Unit	1154
Title	Describe Road Building Equipment
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BC **Forest Safety**

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Unit Introduction

What you will learn in this unit

By the end of this unit, you will be able to demonstrate knowledge of:

- Dozers
- Excavators
- Backhoes
- Graders
- Wheel Loaders
- Rock Drills

Why it's important for you to learn this unit

You are not just a passive participant in the health and safety of your work area. You have responsibilities and rights, when it comes to your own health and safety and that of your fellow workers, particularly in the woods where the potential hazards are high.

Understanding road building equipment allows you to identify safety hazards while working around equipment, and provides an understanding of what each piece of equipment is used for and what the capabilities of the machine are.

You have the right to a safe workplace. You need to know what the hazards are and understand your right to refuse unsafe work. You also have a responsibility to follow safe work procedures, be alert to hazards and report them, and use protective clothing and equipment.

Are you ready to take this unit?

Prior to taking this unit, it is recommended that you complete the following units:

- 1002 Describe Forest Industry
- 1003 Describe Safe Work Practices

Does this unit apply to you?

This unit applies to these occupations:

- Heavy Equipment Operator
- Forestry Worker – Surveyor or Engineer

Section G1-1: Equipment

What you need to know about this section

By the end of this section, you will be able to demonstrate knowledge of the following key points:

1.1 Dozer

1.2 Excavator

1.3 Backhoe

1.4 Grader

1.5 Wheel Loader

1.6 Rock Drill

Key Point 1.1: Dozer

A dozer is a crawler equipped with a blade used to push large amounts of soil, sand, rubble, or other material. Dozers are typically equipped at the rear with a claw-like device, called a ripper, to loosen densely compacted materials.

Learning Point

The term "bulldozer" refers only to a tractor (usually tracked) fitted with a dozer blade.

A Crawler Tractor (Dozer) building road near Revelstoke, BC. *(Photo Credit: Chris Cole, RPF, PEng)*

Dozer Function

Bulldozers are large and powerful tracked heavy equipment. The tracks give them excellent ground holding ability and mobility through rough terrain. Wide tracks help distribute the bulldozer's weight over a large area which prevents it from sinking in sandy or muddy ground. Extra wide tracks are known as swamp tracks or LGP (low ground pressure) tracks.

Dozer Use

Bulldozers are often used in road building, construction, mining, forestry, land clearing, infrastructure development, and any other projects requiring highly mobile, powerful, and stable earth-moving equipment.

Dozer uses in forestry include:

- Pushing heavy materials around the site
- Spreading rocks and other material on roads
- Smoothing out road surfaces

Learning Point

Many operators don't use dozers for road building. Instead, the excavator operator grabs a large flat steel beam with the bucket and scrapes it on the road surface. The grader is used to do the final surface smoothing.

Dozer—Self-Quiz

1. Dozers are typically equipped at the rear with a claw-like device called a:

   - ☐ Gripper
   - ☐ Ripper
   - ☐ Grappler
   - ☐ None of these answers

2. Extra-wide tracks on a dozer are known as:

   - ☐ Stable tracks
   - ☐ Sidewinding tracks
   - ☐ Swamp or LGP tracks
   - ☐ None of these answers

Now check your answers on the next page.

Dozer—Self-Quiz Answers

1. Dozers are typically equipped at the rear with a claw-like device called a:

   Answer: **Ripper**

2. Extra-wide tracks on a dozer are known as:

   Answer: **Swamp or LGP tracks**

Key Point 1.2: Excavator

Excavators are heavy construction equipment consisting of a boom, stick, bucket, and cab on a 360-degree rotating platform. This platform is also known as the house. The house sits on an undercarriage with tracks or wheels.

An excavator staged with a truck at jobsite near Merritt, BC. (Photo Credit: Chris Cole, RPF, PEng)

The two main sections of an excavator are the undercarriage and the house. The undercarriage includes the blade, tracks, track frame, and final drives. The house includes the operator cab, counterweight, engine, fuel and hydraulic oil tanks. The house attaches to the undercarriage by way of a center pin.

Attached to the end of the boom is the stick (or dipper arm). The stick provides the digging force needed to pull the bucket through the ground. The stick length is optional depending whether reach (longer stick) or break-out power (shorter stick) is required.

