CHAPTER 24
PLANT, LABOUR AND ORGANIZATION OF WORK
SECTION 107- EARTH MOVING PLANT AND TRANSPORT

Earth Moving Plant

2401.   The production graphs in RESPB No 5c (WO Code No 8632 should be used for assessing output on normal earth moving tasks. Some special applications of machines are dealt with in appropriate sections of this book.

2402.   Table 24.1 gives Figures which of embankments, sub grade when planning the formation of embankments, sub grade preparation and laying bases. These Figures are

TABLE 24.1 PLANT PERFORMANCE ON ROAD MAKING TASKS
(To use as a guide only)

Serial No	Task	Plant Item	Output per hour
(a)	(b)	(c)	(d)
1	Embankment formation spreading loose material	Size I dozer	250 cu yds Ɨ
2.	embankment formation spreading loose material	Size II dozer	175 cu yds Ɨ
3.	embankment formation spreading loose material	Size III dozer	121 cu yds Ɨ
4.	embankment formation spreading loose material	Size IV dozer	100 cu yds Ɨ
5.	embankment formation spreading loose material	Size V dozer	58 cu yds Ɨ
6.	Subgrade preparation shaping	Grader	400 sqyds
7.	Base and surfacing layers- Spreading material	Grader	200 sqyds Ɨ +50 sqyds
8.	Shaping surface		
9.	Compaction- a. Subgrade- 9 in layer, 10 passes	Sheep foot roller (tandem,	1.200 sqyds

10	b.	Base-Gravel	Smooth wheel roller. 6 ton	250 sqyds
11.		Water bound Macadam	Smooth wheel roller. 8 or 10 ton	100 sqyds
12.		Tarmacadam	Smooth wheel roller, 8 ton	300 sqyds
13.	c.	Surface-Finishing, 5 passes	Pneumatic tyred roller $	1.500 sqyds

* See para 612

Ɨ Volumes given relate to loose material.

£ Size I to II tractor

\$ Preferably drawn by a wheeled tractor size IV crawler tractor can be used if necessary.

Based work level sites close and 100 percent efficient in organization and operation. They require modification to allow for:

      a.   Operating efficiency (often taken as 75 per cent).

      b.   Uphill or downhill grades (from 60 to 125 per cent).

      c.   Inclement weather and incidental delays.

2403.   <u>Excavators</u>.   Output on any particular task is reduced unless the most suitable front-end equipment is used. Output when loading loose material is greater than when digging.

      Digging outputs are given in RESPB No 5c

      Some Figures for loading time are given is table 24.2

TABLE 24.2- TIME TAKEN TO LOAD LOOSE MATERIALS INTO TRANSPORT USING EXCAVATOR WITH SKIMMER

(Assuming good conditions and 100 percent efficiency of plant)

Serial No	Nature of material (loose in stockpiles convenient for loading)	Time of loading truck (hrs per ton)			Time of loading to skips or dumpers		
		Size of excavator bucket (cu yds)					
		¼	3/8	½	¼	3/8	½
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
1.	Ashes	0.19	0.11	0.08	0.12	0.07	0.055
2.	Clinker	0.21	0.12	0.095	0.12	0.07	0.055
3.	Sand	0.105	0.06	0.05	0.12	0.07	0.055
4.	Aggregate Ɩ	0.105 to 0.14	0.06 to 0.07	0.05 to 0.06	0.125	0.075	0.058
5.	Loose gravel Ɩ	0.105 to 0.125	0.06 to 0.075	0.05 to 0.06	0.125	0.075	0.058
6.	Shingled	0.105 to 0.120	0.06 to 0.075	0.05 to 0.06	0.125	0.075	0.058
7.	Road metal Ɩ	0.105 to 0.13	0.06 to 0.08	0.05 to 0.06	0.125	0.075	0.058
8.	Hardcore brick	0.16	0.08	0.075	0.15	0.09	0.07
9.	Hardcore, stone	0.125	0.075	0.06	0.15	0.09	0.07
10.	Asphalt, without	0.09	0.055	0.04	0.14	0.085	0.065

	grit					
11.	Tarmacadam (average Figures)	0.135	0.08	0.06	0.14	0.085	0.065

*   When a shovel or dragline is used instead of a skimmer, the time taken may be reduced by 15 to 20 per cent. Loading by grab takes approximately twice as loading by skimmer.

