Surveying 1 / Dr. Najeh Tamim

CHAPTER 3

CHAIN SURVEYING (TAPE MEASUREMENTS)

3.1 INTRODUCTION

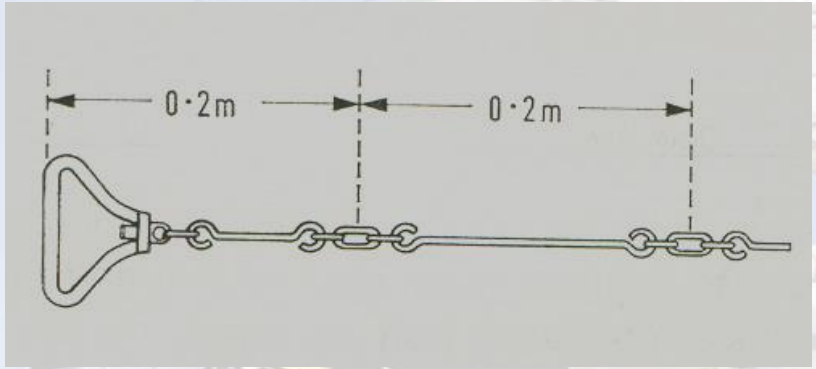
- Length measurements in the horizontal direction. (good for small areas).

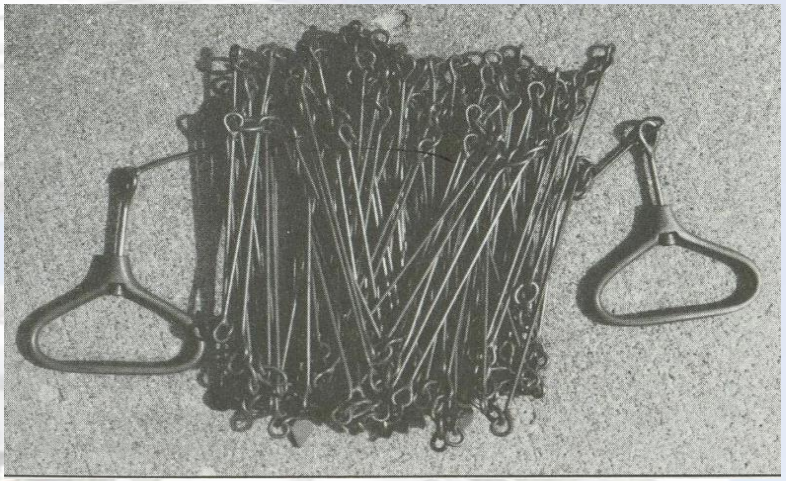
- Methods of distance measurement:
  - Pacing (R.P. = 1/100)
  - Chaining (taping) (R.P. = 1/3000)
  - Tacheometry
  - EDM
  - Other advanced methods.

3.2 EQUIPMENT USED IN CHAIN SURVEYING

- **Equipment used for the measurement of lines:**

1) The Chain.





2) Tapes.

3) Invar tapes.

b) Equipment used for making right angles:

