

RESTRICTED
CHAPTER 25
EXPEDIENTS
SECTION 111-EMERGENCY SURFACES

2501. The first requirement in improving a cross-country track or earth road under changeable weather conditions is to provide drainage at the soft spots. This, together with some form of surfacing, may result in a route remaining open and thus contributing to the success of an operation. The simplest method of improving bad going is to roll in stone, hardcore, clinker, gravel or sand. Where this is impracticable, various temporary surfaces can be used, depending on the materials or stores available. Even simple materials such as grass, straw, reeds and brushwood may help, but such emergency surfaces last only a very short time and they require constant maintenance.

2502. Table 25.2 contains some data which may help in the organization of work.

Tracks and Detours

2503. The simplest kind of cross-country track is formed by the removal of obstacles, eg cutting gaps in banks and hedges, lopping low branches of trees, rough levelling, and grading of any slopes too steep for traffic to overcome. Such tracks may be able to carry an appreciable volume of wheeled traffic in dry weather but, in most soils, they quickly become impassable under wet conditions.

2504. **Width.** The minimum width of a one-way track for tanks is 3.7 m, for wheeled vehicles 3 m, and for pack transport 1.5 m. Passing places must be provided at frequent intervals (200 to 300 m apart), the aim being to have them visible from each other. Porter tracks should be 1 m wide.

2504. **Marking.** For day use, posts with cross-pieces nailed on to form an arrow pointing to the next marker and placed at intervals of approximately 50 m, according to the nature of the country, should be adequate. When markers are provided on one side of a track only, notices should indicate the side on which markers are to be passed, eg 'Keep left of marking posts'. For night movement, lights may be required to mark the route and taping at bends and difficult places may be advisable. When concealment is important, lights must be masked from the enemy side. Lanterns, traffic and electric lights or cyalumes are suitable. Tapes are visible from the air by day.

2505. Key Requirements. The most important requirements are:

a. Improvement of Soft Places. Soft places can be improved by ramming in hardcore, gravel, etc, or by providing a fabricated surfacing. Good marking is required to prevent vehicles moving off the improved alignment.

b. Drainage of Wet Ditch Crossings. Some form of covered drain or culvert is necessary and, probably, track improvement as mentioned above.

c. Maintenance in Wet Weather. Even if the track is to remain in use for only a few days, every effort must be made to provide side drains (see Figure 8/1). If bad weather is expected, a fabricated surface over all except rocky or gravelly stretches must be considered.

2506. Mountain Construction. In mountain route construction, drainage usually presents a difficult problem. Wherever possible, the surface of any track in a side-hill cut should slope inwards to a side drain from which water is discharged either by culverts or over Irish bridges. For very hasty work on tracks for 1/4 ton trucks or pack animals, time and labour may be saved by giving the surface a tilt outwards at a slope of 1 in 15 to 1 in 20. Such tracks, however, soon become dangerous in wet weather. On long, steep slopes, heavy rain forms channels down the middle of an unsurfaced track unless water is diverted over the edge or into an inner drain. For this purpose, projecting ridges of stone or timber should be set across the track at an angle of 45°. As a rough guide, the spacing between them should equal about one third of the square of the gradient, e.g. 30 m apart for a slope of 1 in 10.

Earth Roads

2507. In general, the design of earth roads to be built by manual labour follows that given previously, i.e. a carriageway and side drains with shoulders in between. Besides tactical considerations and the standards specified in Table 89, the design and method of construction may be affected by the nature of the soil and drainage and also by the time and labour available for the task. Consideration of these factors may result in the adoption of either the rapid or the deliberate method of construction. Both of these methods are described below.

2508. **Setting-out.** Setting-out is by centre-line pegs at 30 m intervals with intermediate pegs where necessary, eg on curves. From these centre-line pegs, the position of off-set pegs marking the edges of the carriageway and the inner edges of the drainage ditches are measured. For many cross-country routes, detailed calculations and very accurate setting-out is generally unnecessary and curves are usually fitted to the ground largely by eye.

