Unit-4

Graders

ROAD GRADER

Defination

A grader, also commonly referred to as a road grader, a blade, a maintainer, or a motor grader, is a construction machine with a long blade used to create a flat surface during the grading process.

HISTORY

- Early graders were drawn by people and draft animals
- The era of motorization by traction engines, steam tractors, motor trucks, and tractors saw such towed graders grow in size and productivity
- The first self–propelled grader was made in 1920 by the Russell Grader Manufacturing Company, which called it the Russell Motor Hi–Way Patrol.

FIRST GRADER 1920

Hydraulic grader

Galion developed one of the first hydraulic power grader systems in the 1920s. By the early 1930s hydraulics were standard on all motor graders. An example of a 1922 ‘Galion Patrol‘ is shown here.

PURPOSE IN CIVIL ENGINEERING

ಪ In civil engineering, the grader's purpose is to 'finish grade' (to refine or set precisely) the 'rough grading' performed by heavy equipment or engineering vehicles such
as scrapers and bulldozers.

COMMONLY USES

Graders are commonly used in the construction and maintenance of dirt roads and gravel roads


720A
CHAMPION
CHAMPION

Graders can produce inclined surfaces, to give cant (camber) to roads.

Regional uses

- In some locales such as Northern Europe, Canada, and places in the United States, graders are often used in municipal ,
- Residential snow removal .

Snow removing

In scrubland and grassland areas of Australia and Africa, graders are often an essential piece of equipment on ranches, large farms, and plantations to make dirt tracks where the absence of rocks and trees means bulldozers are not required

Thank You

Chapter 3

Scrapers

The design of scrapers (tractor scrapers) allows for loading, hauling, dumping, and spreading of loose materials. Use a scraper for medium-haul earthmoving operations and for moving ripped materials and shot rock. The haul distance (zone of operation), the load volume, and the type and grade of surface traveled on are the primary factors in determining whether to use a scraper on a particular job. The optimum haul distance for small- and medium-size scrapers is 3,000 feet or less.

DESCRIPTION

3-46. *Figure 3-1, page 3-2,* shows a CAT® 621B single-powered-axle wheel scraper. The CAT 621 is designed to operate using a push tractor for loading assistance. The air-droppable CAT 613B wheel scraper has a chain-elevator loading mechanism that allows it to load without the assistance of a push tractor. The basic operating parts of a scraper are these:

- **Bowl.** The bowl is the loading and carrying component. It has a cutting edge, which extends across the front bottom edge. Lower the bowl until the cutting edge enters the ground for loading, raise it for carrying, and lower it to the desired lift thickness for dumping and spreading.
- **Apron.** The apron is the front wall of the bowl. It is independent of the bowl and, when raised, it provides an opening for loading and spreading. Lower the apron during hauling to prevent spillage.
- **Ejector.** The ejector is the rear wall of the bowl. Keep the ejector in the rear position when loading and hauling materials. Activate the ejector to move forward during spreading to provide positive discharge of materials.

CAPACITY

3-47. *Struck* capacity means the bowl has a full load of material that is level with its sides. *Heaped* capacity means the material is heaped in the bowl and slopes down on a 1:1 repose slope to the sides of the bowl. In practice, these will be LCY of material because of how a scraper loads. Therefore, load volume in terms of BCY moved depends on both the bowl size and the material type being loaded. The rated volumetric capacity of the Army 621B scraper is 14-cubic-yards struck and 20-cubic-yards heaped. The capacity of the CAT 613B scraper is 11-cubic-yards heaped. Elevating scrapers, like the Army 613, are not given struck capacity ratings.

