Civil Engineering

CVG 4173 **Construction Management**

Due on: 22/11/2012 SOLUTION Assignment # 3

Question 1:

A small hydraulic excavator will be used to dig a trench in hard clay (bucket fill factor = 0.80). The minimum trench size is 26 in. (0.66m) wide by 5 ft (1.53m) deep. The excavator bucket available is 30 in. (0.76m) wide and has a heaped capacity of ¾ yd^3 (0.57 m^3). The maximum digging depth of the excavator is 16 ft (4.9m). The average swing angle is expected to be 85°. Estimate the hourly trench production in linear feet (meters) if job efficiency is 70%.

Solution:

Actual volume/ft of trench = $\frac{30}{12} \text{ x } 5 \text{ x } \frac{1}{27} = 0.46 \text{ BC}$

Load factor = 0.77 (From table)

Standard cycles/h = 160 (From table)

% maximum depth = $\frac{5.0}{16.0} \text{ x } 100 = 31\%$

Swing-depth factor = 1.16 (From table)

(85° swing, 31% maximum depth)

Heaped bucket volume = 0.75 LCY (0.57 LCM)

Bucket fill factor (average) = 0.80 (From table)

Job efficiency = 0.70

Trench adjustment factor = 0.98 (From table)

Production (loose) = C x S x V x B x E

= 160 x 1.16 x 0.75 x 0.80 x 0.70 x 0.98 = 76 LCY/h

Trench production = $\frac{59}{0.46} = 128 \text{ ft/h}$

Question 2:

Estimate the time required to load 500 yd^3 (382m^3) of gravel from a stockpile into trucks using a clamshell having a heaped capacity of 0.75 yd^3 (0.57m^3). Estimated cycle time is 20 s. Job efficiency is estimated to be 50 min/hr.

Solution:

Bucket fill factor (average) = 0.95 (From table)

Bucket load = 0.75 x 0.95 = 0.71 LCY

Job efficiency = 50 / 60 = 0.833

Production = volume/cycle x cycles/h (include efficiency)

$$= 0.71 \text{ x } \frac{3600}{20} \text{ x } 0.833 = 106 \text{ LCY/h}$$

Time required = $\frac{500}{106} = 4.7 \text{ h}$

Question 3:

A 4 yd^3 (3.06m^3) (heaped) hydraulic shovel with a bottom-dump bucket is excavating tough clay. The swing angle is 150^o and job efficiency is 50 min/hr. Estimate the shovel's hourly production in bank measure.

Solution:

Standard cycles/h = 150 (From table)
Swing factor (150^o swing) = 0.89 (From table)
Heaped bucket volume = 4.0 LCY
Bucket fill factor (average) = 0.80 (From table)
Job efficiency = 50 / 60 = 0.833
Load factor = 0.77 (From table)
Production (loose) = C x S x V x B x E
= 150 x 0.89 x 4.0 x 0.80 x 0.833 = 356 LCY/h
= 356 x 0.77 = 274 BCY/h

Question 4:

A tractor-scraper has a rated payload of 4,000 ft (1,220m) up a 5% grade from the cut to the fill and returns empty over the same route. The rolling resistance factor for the haul road is 120 lb/ton (60kg/t). Estimate the scraper travel time.

Solution:

Effective grade haul = 12%

Effective grade return = 4%

Maximum speed haul = 6.8 mph (From graph)

(12% effective grade, rated load)

Maximum speed return = 31 mph

(4% effective grade, empty)

Average speed factor haul = 0.86 x 0.86 = 0.74 (From table)

Haul time = $\frac{2000}{6.8 \text{ x } 0.74 \text{ x } 88} = 4.5 \text{ min}$

Return time = $\frac{2000}{31 \text{ x } 0.74 \text{ x } 88} = 1.0 \text{ min}$

Travel time = 4.5 + 1.0 = 5.5 min

Question 5:

A power-shift crawler tractor is excavating tough clay and pushing it a distance of 95 ft (29m). Maximum reverse speeds are as follows: first range, 3 mi/h (4.8km/h); second range, 5 mi/h (8.0km/h); and third range, 8 mi/h (12.9km/h). Rated blade capacity is 10 LCY (7.65 LCM). Estimate the dozer production if the job efficiency factor is 0.83.

Solution:

Blade load = 10 LCY

Fixed cycle time = 0.15 min (From table)

Haul time = $\frac{95}{1.5 \text{ x } 88} = 0.72 \text{ min}$

Return time = $\frac{95}{5 \text{ x } 88} = 0.22 \text{ min}$

Cycle time = 0.15 + 0.72 + 0.22 = 1.09 min

Production = $10 \text{ x } \frac{60}{1.09} \text{ x } 0.83 = 457 \text{ LCY/h}$