NEXT GEN EQUIPMENT TRAINING

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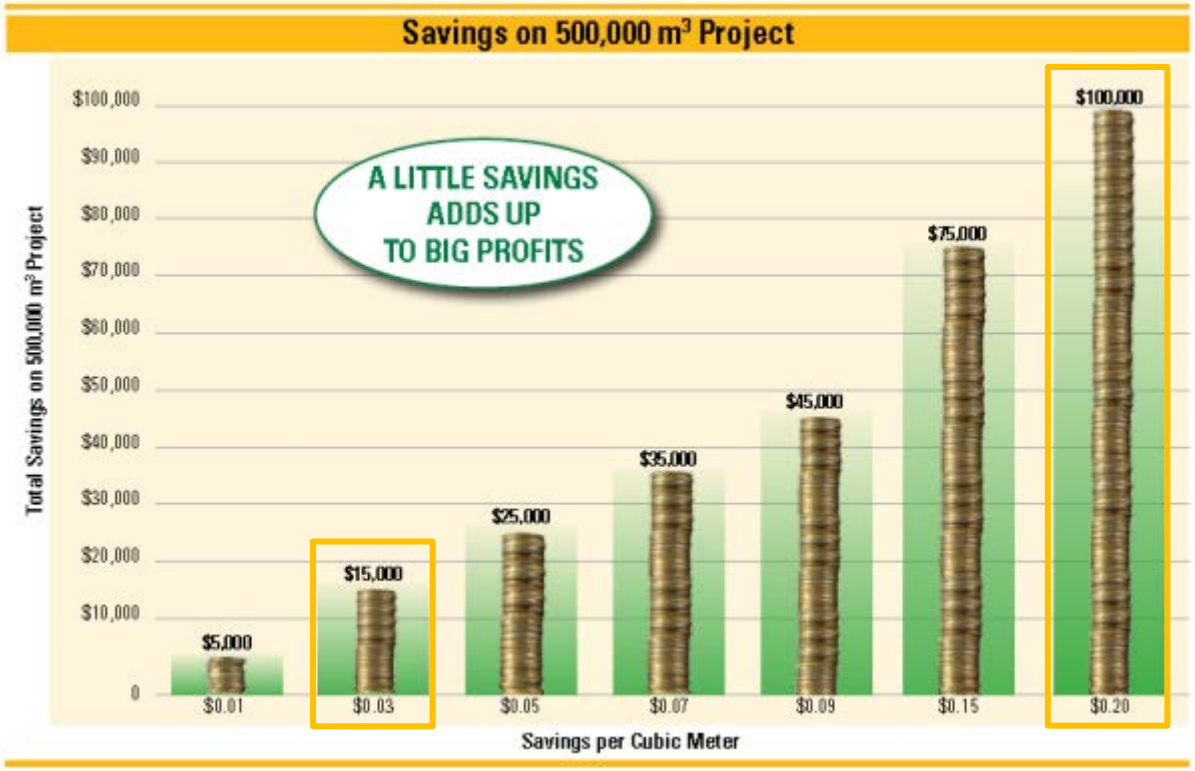
Impact of Cost per Unit…

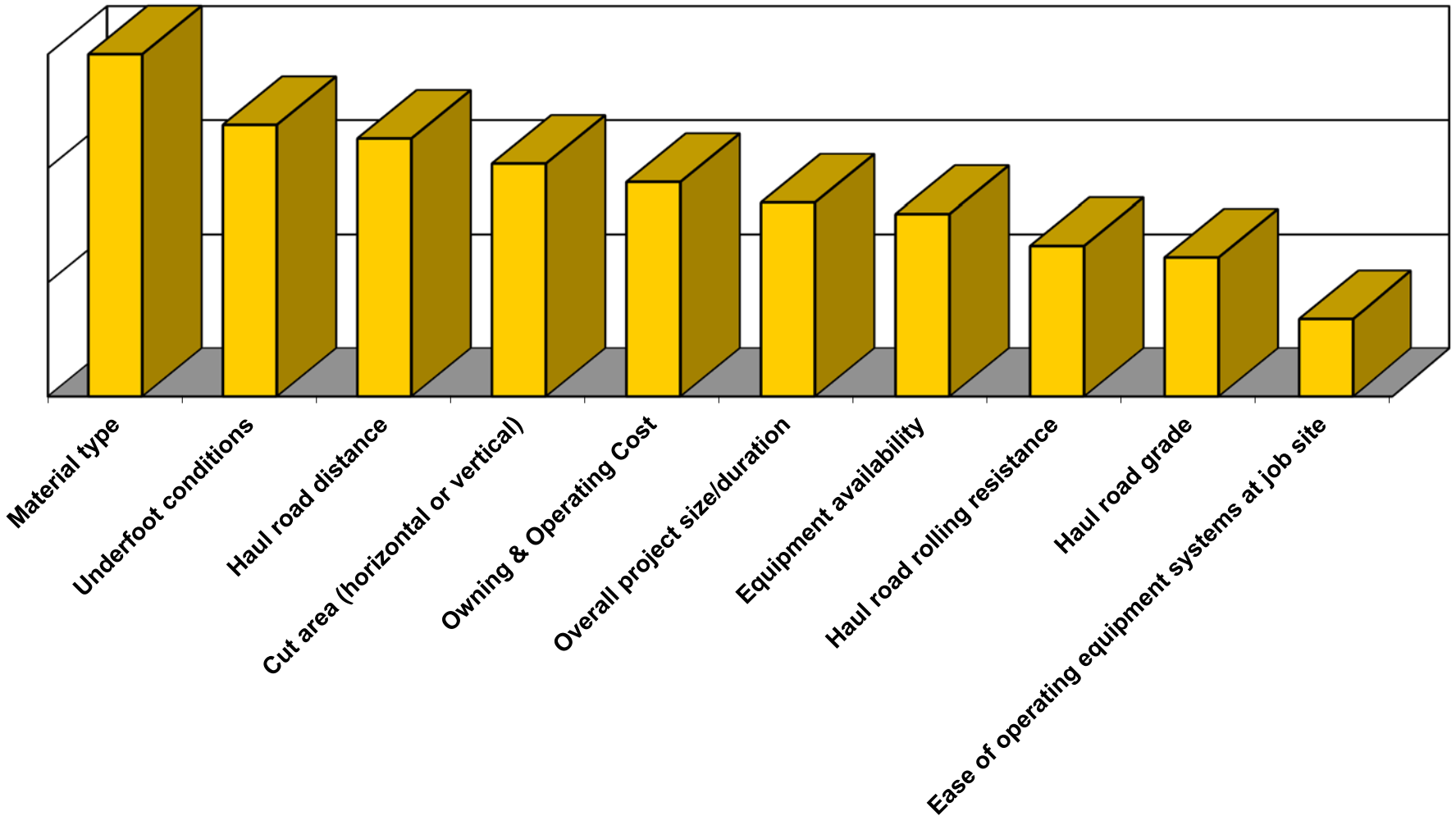
Whatever your application, the **key to profitability** is to get the job done as **efficiently as possible** by achieving the **lowest cost per unit** of material moved — getting the most productivity with the least amount of input.