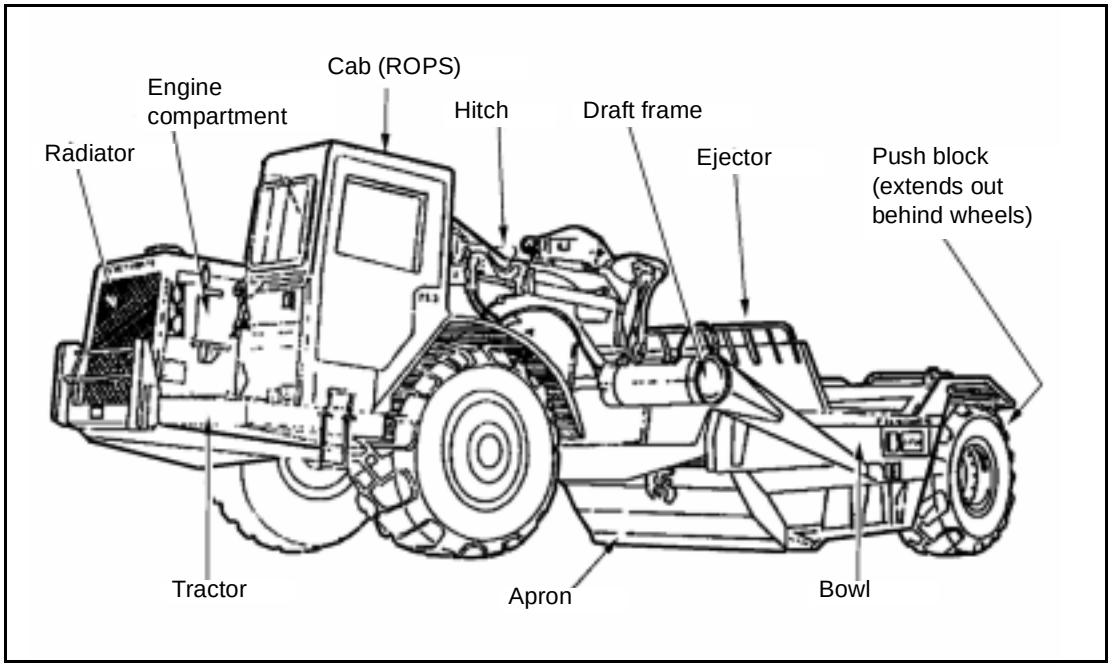

Figure 3-18. CAT 621B Wheel Scraper

OPERATING RANGE

3-48. The optimum haul distance for the small- and medium-size scrapers is 300 to 3,000 feet. There are larger scrapers that are effective up to 5,000 feet.

SELECTION

3-49. A scraper is a compromise between a machine designed exclusively for either loading or hauling. For medium-distance movement of material, a scraper is better than a dozer because of its travel-speed advantage and it is better than a truck because of its fast load time, typically less than a minute. Another advantage of the scraper is that it can spread its own load and quickly complete the dump cycle.

PRODUCTION CYCLE

3-50. The production cycle for a scraper consists of six operations—loading, haul travel, dumping and spreading, turning at the dump site, return travel, and turning and positioning to load. *Figure 3-2* shows the functions of the apron, bowl, and ejector during loading, hauling, and dumping.

LOADING

3-51. The CAT 621 loads with push-tractor assistance. This scraper can load to a limited extent without assistance, but requires push loading to achieve maximum production. Pusher assistance is necessary to reduce loading time and wheel spinning. Reducing scraper wheel spinning increases tire life. The scraper should not depend on the pusher to do all the work. Conversely, do not spin the scraper's wheels to pull away from the pusher. Use pusher assistance for either straight, downhill, or straddle loading. Always load the scraper in the direction of haul. Do not turn the scraper at the same time it is

accelerating from the loading operation. The CAT 613 is a self-loading machine, and pushing during loading will damage the scraper's loading elevator.

