HYDRAULIC EXCAVATOR

Sample of Equipment taken for analysis:

Make	**Komatsu**
Model	PC 200
Operating weight, kg	18 000
Flywheel HP	120
Bucket capacity (heaped),m^3	
SAE Range	0.36~1.40
Bucket chosen	107
Estimated cycle time, s	27
Estimated Standard Production, Q^{std}*, m^3/hr	107

*Figures are obtained by interpolating values from the chart: CPH-11/95 & KSAH-10/3A-121

Production as per Estimating Production chart:

Estimated production, Q = Estimated Standard Production x Bucket Factor x Job Efficiency
$Q = Q^{std} \times K \times E$ (m^3/hr)

Soil Type*	**Bucket factor, K****		**Job efficiency, E**	
	Excavating condition	**K**	**Operating condition**	**E**
I	Easy excavating	1.1 ~ 1.2	Good	0.83
II	Average excavating	1.0 ~ 1.1	Average (taken)	0.75
III	Rather difficult excavating	0.8 ~ 0.9	Rather poor	0.67
IV	Difficult excavating	0.7 ~ 0.8	Poor	0.58

***Soil Type**	**I(85%)**	**II(5%)**	**III(5%)**	**IV(5%)**
	Soft soil	**Hard soil**	**Soft rock**	**Hard rock**
**K	1.1	1.0	0.8	0.7

Estimated Production, Q (m^3/hr):

$K*E*Q^{std}$ = (1.1*0.85+(1+0.8+0.7)*0.05)*0.75*107=85.065 cu.m/hr

Estimated production calculation as per formulae, Q (m3/hr):

Q = q x (60 x 60 / Cm) x K x E where, q : production per cycle, (m3/cycle)
Cm : cycle time, (s)

Cycle time, Cm (s)

Standard Cycle Time, C_m^{std} (s) (KSAH-10/12A-10)

Swing Angle Range, (°)	Machine model			
	PC 100	PC 150	PC 200	PC 300
45 ~ 90	11 ~ 14	13 ~ 16	13 ~ 19	15 ~ 18
90 ~ 180	14 ~ 17	16 ~ 19	16 ~ 19	18 ~ 21

Fuel Consumption (estimated), l/hr:

Equipment model	PC 100	PC 150	PC 200	PC 300
Fuel consumption, l/hr	8	10	12	20

Hourly Production of JCB-3CX type Backhoe Excavator:

Rated Power, HP	78
Bucket Capacity	0.18 ~ 0.56, take 0.2
Cycle Time, Cm (s)	15
No. of Cycles per hour, N	240
Production per hour, Q (m3/hr)	26
Fuel Consumption, l/hr	8

TRANSPORTATION BY TRUCK

Sample units taken for analysis:
Payload Capacity
Category of Trucks: 5 000 kg
Analysis is taken with assumption that:
Loading and unloading both are carried out manually
Loading is done by machine and unloaded manually

1. Manual loading and unloading:

Ct = $(t_1 + t_2 + t_3 + t_4)$/60hr where, Ct: cycle time(min)
t_1: loading time(min)
t_2: travel time(min)
t_3: unloading time(min)
t_4: return time(min)

$$Ct = \frac{t_1 + t_3}{60} + 2\frac{D}{V}, \text{(hr)}$$ where,D: distance traveled (km)

V: average speed of the vehicle (km/hr)

$$Ct = 0.75 + 2\frac{D}{V} \text{ hr}$$

Cycle time for manual loading/unloading, Ct(hr)

Distance, D(km)	Cycle Time (time required to make a trip), Ct (hr)	
	Vehicle speed, V(km/hr)	
	10	20
1	0.95	0.85
2	1.15	0.95
3	1.35	1.05
4	1.55	1.15
5	1.75	1.25
Each additional km beyond 5	0.10	0.10

2. Loading by machine and unloading manually

Loading Time, t_1 = Cm x no. of cycles to fill dump truck

$$= C_m \times \frac{C_1}{q_1 x K} \text{ (min)}$$

where, Cm: cycle time of loader (min)
C1: bucket capacity of truck,(m3)
q_1: bucket capacity of loader, (m3)

Loading Time, t_1 (min)

Bucket Capacity of Loader, q_1,(m≥)	Cm min	Payload Capacity of Truck, (kg)			
		5000			
		C_1=3 m^3			
		K			
		1.00	**0.90**	**0.85**	**0.80**
1.0	1.0	3.00	3.34	3.53	3.75
1.5		2.00	2.22	2.36	2.50
2.0		1.50	1.67	1.77	1.88
2.5		1.20	1.34	1.41	1.50

#for practical purpose, take C_1= 2, 3 and 5 m^3 instead of 2, 3.3 and 5.3 m^3

∗Bucket Factor, K

Loading Condition	Bucket Factor, K
Easy loading	1.00~1.10
Average loading	0.85~0.95
Rather difficult loading	0.80~0.85
Difficult loading	0.75~0.80

Travel and return time, $t_2 + t_4$ (hr):

$t_2 + t_4 = 2\frac{D}{V}$ (hr)

Time required for manual unloading, t_3 (hr):

If the truck was manually loaded and unloaded, time would have taken 0.75 hr. Assuming that unloading time is approximately one third of total loading and unloading time.

t_3 = 0.75/3 = 0.25(hr)

Cycle time, $Ct = t_1 + t_2 + t_3 + t_4$

$= t_1/60 + 2\frac{D}{V} + 0.25$ (hr)

Out put per trip, C_1(m3):

S.N	Material	Density, kg/m3	Void, %	Category of Truck, kg
				5000
1	Soil, loose	1450	20	4.14
2	Sand, Murram, Surkhi	1450	30	4.48
3	Gravel, 40 mm	1600	25	3.90
4	Shingle, 40 mm	1450	35	4.65
5	Stone, crushed, 40 mm	1600	30	4.06
6	Stone, crushed, 40 mm	1450	40	4.83
7	Brick rubble	1000	35	6.75
8	Stone, Soling, Boulders	2400	40	2.92
9	Stone, excavated	2400	50	3.13
10	Brick			2000 no
11	Cement, Iron			5000 kg
12	Bitumen			
13	Stone block			
14	G.I., C.I.			
15	C.C. Pipe			
16	Lime, Timber			5000 kg

Select the truck and the material to be transported. From the tables, find C1(m^3/trip) and Ct(hr/trip)

Time required to transport unit quantity of material, $T = \frac{Ct}{C_1}$ (hr/m^3)