**For cotm 3rd year 2nd semester regular and extension students.**

**Construction equipment and plant management course supportive examples and answers**

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***Equipment production estimation example***

1. Estimate the production in loose cubic yards per hour for a medium-weight clamshell excavating loose earth. Heaped bucket capacity is1cuyd (0.75m 3 ).The soil is common earth with a bucket fill factor of 0.95. Estimated cycle time is 40 s. Job efficiency is estimated at 50 min/h.

Solution

Production (LCY/h ) =3600 \* 1\*0.95\*50/60=71 LCY/h

 40

Production (LCm/h) =3600 \* 0.75\*0.95\*50/60=71 LCm/h

 40

1. 8 km of gravel road requires reshaping and leveling. You estimate that 5 passes of a motor grader will be required. Based on operator skill, machine characteristics, and job conditions, you estimate 1st and 2nd passes at 2.06, 3rd 4th passes at 4.0 km/hr, and 5th pass at 4.82 km/hr. If job efficiency is 0.80, how many grader hours will be required for this job?

Solution

T**1,2**= 2\*8 =9.71hr

 2.06\*0.8

T**3,4**= 2\*8 =5 hr

 4.0\*0.8

T**5**= 1\*8 =2.1 hr

 4.82\*0.8

∑=16.81hr

1. Estimate the production of smooth steel wheel roller which is compacting a road under the following conditions: average speed of the roller is 7.6 km/hr, compacted lift 25 cm, effective roller width is 2.2m, number of pass required is 8 and job efficiency is 50 min/hr.

 Solution

 Production = 10\*W\*S\*L\*E

 P

 = 10\*2.2\*7.6\*25\*0.833

 8

 =435.4 cm3/hr

***Equipment cost calculation example***

Note

COST OF OWNING AND OPERATING CONSTRUCTION EQUIPMENT

1. Factors affecting the cost include:
* Cost of equipment delivered to the owner.
* The severity of the conditions under which it is used.
* The care with which it is maintained and repaired.
* The number of hours used.
* The demand for used equipment (salvage value = SV)

2. Estimate Cots: includes

1. - Depreciation Costs.
2. – Maintenance & Repair.
3. – Investment cost.
4. – Fuel consumption.
5. – Lubricating Oil.

a- Depreciation Costs:

Depreciation is the loss in value of equipment resulting from use or age (useful life). Assume a unit of equipment will decrease in value from its original total cost at a uniform rate. There are 3 three methods for influential the cost of depreciation.

1. Straight Line Method.
2. Declining – Balance Method.
3. Sum of the Years Digit Method.

b– Maintenance & Repair.

 Vary with the type , the service and the care.

 Expressed as a % of annual cost of depreciation

 Experience records serve as a guide in estimating these costs.

c– Investment cost.

 Includes interest on the money invested, taxes of all types , insurance and storage as a % of ~ 15-25%.

d– Fuel consumption.

 Two types of engines used in construction equipments: Gasoline and Diesel engines

Diesel engine consumption =0.04 gal / hp. hr.

**Lubricant oil**

q= hp\*f\*0.006lb/hp.hr + c

 7.4 lb/gal t

* + - q = quantity assumed, gal / hr.
		- hp. = rated horse power for engine.
		- c. = capacity of crankcase, gal
		- f. =operating factor
		- t. = # no. of hours between changes.
		- The above formula based on :
		- An operating factor of 60 % Quantity of oil consumed per rated horsepower hour, between changes, will be 0.006 lb.
1. Calculate the ownership cost per hour for an excavator powered by a 250-hp engine based on the following data:
* Purchase price (P) = 420,000 Br
* Salvage value (F) = 250,000 Br
* Operation factor = 50%
* Useful life (N) = 6 years
* Working hours per year = 2000
* Maintenance and repair costs = 110% of annual depreciation
* Diesel fuel price = 3.8/gallon
* Fuel consumption = 0.04 gallon/hp/hr
* Lube oil cost = 10% of fuel
* Interest rate (i) = 10%

 **Solution**

 Depreciation (assume straight-line) = (420000 – 250000) / 6 = 28333.33 Br /year

 Investment annual cost is calculated as follows:

