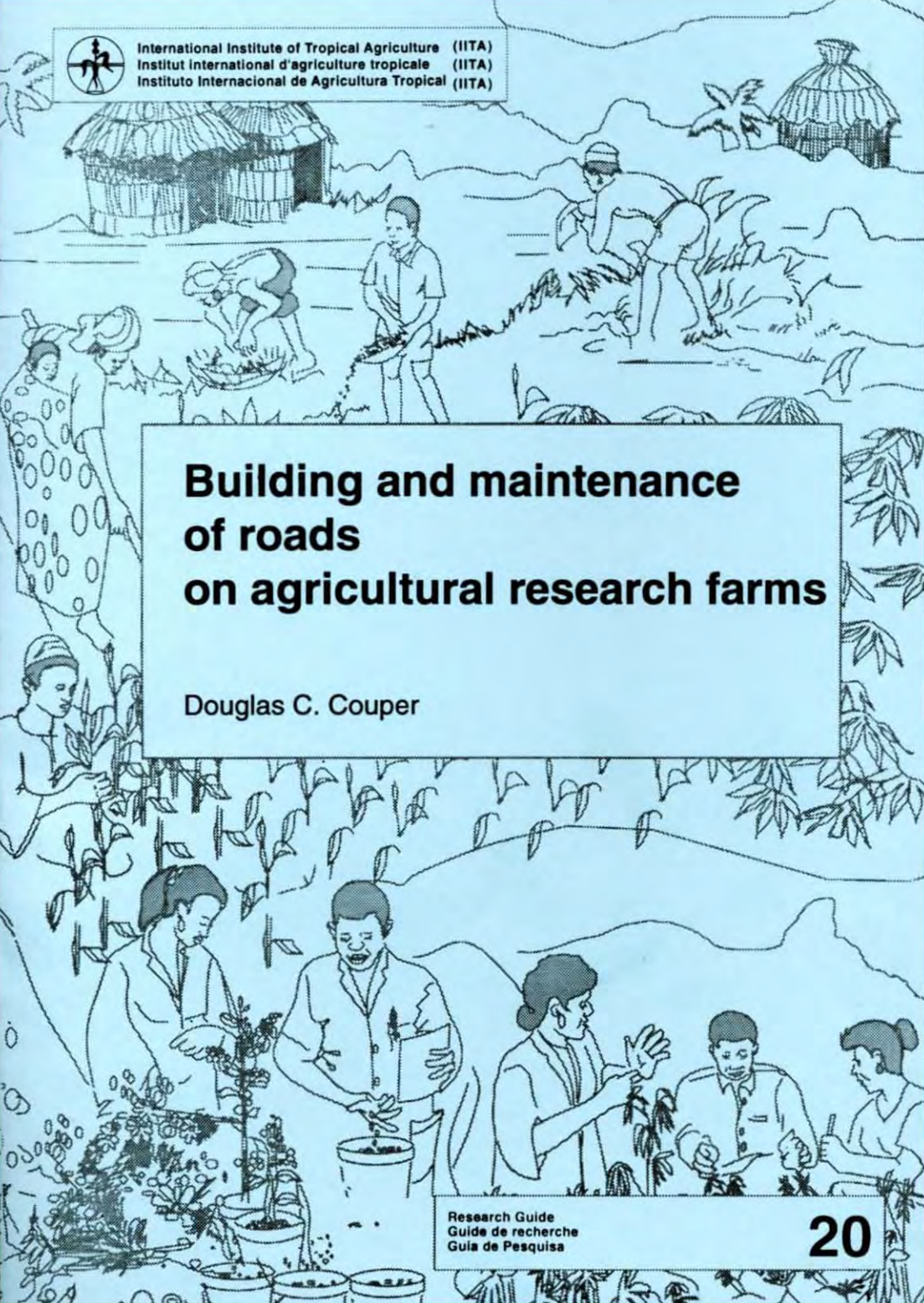

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Building and maintenance of roads on agricultural research farms

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Research Guide
Guide de recherche
Guia de Pesquisa

20

IITA Research Guide 20

Building and maintenance of roads on agricultural research farms

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IITA Research Guides

IITA Research Guides provide information and guidance to agricultural researchers, technicians, extension specialists, educators and students involved in research and training. The Research Guides are periodically updated to meet advances in scientific knowledge.

