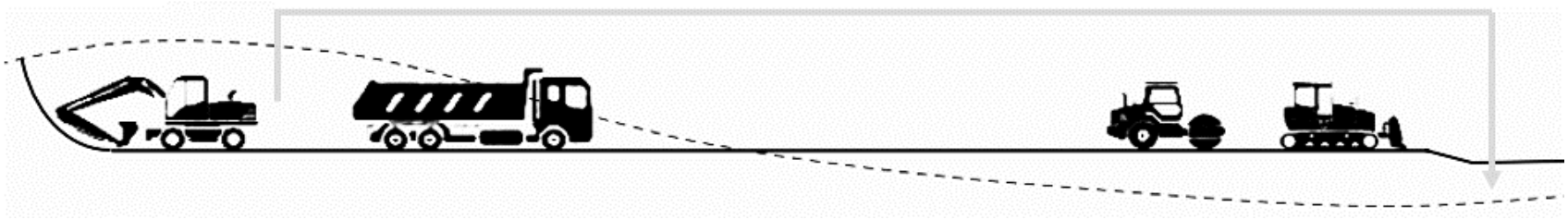
SELECTING MACHINES OF SYNCHRONIZED PROCESSES



Description	Quantity	Unit	Remarks
Volume of earth to move (V)	12 000	m^3	According to earthwork balancing plan(s)
Average haulage distance (L)	1 500	m	Based on site maps, available haulage roads (permanent and/or temporary)
Scheduled duration (T)	150	h	According to the accepted time plans (here: 3 weeks, 5 days a week, 10 hours a day)
"MATERIAL FLOW" (F)	80	m^3/h	F = V / T ("master intensity")

EXCAVATION

Number of main units ("capacity") (C)	1	pcs	here: hydraulic slewing excavator(s) Based on site surveys, on-site managerial considerations and …
Expected effective output of a main unit (N_{eff})	80	m^3/h	… available/estimated capacities ($N_{eff} = F / C$)
Working conditions' coefficients:			Actual values can be estimated on the basis of past experiences, engineering analyses and/or on-site tests
- extent of site (m_1)	0,80	-	Based on site suveys, in range of 0,60÷1,00 (here: "average/ordinary conditions")
- soil conditions (m_2)	0,95	-	Based on soil mechanics reports, in range of 0,65÷1,10 (here: "average/medium soil")
- unloading/discharging (m_3)	0,90	-	Based on experiences and/or tests, in range of 0,55÷1,00 (here: "discharging to a truck")
- truck capacity (m_4)	1,00	-	Based on box/backet ratio, in range of 0,8÷1,00 (here: "over 6 buckets per box")
- swivel/slewing (m_5)	1,00	-	Depends on the slewing angle, -5% ÷ -7% per each 30° over 90° (here: "truck at the side of the excavator")
- general condition of the machine (m_6)	0,95	-	Based on amortization and maintenance, in range of 0,80÷1,00 (itt: "some years old in good condition")
- skill of the operator (m_7)	0,95	-	Based on experiences and age of the operator, in range of 0,70÷1,00 (here: "experienced young operator")
- overall working conditions (m)	0,62	-	$m = m_1*m_2*m_3*m_4*m_5*m_6*m_7$
- time efficiency factor (g)	0,90	-	Based on on-site technical estimates, in range of 0,80÷0,95 (here: "less than an hour idle time per shift")
Expected operative output (N_{op})	130	m^3/h	$N_{op} = N_{eff} / m$
Expected technical output (N_{tech})	144	m^3/h	$N_{tech} = N_{op} / g$ (Experiences: $N_{tech} = 1,25÷2,50 * N_{eff}$, that is, $N_{eff} = 0,40÷0,80 * N_{tech}$)

Attachment			here: backacter bucket
Operation time analysis			Based on technological analyses and/or on-site tests
- bucket down (t_1)	3	"	Depends on vertical position of the machine (depth of the trench/ditch, height of discharging)
- filling/extracting (t_2)	3	"	Depends on soil conditions and on the design of the actual attachment (bucket)
- bucket up (t_3)	3	"	Depends on vertical position of the machine (depth of the trench/ditch, height of discharging)
- slewing (t_4)	4	"	Depends on horizontal position of truck/discharging (slewing angle)
- discharging (t_5)	3	"	Depends on soil conditions
- slewing back (t_6)	4	"	Depends on horizontal position of truck/discharging (slewing angle)
Cycle time (t)	20	"	$t = t_1+t_2+t_3+t_4+t_5+t_6$
Cycles per hour (c)	180	cycles/h	$c = 3600 / t$ (Experinces: c = 160÷220 cycles/h)
Minimum size of the (backacter) bucket (V)	0,80	m^3	$V = N_{tech} / c$ (Usually in range of 0,50÷2,00 m^3)
Selected machine(s):			...