What is the best machine for these applications?

There is <u>NO ONE SPECIFIC</u> earth moving system that represents the lowest cost per meter *<u>for all jobs</u>*.

Customer’s Job Characteristic Ranking

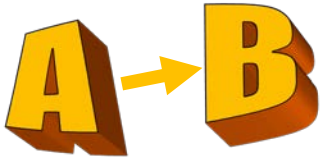


Discover the right hauling system for the work you do...

1. What type of material?
   - *Dirt, sand, gravel, rock, etc.? Densities?*
2. What are the underfoot conditions?
   - *Dry or wet? Smooth or Uneven?*
3. How much material has to be moved?
   - *How many tonnes? How many m^3?*
4. How far do we have to move the material?
   - *What is the total job cycle distance?*
5. What are the job site time/ production requirements?
   - *Time (months, years)? Production (tons/ h, m^3/ year)? Fuel Consumption (liters/ ton, liters/ hour, etc.) Rates (paid by ton moved/ equipment hour)?*

System Selection

- Identify required **system utilization**.
- Expend the **minimum** amount of **energy to move** the **maximum amount** of material.
- Move materials over the **shortest possible distance**



- **Move** the materials **once**

During a machine walk around, how do I know if I have the correct tire air pressure?

Correct Tire Pressure

2 – 2.5 lugs contacting the ground

Tire Pressure to high

1 – 1.5 lugs contacting the ground

Tire Pressure to low

3 – 4.5 lugs contacting the ground

During a machine walk around, how do I know if I have the correct tire air pressure?

Correct Tire Pressure

2 – 2.5 lugs contacting the ground

During a machine walk around, how do I know if I have the correct tire air pressure?