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Building and maintenance of roads on agricultural research farms

Objectives. This guide is intended to enable you to:

- discuss the importance of good roads,
- design and construct roads,
- maintain roads,
- construct alternative maintenance equipment.

Study materials

- A few meters of bad road.
- Material for constructing roads.
- Grader, pay-loader, sprayer, vibrating roller.
- Home-built roller and grader.

Practicals

- Demonstrate the effects of a bad road on machinery.
- Practice road design and construction.
- Practice road maintenance.

Questions

1 What vehicles are most affected by bad roads?
2 What are the characteristics of suitable material for constructing roads?
3 Why should roads be above the bordering land?
4 What should you do with top-soil when preparing roads?
5 How wide should a farm road and its drains be?
6 Describe the procedure for marking a road.
7 What is the ideal machine if many roads have to be constructed?
8 What is the objective of a camber?
9 Describe the shape of a 6 m wide road.
10 What material should you use for surfacing the road?
11 Where should you place culverts?
12 How can you prevent erosion on road drains?
13 Describe the process of road deterioration.
14 Why should you grade roads frequently?
15 What is the detrimental effect of grading off grass outwards to the sides of the road?
16 How can you avoid transporting large amounts of laterite to rebuild roads?
17 In what direction should you grade when maintaining a road?
18 Describe the correct grading operation.
19 Describe alternative maintenance equipment.

Building and maintenance of roads on agricultural research farms

Abstract. Good roads can prevent costly damage to machinery. Erosion of roads can be avoided by proper design and construction. Earth roads require continuous maintenance. Maintenance is easy if carried out correctly and routinely.

1 Importance of roads

Roads are important on the research station because they provide access. Roads may be:

- hard-surfaced with tar and chippings or with asphalt;
- earth, dirt or laterite.

While access roads to building and housing areas are generally hard, majority of roads on research stations, particularly those on the research farm, are earth roads.

Poor and badly maintained roads cause:

- inconvenience to users;
- damage to vehicles plying the roads.

On a farm, the vehicles most affected by bad roads are tractors. Tractors carrying heavy implements on their three point linkage, bouncing through pot-holes, experience considerable stress on their hydraulic systems.

2 Road design and construction

Make earth roads from suitable local soil material. Suitable soil material is:

- lateritic,
- low in clay content,
- high in gravel content.

Prefer gravelly soils as they give a vehicle good tyre grip, even when wet. Avoid clay as it causes tyre slippage when wet, and can be dangerous.

Construct roads to ensure they shed water. Always site roads above the bordering land so that water drains off during heavy rainfall. Older, poorly maintained roads can sink below the bordering land due to soil erosion, with the result that the road becomes a river bed during heavy rainfalls.

Initial preparation. Remove good topsoil either by grading it to one side and then piling with a pay loader, or by pushing it into heaps with a bulldozer. Store this top soil for future use in landscaping building areas, or for use in greenhouses, screenhouses or pot plant experiments.

Establishing road width and drains. Peg out the center-line of the road. Use this line to establish the side boundaries of the road. Farm roads should be at least 6 m wide with a drain of at least 2 m wide on either side of the road.

Marking the road (Figure 1):

- Run a grader exactly along the middle of the road, keeping the center-line pegs lined up with