Rapid Construction of Earth Roads

2509. Figure , which shows the stages in construction, includes no reference to the removal of top soil. This is because it is not always necessary to do so, particularly in rapid construction. Frequently, best results are obtained by disturbing the existing ground surface as little as possible. The vegetation helps to bind the earth, thus improving the bearing qualities. Top soil has to be removed when the surface offers no resistance, usually through dampness, and the track must be based on more stable soil.

2510. Only enough spoil to fill the low spots on the carriageway should be taken from the ditches, the remainder being thrown outside the road width. The curbs may be made from 150 mm saplings, if available, wired to stout pickets driven about 600 mm into the ground. Alternatively, whitened stones or half-filled sandbags placed on the surface at 5 m intervals can be used. If necessary the drains can be completed after the road is opened to traffic.

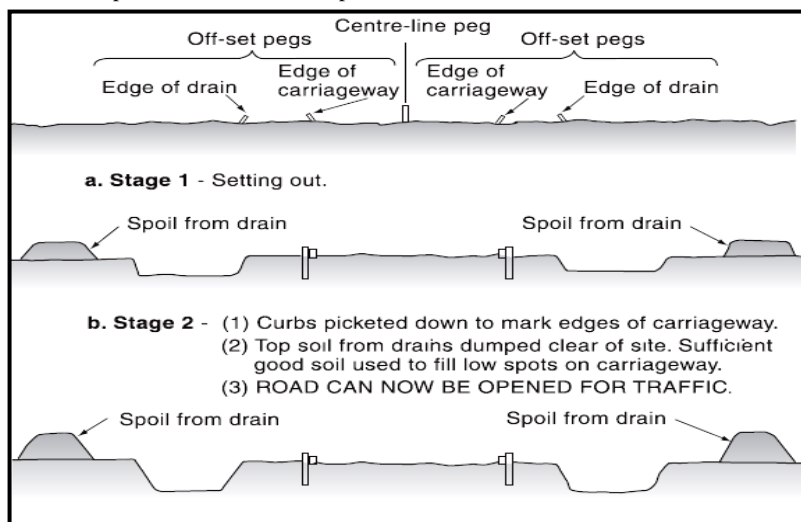


Figure 25-1: Stages in the Rapid Construction of an Earth Road by Manual Labour.

Deliberate Construction of Earth Roads

2511. Stages in the deliberate construction are illustrated in Figure 8/2. The consolidation of the base is particularly important and the illustration shows that the top soil has been removed to reach more stable soil. Such action is not always necessary and the remarks on topsoil removal in Paragraph -- apply equally in this method of construction.

