>
<th>Track Loader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose materials</td>
<td>0.35</td>
<td></td>
<td>0.30</td>
</tr>
<tr>
<td>Average material</td>
<td>0.50</td>
<td></td>
<td>0.35</td>
</tr>
<tr>
<td>Hard materials</td>
<td>0.65</td>
<td></td>
<td>0.45</td>
</tr>
</tbody>
</table>
Example

Estimate the hourly production in loose volume (LCY or Lm$^3$) of a 3½ yd (2.68 m$^3$) wheel loader excavating sand and gravel (average material) from a pit and moving it to a stockpile. The average haul distance is 200 ft (61 m), the effective grade is 6%, the bucket fill factor is 1.00, and job efficiency is 50 min/hr.
Figure 4.14

Travel time, wheel loader (haul + return)

Time (min)

One way haul distance

ft
m

80 140 200 300 400 500 600
25 50 75 100 125 150 175
Bucket volume = 3.5×1 = 3.5 LCY (2.68 Lm³)

Basic cycle time = 0.50 min. (Table 4-6)

Travel time = 0.30 min. (Figure 4-14)

Cycle time = 0.50 + 0.30 = 0.80

Production = 3.5× \frac{50}{0.80} = 219 LCY/hr

\[ = 2.68× \frac{50}{0.80} = 168 \text{ Lm}^3/\text{hr}] \]