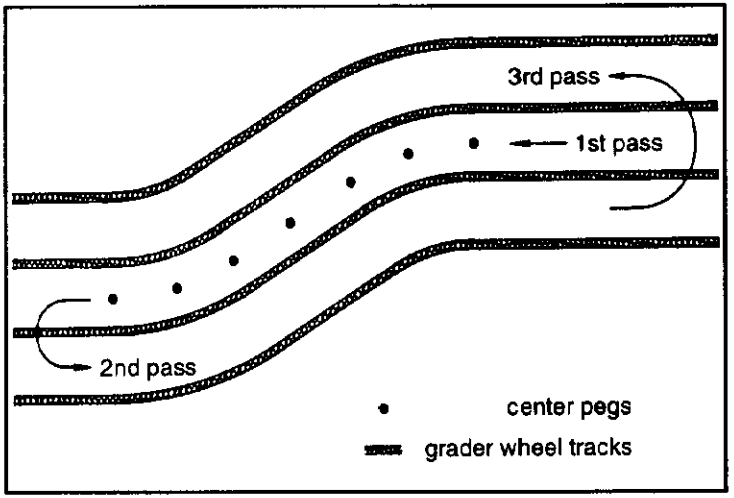
the middle of the grader (1st pass). The grader is 2 m wide and you will see two wheel tracks at 1 m either side of the center-line.

- Turn back to the left and follow the former wheel track with your left wheels, creating another line 2 m wide (2nd pass).

- Do the same in the opposite direction (3rd pass), so that there are now 4 wheel tracks demarcating three widths of the grader. The outer wheel tracks mark the sides of the road, 6 m wide.

- Make another pass in each direction to establish the drain limits.

Figure 1. Marking the road using grader wheel tracks.



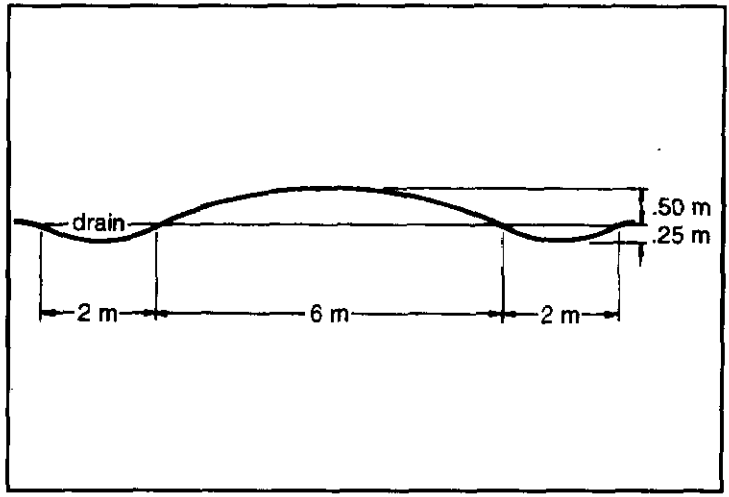
Building the road. Start building the road by excavating the drains on either side and placing the cut material onto the proposed road. If many roads have to be made, a scraper is ideal. Otherwise, use a pay-loader if available. You can also use a grader; working with a grader is slow, however.

Shaping the road (Figure 2). Camber the road to ensure that water is shed from the road into the drains. If a camber is not present, water will stand on the road causing:

- inconvenience to users,
- damage to road surface.

To camber the road, shape it so that the middle is slightly higher than the edges. Grade and compact all material added to the road, using a roller (preferably vibrating).

Figure 2. Shaping the road.



On a road 6 m wide, make the road profile as follows:

- center 50 cm higher than road edges,
- drains 25 cm lower than road edges.

Surfacing the road. Material used for the foundation of the road is not usually suitable for the final surface. Transport suitable high gravel/low clay material from a borrow pit or quarry in dump trucks or tippers and deposit in heaps along the center of the road.

Spread this material evenly over the entire road surface, using a grader. If dry, water before final compaction. Compact and regrade several times over the following months until the road is stable.

Draining the road. Because the road is above the surrounding land, it may block natural drainage ways. Water run-off from the land may cross the road and wash it away. To prevent this, place culverts at strategic low areas wherever water gathers. Culverts are constructed from concrete or corrugated iron rings which run under the road, providing a water tunnel.

Construct wing walls at the entrance and exit of the culverts to prevent water wash. These wing walls also alert drivers to the culverts helping to prevent damage. Grass over road drains whenever possible to prevent erosion. A suitable grass for drains is *Paspalum notatum*.