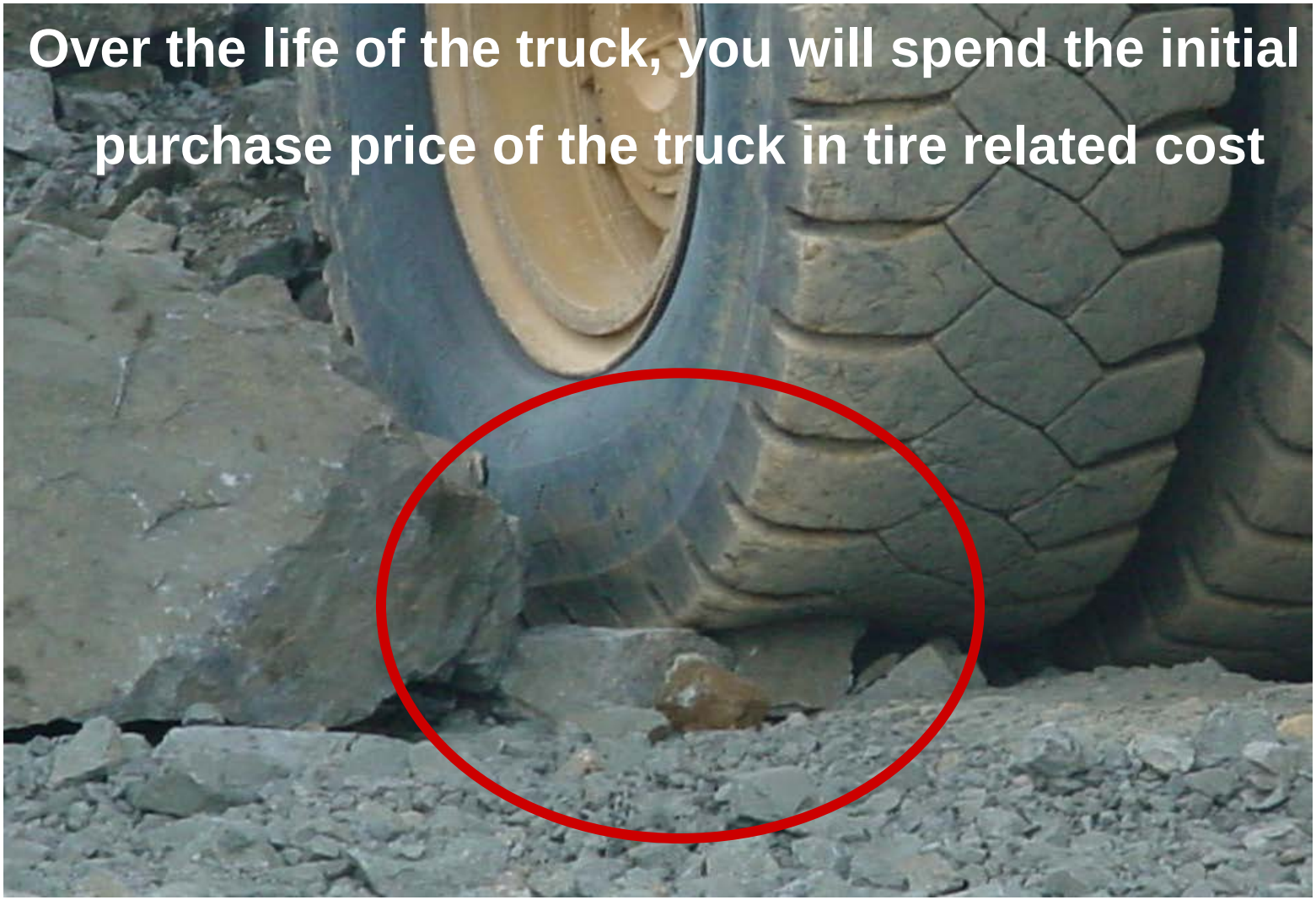
Tire Pressure too low

3 – 4.5 lugs contacting the ground

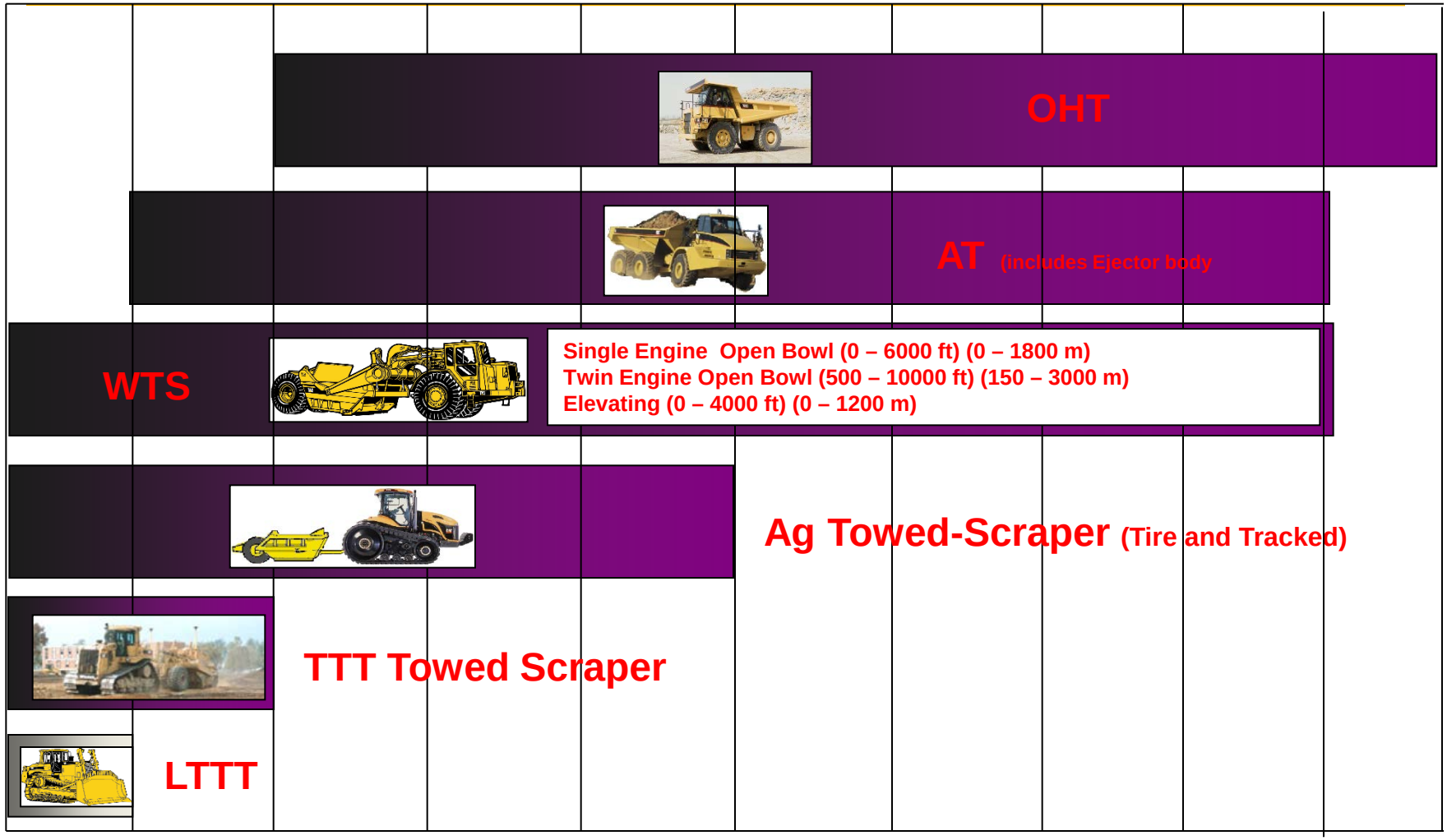
Influence of Pressure on Average Tire Life

Inflation Pressure	Life Reduction
Recommended Pressure	0%
10% Under Inflated	-10%
20% Under Inflated	-25%
30% Under Inflated	-70%
20% Over Inflated	-10%

Equipment Tires



Recommended Loaded Haul Distances



Dozer Track-type Tractors - Slot Dozing

- 152 m *(500 ft)* max. push
  - 5 & smaller 30m *(100 ft)* max.
  - D6 – D8: 76 m *(250 ft)* max.
  - D9 – D11: 152 m *(500 ft)* max.
- Push in 1st Gear
- Big Loads/ Slow Push
- Avoid 3R when Returning
- Minimize reverse distance
- Avoid track slip
- Steer with tilt cylinders
- Avoid sharp turns

Dozer Operating Techniques

- Make steering maneuvers in reverse
- Minimize time and distance in reverse
- Avoid 3rd gear tramming
- Tram in forward gear (2/3 throttle 2nd gear)
- Carry blade close to ground when tramming and ripping
- 1st gear when ripping (2/3 throttle)
- Use proper ripper tip and shank angle
  - Back for penetration
  - Forward for ripping (pins tractor to the ground)

Slot Dozing

- Windrows trap the material for larger blade loads
  - Increases blade load 10-30%
- Dimension of Slot
  - ¾ to full height of blade
    - NEVER higher than blade
- ⅓ blade width between slots
- Use it whenever you can!