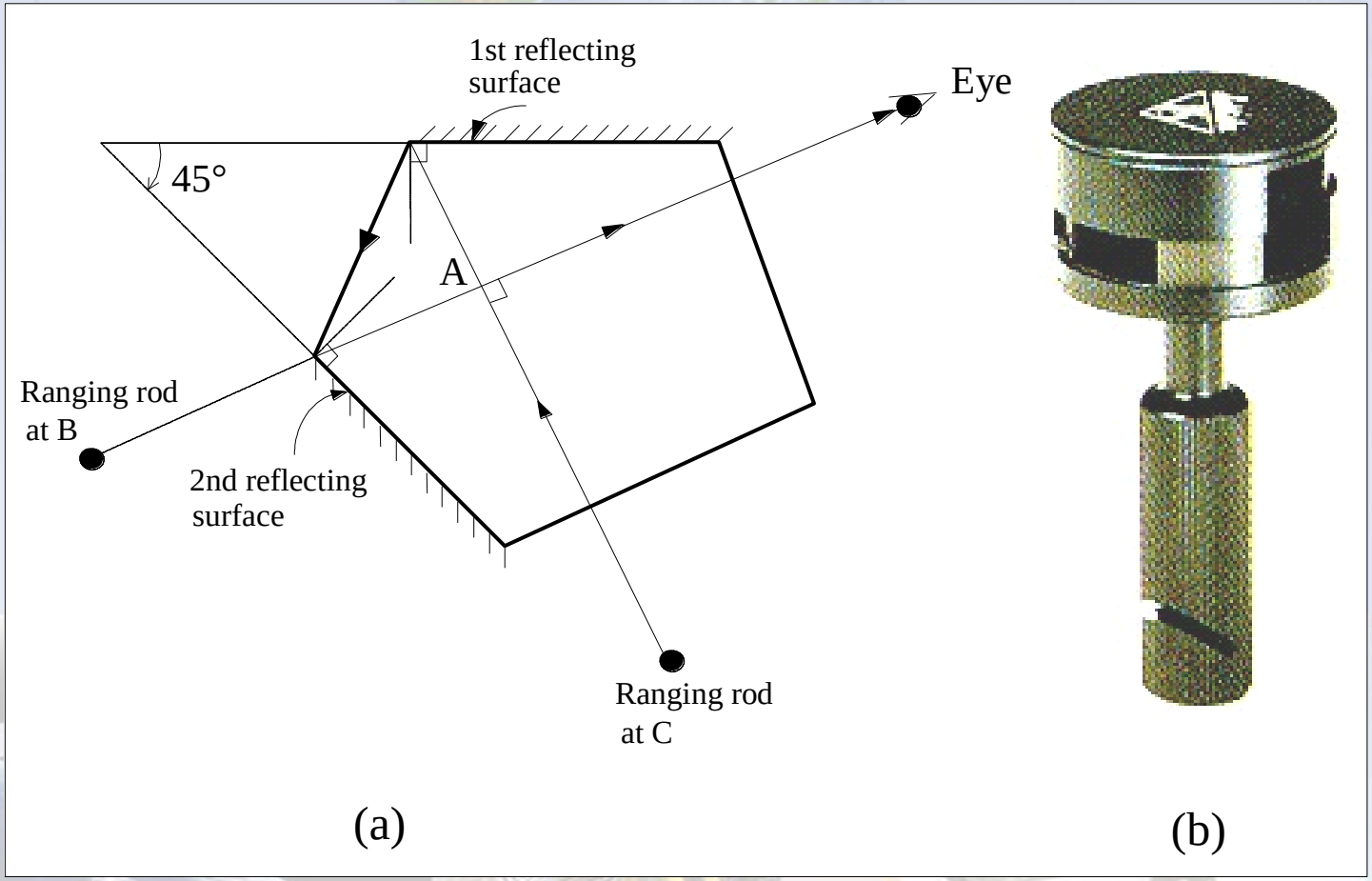


FIGURE 3.5: Prism type optical square.

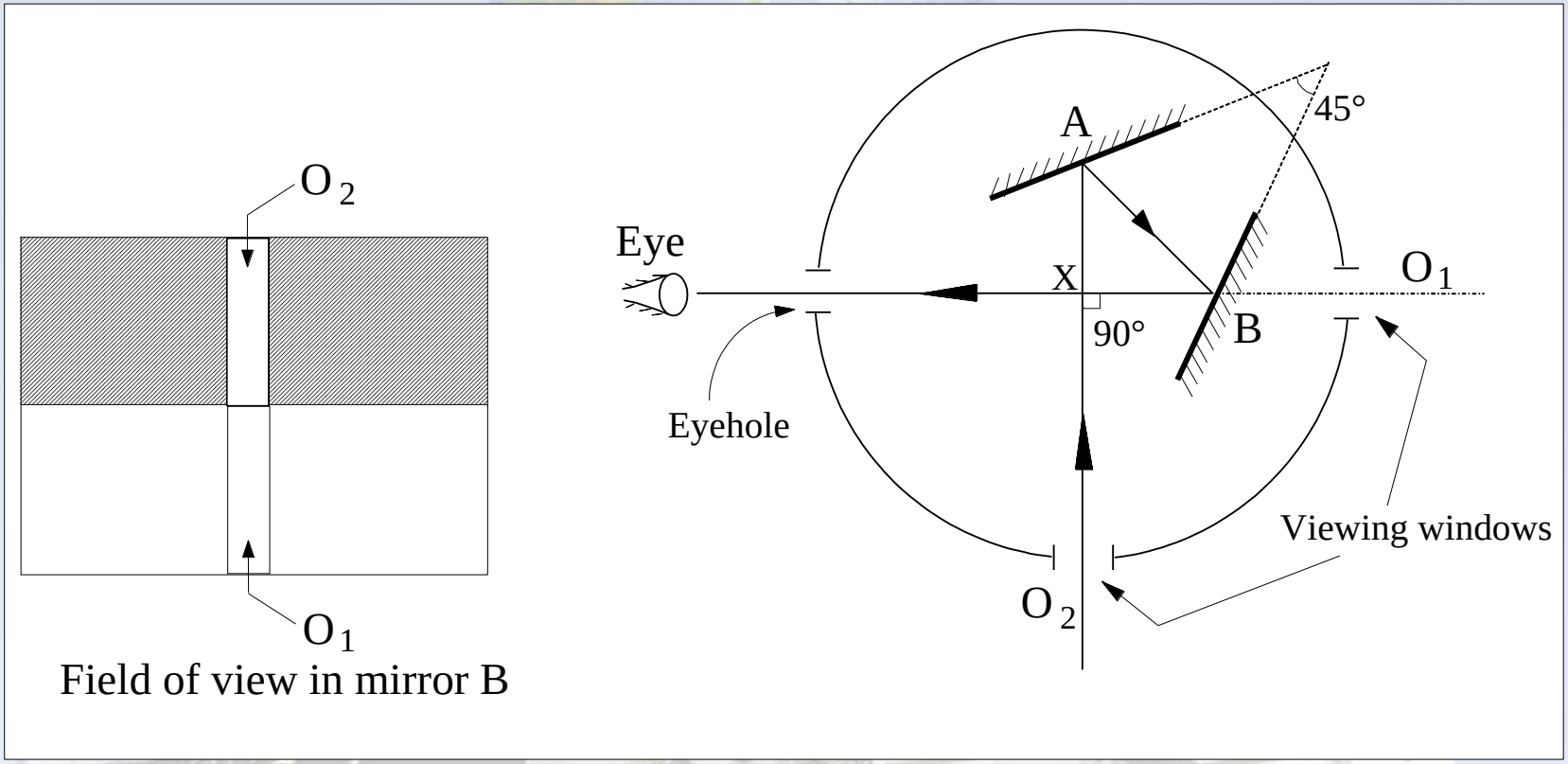


FIGURE 3.4: Mirror type optical square.

c) Other Equipment:

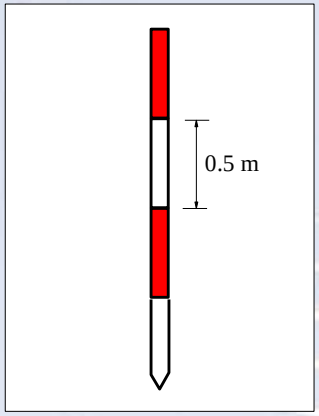


FIGURE 3.6: Ranging rod.

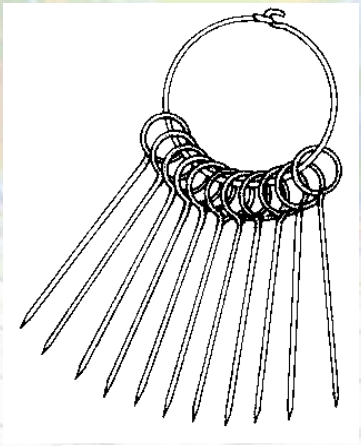


FIGURE 3.7: Arrows.