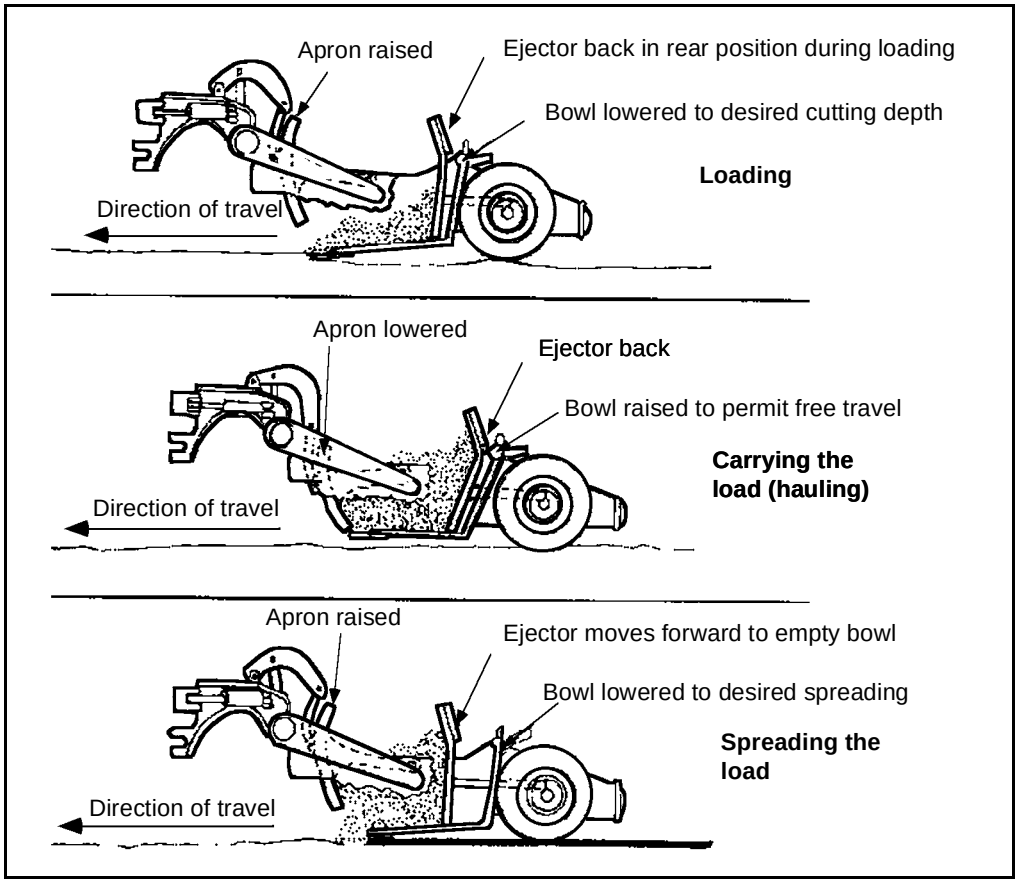

Figure 3-19. Functions of the Apron, Bowl, and Ejector

Downhill Loading

3-52. Downhill loading enables a scraper to obtain larger loads in less time. Each 1 percent of favorable grade is equivalent to increasing the loading force by 20 pounds per ton of gross scraper weight.

Straddle Loading

3-53. Straddle loading (*Figure 3-3, page 3-4*) requires three cuts with a scraper. The first two cuts should be parallel, leaving a ridge between the two cuts. The scraper straddles this ridge of earth to make the final cut. The ridge should be no wider than the distance between a scraper's wheels. With straddle loading, time is gained on every third trip because the center strip loads with less resistance than a full cut.

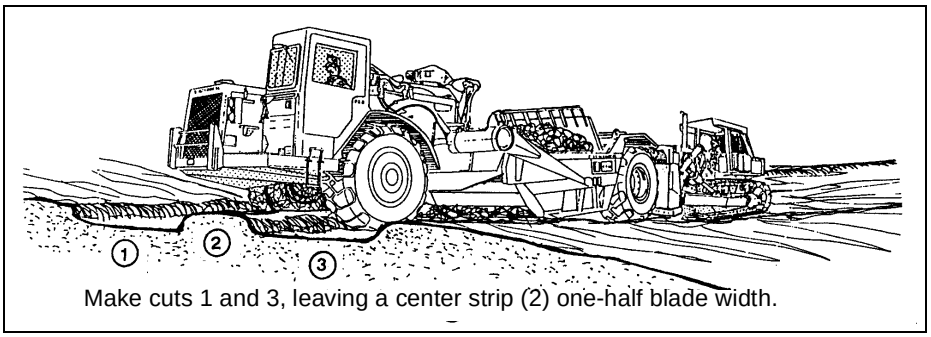

Figure 3-20. Straddle Loading With Pusher Assistance

Push-Loading

3-54. **Back-Track.** Use the back-track push-loading technique *(Figure 3-4)* where it is impractical to load in both directions. However, this method is inefficient due to the time spent in backing up and repositioning for the next load.

3-55. **Chain.** Use the chain push-loading technique *(Figure 3-4)* where the cut is fairly long, making it possible to pick up two or more scraper loads without backtracking. The pusher pushes one scraper, then moves behind another scraper that is moving in the same direction in an adjacent lane.