Slot / Berm Dimensions

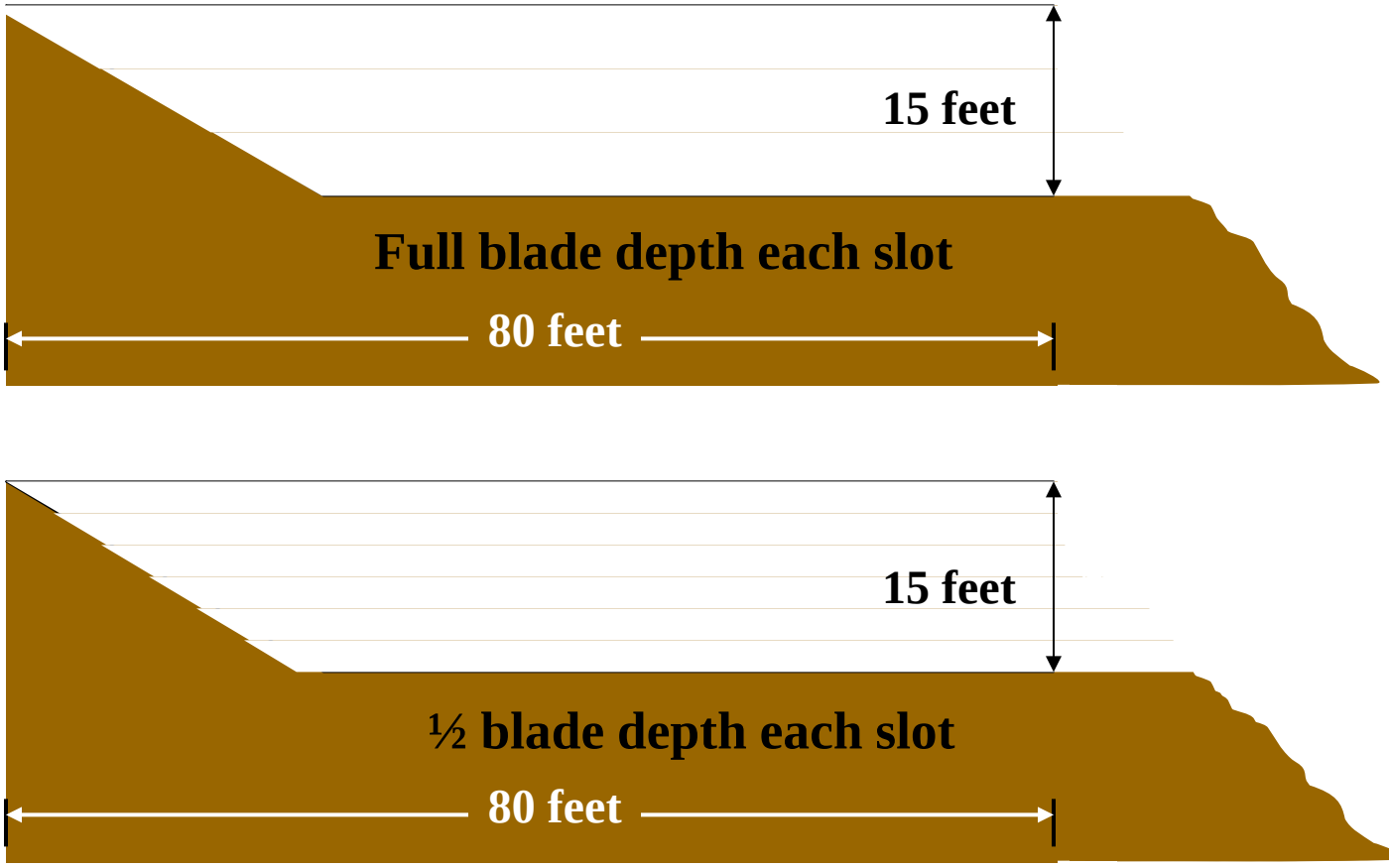
- **Height**

- **Width**

Slot Depth – ½ blade vs full blade

- Deeper slot = fewer passes, more efficient

- Fewer passes =
  - less fuel
  - lower GET cost
  - lower cost on undercarriage



Dozer Operating Techniques

- Back Each Pass

Dozer Operating Techniques

- Back Each Pass
- Back to Front

Dozer Operating Techniques

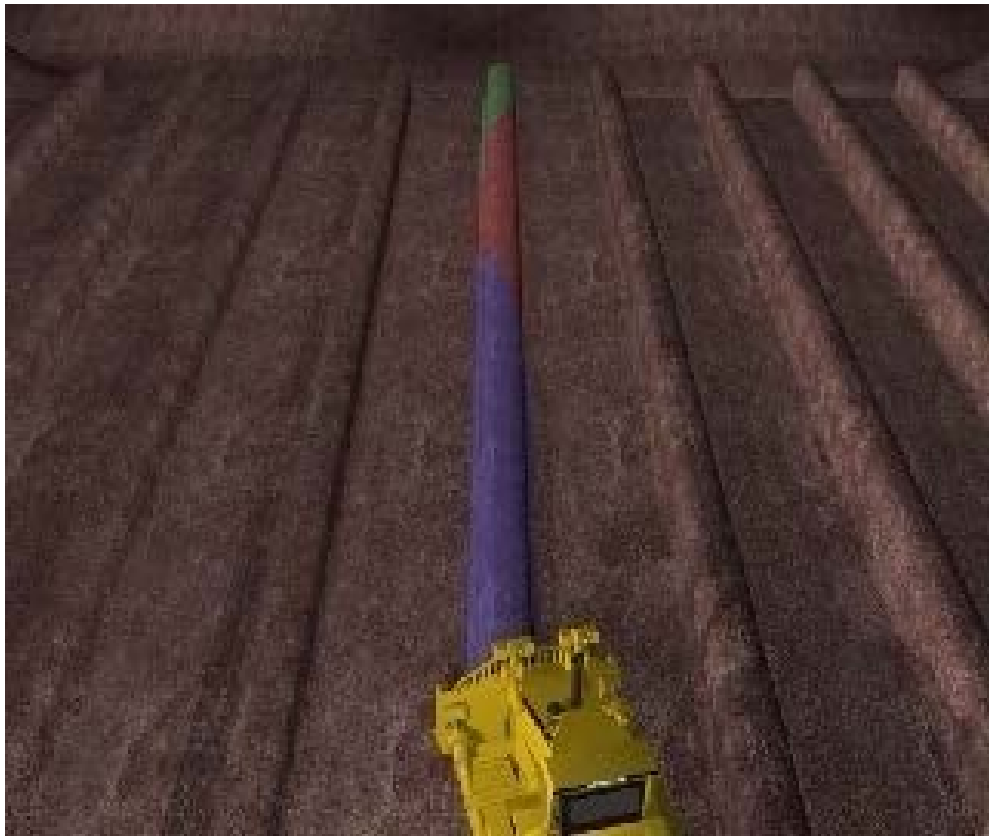
- Back Each Pass
- Back to Front
- Front to Back

Dozer Windrow / Berm Cleanup

- Straddle method
  - Less efficient
  - Straight dozing
  - Creates windrows once blade is full
  - More passes required

