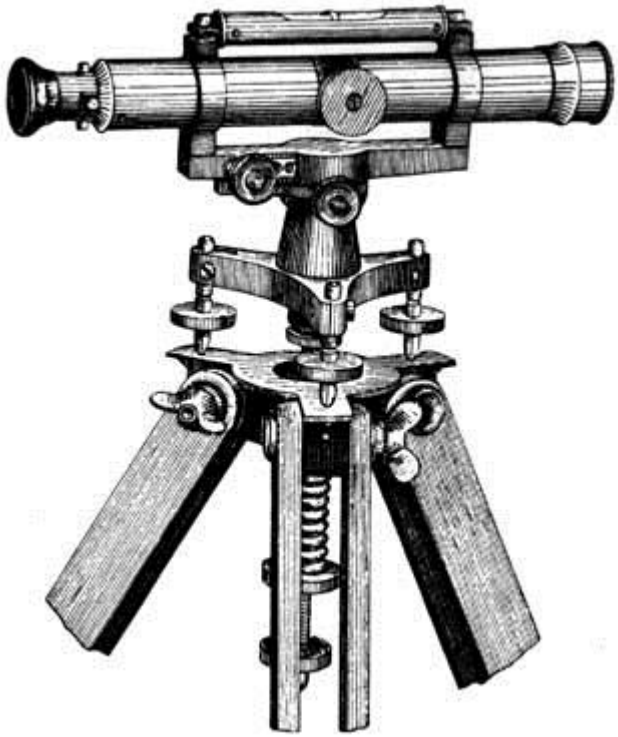
Chapter 2

6. HORIZONTAL LINES, SLOPES, CONTOUR LINES AND DIFFERENCES IN ELEVATION

Surveying or survey levelling is practised to determine the differences in elevation (= vertical distances) between various points in the field, to measure distances (horizontal distances), to set out contour lines etc. Major surveying works are done by engineers or qualified surveyors using sophisticated equipment such as the levelling instrument (see Fig. 33). This Section will only deal with elementary equipment. Most equipment can be home-made and be used by the farmers themselves after little training.

Fig. 33 An example of a levelling instrument



The various types of equipment and their use described in the sections that follow, are:

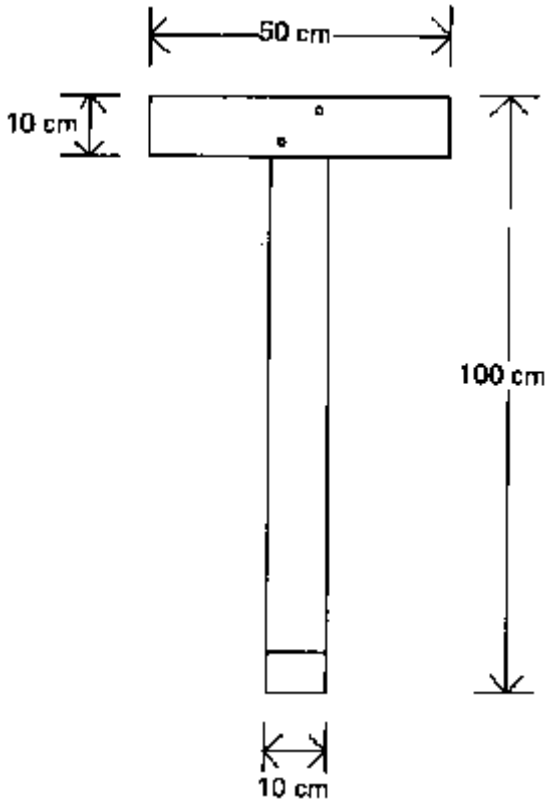
- Boning rods: horizontal lines and slopes
- N-frame level: slopes and contour lines
- Flexible tube water level: contour lines and differences in elevation
- Hand level: contour lines and differences in elevation.

6.1 Boning Rods

6.1.1 Description

Boning rods are T-shaped and made of wood. Their height is normally 100 cm and the cross-lath is 50 cm x 10 cm. The bottom part is sometimes reinforced with metal (see Fig. 34).