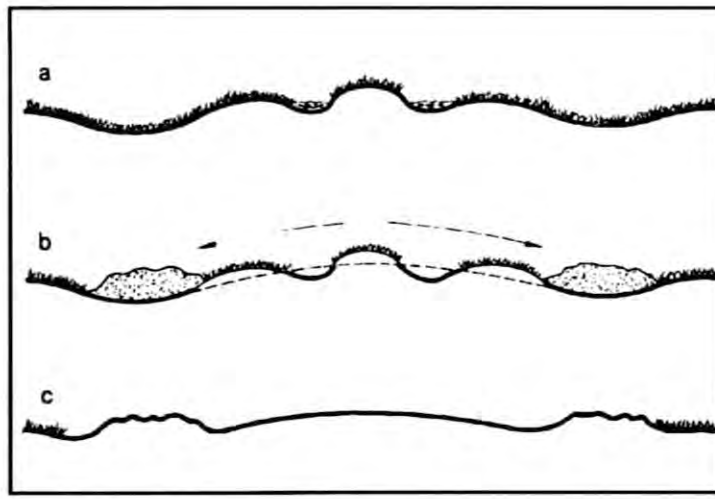
3 Road maintenance

Earth roads require continuous maintenance. On narrow single-lane roads, traffic keeps following the same tracks causing two depressed, compacted strips along the road, with higher strips often covered in grass, along the center-line and two edges of the road (Figure 3a).

Water collects in the depressed strips and can only escape at low spots. The resultant erosion causes gullies and the road may have to be rebuilt.

Grade roads frequently to prevent eroded wheel tracks and grass growth on little used areas of the road, but be careful, as poor grading can result in costly and difficult road repairs.

Figure 3. Bad grading procedure: grading outwards **destroys** roads.



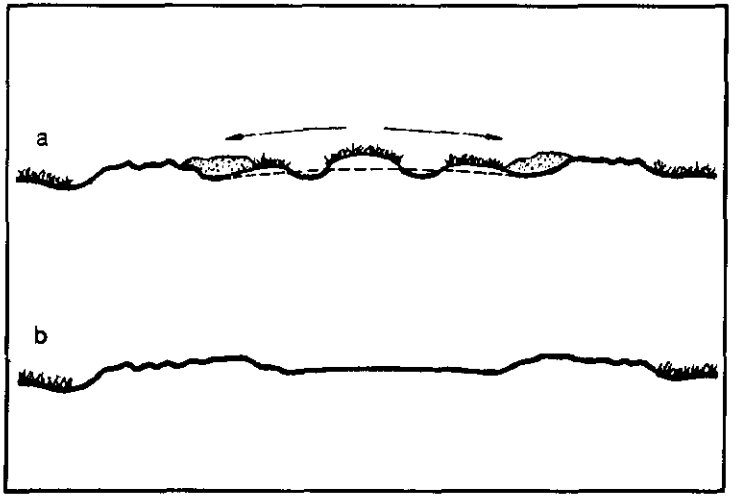
If wheel tracks do become eroded, and grass does grow on the center-line and edges of the road, avoid grading the grass outwards to the sides of the road. Grading outwards leaves a ridge of soil and grass down each side of the road (Figure 3b), which blocks off the drains rendering them ineffective. The road becomes narrower (Figure 3c).

If incorrect grading operations are repeated, the cycle is repeated until the road is beneath the level of the adjoining land and becomes itself a drainage way (Figure 4).

The only cure at this stage is to transport large amounts of laterite to build up the road again and to re-establish the road-side drains.

Never permit a grader operator to grade outwards. Always grade inwards towards the center of the road to keep it built up and keep the drains free.