 Annual investment=$\left[420000\left(\frac{0.1\left(1.1\right)\frac{6}{}}{\left(1.1\right)}\right)-420000/6\right] -\left[250000\left(\frac{0.1}{\left(1.1\right)}\right)-250000/6\right]$

 Annual investment = (420000 × 0.2296 – 70000) – (250000 × 0.1296 – 41666.67) =

 26432 – (- 9264.82) = 35696.82 Br /year

 Maintenance and repair cost = 1.1 × 28333.33 = Br 31166.67/year Then, the total yearly

 Costs = 28333.33 + 35696.82 + 31166.67 = 95196.81 Br/year

 Accordingly, the hourly cost = 95196.81 / 2000 = Br 47.6/hr

 Fuel consumption = 250 × 0.04 × 0.5 = 5 gallon/hr Fuel cost = 5 × 3.8 = Br 19/hr

 Lubricate oil cost = 19 × 0.1 = Br 1.9/hr

1. Calculate the hourly rate of equipment based on the following data:

- Purchase price (P) = LE460,000

 - Salvage value (F) = LE40,000

- Useful life (N) = 10 years

- Working hours per year = 2000 years

- Annual maintenance costs = 10% of purchase price

- Annual operating costs = LE47,000

 - Interest rate (i) = 15%

**Solution**

 Depreciation (assume straight-line) = (460000 – 40000) / 10 = LE42000/year

 Investment annual cost is calculated as follows:

 Annual investment=$\left[460000\left(\frac{0.15\left(1.15\right)\frac{10}{}}{\left(1.15\right)}\right)-460000/10\right] -\left[40000\left(\frac{0.15}{\left(1.15\right)}\right)-40000/10\right]$

 Annual investment = 47684 Br/year

 Maintenance and repair cost = 0.1 × 460000 = Br 46000/year

 Operating costs =47000 Br/year

 Then, the total annual costs = 42000 + 47684 + 46000 + 47000 = 182684 Br/year

 Accordingly, the hourly cost = 182684/ 2000 = 91.34 Br/hr

1. Determine the probable cost per hour for owning and operating a 25 cu-yd heaped capacity bottom dumb wagon with six rubber tires, the following information will apply:
	* + Engine 250 hp, Diesel.
		+ Crankcase capacity 14 gallon
		+ Time between oil changes 80 hr
		+ Operating factor 60 %
		+ Useful life 5 years – 2000 hr/yr – with no salvage value
		+ Life of tires 5,000 hr
		+ Repair of tires 15% of tire depreciation
		+ Cost delivered including freight and taxes = $ 92,623
		+ Cost of tires =$ 12,113
		+ M & R = 50% OF Depreciation
		+ Investment rate = 15%

 **Solution**

 1- fuel consumed per hr = 250 \* 0.6 \* 0.04 = 6.0 gal

 2- Lubricating oil consumed per hr:

q= 250\*0.6 \*0.006lb/hp.hr + 14

 7.4 lb/gal 80

 =0.3gal/hr

3. Cost of owner

Cost delivered including freight and taxes = $ 92,623

Less cost of tires = ($ 12,113)

 Net cost less tires = $ 80,510

Average annual investment cost (AAI) = P(n+1)/2n = 92,623 (5+1)/2\*5 = $ 55,744

No salvage value case

4-Annual cost:

Depreciation = (80,510 – SV) / 5 = $ 16,102

Maintenance and Repair = 50% \* 15,102 = $ 8,051

Investment = 15% \* (AAI). = $ 8,362 Total annual fixed costs = $ 32,515

5-Hourly cost:

Fixed cost = 32,515 / 2000 hr = $ 16.26 Tire depreciation =12,113 / 5,000 = $ 2.42 Tire repairs = 0.15 \* 2.42 = $ 0.36

Fuel = $4 \* 6 gal = $ 24.00 Lubricating oil = 0.3 \* $15 = $ 4.50 Total cost per hour... Excluding labor = $ 47.54

Say the labor takes $10/ hr

Then the total cost = $57.54

You must add profit margin By about 10 to 15 %