Fig. 34 A boning rod



It is important that all boning rods have exactly the same height (100 cm) and while working with the boning rods, the sun should be kept in the back, as it would otherwise be difficult to see them. Usually a total of 3 or 4 boning rods is required.

6.1.2 Use of boning rods

Boning rods are used to set out horizontal lines or lines with a constant slope. In particular they are used for setting out canal excavation works, but also for roads and dyke construction.

To be able to set out horizontal lines or lines with a constant slope, the elevation (or height) of two points on the line (preferably the starting and end points) must be known.

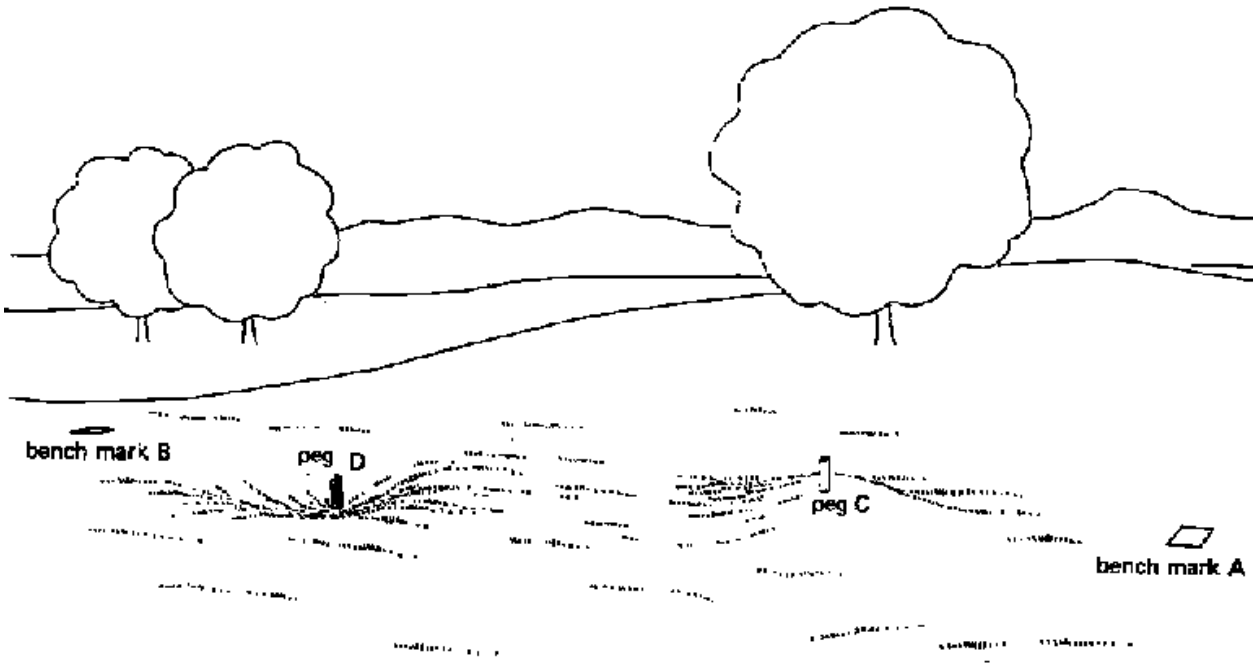
6.1.2.1 Setting out horizontal lines

Suppose a horizontal line has to be set out between the Bench Marks A and B. Bench marks A and B have the same elevation. The procedure is:

Step 1

Set out a straight line between A and B (see Chapter 2) and place intermediate pegs at regular intervals (see Fig. 35a; pegs C and D).