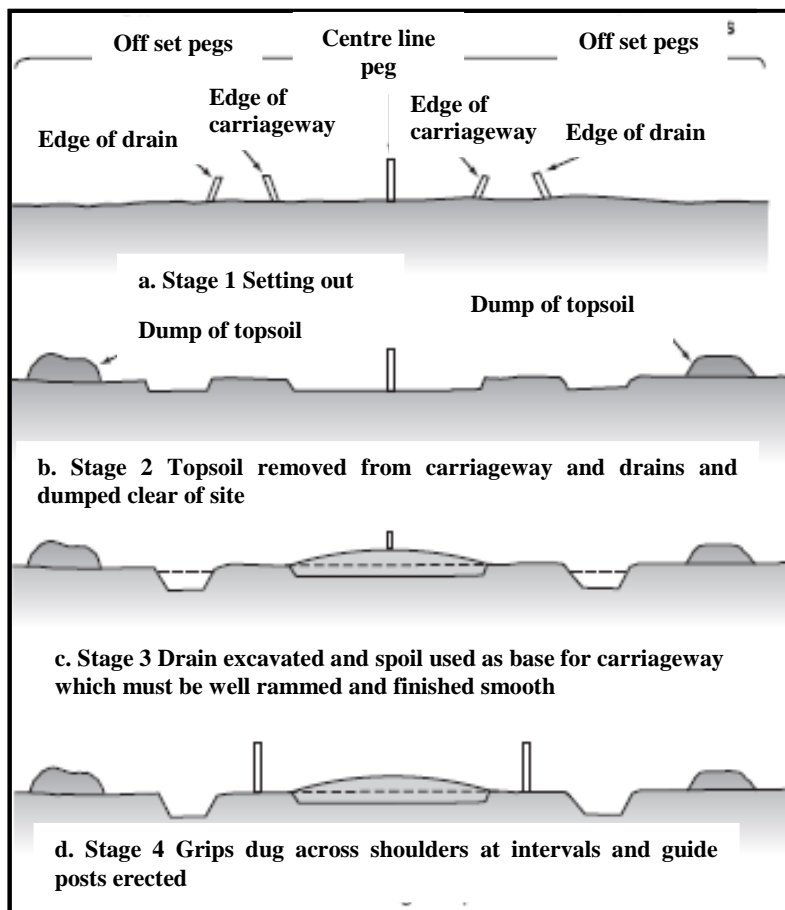


Figure 25-2: Stages in the Deliberate Construction of an Earth Road by Manual Labour.

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2512. Where necessary the earth from the drains must be spread evenly and then either rammed or trampled down or rolled in by any light pneumatic tyred vehicle until a hard smooth and correctly cambered surface is obtained. Just sufficient water to make the soil bind can be added but no more. If additional soil is required, it is obtained by widening the drains (not deepening them) or from borrow-pits.

2513. Rapidly constructed earth roads may require a prefabricated surface if they are to last for more than a few days, especially in wet weather. This requirement applies less to deliberately constructed earth roads because of their properly cambered and drained surface: it must not, however, be overlooked in their case, especially in wet areas.

Figure 25.3 shows the final stage of construction (taken from Figure 8/2) with the dimensions indicated by symbols. These symbols can be replaced by the dimensions given in Table 1-1 and the following desirable minimum dimensions for drains:

Depth: 450 mm below formation level

Width at invert level: 225 mm

Fall: 1 in 150.

It is not always practicable to dig drains to a depth of 450 mm below formation level as specified above and, in these circumstances; the invert level of the drain must be below the formation level (*see* Figure 8). Shoulders should be 1.5 m wide.

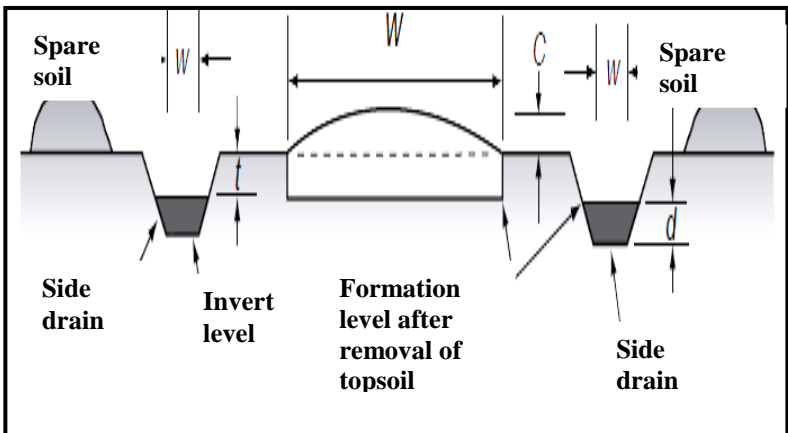


Figure 25-3: Dimensions for a General Purpose Earth Road
- Deliberate Construction.

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2514. Labour Requirements. The average labour requirements for the deliberate construction of general purpose earth roads by manual labour are given in Table 89 which is closely related to Figure 25.3.

TABLE 25.1 AVERAGE LABOUR REQUIREMENTS FOR THE CONSTRUCTION OF A GENERAL PURPOSE EARTH ROAD

Serial	Main dimensions of road					required per 100 m (man- hours) ⁽ⁱ⁾
	W (m)	C (mm)	t (mm)	w (m)	d (m)	
(a)	(b)	(c)	(d)	(e)	(f)	(g)
1	3.7	110	75	0.30	0.45	230
2	3.7	110	150	0.60	0.45	390
3	7.3	225	75	1.00	0.60	760
4	7.3	225	150	1.20	0.75	1,140

Note: i. Work includes excavation, shoveling where necessary, spreading and ramming.(see Table 25.1)