Ɨ   Time of loading varies with size and nature of stone.

TABLE 24.3 NUMBERS OF HAULAGE VEHICLES REQUIRED, PER FACE SHOVEL OR SKIMMER, FOR VARIOUS LENGTHS OF HAUL

Ser No	Length of haul	Type of haulage vehicle and size of excavator bucket (in cu yds)																								
		2 ton tipping truck					3 ton tipping truck					5 ton tipping truck					2 cu yd dumper					3 cu yd dumper				
		¼	3/8	½	5/8	¾	¼	3/8	½	5/8	¾	¼	3/8	½	5/8	¾	¼	3/8	½	5/8	¾	¼	3/8	½	5/8	¾
1.	220 yds	2	2	2	2	2	5	2	2	2	3	2	2	2	2	2	2	2	3	3	3	2	2	2	2	3
2.	½ mile	2	3	3	4	4	3	2	3	3	3	2	2	2	3	3	2	3	4	4	5	2	2	3	3	4
3.	1 mile	3	4	4	5	6	3	3	4	4	5	2	2	3	3	3	-	-	-	-	-	-	-	-	-	-
4.	2 mile	4	5	5	6	8	3	4	5	5	6	2	3	3	4	4	-	-	-	-	-	-	-	-	-	-
5.	3 mile	5	6	7	8	10	4	5	6	7	8	3	3	4	5	5	-	-	-	-	-	-	-	-	-	-

Note: The most economical teams are shown in italic type.

Transport

2404.   Balanced teams of transport and excavating/loading plant should be aimed at

As a guide:-

No. of vehicle required, per loading machine} $= \dfrac{\text{Travelling time}}{\text{loading time}} + 1$

Table 24.3 gives the number of vehicles required per excavator for various lengths of haul.

2405.   Transport routes must be properly planned and traffic control must be organized. When using wheeled transport, the preparation and maintenance of goop haul roads are vitally important.

2406.   Tables 24.4 to 24.5 give planning Figures for the capacity and performance of certain vehicles.

TABLE 24.4 – VOLUME OF EXCAVATED MATERIAL (SOLID MEASURE) HAULED PER LOAD

Serial No.	Nature of material	Weight of solid material		Volume (solid) per rated ton (cu yds)	Volume (solid) per rated cu yd (cu yds)
		Cu yds per ton	Tons per cu yd		
(a)	(b)	(c)	(d)	(e)	(f)
1.	Chalk	0.58	1.725	0.58	0.70
2.	Gravel	0.75	1.33	0.75	1.14
3.	Loam	0.87	1.15	0.87	0.92
4.	Loamy soil	0.75	1.33	0.75	0.85
5.	Mari	0.75	1.33	0.75	0.98
6.	Sand	0.87	1.15	0.87	1.09
7.	Sandy clay	0.75	1.33	0.75	0.85
8.	Stiff clay	0.69	1.45	0.69	0.80

*A horse and cart will normally haul ½ ton of material per load. The safe load for a 3-ton truck is found by multiplying the appropriate Figure in this column by 3. For a 10 tonner, multiply by 10. The limiting factor is often the capacity of the body. The volume of each type of vehicle body should be measured, and the capacity loading checked from the Figures is column (f)