Dozer Windrow / Berm Cleanup

- Straddle method
  - Less efficient
  - Straight dozing
  - Creates windrows once blade is full
  - More passes required
- Criss-cross method
  - More efficient
  - Fill blade on angle to slot
  - Steer into slot with blade tilt cylinders
  - Use existing berm to hold material in front of blade



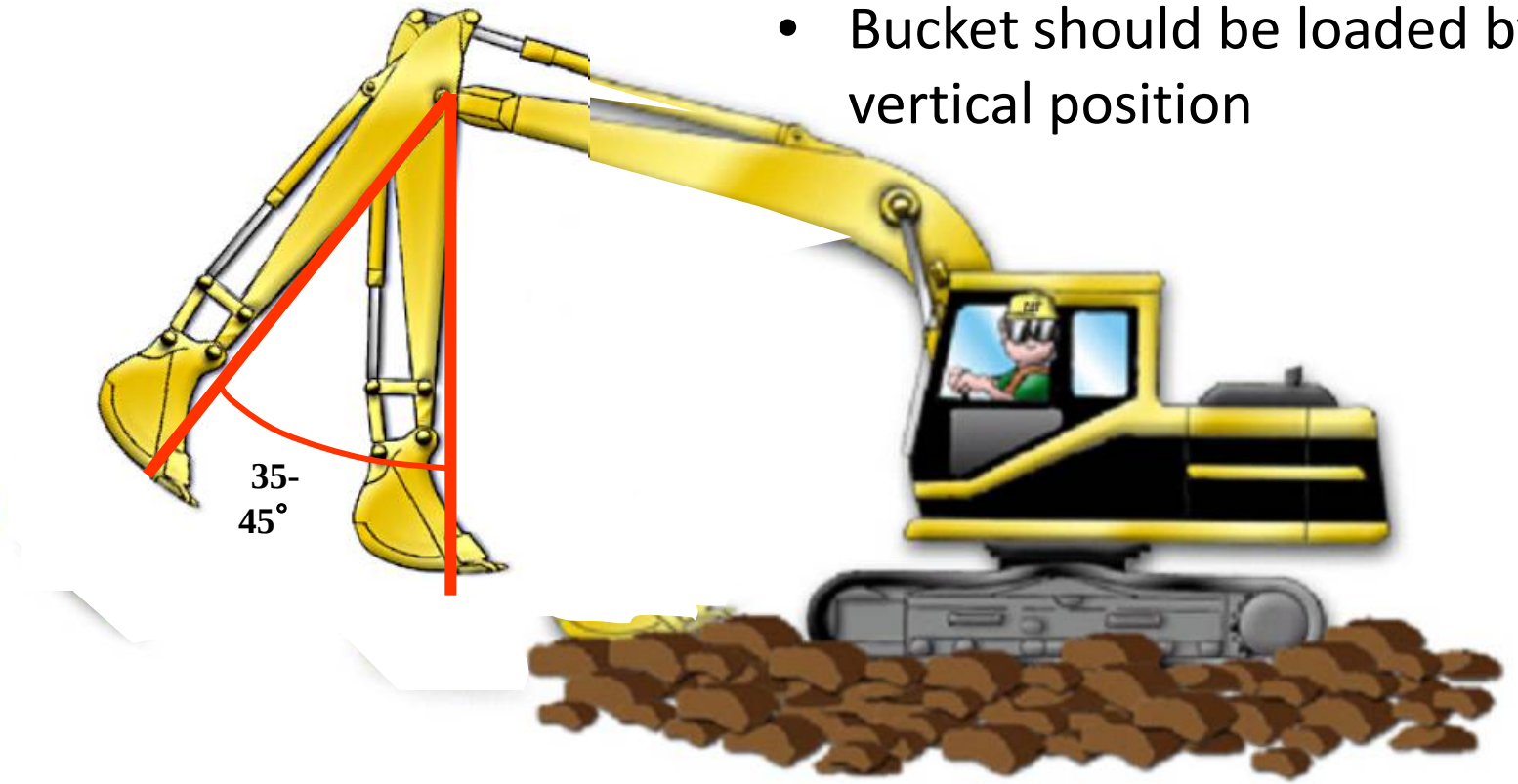
Dozer Ripping Techniques

- Rip in 1st gear
  - 1-1½ mph @ 2/3 throttle
- Plan ripping pattern
- Rip downhill whenever possible
- Rip as deep as possible without excessive track slip

- Use deceleration to avoid track slip
- Use proper shank height adjustment
- With ripper at depth, ripper frame should be parallel to ground
- Lift ripper before turning or backing up

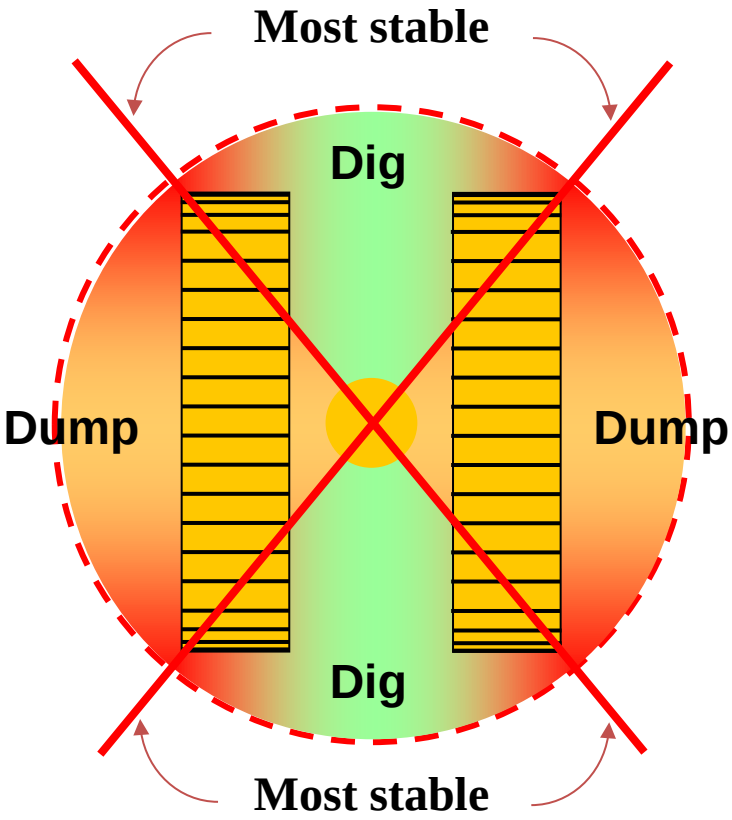
Excavator Proper Digging Range

- 35º-45º out from vertical to the vertical position
- Bucket should be loaded by vertical position