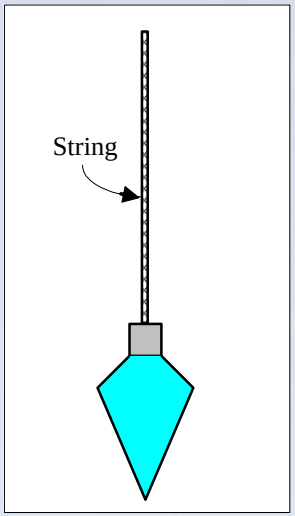


FIGURE 3.9: The plumb bob.

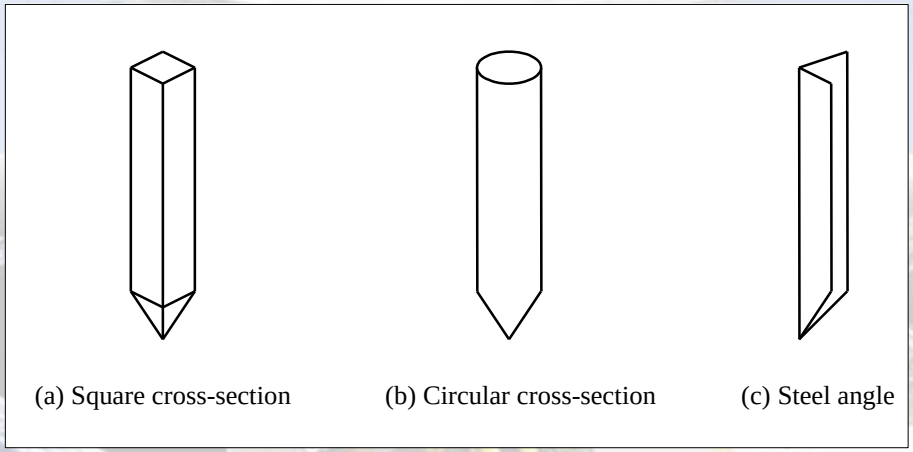
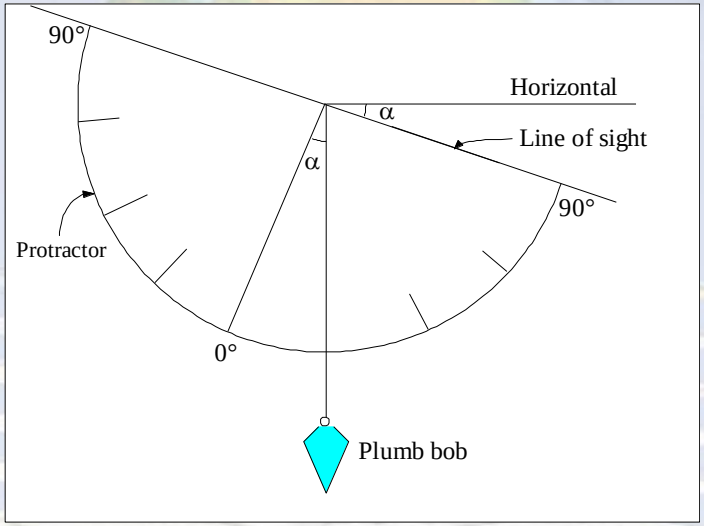
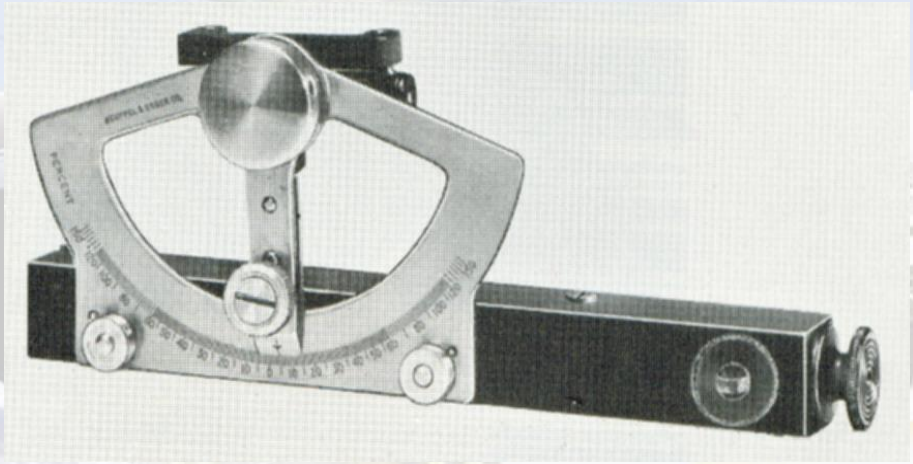


FIGURE 3.8: Types of pegs.

The Clinometer



The Abney Level



3.3 PROCESSES IN CHAIN SURVEYING

- **RANGING AND MEASUREMENT OF LINES:**
  - Short lines on flat or relatively flat terrain.
  - Long lines on flat or relatively flat terrain ⇒ Ranging
    - ♣ Forward ranging
    - ♣ Backward ranging.
  - Lines on uniformly (regularly) sloping ground.