Fig. 35a Setting out a horizontal line, Step 1

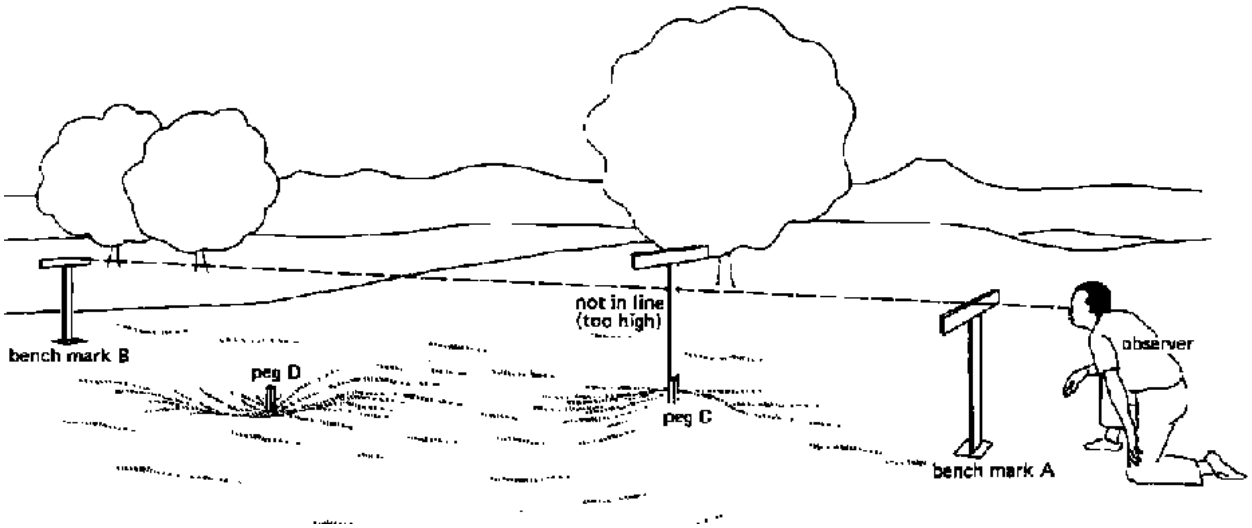


Step 2

Place boning rods on top of the two Bench Marks and on top of peg C. The observer, looking just over the top of boning rod A tries to bring the tops of the boning rods A, B and C in line.

As can be seen from Fig. 35b, boning rod C and thus peg C is too high; the tops of the boning rods are not in line.

Fig. 35b Setting out a horizontal line, Step 2

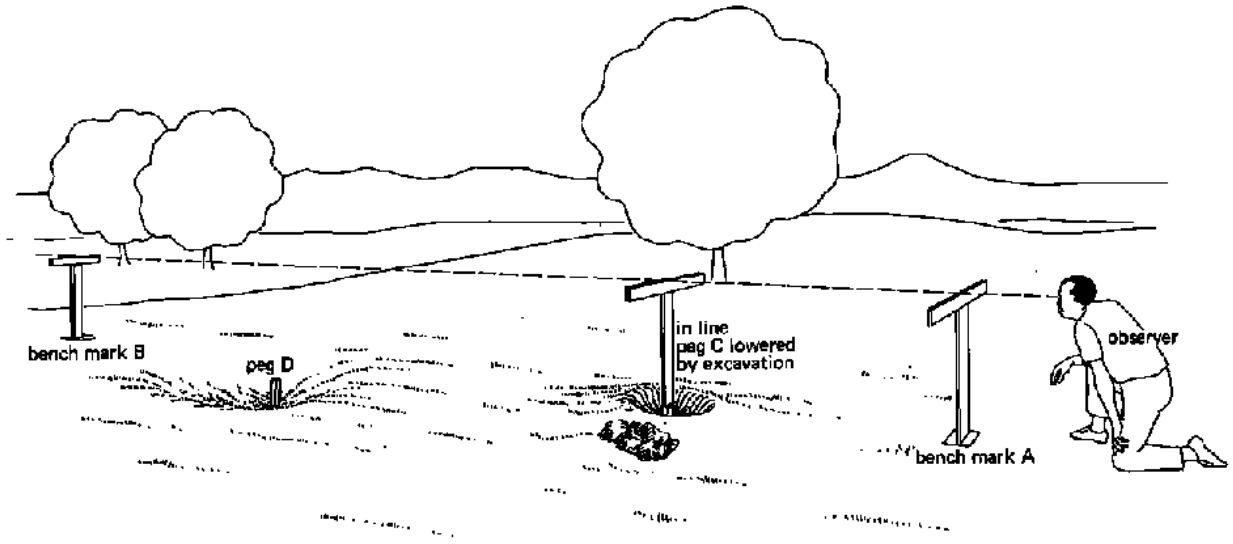


Step 3

Hammer peg C further into the soil. It may be necessary to excavate some of the soil surrounding peg C in order to be able to lower peg C sufficiently.