Excavator Digging Positions

- Larger platform = better stability
- Optimum:
  - Dig to front or rear
  - Dump to sides
- Long reach
  - Dig along diagonal



Hydraulic Excavator

- Three ways to increase productivity:
- 10 – 15% higher productivity when bench is correct height vs too high
- 15 – 20% higher productivity when trucks are spotted on the floor below the excavator vs trucks on same bench
- Shorten swings
  - 5% higher productivity when excavator swings 60º vs 90º
  - Possibly 35% more productive when excavator swings 15º vs 90ºº

The Cost of a Poor Pass Match (Bucket & Truck Size)

40 ton (Short Ton) Off-Highway Truck Example

	49T Excavator	74T Excavator
Bucket Capacity	2.69 m^3	3.80 m^3
Load Cycles to Achieve Target Payload	8	6
Maximum Trucks Loaded per Hour	23	30
Maximum Trucks Loader per 10 Hour Shift	230	300
Maximum Production per 10 Hour Shift	7747.2 Tonnes	10944.0 Tonnes

Assumptions:

- Target payload is 36,572 kg
- Weight of crushed stone is 1600 kg/m^3
- Average load cycle (with exchange time) is 20 seconds

"Making do" with a smaller excavator with poor pass match results in 29% less production.

Excavator Parameters

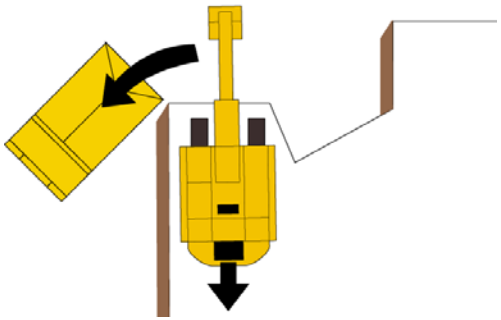
Optimum bench height	Length of stick, or between truck side-rail and dovetail
Cycle times	18 - 24 seconds (avg. 21 seconds)
Bucket fill factor in well-shot rock	80 – 110%
Most efficient pass match	4 – 6 passes

Bucket Face Time 5 – 7 Seconds

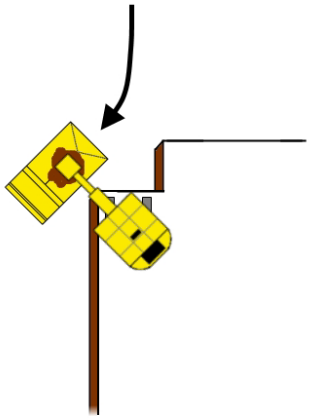
Loading Methods

Digging Techniques

Drive By



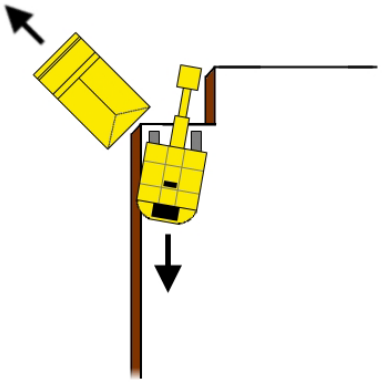
MODIFIED DRIVE-BY



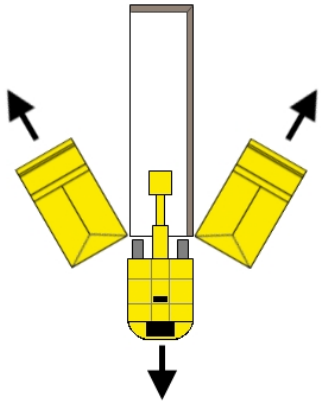
MEDIUM HAULS
1-2 KM

OVER THE RAIL

BETTER VISIBILITY
LONGER HAULS



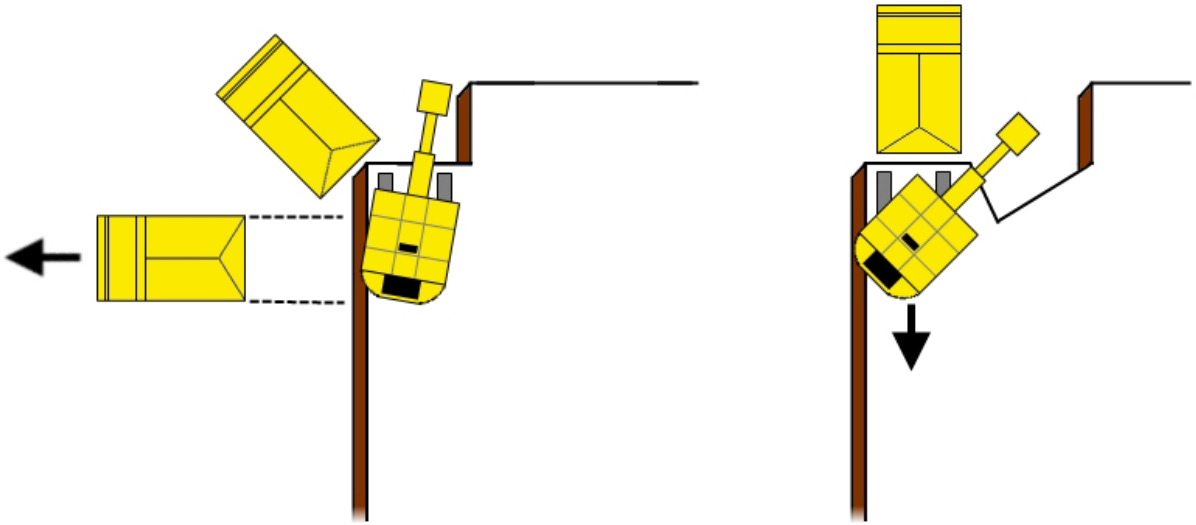
SAME LEVEL LOADING WITH TWO TRUCKS



TRUCKS LEAVE FORWARD
IMPROVED VISIBILITY
SHORT SWINGS 15-30 DEGREES

Loading Methods

Out of the Pocket



“DRIVE BY” LOADING TECHNIQUE *1/4 MILE (400M) OR LESS HAULS

- **Pros**
  - Most widely used truck loading method
  - Truck pulls straight in
  - Not a lot of operator training required
  - Good for quick, short cycles
  - Used to get the trucks moving
  - Truck fill factor not as important and truck cycle times
- **Cons**
  - Potential Bunching
  - Swings of 90º to 120º
  - Poor tech. for benches with weak angle of repose.
  - Keep stick at 90º when dumping
  - Indexing of tracks is a must
  - Visibility loading truck
  - Poor load positioning
  - Large sized buckets can take longer to dump
  - Limited bench width