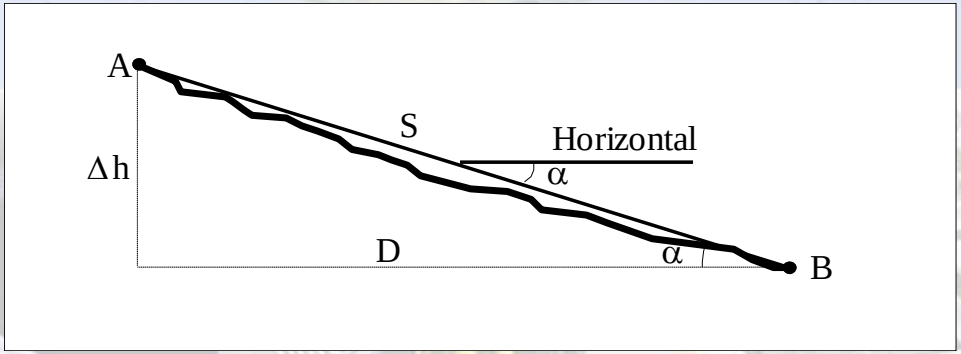


FIGURE 3.13: Distance measurement on a uniformly sloping ground

- Uneven Ground (Terrain)

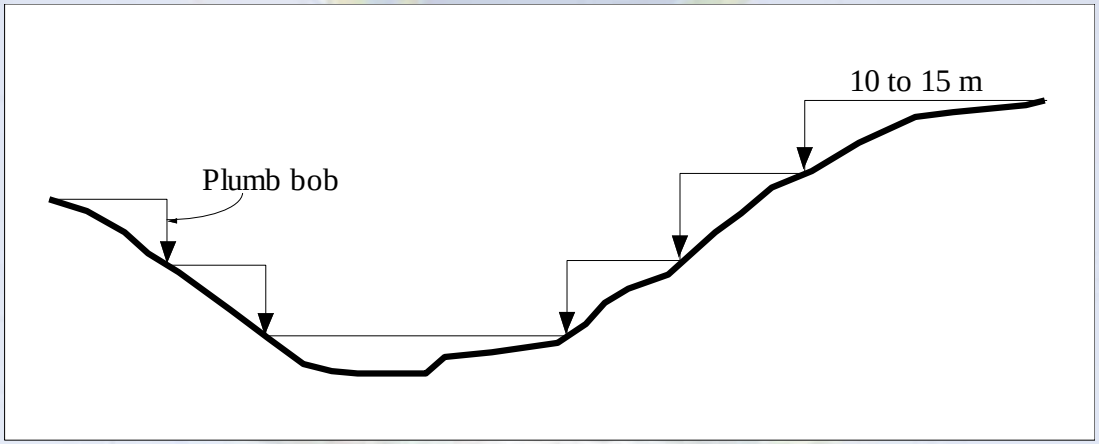


FIGURE 3.14: Stepping.

SETTING OUT RIGHT ANGLES:

- Setting out (Erecting) a line at right angles to another line such as AB from a given point C on this line.

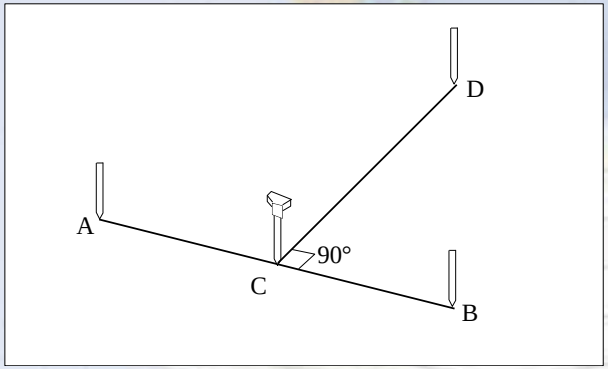


FIGURE 3.16: Erecting a perpendicular using the optical squar with double prism.

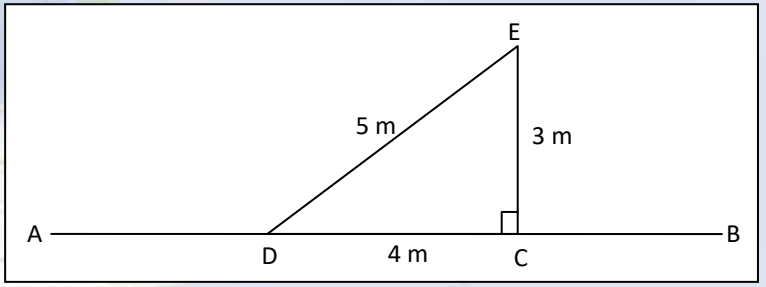


FIGURE 3.18: Pythagoras theorem method for setting out a perpendicular to a chain line.

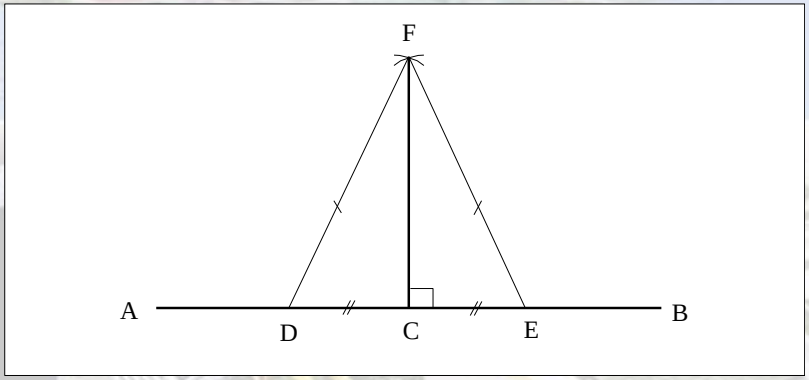


FIGURE 3.17: Setting out a perpendicular using the equilateral triangle.

- Dropping a perpendicular from a point C to a line AB.

