Chapter # 2 Part # 2

1) Estimate the actual volume of common earth in bank measured carried by a hydraulic excavator bucket whose heaped capacity is 2.5 cu yd.

Solution:

From table 3 – 2, Bucket fill factor = $\frac{0.8+1.10}{2}$ = 0.95

Bucket load = 2.5 LCY × 0.95 = 2.38 LCY

From table 2 − 5, load factor = 0.8

Bucket load = 2.38 LCY × 0.8 = 1.9 BCY

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2) A 3.5 yd hydraulic shovel with bottom dump bucket is excavating tough clay. The swing angle is 120° and job efficiency is 75%. Estimate the shovel's hourly production in bank measure.

Solution:

Shovel's hourly production (LCY/hr) = $C \times S \times V \times B \times E$

From table 3 – 6, C = Cycles/hr = 150 cycles/hr.

From table 3 – 6, S = Swing factor = 0.94

V = Heaped bucket volume in LCY = 3.5 LCY.

From table 3 – 2, B = bucket fill factor = $\frac{0.65+.95}{2}$ = 0.8

E = Job efficiency = 75% = 0.75

Shovel's hourly production (LCY/hr) = $150 \times 0.94 \times 3.5 \times 0.8 \times 0.75$ = 296.1 LCY/hr

From table 2 – 5, load factor = 0.77

Shovel's hourly production (BCY/hr) = 296.1 LCY/hr × 0.77 = 228 BCY/hr

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3) A hydraulic excavator is excavating the basement of a building. Heaped bucket capacity is 1.5 cu yd. The material is common earth with a bucket fill factor of 0.9. Job efficiency is estimated to be 50 min/hr. The machine's maximum depth of cut is 24 ft and the average digging depth is 13 ft. Average swing angle is 90°. Estimate the hourly production in bank measure.

Solution:

Backhoe's hourly production (LCY/hr) = $C \times S \times V \times B \times E$

From table 3 – 3, C = Cycles/hr = 160 cycles/hr.

S = Swing factor

Depth of cut (% of maximum) = $\frac{actual\ \ dept\ h}{optimum\ \ dept\ h} \times 100 = \frac{13\ ft}{24\ ft} \times 100 = 54\%$

➔ From table 3 – 4,

@ 50 % of maximum, S = 1.1

@ 70 % of maximum, S = 1.0

➔ S @ 54% of maximum = $1.1 - \frac{1.1+1.0}{0.7-0.5} \times (0.7 - 0.54) \approx 1.02$

V = Heaped bucket volume in LCY = 1.5 LCY.

From table 3 – 2, B = bucket fill factor = $\frac{0.8+1.10}{2} = 0.95$

E = Job efficiency = $\frac{50\ min\ /hr}{60\ min\ /hr} = 83\% = 0.83$

Backhoe's hourly production (LCY/hr) = $160 \times 1.02 \times 1.5 \times 0.95 \times 0.83$ = 193 LCY/hr

From table 2 – 5, load factor = 0.8

Backhoe's hourly production (BCY/hr) = 193 LCY/hr × 0.8 = 154.4 BCY/hr

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4) A small hydraulic excavator is used to dig a trench in hard clay. The minimum trench size is 26 in wide by 4.8 ft deep. The excavator bucket available is 30 in. wide and has a heaped capacity of .75 cu. The maximum digging depth of the excavator is 16 ft. The average swing angle is expected to be 85°. Estimate the hourly trench production in linear feet if job efficiency is 70%.

Solution:

From table 3 – 3, C = Cycles/hr = 160 cycles/hr.

S = Swing factor

Depth of cut (% of maximum) = $\frac{actual\ \ dept\ h}{optimum\ \ \ dept\ h} \times 100 = \frac{4.8\ ft}{16\ ft} \times 100 = 30\%$

➔ From table 3 – 4, S @ angle of swing of 85° by interpolation ≈ 1.17

V = Heaped bucket volume in LCY = 0.75 LCY.

From table 3 – 2, B = bucket fill factor = $\frac{0.65+0.95}{2} = 0.8$

E = Job efficiency = 70% = 0.7

Backhoe's hourly production (LCY/hr) = $160 \times 1.17 \times 0.75 \times 0.8 \times 0.7 = 78.6$ LCY/hr

From table 2 – 5, load factor = 0.77

Backhoe's hourly production (BCY/hr) = 78.6 LCY/hr × 0.77 = 60.5 BCY/hr

From table 3 – 5, Adjustment factor for trench production = $\frac{0.95+1.0}{2} = 0.98$

Backhoe's hourly trench production (BCY/hr) = 60.5 BCY/hr × 0.98 = 59.3 BCY/hr

Depth of trench = minimum trench width × S = 26 in. × 1.17 = 30.4 in.

Cross section area = $\frac{30.4\ in}{12\ in/ft} \times 5\ ft = 12.675\ ft^2$

Linear production = $\frac{Production}{area} = \frac{59.3\ BCY/hr\ \times 27\ cu\ ft/cu\ yd}{12.675\ ft^2} = 126.32$ ft/hr

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Homework: Chapter #3, Problems: 5 , 6 and 9.