CHAPTER 20
GRAVEL AND MACADAM CONSTUCTION
SECTION 87-GRAVEL ROADS AND BASES

2001. Gravel bases. - Well graded gravel bases can carry heavy traffic. They can be built to any re3quired thickness by spreading and compacting in layers form 3 to 6 ins thick.

2002. Gravel roads. - Temporary gravel roads can be built quickly and will carry sustained military traffic for long periods if well maintained, provided that the sub grade is sound and that a sufficient thickness of hard, well graded, and properly compacted material is used. They can subsequently be incorporated as the base of a semi-permanent road by the addition of a more durable surface. A typical cross section is shown in Figure 20.1.

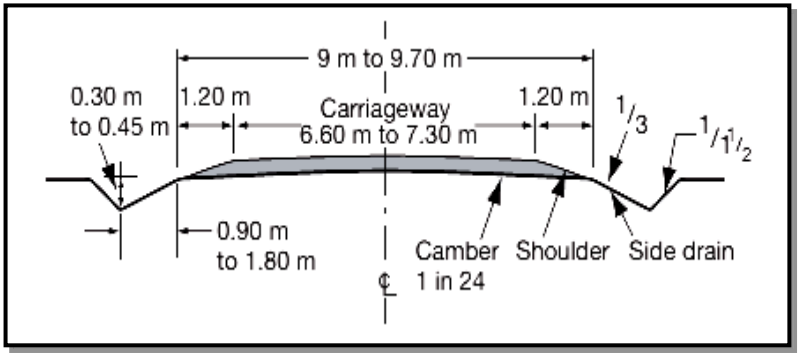

Figure 20-1:Typical cross-section of a gravel road

2003. On average sub grades the thickness recommended for gravel roads is:-

Light traffic	: 6 ins.
Average military traffic	: 6 to 9 ins.
Heavy military traffic	: 9 to 12 ins, of which the top 3 ins should be properly graded surfacing layer.

2004. Material. Screened Gravel is unsuitable, as it lacks fines. Natural deposits are often suitable for use as found but it may be necessary to mix together materials from different sources. Best results are obtained by using a mechanically stable mixture (see RESPB No. 5D, Table 3.10), but for hasty work the rough proportions shown in Table 20.1 may be used.

TABLE 20.1- APPROXIMATE GRADING OF MATERIAL

Grading	Base course	Surface course
$\frac{3}{4}$ to $1\frac{1}{2}$ in	20 Per cent	-
$\frac{3}{4}$ to 1 in	-	15 Per cent
$\frac{1}{4}$ to $\frac{3}{4}$ in	60 Per cent	75 Per cent
Below $\frac{1}{4}$ - in	20 Per cent	10 Per cent

2005. Constructional method:

a. Stages of construction are shown in Table 20.2.

b. When using materials from different sources start by mixing dry, and add the necessary water while spreading and balding.

TABLE 20.2-CONSTUCTION OF GRAVEL ROADS AND BASES

Serial No	Procedure	Plant	Remarks
(a)	(b)	(c)	(d)
1.	Form sub grade to correct cross section free of bumps, depressions, and ruts. Construct shoulders and aide drains. Compact	Grader. Pneumatic-tired or smooth wheel roller	If cut and fill are necessary, an angle dozer and scrapers will also be valuable
2.	On soft sub grades a 3-in layer or coarse stones ($1\frac{1}{2}$ to 3 ins) should first be laid.	Shovels and stone forks	This best done by hand labour
3.	Mix materials if natural deposit is poorly graded either:- (a) by plant mixing or` (b) by mix-in-place	(a) Pug-mills or concrete. (b) Grader or agricultural machinery.	5 to 10 per cent clay in desirable to ensure good binding. For mix-in-place form separate windrows of the different materials, in correct proportions, spread coarse material first and superimpose finer material. Mix by thorough balding or with harrows, etc
4.	On good sub grade when serial No. 2 does not apply form mixed material to a windrow along edge of road way and moisten sub grade	Grader. Water truck and sprinkler, on watering cans	-

5.	Spread gravel mix in layers (to finish at 3 ins thick when compacted) moisten necessary an work material to ensure even distribution	Grader, water truck and sprinkler Shovel, rakes, watering cans and road-drag	Best RESULTS ARE ACHIEVED BY THOROUGH BLIADING. Total water content from 7 to 10 Per cent, or about 1 gal per sq yd per-3-ins compacted thickness.
6.	Compact in-3-in layers	Pneumatic-tired or smooth wheel roller	Controlled pneumatic-tired traffic is also very beneficial in conjunction with balding.

c. When spreading ensures that the material is evenly graded .note in particular that motor graders tend to spread the coarser material from a central window towards the edges.

2006. Quantities: For estimating purposes allow I cu yd of broken stone or gravel per 9 sq yds of 3 in thickness.

Approximate volumes and transport requirements are given in Tables 20.3 and 20.4.

TABLE 20.3- APPROXIMATE VOLUME OF BROKEN STONE OR GRAVEL PER 3-IN LAYER OFLOOSE MATERIAL

Width of pavement (ft)	9	12	15	18	20	24	30
Approx volume of loose material per 100-yd length (cu yds)	25	33.3	41.6	50	56	66.7	83.3

TABLE 20.4- APPROXIMATE TRANSPORT REQUIRE- MENTS PER 3-IN LAYER OFLOOSE MATERIAL

Distance of raw material from site (miles)	APPROX truck-days per mile per 3-in layer (based on an average truckload of 3 cu yds)	
	12-ft road	20-ft road
(a)	(b)	(c)
1 to 2	24	42
3 to 5	34	60
6 to 9	44	80
10 to 13	66	120
14 to 16	80	150