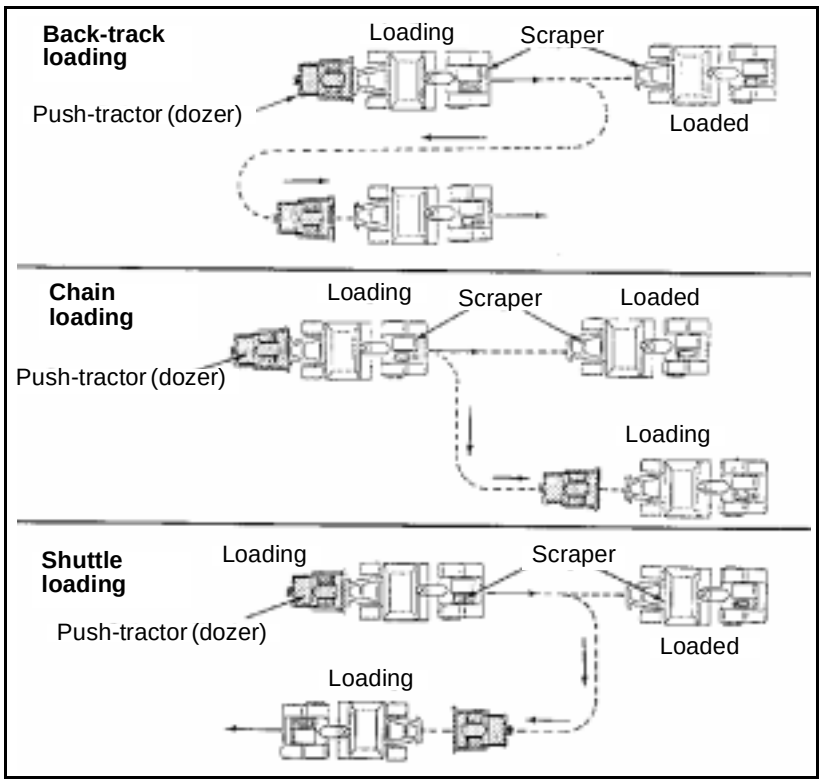

Figure 3-21. Push-Loading Techniques

3-56. **Shuttle.** Use the shuttle push-loading technique *(Figure 3-4)* for short cuts where it is possible to load in both directions. The pusher pushes one scraper, then turns and pushes a second scraper in the opposite direction.

Cut-and-Load Sequence

3-57. The scraper loading sequence is as follows:

Step 1. Use the service brake to reduce scraper travel speed when close to the cut (loading lane), and downshift to first gear for loading.

Step 2. Move the ejector to the rear.

Step 3. Open the apron partway.

Step 4. Lower the bowl to an efficient cut depth after the scraper enters the cut. Continue moving forward until the dozer contacts the scraper and begins pushing. If the scraper tires spin before the dozer makes contact, stop and allow the dozer to assist. When the dozer makes contact, push down both the differential lock and the transmission hold pedal and proceed in second gear. The cut should be as deep as possible, but it should allow the scraper to move forward at a constant speed without lugging the engine. Decrease the cut depth if the scraper or pusher lugs or if the drive wheels slip. Use the router bits on the vertical side of the bowl to gauge the depth of cut. Once an efficient depth of cut is determined, use that same depth on successive passes.

Step 5. Mark the cut. When cutting—

- Regulate the apron opening to prevent material from piling up in front of the lip or falling out of the bowl.
- Keep the machine moving in a straight line while maintaining pusher and scraper alignment.
- Do not overload the scraper. Overloading lowers efficiency and places unnecessary stresses on the machine.
- Raise and lower the bowl rapidly when loading loose material such as sand.

NOTE: When a push tractor is used, it should be waiting about 45° off of the lane to be cut. This allows the loading unit to come in with the least delay and difficulty.

Step 6. Raise the bowl slowly when full, while at the same time closing the apron to prevent spillage.

Step 7. Allow the pusher to help the machine out of the cut area, if necessary.

NOTE: When exiting the cut, release the transmission hold and/or the differential lock, if in use. Accelerate to travel speed as quickly as possible. Travel a few feet before lifting the bowl to the carrying position. This spreads any loose material piled up in front of the bowl and allows the following scraper to maintain speed.

Materials

3-58. **Loam and Clay. .** Loam and most clay soils cut easily and rapidly with minimum effort. However, loosen very hard clay with a dozer ripper before loading.

3-59. **Sand.** Since sand has little or no cohesion between its particles, it has a tendency to run ahead of the scraper blade and apron. The condition is worse for finer and drier particles. When loading sand, the best method is as follows:

Step 1. Enter the loading area fast, lowering the bowl slowly, and pick up as much material as possible using the momentum of the scraper unit. This will fill the hard-to-reach rear area of the bowl.

Step 2. Shift to a lower gear once the momentum is lost, and allow the pusher to assist.

Step 3. Pump the bowl up and down *(Figure 3-5)*. For best pumping results, drop the bowl as the scraper's rear wheels roll into the depression of the previously pumped area and raise the bowl as the wheels are climbing out of the depression.

Step 4. Drop the bowl sharply two or three times at the end of the loading area to top out the load. Then close the apron, raise the bowl, and exit the cut area.