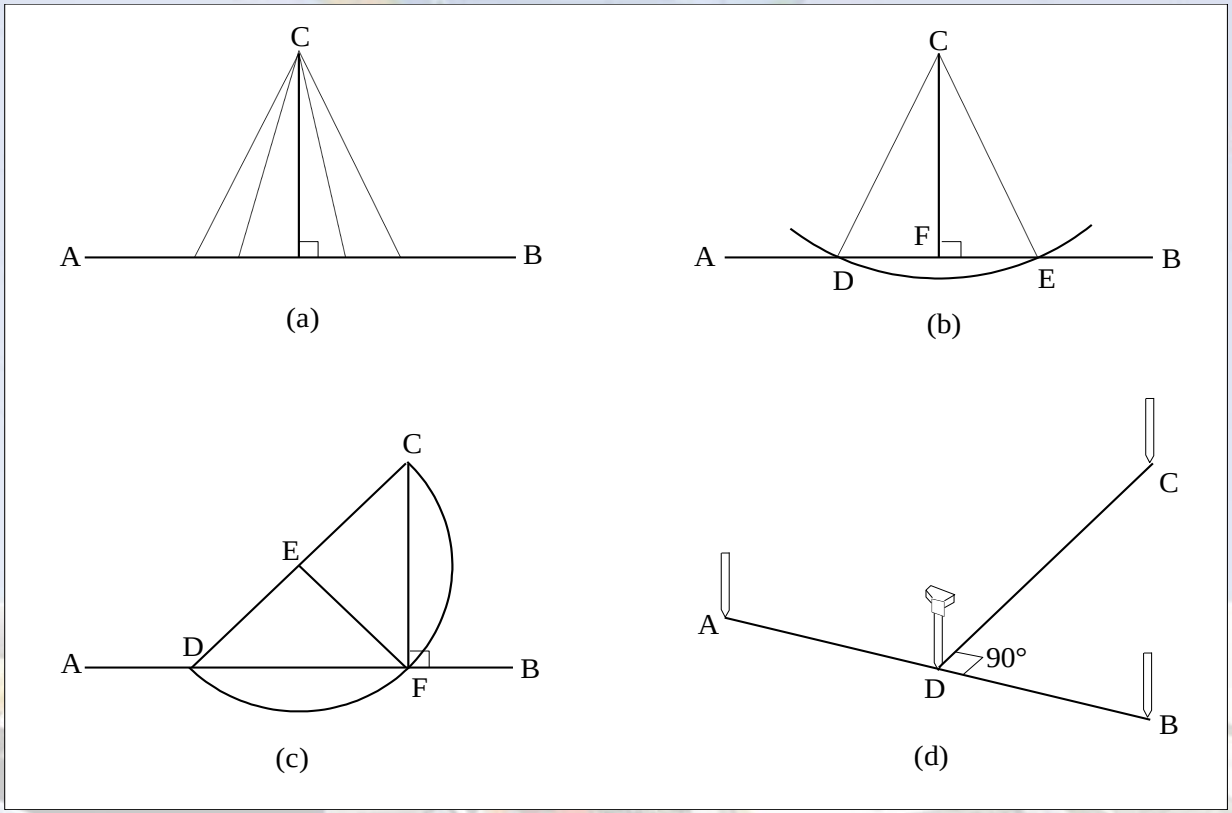


FIGURE 3.15: Methods of dropping a perpendicular from a point (C) to a chain line (AB).

3.4 MAPPING DETAILS USING CHAIN SURVEYING

- Visit the site and make a reasonable sketch.

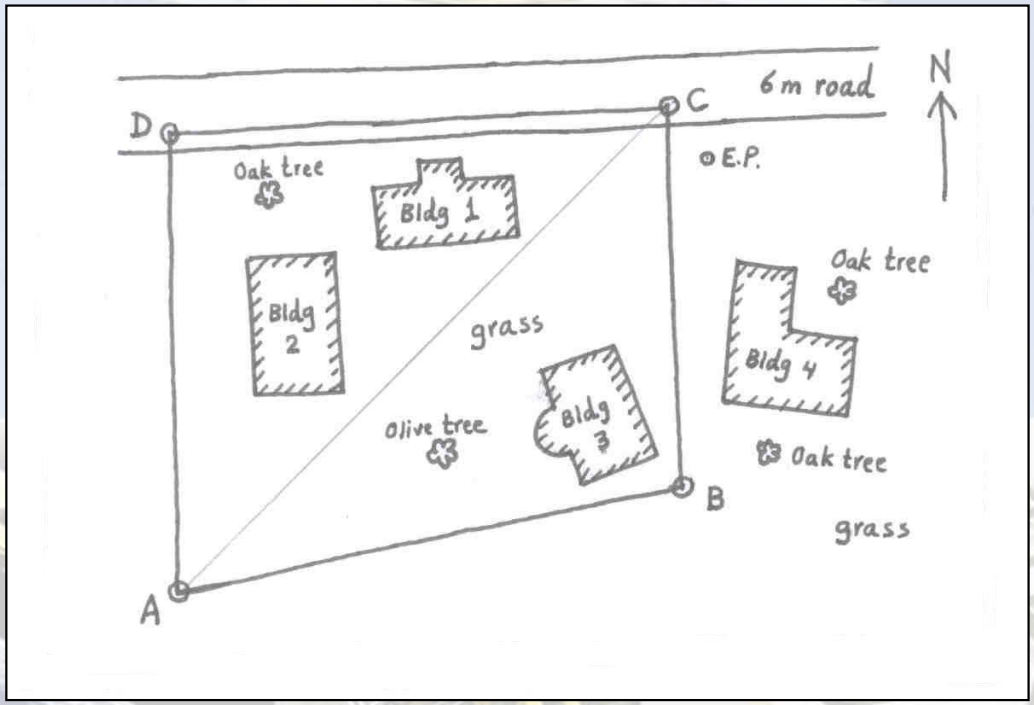


FIGURE 3.20: An example of a sketch for an area to be chained.

Details are measured using one or both of the following methods:

- Method of ties.
- Method of offsets.

