LECTURE 3

TRUCKS & HAULING EQUIPMENT
OUTLINE

1. Introduction
2. Classification of Trucks
3. Factors Affecting Haulers’ Productivity
4. Calculating Truck Productivity
1. Introduction

HAULING:
To Haul/Transport Dirt (on/off road) over a Long Distance

- Trucks are hauling units that provide relatively low hauling cost.
- The productive capacity of a truck depends on size of load and the number of trips it can make in an hour.
- Truck function: in transporting excavated material, processed, aggregates and construction material.
2. Classification of Trucks

- Method of dumping the load
  - Rear-dump
  - Bottom-dump
  - Side-dump
  - Articulated dump truck

- Capacity
  - Gravimetric: carried load expressed as weight in tons
  - Volumetric/struck volume: carried load expressed as volumetric amount in cubic meter/cubic yard
Method of dumping the load

Type of Dump Truck
- Bottom Dump Truck

- Dump Trucks
Side Dump Truck

Articulated Truck
Volvo Truck Family
When it comes to performance, **SIZE DOES MATTER**

- **930E Komatsu**
  - Empty: 200 tons
  - Loaded: 500 tons (211 M$^3$)

All dimensions are with 211 m$^3$ 276 yd$^3$ body.
Type of frame

Type of Dump Truck
3. Factors Affecting Haulers’ Productivity

- Types and characteristics of soils
- Payload
  - (volume / weight)
  - Empty vs. Loaded
- Roads
  - Haul - Return
  - Grades
  - Distance
- Efficiency and condition of equipment
- Efficiency and condition of work
- Loader’s Capacity / Productivity
Loading and Hauling Cycle

- Loading Cycle
  - excavation
  - loading

- Hauling and Dumping Cycle
  - hauling
  - spreading
  - compaction

- Loosening (swelling)
  - return

- Compacting (shrinkage)
4. Calculating Truck Productivity (1)

Analyzes the performance of 22 ton rear dump trucks being loaded by hydraulic hoe having 3 cy bucket and the hoe should be able to cycle in 20 sec. Rear dump trucks with specification as follow are used to haul sandy clay material.

Struck, 14.7 cy
Heaped 18.3 cy

Net weight empty = 36,860 lb; speed 22 mph
Payload/muatan = 44,000 lb
Max Gross vehicle weight = 80,860 lb

Truck speed at gross v. weight 72000-73000 = 16 mph
Truck speed at gross v. weight 73000-74000 = 15 mph
Truck speed at gross v. weight 74000-75000 = 14 mph
Truck speed at gross v. weight 75000-76500 = 13 mph

The haul route from loading point to the waste site is 3 mile
Dump time 2 min, the sandy clay has a loose unit weight of 2,150 lb/cy
Efficiency estimate for this work is a 50 min hour
STEP 1
The bucket fill factor for the hoe handling sandy clay has been determined to be 110%. The heaped capacity of the truck is 18.3 lcy, truck fill factor is estimated at 100%.

Therefore the hoe volume bucket $3 \text{ cy} \times 1.1 \Rightarrow 3.3 \text{ lcy}$

Balance number of bucket

\[
\frac{18.3 \text{ (lcy)}}{3.3 \text{ (lcy)}} = 5.5 \text{ bucket}, \text{ can be 5 or 6 bucket per truck}
\]
STEP 2

Load Time = N of bucket loads x excavator cycle time

Load Time (5 bucket) : \( 5 \times \frac{20 \text{ sec}}{60 \text{ sec/min}} = 1.7 \text{ min} \)

Load volume bucket (5 bucket): \( 5 \times 3.3 \text{ lcy} = 16.5 \text{ lcy} \)
Check load weight 16 lcy x 2150 lb/lcy = 35.475 lb
35.475 lb < 44.000 lb payload \( \rightarrow \) okay

