Chapter # 4 Part #1

1) A tractor scraper hauls its rated payload 4000 ft up a 5% grade from the cut to fill and returns empty over the same route. The rolling resistance factor for the haul road is 120 lb/ton. Estimate the scraper travel time.

Solution:

At hauling, scraper is loaded

Grade = + 5%, rolling resistance factor = 120 lb/ton

Effective Grade % = Grade % + (Rolling Resistance factor lb/ton) / 20

Effective Grade % = 5% + 120/20 = 11%

From figure 4 – 4;

Hauling time = 5.2 min.

At retaining, scraper is empty

Grade = −5 %, rolling resistance factor = 120 lb/ton

Effective Grade % = −5% + 120/20 = 1%

From figure 4 – 5;

Retuning time = 1.6 min.

Scraper travel time = hauling time + retuning time

Scraper travel time = 5.2 + 1.6 = 6.8 min.

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2) A power shift crawler tractor is excavating loose common earth and pushing it a distance of 120 ft. Maximum reverse speeds are: first range, 3 mph; second range, 5 mph; and third range, 8 mph. Rated blade capacity is 11 LCY. Estimate dozer production if the job efficiency factor is 0.75.

Solution:

Production = (Rated Blade Capacity /Cycle Time) × Job Efficiency

Cycle Time = Fixed Time + Dozing Time + Retuning Time

● Fixed time:

From table 4 – 4; fixed time = 0.05 min

● Dozing time:

Pushing distance = 120 ft.

From table 4 – 5, dozing speed = 2.5 mph

Dozing time = $\frac{Pushing\ \ Distance}{Dozing\ \ Speed} = \frac{120\ ft}{2.5\ mp\,h \times 88\ \frac{ft/min}{mp\,h}}$ = 0.55 min

● Retuning time:

Retuning distance = 120 ft.

From table 4 – 5, retuning speed = 8 mph

Dozing time = $\frac{Retuning\ \ Distance}{Retuning\ \ Speed} = \frac{120\ ft}{8\ mp\,h \times 88\ \frac{ft/min}{mp\,h}}$ = 0.17 min

➔ Cycle Time = 0.05 + 0.55 + 0.17 = 0.77 min

➔ Production = (11 LCY /0.77) × 0.75 = 10.71 LCY/ min = 642.86 LCY/hr.

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3) How many hours should it take an articulated wheel loader equipped with a 4 yd bucket to load 3000 cu yd of gravel from a stockpile into rail cars if the average haul distance is 300 ft one way? The area is level with a rolling resistance factor of 120 lb/to. Job efficiency is estimated at 50 min/hr. bucket fill factor = 1.

Solution:

Production = (Bucket Volume /Cycle Time) × Job Efficiency

Bucket Volume = 4 LCY × 1 = 4 LCY.

Job Efficiency = 50 (min/hr) / 60 (min/hr) = 0.833 = 83.33%

Cycle Time = Basic time + Travel Time

● Basic Time:

From table 4 – 6, basic time = 0.65 min.

● Travel Time:

The area is level ➔ Grade = 0 %, rolling resistance factor = 120 lb/ton

Effective Grade % = Grade % + (Rolling Resistance factor lb/ton) / 20

Effective Grade % = 0 % + (120 lb/ton) / 20 = 6 %

From figure 4 – 14, travel time ≈ 0.5 min

➔ Cycle Time = 0.65 + 0.5 = 1.15 min

➔ Production = (4 LCY /1.15 min) × 0.833 = 2.899 LCY/min = 173.9 LCY/hr

No. of hours = Total Volume/ Production

No. of hours = 3000 (LCY)/ 173.9 (LCY/hr) = 17.25 hours = 17 hours and 15 minutes.

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