Excavator Function

On the end of the stick is usually a bucket. A wide, large capacity (clean up) bucket with a straight cutting edge is used for cleanup and levelling or where the material to be dug is soft, and teeth are not required. A general purpose (GP) bucket is generally smaller, stronger, and has hardened side cutters and teeth used to break through hard ground and rocks. There are also many other attachments which are available to be attached to the excavator for boring, ripping, crushing, cutting, lifting, etc.

Excavator Use

After the forestry layout crew has identified the road location and the trees have been felled, an excavator is used to:

- Scrape off the overburden or organic soil layers
- Set the overburden or soil aside
- Cut soil and rock from the higher side
- Fill the lower side of the road to build up a flat road prism or shape
- Build a ditch along both sides of the road
- Smooth out the road's rough grade

Learning Point

Excavators can also be used to mulch material, dredge rivers, and drive piles with a pile driver.

Excavator—Self-Quiz

1. What are the two main sections of the excavator?
   - ☐ Undercarriage and house
   - ☐ Cab and engine
   - ☐ House and engine
   - ☐ None of these answers
2. What is one of the main uses of excavators in forestry?
   - ☐ Smoothing out a road's rough grade
   - ☐ Building ditches on the side of the road
   - ☐ Scraping off soil and setting it aside
   - ☐ All of these answers

Now check your answers on the next page.

Excavator—Self-Quiz Answers

1. What are the two main sections of the excavator?

   Answer: **Undercarriage and house**

2. What is one of the main uses of excavators in forestry?

   Answer: **All of these answers**

Key Point 1.3: Backhoe

Source: https://en.wikipedia.org/wiki/Backhoe and Chris Cole, RPF, PEng.

A backhoe is a type of excavator, with a digging bucket on the end of a two-part articulated arm. It is typically mounted on the back of a tractor or front loader.

The section of the arm closest to the vehicle is known as the boom, while the section which carries the bucket is known as the stick or dipper. The boom is generally attached to the vehicle through a pivot known as the king-post, which allows the arm to pivot, usually through 180 to 200 degrees.

Typical Rubber Tired Loader Backhoe (Tractor). (Photo source unknown)

Backhoe Function

The name backhoe refers to the action of the shovel, not its location on the vehicle. A backhoe digs by drawing earth backwards, rather than lifting it with a forward motion like a bulldozer. Most backhoes are at their strongest curling the bucket, with the dipper arm next most powerful, and boom movements the least powerful.

Backhoe loaders are general-purpose tools, different from specialist tools like the excavator. Sometimes a backhoe bucket is reversed to work in a power shovel configuration. This is generally when loading from a large stockpile, for picking up or filling material next to walls, to increase the reach of the machine, or working around obstacles such as pipes. Sometimes a backhoe arm is used as a crane, by slinging the lifted object from the support linkages behind the scoop.

Backhoe Uses

Backhoes can be used to:

- Scoop and move aggregates and sand around work sites
- Level and smooth terrain around jobsites
- Maintain slopes and embankments
- Clean out culvert inlets, plugged ditches, large potholes
- Smooth bridge approaches
- Dig signpost holes

They are also useful for any activity that requires travel along the road surface with frequent stops of short duration work.

Learning Point

Backhoes are useful to complete jobs that require several stops. They are more cost effective for small road maintenance jobs than excavators.

Backhoe—Self-Quiz

1. Backhoes can be used to:
   - ☐ Scoop and move aggregates
   - ☐ Level the terrain around worksites
   - ☐ Clean out culverts
   - ☐ All of these answers
2. What is the name of the arm section closest to the vehicle?
   - ☐ The boom
   - ☐ The pivot
   - ☐ The king-post
   - ☐ The stick

Now check your answers on the next page.

Backhoe—Self-Quiz Answers

1. Backhoes can be used to:

   Answer: **All of these answers**

2. What is the name of the arm section closest to the vehicle?

   Answer: **The boom**

Key Point 1.4: Grader

A grader is a construction machine with a long blade used to create a flat surface during the grading process. Typical models have three axles, with the engine and cab above the rear axles and a third axle at the front end, with the blade in between.

Grader Working with Rolling Compactor at a log sorting facility near Nanaimo, BC. Photo Credit: Chris Cole, RPF, PEng.