TRANSPORT (HAULAGE)

Bulking coefficient (b_c)	1,25	-	Function of soil characteristics (here: average/medium "sandy gravel")
Box size of the dumper truck (V_{tech})	15	m^3	here: ..... typed dumper truck
Effective box size o the dumper truck (V_{eff})	12	m^3	$V_{eff} = V_{tech} / b_c$ (converted to natural/dense soil)
Operation time analysis			Based on technological analyses and/or on-site tests
- loading (t_l)	9	'	$t_l = (V_{eff} / F) * 60$
- average travelling speed when loaded (v_f)	10	Km/h	Based on experiences, on-site tests and/or on-site regulations (... on given distance (range), dust road, ...)
- travelling time when loaded (t_f)	9	'	$t_f = ((L / 1000) / v_f) * 60$
- discharging, to prism (including positioning) (t_d)	2	'	Based on technical characteristics of the truck and/or on-site tests
- average travelling speed when empty (v_b)	15	Km/h	Based on experiences, on-site tests and/or on-site regulations (... on given distance (range), dust road, ...)
- travelling time when empty (t_b)	6	'	$t_b = ((L / 1000) / v_b) * 60$
- estimated idle time (queueing) (t_q)	4	'	Based on experiences, mathematical models ("Theorems of queueing") and/or on-site tests
Cycle time (t)	30	'	$t = t_l+t_f+t_d+t_b+t_q$
Necessary capacity (C)	3,3	pcs	$C = t / t_l$ (Reasonably to be rounded upward!)
Assigned fleet of trucks:			...

SPREADING

Technical parameters of the main unit:			here: Bulldozer
- width of the blade (w)	1,50	m	Based on technical parameters of the machine
- working speed, forward only (v_{tech})	1,50	Km/h	Based on technical parameters of the machine
- average (effective) working speed (v_{eff})	1,00	Km/h	$v_{eff} = v_{tech} * 0,67$ Considering ways back (backward and manoeuvring idle times)
- effective layer thickness when spreading (h_{eff})	0,15	m	Based on technical parameters of the machine and considering soil characteristics
Estimated technical output (N_{tech})	225	m^3/h	$N_t = w * v_{ef} * 1000 * h_{eff}$
Working conditions' coefficients:			Actual values can be estimated on the basis of past experiences, engineering analyses and/or on-site tests
- soil conditions (m_2)	0,95	-	Based on soil mechanics reports, in range of 0,70÷1,00 (here: "average/medium soil")
- general condition of the machine (m_6)	0,90	-	Based on amortization and maintenance, in range of 0,80÷1,00 (itt: "old machine in good condition")
- skill of the operator (m_7)	0,85	-	Based on experiences and age of the operator, in range of 0,70÷1,00 (here: "motivated/keen novice")
- overall working conditions (m)	0,73	-	$m = m_2*m_6*m_7$
- time efficiency factor (g)	0,90	-	Based on on-site technical estimates, in range of 0,80÷0,95 (here: "less than an hour idle time per shift")
Operative output (N_{op})	164	m^3/h	$N_{op} = N_{tech} * m$
Effective output (N_{eff})	147	m^3/h	$N_{eff} = N_{op} * g$ (If not too much bigger than "F" then OK!)
Selected machine:			...

COMPACTING

Technical parameters of the main unit:			here: Ride-on typed vibro roller
- width of the roller (w)	1,10	m	Based on technical parameters of the machine
- working speed when compacting (v_{tech})	1,00	Km/h	Based on technical parameters of the machine, back and forth the same ($v_{eff} = v_{tech}$)
- effective depth of compaction (h_{eff})	0,25	m	Based on technical parameters of the machine and considering soil characteristics
- specified passes (cycles) per layer (c)	3	-	Based on soil mechanics report and/or on-site tests
Estimated technical output (N_{tech})	92	m^3/h	$N_t = (w * v_{eff} * 1000 * h_{eff}) / c$
Working conditions' coefficients:			Actual values can be estimated on the basis of past experiences, engineering analyses and/or on-site tests
- general condition of the machine (m_6)	1,00	-	Based on amortization and maintenance, in range of 0,80÷1,00 (itt: "new machine in perfect condition")
- overall working conditions (m)	1,00	-	$m = m_6$
- time efficiency factor (g)	0,90	-	Based on on-site technical estimates, in range of 0,80÷0,95 (here: "less than an hour idle time per shift")
Operative output (N_{op})	92	m^3/h	$N_{op} = N_{tech} * m$
Effective output (N_{eff})	83	m^3/h	$N_{eff} = N_{op} * g$ (If not too much bigger than "F" then OK!)
Selected machine:			...

Small figures of machines downloaded from: https://hu.depositphotos.com/187613414/stock-illustration-set-various-transportation-construction-machinery.html 16-04-2020