The top of peg C is at the correct elevation when, looking over the top of boning rod A, the tops of the boning rods A, C and B are in line (see Fig. 35c).

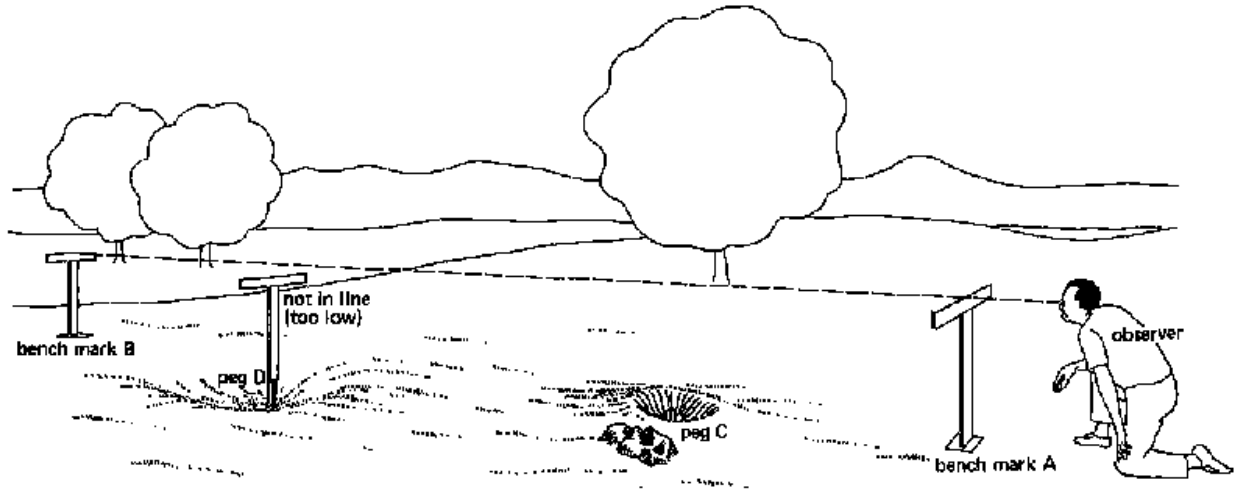
Fig. 35c Setting out a horizontal line, Step 3



Step 4

Place a boning rod on peg D. When looking over the tops of the boning rods A and B it is not possible to see the top of the boning rod on peg D, as peg D is too low (see Fig. 35d).

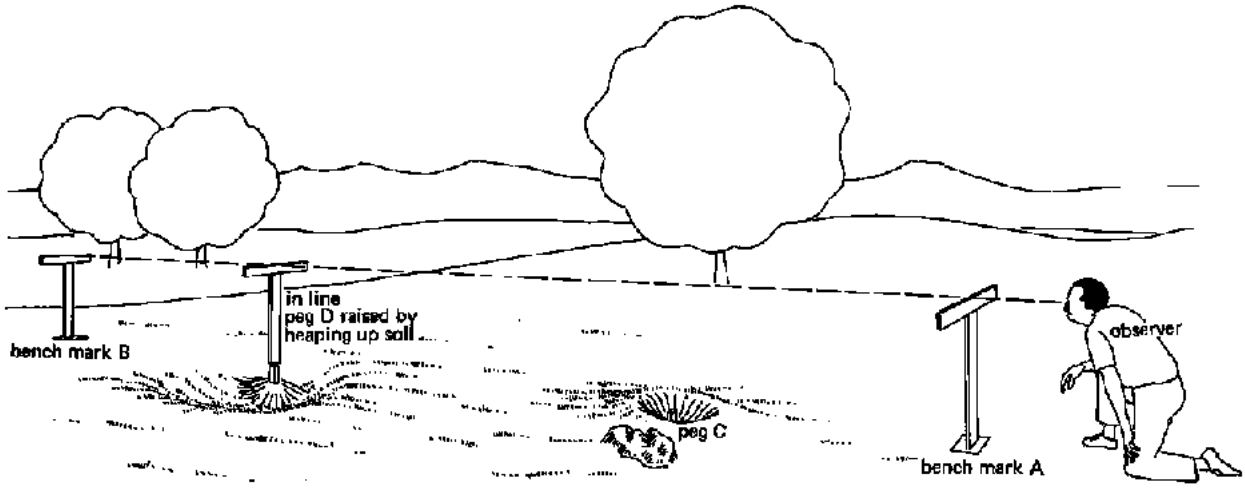
Fig. 35d Setting out a horizontal line, Step 4