Grader Function

The angle, tilt, and height of the grader's blade can be adjusted to do precision grading of a surface. The rough grading is done by heavy equipment such as scrapers and bulldozers.

Many graders have optional attachments for the rear such as the:

- Ripper
- Scarifier
- Blade
- Compactor

Grader Uses

Graders are used in the construction and maintenance of dirt roads and gravel roads. Graders are also used to set native soil or gravel foundation pads to finish grade prior to the construction of large buildings. Graders can produce inclined surfaces, to give side slope to roads.

Grader—Self-Quiz

1. How many axles does a typical grader have?

   - ☐ 2
   - ☐ 3
   - ☐ 4
   - ☐ 6

2. What are two optional attachments for a grader?

   - ☐ Digger and gripper
   - ☐ Compactor and blade
   - ☐ Bucket and smoother
   - ☐ Blader and smoother

Now check your answers on the next page.

Grader—Self-Quiz Answers

1. How many axles does a typical grader have?

   Answer: **3**

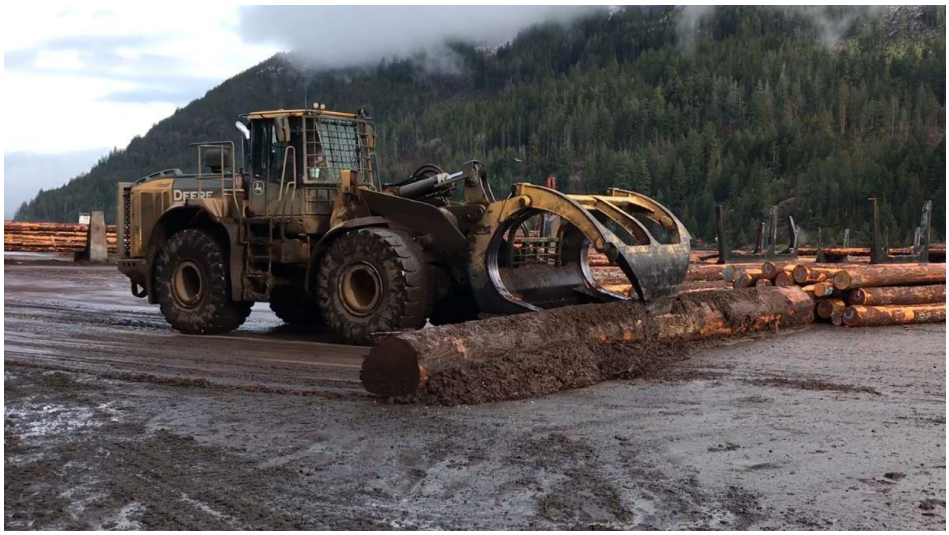
2. What are two optional attachments for a grader?

   Answer: **Compactor and blade**

Key Point 1.5: Wheel Loader

A wheel loader is a type of tractor with wheels that has a front-mounted square wide bucket connected to the end of two arms. These arms scoop up loose material from the ground, such as dirt, sand, or gravel, and move it from one place to another without pushing the material across the ground.

The loader assembly may be a removable attachment or permanently mounted. Often the bucket can be replaced with other devices or tools. For example, many can mount forks to lift heavy pallets, or a hydraulic "clamshell" bucket allows a loader to act as a light dozer or scraper.



A wheel loader uses a log to clean debris from the surface of a log sorting facility near Port Alberni on Vancouver Island. Photo Credit: Chris Cole. RPF, Peng.

Wheel Loader Function

Unlike backhoes and tractors, many large loaders use hydraulic steering mechanisms. They steer by a hydraulically actuated pivot point set exactly between the front and rear axles. This allows the front axle to be solid, to carry greater weight, and to maneuver better.

Since the front wheels and attachment rotate on the same axis, the operator is able to steer his load in an arc after positioning the machine, which can be useful. The tradeoff is that, it has a greater risk of turning over to the wide side.

Learning Point

Tracked loaders are best used where sharp-edged materials in construction debris would damage rubber wheels, or where the ground is soft and muddy.

Wheel Loader Uses

Loaders are used mainly for loading materials into trucks, laying pipe, clearing rubble, and digging. A wheel loader is used to move a stockpiled material from ground level to a truck or into an open trench excavation.

Wheel loaders provide better mobility and speed than tracked loaders. They do not damage paved roads as much as tracks but provide less traction.