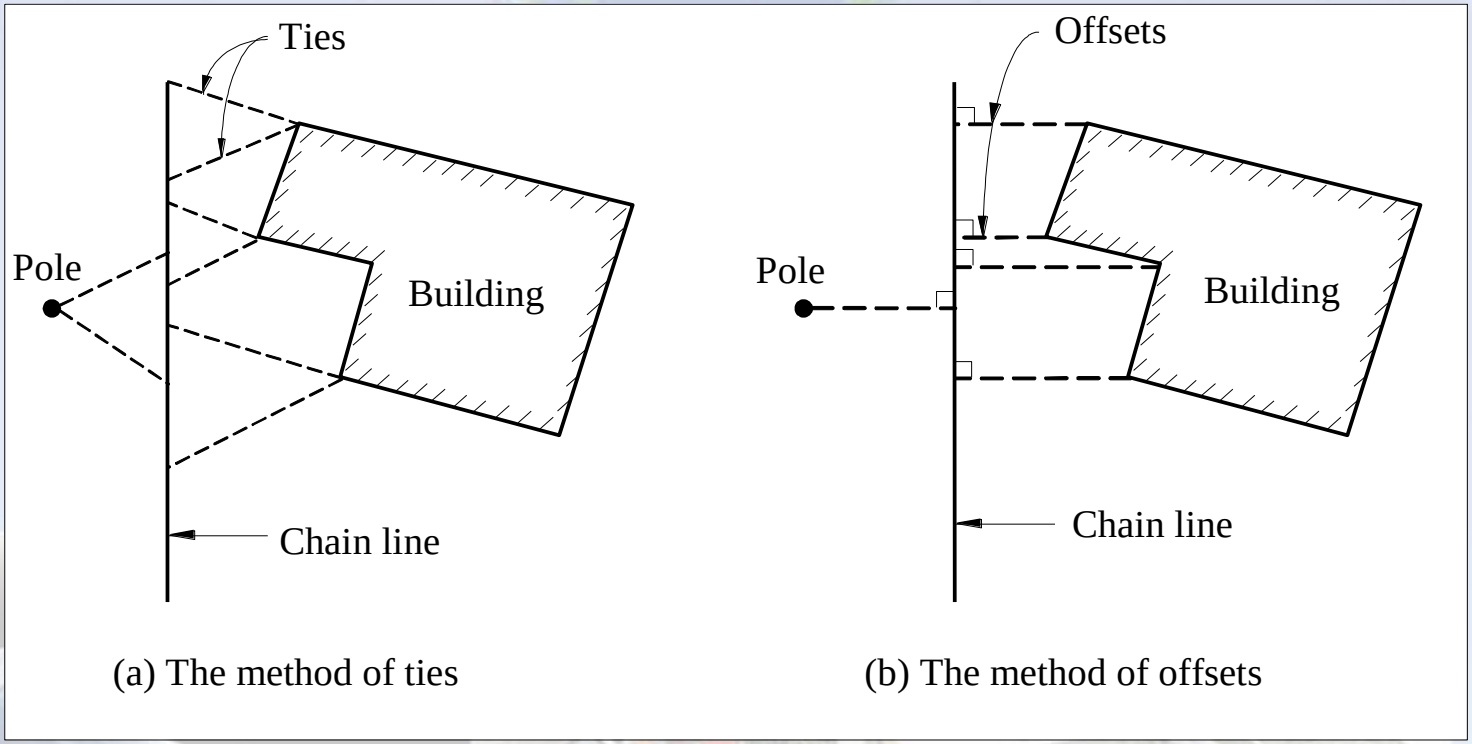


FIGURE 3.19: Methods of locating ground details.

CHOICE OF CHAIN LINES

- Should form well-conditioned triangles.

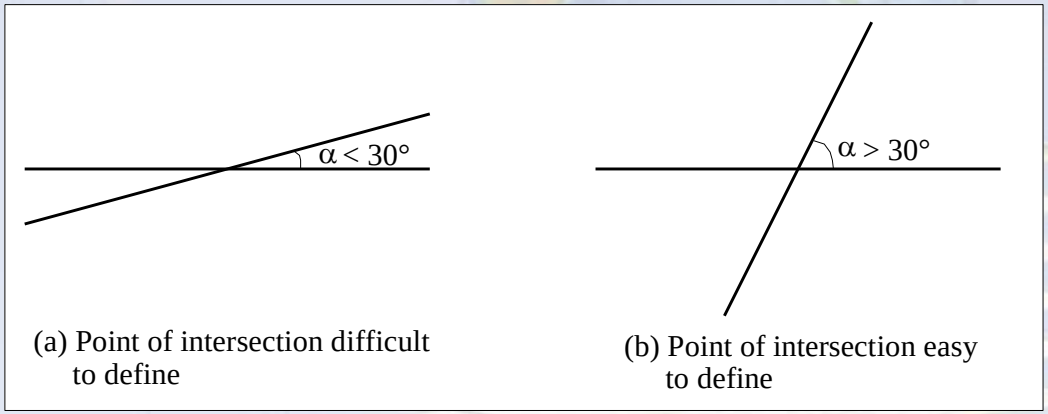
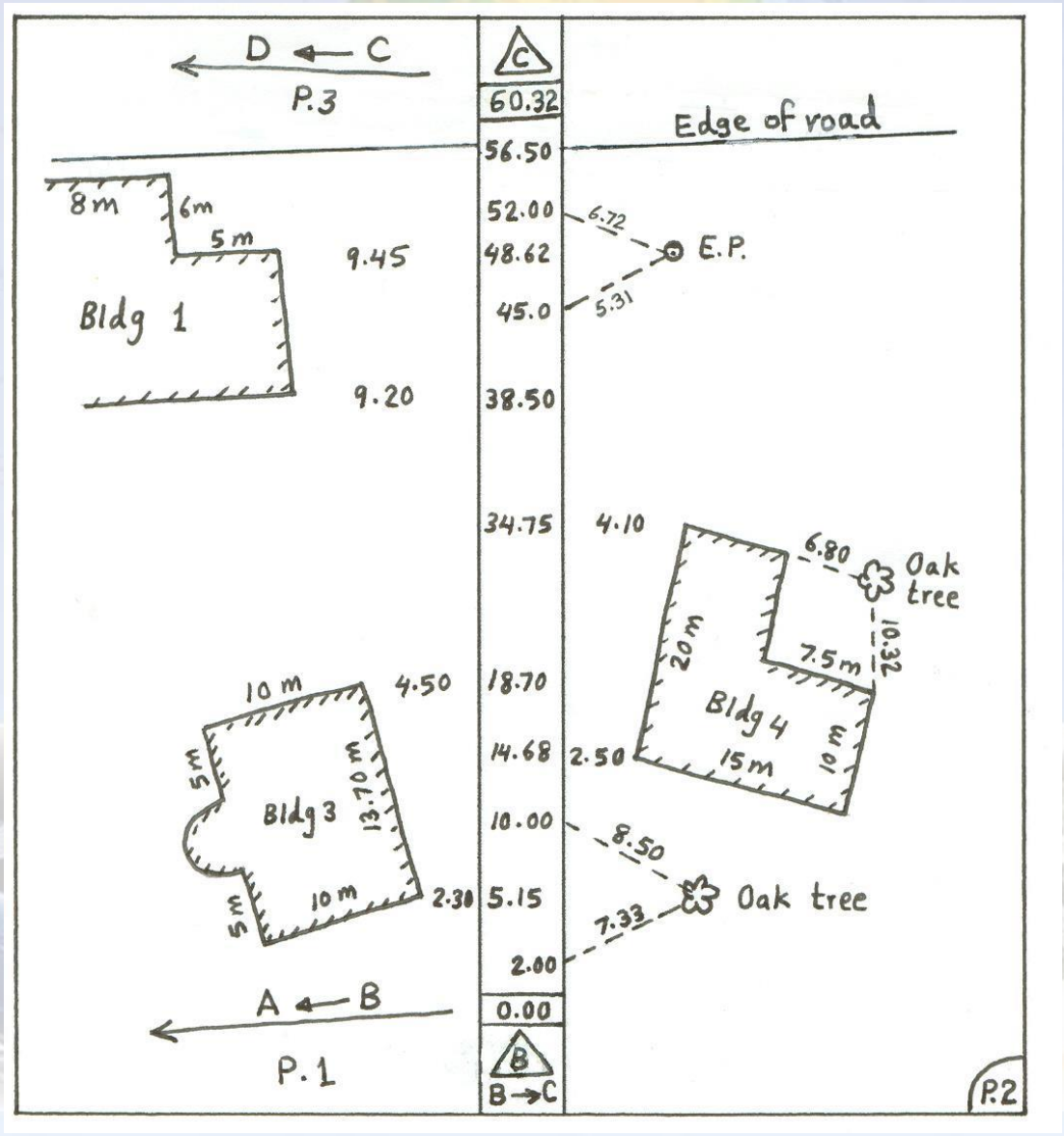