Step 5

Replace peg D by a longer peg or pull out peg D and add some soil in the immediate surroundings of D and hammer peg D again into the soil. Repeat this process until the correct elevation of peg D is found (see Fig. 35e).

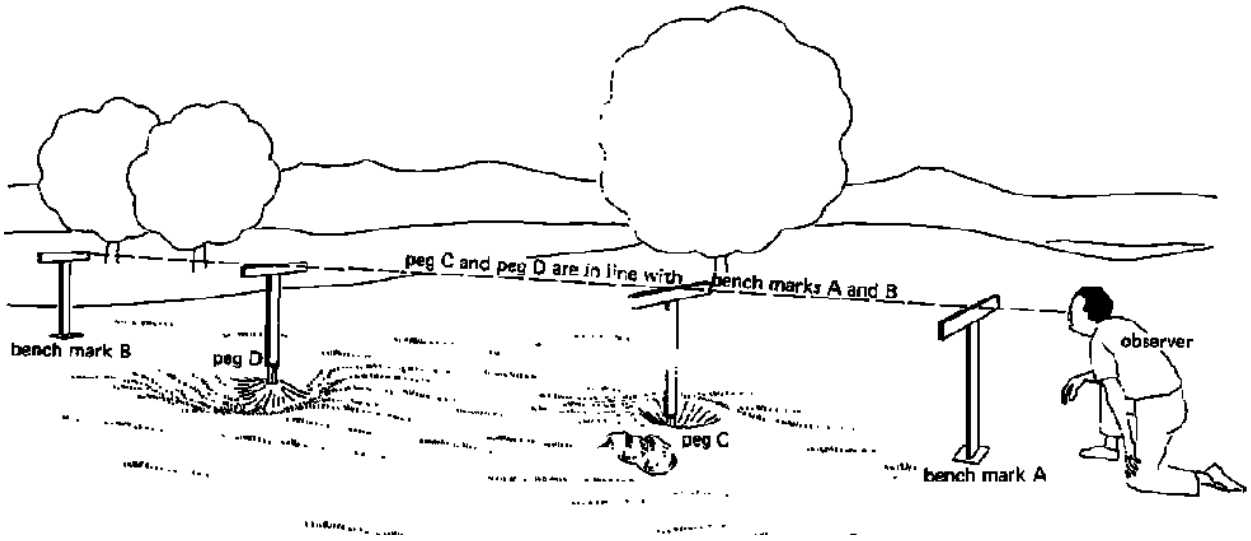
Fig. 35e Setting out a horizontal line, Step 5



Step 6

The two Bench Marks A and B and the pegs C and D all have the same elevation. Line ACDB is horizontal (Fig. 35f).

Fig. 35f Setting out a horizontal line, Step 6



6.1.2.2 Setting out slopes

The use of boning rods when setting out a slope is the same as described in 6.1.2.1 only, in this case, the Bench Marks A and B do not have the same elevation. Bench Mark A is either higher or lower than B. When the difference in elevation and the horizontal distance between A and B are known, the slope can be calculated (see Volume I, Chapter 3 and Volume 2 Chapter 3 and sections 6.3 and 6.4).

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