Note: A loader is not the most efficient machine for digging as it cannot dig very deep below the level of its wheels. Backhoes and excavators are better machines for digging.

The term “Loader” or “Log Loader” in forestry often refers to a steel tracked machine with a raised cab like the one shown above.

Wheel Loader—Self-Quiz

1. When are wheel loaders used instead of tracked loaders?

   - ☐ Jobs requiring even distribution of weight
   - ☐ Jobs requiring traction and heavy-lifting
   - ☐ Jobs requiring speed of movement and mobility
   - ☐ None of these answers

2. What can happen when a wheel loader is twisted to one side and a heavy load is lifted high?

   - ☐ Losing the load
   - ☐ Risk of rolling over
   - ☐ Losing traction
   - ☐ Breaking the axle

Now check your answers on the next page.

Wheel Loader—Self-Quiz Answers

1. When are wheel loaders used instead of tracked loaders?

   Answer: **Jobs requiring speed of movement and mobility**

2. What can happen when a wheel loader is twisted to one side and a heavy load is lifted high?

   Answer: **Risk of rolling over**

Key Point 1.6: Rock Drill

A rock drill is a track-mounted machine that drills deep holes into solid rock during forest construction projects. The machine is equipped with drill rigging powered by a compressor and engine. The drilled holes are later charged with explosives that are set-off to break-apart the rock removed for road construction, or needed for gravel crushing.

Rock drills can also be created by putting an attachment on an excavator or backhoe. The attachment is built to be dependable, rugged and versatile. The drill mounts to the excavator (stick). After installation, the change from drilling to bucket or breaker work can happen in a short window of time.

Rock Drills. Photo Credit: Mark Ponting – Ponting Contracting

Rock Drill Function

Typically, a rock drill is a dedicated machine with tracks, but excavator mounted drills are common as well.

Rock Drill Uses

Rock drills are primarily used for road building. Specifically, drilling holes in hard rock for the purpose of loading powder. The rocks are then blasted into small fragments so they can be moved by an excavator and the road can be built on the required safe grade. The holes in the rock are drilled in various density patterns and depth, depending on the type of rock and desired blasting result (small vs. large rock).

Rock is also drilled and blasted for the purpose of developing pits at the side of the road. Blasted rock from pits, or “borrow pits,” is used to spread on the surface of the road.

Spreading the rock makes the road able to support heavy industrial traffic such as log trucks and low beds for moving equipment. Rock-surfaced roads also reduce soil erosion and sediment movement into ditches and streams. When the surface of the road is coarse blasted rock, there is no sediment that runs off during rain, and the road does not become rutted and ruined during use.

Rock Drills. Photo Credit: Nancy Ponting - Ponting Contracting

Rock Drill Safety

Rock drill safety is covered in the WorkSafeBC Occupational Health and Safety Regulations (OHS Regulations). Be sure to thoroughly review the regulations on safely handling rock drills included in sections 12.84 to 12.92.

Note: The sections below cover the key safety points, but you must be familiar with all of the safety requirements in the OHS Regulations.

General Requirements

The employer must ensure that before drilling:

- The back, face and sides of the work area have been scaled and stabilized
- The working face and surrounding area have been washed
- Remnants of holes have been inspected for explosives and marked

Drilling Equipment

The employer must ensure that:

- A rock drill is not used unless equipped with a water jet or other device capable of suppressing rock dust and
- Restraining devices are installed on hose connections under pressure, if disconnection could endanger workers

Drilling Procedures

A driller must ensure that:

- The cut is not drilled in the same location as the previous round
- Holes are not drilled within 15 cm (6 in) of any part of a bootleg
- There is no drilling at a face when a hole is loaded or being loaded with explosives (except when confirming to the requirements on drilling to refire a misfire)

Rock Drill—Self-Quiz

1. What powers the rock drill?
   - ☐ Compressor and engine
   - ☐ Compressor
   - ☐ Engine
   - ☐ None of these answers
2. What is a rock drill primarily used for?
   - ☐ Road building
   - ☐ Laying out rock
   - ☐ Digging out dirt pits
   - ☐ None of these answers

Now check your answers on the next page.

Rock Drill—Self-Quiz Answers

1. What powers the rock drill?

   Answer: **Compressor and engine**

2. What are rock drills primarily used for?

   Answer: **Road building**