Load Time (6 bucket) : \( 6 \times \frac{20 \text{ sec}}{60 \text{ sec/min}} = 2 \text{ min} \)

Load volume bucket (6 bucket): \( 6 \times 3.3 \text{ lcy} = 19.8 \text{ lcy} \)
Check load weight 19.3 lcy x 2150 lb/lcy = 39.345 lb
39.345 lb < 44.000 lb payload \( \rightarrow \) okay
**STEP 3**

\[ Haul Time = \frac{Haul distance}{Haul Speed} \]

Haul Time (5 bucket) : \( \frac{3}{16 \text{ mph}} \) = 11.3 min

Haul Time (6 bucket) : \( \frac{3}{13 \text{ mph}} \) = 13.9 min

gross v. weight = empty truck net weight + weight of load

5 bucket
gross v. weight = 36860 + 35475 \( \rightarrow \) 72335 lb

6 bucket
gross v. weight = 36860 + 39345 \( \rightarrow \) 76205 lb
STEP 4

\[
Return\ Time = \frac{Return\ distance}{Haul\ Speed}
\]

Return Time: \[
\frac{3}{22\ mph} = 8.3\ min
\]

STEP 5

Dump time 2 min
■ **STEP 6**

**Truck Cycle Time**

TCT = (LT + HT + DMT + RT)

5 Bucket = 1.7 + 11.3 + 2.0 + 8.2
= 23.2

6 Bucket = 12.0 + 13.9 + 2.0 + 8.2
= 26.1
STEP 7

Number Truck Required = \( \frac{\text{Truck cycle time}}{\text{excavator cycle time}} \)

N truck Required (5 bucket) : \( \frac{23.2}{1.7} = 13.7 \)

N truck Required (6 bucket) : \( \frac{26.1}{2 \text{ min}} = 13.1 \text{ min} \)
STEP 8 (1)

The Production if an integer number of Truck lower than the result of Number Truck Required

Production = Truck Load x Numbers of Truck x $\frac{60 \text{ min}}{\text{Truck cycle time}}$

The Production if an integer number of Truck Greater than the result of Number Truck Required

Production = Truck Load x $\frac{60 \text{ min}}{\text{Excavator cycle time}}$
**STEP 8 (2)**

Production 5 bucket and 13 trucks $= 16.5 \times 13 \times \frac{60 \text{ min}}{23.2} \times \frac{50 \text{ min}}{60} = 462 \text{ lcy/br}$

Production 5 bucket and 14 trucks $= 16.5 \times \frac{60 \text{ min}}{1.7} \times \frac{50 \text{ min}}{60} = 485 \text{ lcy/br}$
STEP 8 (3)

Production 6 bucket and 13 trucks = \(18.3 \times 13 \times \frac{60 \text{ min}}{26.1} \times \frac{50 \text{ min}}{60} = 456 \text{ lcy/hr}\)

Production 6 bucket and 14 trucks = \(18.3 \times \frac{60 \text{ min}}{2} \times \frac{50 \text{ min}}{60} = 457 \text{ lcy/hr}\)
4. Calculating Truck Productivity (2)

**Given information:**
- Excavator production at 100% efficiency = 283 bcm/h
- Job efficiency = 75%
- Truck capacity = 15.3 bcm
- Truck cycle time = 0.5 h (excluding loading)

**a. Calculate number of trucks**

**b. Calculate expected production if two trucks are broken**

**Solution**

**Step 1**

\[
\text{Load time} = \frac{\text{truck unit capacity}}{\text{loader production at 100\% efficiency}}
\]

*Or Load time number of bucket load x excavator cycle time*
4. Calculating Truck Productivity (2)

Step 2

\[ \text{Number of trucks required } (N) = \frac{\text{truck unit cycle time}}{\text{load time}} \]

\[ \text{Expected production} = \text{Actual number of unit} \times \text{excavator production at job efficiency} \]

Solution:

..........................
Safety First!!!!
THANK YOU