FIGURE 3.21: Relationship between the angle of intersection between chain lines and the location of the point of intersection.

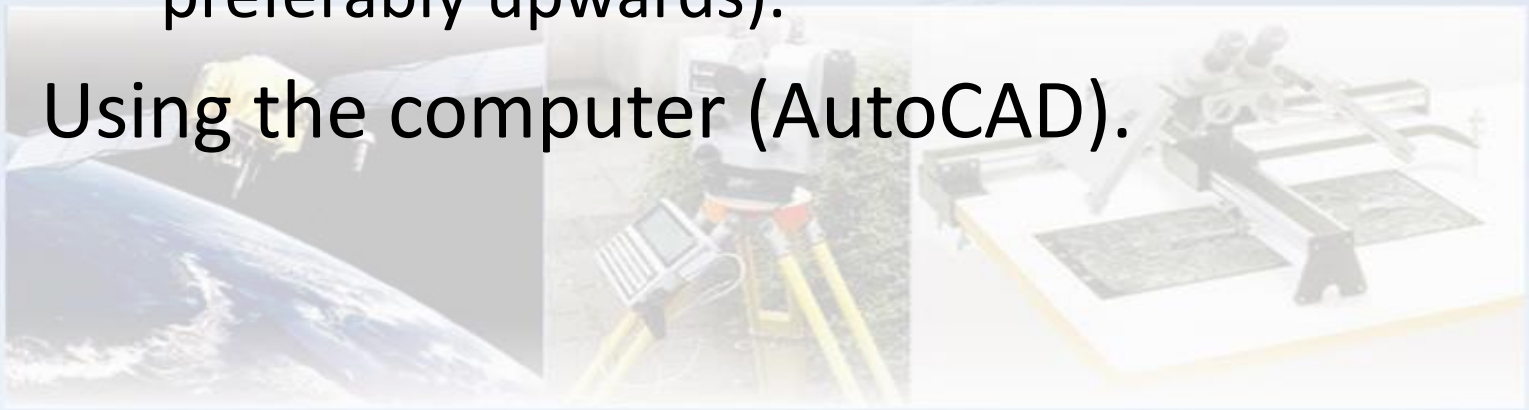
- Should be as close as possible to the details.
- # of chain lines should be minimum.
- No obstacles.
- Provide check lines.
- Tie to nearby stable features.

3.4.2 BOOKING THE MEASUREMENTS



PLOTTING THE DETAILS

- Manual (by hand and drawing tools).
  1. Scale and paper size.
  2. Plot using pencil in an orderly manner.
  3. Check plan in the field if possible.
  4. Ink and prepare the final drawing (North arrow preferably upwards).
- Using the computer (AutoCAD).