DRIVE BY LOADING

“PARTIAL DRIVE BY” LOADING TECHNIQUE *1/4 MILE (400M) TO 1/2 MILE(800M) HAULS

- **Pros**
  - Shorter swings of 30º - 90º
  - Quicker loader cycles
  - Truck can pull straight away and not turn
  - Better visibility
  - Better load positioning
  - A bit better if you have a weak angle of repose
- **Cons**
  - Potential Bunching
  - Operator forced to back up
  - More operator training required
  - Potentially longer truck transition times
  - Large sized buckets can take longer to dump
  - Limited bench width

PARTIAL OR MODIFIED DRIVE BY LOADING TECHNIQUE

“90º OVER THE RAIL” LOADING TECHNIQUE * 1/2 MILE(800M) OR LONGER HAULS

- **Pros**
  - Longer Hauls
  - Better for weak angles of repose
  - Keeps truck tires off of bench and out of the debris
  - Truck fill factors more important than cycle times
  - Much better load positioning
- **Cons**
  - Longer loader cycle times
  - Swings of 90º- 120º
  - Longer truck transition times
  - More in-depth operator training
  - Trucks may have to turn when fully loaded
  - Restricted bench widths

90º OVER THE RAIL LOADING TECHNIQUE

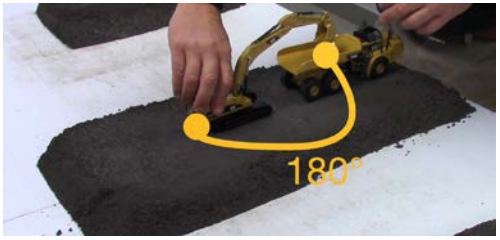
“OUT OF THE POCKET” LOADING TECHNIQUE * SUITABLE OF ALL HAULS

- **Pros**
  - Can be used on all Hauls
  - Shorter swings of 15º - 30º
  - Can load from both sides of the truck
  - 2nd truck can get positioned while first one is being loaded
  - Minimal truck transition times
  - Excellent for truck fill factors and load positioning
  - Trucks can pull straight away
  - Much wider bench width
    - Minimizes excavator tramming
- **Cons**
  - Trucks have to back up a bit
  - Much more operator training required
  - Trucks have to be on good footed materials

Out of the Pocket

“SAME LEVEL” LOADING TECHNIQUE

- 180º Over The Rail

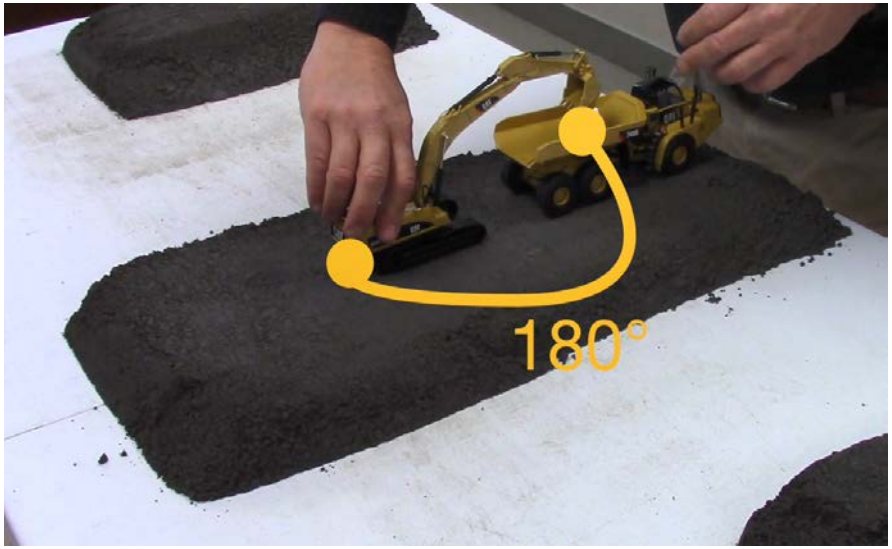


- 180º Through The Gate

- Out Of The Pocket

“SAME LEVEL” LOADING TECHNIQUE
“180º OVER THE RAIL”

- **Pros**
  - Good visibility into bed
  - Better truck load fill factors
  - Better truck load positioning
  - Great for working along roads and narrow areas
  - Minimizes real-estate needed
  - More focus on precision and perfection rather than production and performance
- **Cons**
  - Most time consuming truck loading technique
  - Longer truck transition times
  - Trucks usually have to back up a greater distance



“SAME LEVEL” LOADING TECHNIQUE
“180º THROUGH THE GATE”

- **Pros**
  - Can reduce loader cycle times by a few seconds

- **Cons**
  - Must have the real estate to set up this way
  - Trucks may have to turn under a load
  - Must **NEVER** swing a loaded bucket over the operators station

“SAME LEVEL” LOADING TECHNIQUE
“OUT OF THE POCKET”

- **Pros**
  - Shorter swings of 15º - 30º
  - Can load from both sides
  - Minimal truck transition times
  - Excellent for truck fill factors and load positioning
  - Trucks can pull straight away
  - Flexibility to keep trucks on same side while loading if site restricted
    - Set up more like a drive by technique

- **Cons**
  - Must have the real estate to set up this way
  - Trucks may have to turn under a load
  - Must **NEVER** swing a loaded bucket over the operators station

Loading Methods

Out of the Pocket

Wheel Loaders

Optimum bench height	Just above Boom/Bucket Pin at Full Hoist Position
Cycle times	30 – 38 seconds (avg. 35 seconds)
Bucket fill factor in well-shot rock	80 – 100%
Most efficient pass match	3 – 5 passes