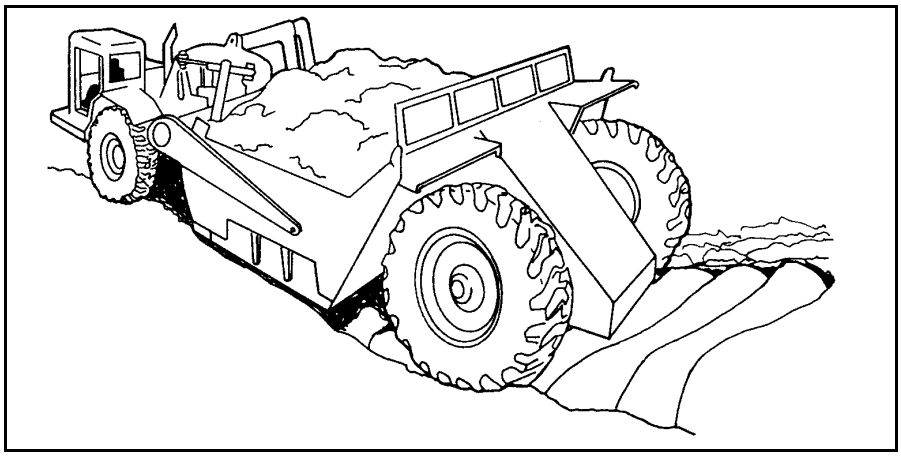

Figure 3-22. Pumping a Scraper Bowl to Load Sand

3-60. **Rock and Shale.** Loading rock and shale with a scraper is a difficult task that causes severe wear and tear on the equipment. Ripping will ease this problem. Ripping depth should exceed the depth of the scraper cut. When loading the scraper, leave a loose layer of ripped material under the tires to provide better traction and to reduce both track and tire wear. Some soft rock and shale can be loaded without ripping.

3-61. Start the scraper's cutting edge in dirt (if possible) when loading stratified rock. Move in to catch the blade in planes of lamination. This forces material into the bowl. Pick up loose rock or shale on the level or on a slight upgrade, with the blade following the lamination planes.

Load Time

3-62. Loading time is critical for obtaining maximum scraper production. Push loading should normally take less than one minute within a distance of 100 feet (time and distance change with the material being loaded). Studies of load volume versus loading time indicate that for a normal operation, about 85 percent of scraper load capacity is achieved in the first 0.5 minute of loading. Another 0.5 minute will only produce about another 12 percent increase in

load volume. Therefore, extra loading time (past about one minute) is not worth the effect because increased total cycle time will decrease production.

Borrow-Pit Operation

3-63. It is essential to have highly competent personnel in the borrow-pit area. Traffic control within the borrow-pit area reduces waiting time and excess travel of earthmoving support units. Maintaining adequate drainage throughout the borrow pit will reduce downtime caused by bad weather.

HAULING

3-64. Hauling, or travel time, includes the haul time and the return time. Here the power and traction characteristics of the scraper become very important. The following factors can greatly effect travel time.

Haul-Route Location

3-65. Lay out the haul routes to eliminate unnecessary maneuvering. Plan the job to avoid adverse grades that could drastically reduce production. Remember, where grades permit, the shortest distance between two points is always a straight line.

Road Maintenance

3-66. Keep haul roads in good condition. A well-maintained haul road permits traveling at higher speeds, increases safety, and reduces operator fatigue and equipment wear.

- **Ruts and rough surfaces.** Use a grader or dozer to eliminate ruts and rough (washboard) surfaces. (See *Chapter 4* for haul-road maintenance with a grader.)
- **Dust.** Use water distributors to reduce dust. Reducing the amount of dust helps alleviate additional mechanical wear, provides better visibility, and lessens the chance of accidents. Keeping roads moist (but not wet) allows them to pack into hard, smooth surfaces permitting higher travel speeds.

Travel Conditions

3-67. Once on the haul road, the scraper should travel in the highest safe gear appropriate for road conditions. When possible, carry the scraper bowl fairly close to the ground (about 18 inches). This lowers the center of gravity of the scraper and reduces the chance of overturning.

- **Lugging**. Avoid unnecessary lugging of the engine. Downshift when losing momentum. Lugging the engine usually results in a slower speed than the top range of the next lower gear. Although the machine can make it, it is best to downshift and accelerate faster. Lugging causes a decrease in engine revolutions per minute (rpm) thereby reducing hydraulic pressure. This will result in a loss of steering control.
- **Coasting**. Never coast on a downgrade. When approaching a downgrade, slow down and downshift the transmission. To prevent unwanted upshifting, use the transmission hold on a downgrade if it is available. Also, use it when approaching an upgrade or in rough