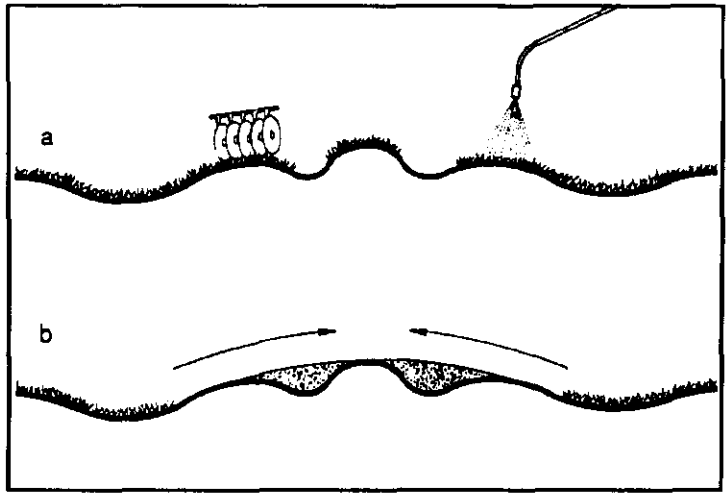
Figure 4. Continued deterioration of road.



In correct grading operations, grade only one side of the road at a time:

- Kill the grass with a few passes of the harrow or with an application of paraquat herbicide (Figure 5a).
- Leave the harrowed or sprayed grass to decompose for a few days.
- Grade back the laterite under the grass **onto the crown** of the road (Figure 5b), leaving drains free.

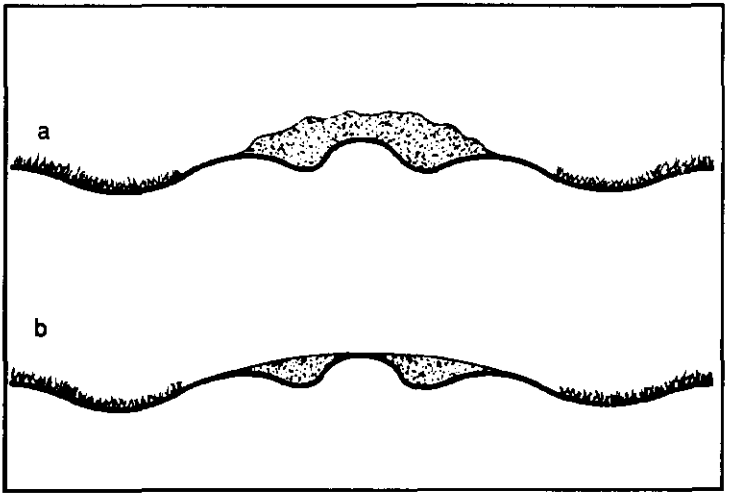
Figure 5. Correct road maintenance.



To maintain the height of the road in easily eroded areas on steep slopes, add some laterite from time to time (Figure 6):

- spread and compact the laterite,
- do not disturb the grassed sides of the road to reduce erosion.

Figure 6. Most efficient road maintenance.



4 Alternative maintenance equipment

Few research stations own motorized graders. If possible, hire a grader either from a government ministry or from a private company, ideally at the end of the rains.

Alternatively, use a trailed grader, which is drawn by a farm tractor. Trailed graders are:

- simple and easy to operate,
- suitable for the construction and maintenance of soil conservation works and roads in rural areas.

Trailed graders are normally connected to the hydraulic system of the tractor so that blade raising, lowering and angling etc. is carried out by hydraulic power.

The power required varies with the grader blade width (Table 1). If a sufficiently large tractor is not available, use two tractors in tandem to pull a grader.

Table 1. Power required to pull graders (Simba Machinery Co.).

width of cut (m)	power required (h.p.)
2.5	50 - 100
3.0	70 - 140
3.5	120 - 180

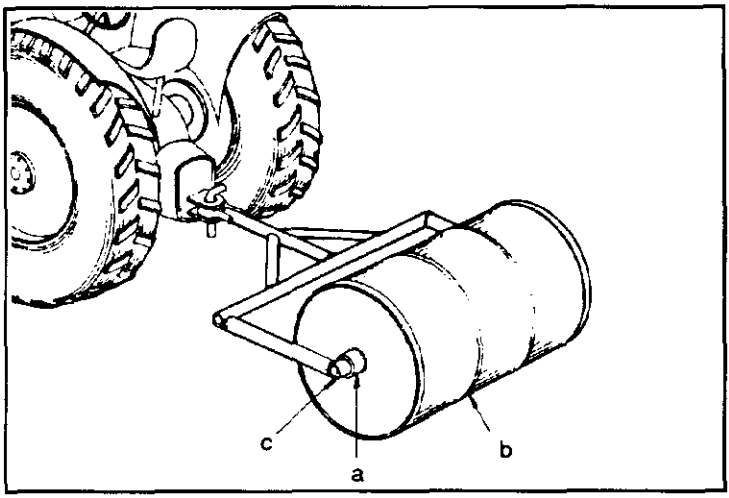
If a trailed grader cannot be obtained, the following methods may be used.