TABLE 24.5-VOLUME OF LOOSE MATERIALS HAULED PER LOAD

Ser No	Class of material	Weight of material		Volume* (loose)per rated ton of vehicle (cu yds)
		Cu yds per ton	Tons per cu yd	
(a)	(b)	(c)	(d)	(e)
1.	Ashes	1.56	0.64	1.56
2.	Ballast	0.82	1.22	0.82
3.	Clinker	1.85	0.54	1.85
4.	Granite, broken 2 ½ '' 1 ½ ''	0.91	1.10	0.91
5.	,, ,, 1 ½ '' ½ ''	0.925	1.08	0.925

RESTRICTED

6.	,, ,, ¾'' -1/8''	0.96	1.04	0.96
7.	Hardcore brick	1.06	0.94	1.06
8.	,, stone	0.83	1.20	0.83
9.	Limestone broken 2 ½ ''- 1 ½ ''	0.96	1.04	0.96
10.	Limestone broken 1 ½ ''- ½ ''	1.00	1.00	1.00
11.	Limestone broken ¾'' -1/8''	1.04	0.96	1.04
12.	Sand pit	0.87	1.15	0.87
13.	Sand pit Washed	0.85	1.20	0.85
14.	Shingle crushed 2 ½ '' 1 ½ ''	0.86	1.16	0.86
15.	,, ,, 1 ½ '' ½ ''	0.89	1.12	0.89
16.	,, ,, ¾'' -1/8''	0.925	1.08	0.925

*The Safe load for a 3 ton truck is found by multiplying the appropriate Figure in this column by 3. For a 10 tonner multiply by 10. The milting factor is often the capacity of the body. The volume of each type of vehicle body should be measured, and the value me of safe loading should be checked against the available capacity.

General Factors Affecting Output

2407.   A part from correct application of plant, remember the following when planning work:-

> a.   Allot servicing periods, servicing time is less than that lost through breakdowns.
> b.   Plan work to avoid mutual interference, e.g., between plant and haulage vehicles.
> c.   Plan and maintain haulage routes and arrange traffic control.
> d.   Reduce equipment changes to the minimum and in planning allot time for coupling up, rigging tackles, etc.
> e.   Plan to dig, spread, and haul on downgrades and to return empty on upgrades.

TABLE 24.6- TIME TAKEN TO HAUL, OFFLOAD, AND RETURN, EXCLUDING LOADING AND WAITING TIME

Length of haul (loading point to of loading point) (yds)	Vehicle hours per load					
	Horse and cart	Tipping truck	Dumper	Set of wagons (Tracked tractor)	Set of wagons (wheeled tractor)	Set of Deauville skips (drawn by loco)
(a)	(b)	(c)	(d)	(e)	(f)	(g)
100 yds	0.12	0.09	0.10	0.16	0.10	0.16
220 yds	0.16	0.11	0.13	0.22	0.12	0.22
300 yds	0.17	0.12	0.14	0.24	0.13	0.24
440 yds	0.25	0.14	0.19	0.28	0.16	0.28
500 yds	0.28	0.15	0.20	0.30	0.17	0.30
660 yds	0.34	0.16	0.23	-	0.18	0.35
½ mile	0.43	0.18	0.26	-	0.21	0.40
1 mile	0.75	0.27	0.40	-	0.31	0.62
2 miles	1.50	0.41	-	-	0.47	0.94
3 miles	-	0.80	-	-	-	-

f.   Output Figures are based on an 8-hours shift. Over longer periods the output rate tends to fall.

g.   Night work reduces output. In strong moonlight or artificial light output is approximately 85 per cent of the daylight Figure.

h.   In Sunday soils, slight moisture increases output.

j.   Wet soils reduce output.

k.   Mud may bog down tractors and reduce output to nil.

l.   Frost may necessitate rooting, even blasting.

m.   A quick thaw may bring work to a stop.

n.   When rain is at all likely drainage is vital.

Drainage work must be planned and must keep pace with construction work. Maintain correct cross sections while working and before stopping work make good ruts and holes and provide temporary ditches if necessary.