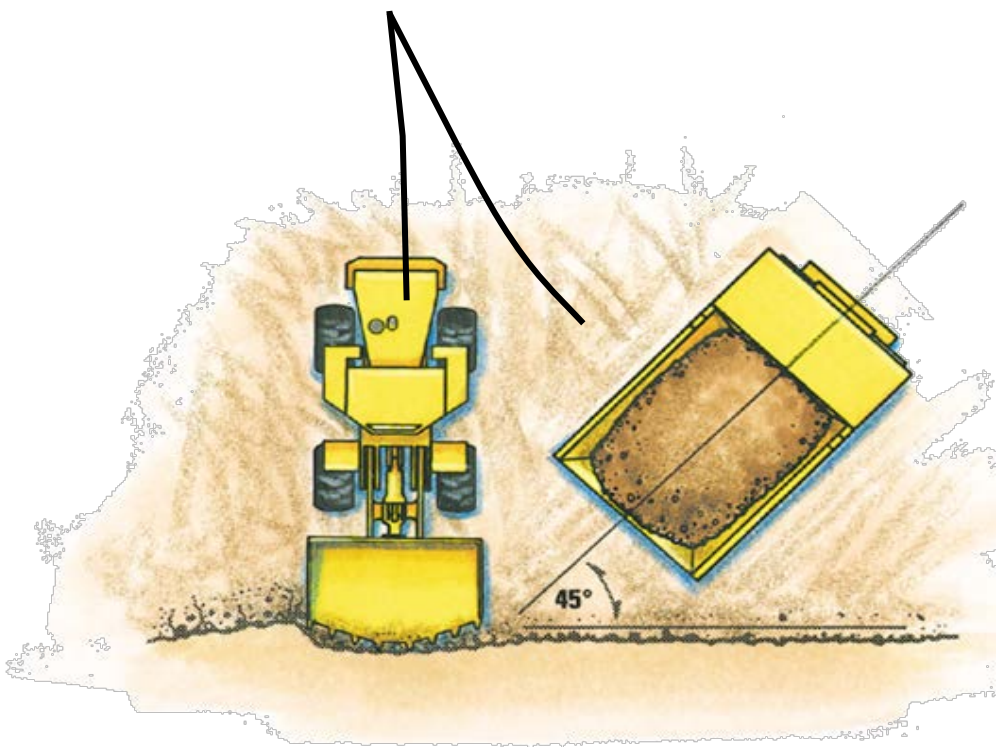
Bucket Face Time 9 – 12 Seconds

Wheel Loaders - Load & Carry System

- Max Loaded Haul: 76 m *(250 ft)* – 152 m
  - SWL 100’ Max
  - MWL (938-980): 250’ Max
  - LWL (988 - 994): 500’ Max
- Load in 1st Gear
- Load Straight Into Face
- Face Height Never Above Boom/Bucket Pin at Full Raise
- Carry Bucket Low
- Use Proper Speeds for Road Conditions
- Minimize Bucket Height When Dumping

Loader Operating Tips

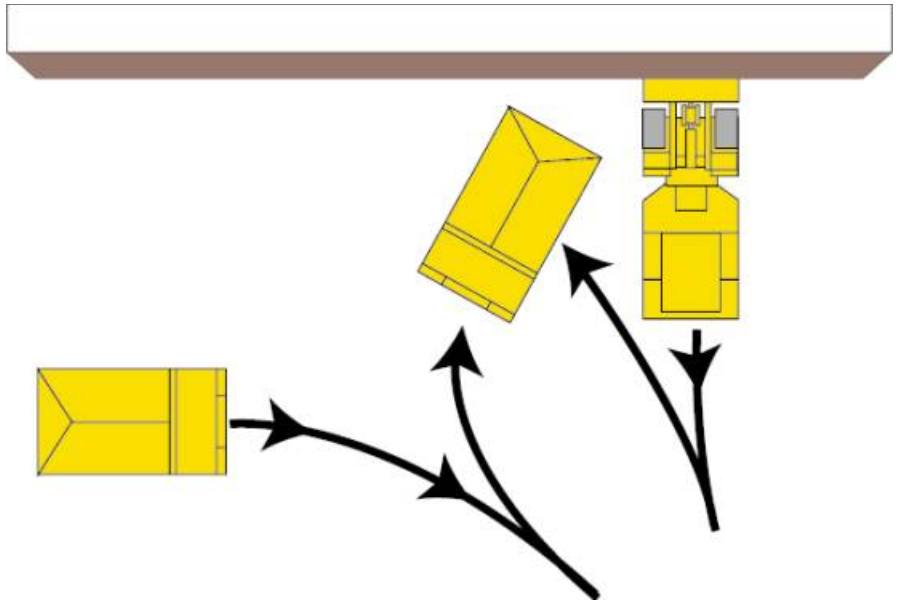
- Position loader 1-1½ wheel revolutions from face to truck
- Enter pile straight on
- Keep frame straight when digging
- Transmission in 1st gear when digging
- Use tight V pattern
- Work face 1½ to 2 buckets wide
- Spot trucks at 45º



Truck Exchange

Truck exchange time:

- Elapsed time from when loaded truck receives last pass until next truck receives first loading pass
- Exchange time:
  - Good - 30 seconds or less
  - Acceptable - 42 seconds



Loader Operating Tips

- Loading time in face below 12 seconds
- Lift bucket before crowding
- Bucket should be full when lift arms are horizontal
- Spot trucks with a loaded bucket
- Pad bed when loading oversize rocks
- Avoid tire spin/engine lugging
- Maintain smooth floor, good drainage

Loader Operating Tips

- Wet rocks cut tires easier
- Keep loose rocks off the floor
- Clean floor between trucks
- Minimize wait time
- Minimize truck maneuvering when loaded
- Keep rear tires of truck off pile
- Never operate a bare edge

Load Placement

- Should be centered
  - **Front-to-back, side-to-side**
  - **Truck Payload System/VIMS**
- Shifted to front
  - **Front brakes, bearings, tires, steering, hydraulic hoist, body rest pads and canopy**
- Shifted to rear
  - **Final drive, rear tires**
  - **Unstable payload, spillage**
- Shifted to side
  - **Final drive, bearings, hoist cylinders, and pivot bore areas**
  - **Unstable payload, spillage**

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