- Use a disc plough to plough inwards from both sides, making many passes so that soil is gradually moved into the center of the road.

- Level with a disc harrow to reduce the largest of lumps and areas of unevenness.

- Make a compaction roller (Figure 7), by fixing a 50 mm (2") pipe (a) through the center of a 200 liter (44 gallon) drum (b). Fill the drum with concrete. Prepare a drawbar out of 37 mm (1.5") pipe which slips inside the 50 mm pipe (c). Tow the roller behind a tractor to compact the soil.

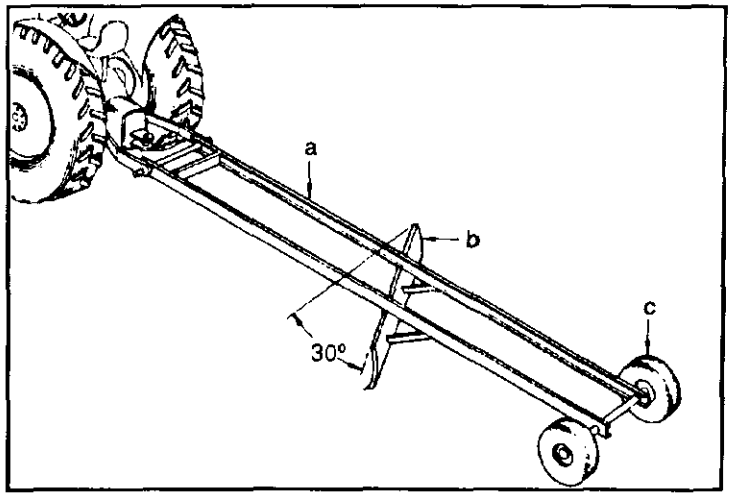
Figure 7. Home-made roller.



- Make a grader (Figure 8) from two pieces of old railway line or two pieces of heavy duty angle iron around 6 meters in length (a). Fix an old D4 bulldozer blade or an old land leveller blade (b) approximately half way along the steel lengths. Brace appropriately. Fit an old pair of wheels (c) on an axle at the rear of the grader. Attach a suitable draw-bar to the lift arms of the three point hitch.

You can use locally manufactured machines, such as rollers and graders, to carry out soil conservation measures and keep farm roads in excellent shape.

Figure 8. Home-made grader.



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6 Suggestions for trainers

If you use this Research Guide in training ...

Generally:

- Distribute handouts (including this Research Guide) to trainees one or several days before your presentation, or distribute them at the end of the presentation.
- Do not distribute handouts at the beginning of a presentation, otherwise trainees will read instead of listen to you.
- Ask trainees not to take notes, but to pay full attention to the training activity. Assure them that your handouts (and this Research Guide) contain all relevant information.
- Keep your training activities practical. Reduce theory to the minimum that is necessary to understand the practical exercises.
- Use the questions on page 4 (or a selection of questions) for examinations (quizzes, periodical tests, etc.). Allow consultation of handouts and books during examinations.
- Promote interaction of trainees. Allow questions, but do not deviate from the subject.
- Respect the time allotted.

Specifically:

- Discuss with participants problems, experiences with road design and construction.

- Present and discuss the content of this Research Guide, using the study materials listed on page 3. You may photocopy the illustrations onto transparencies for projection with an overhead projector.

- Conduct the suggested practicals on page 3 in groups of 2-3. Make sure that each trainee has the opportunity to practice. Have resource persons available for each group and practical. Prevent trainees from scattering around the field. Observe safety regulations when operating equipment.

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