3.6 CHAINING OBSTACLES

a) Vision obscured, chaining possible:

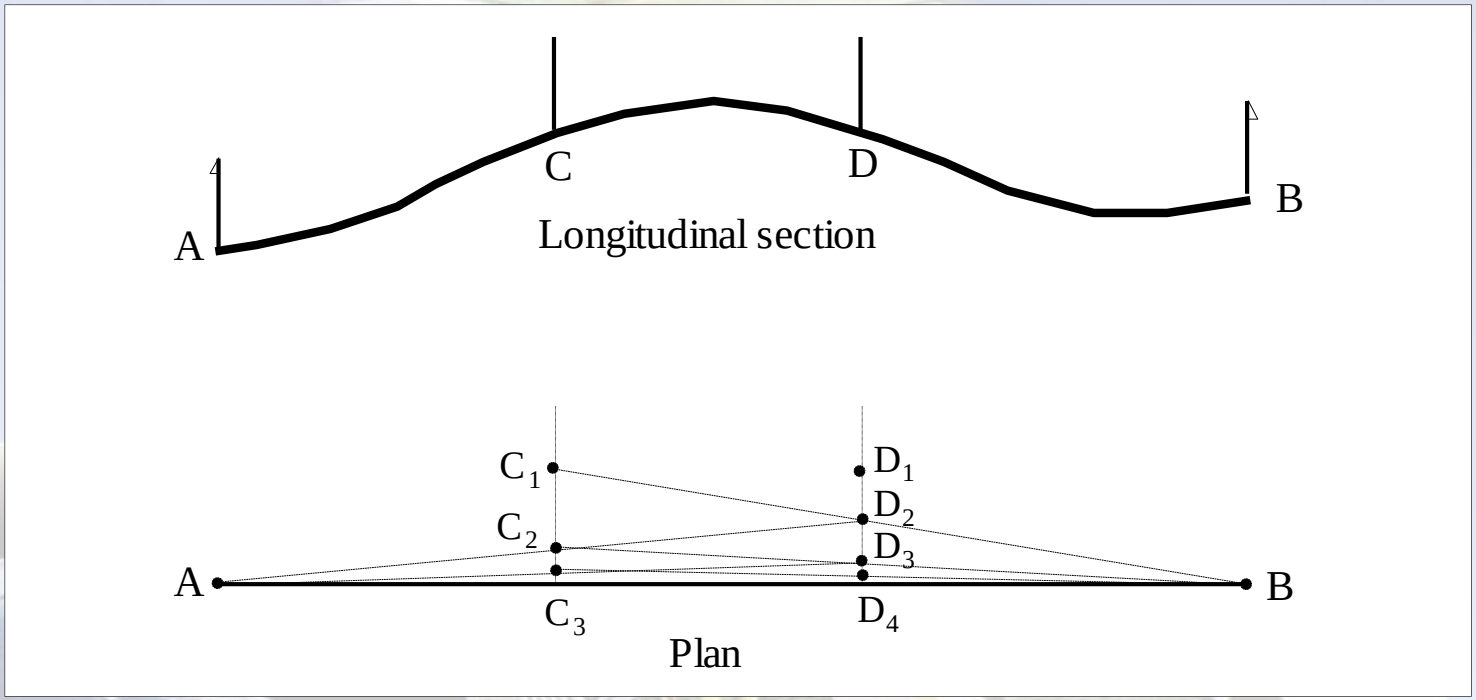


FIGURE 3.23: A hill which obscures vision but does not prevent chaining

b) Vision possible, chaining prevented:

1. Closed Obstacles:

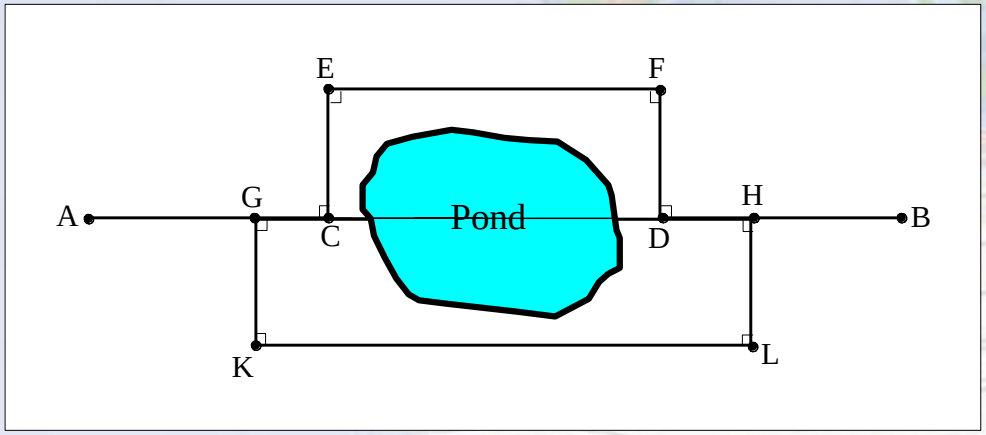


FIGURE 3.24: An obstacle which prevents chaining but not vision, such as a pond.

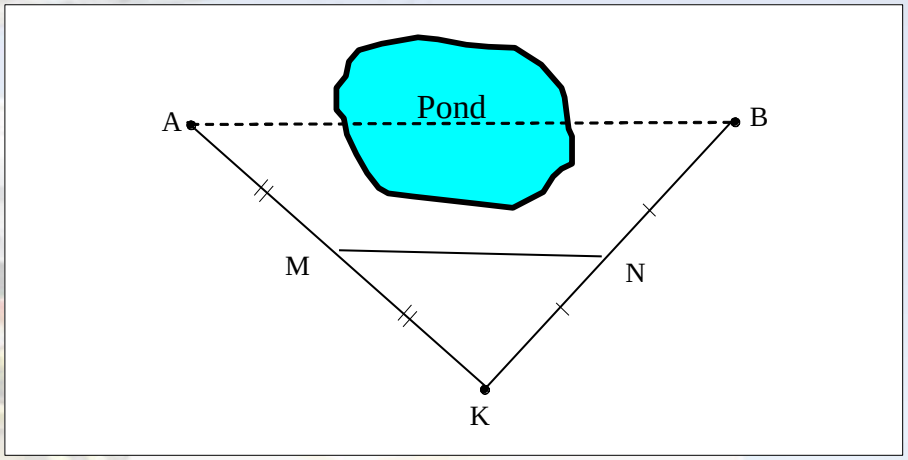


FIGURE 3.25: An obstacle which prevents chaining but not vision, such as a pond.

2. Linear Obstacles:

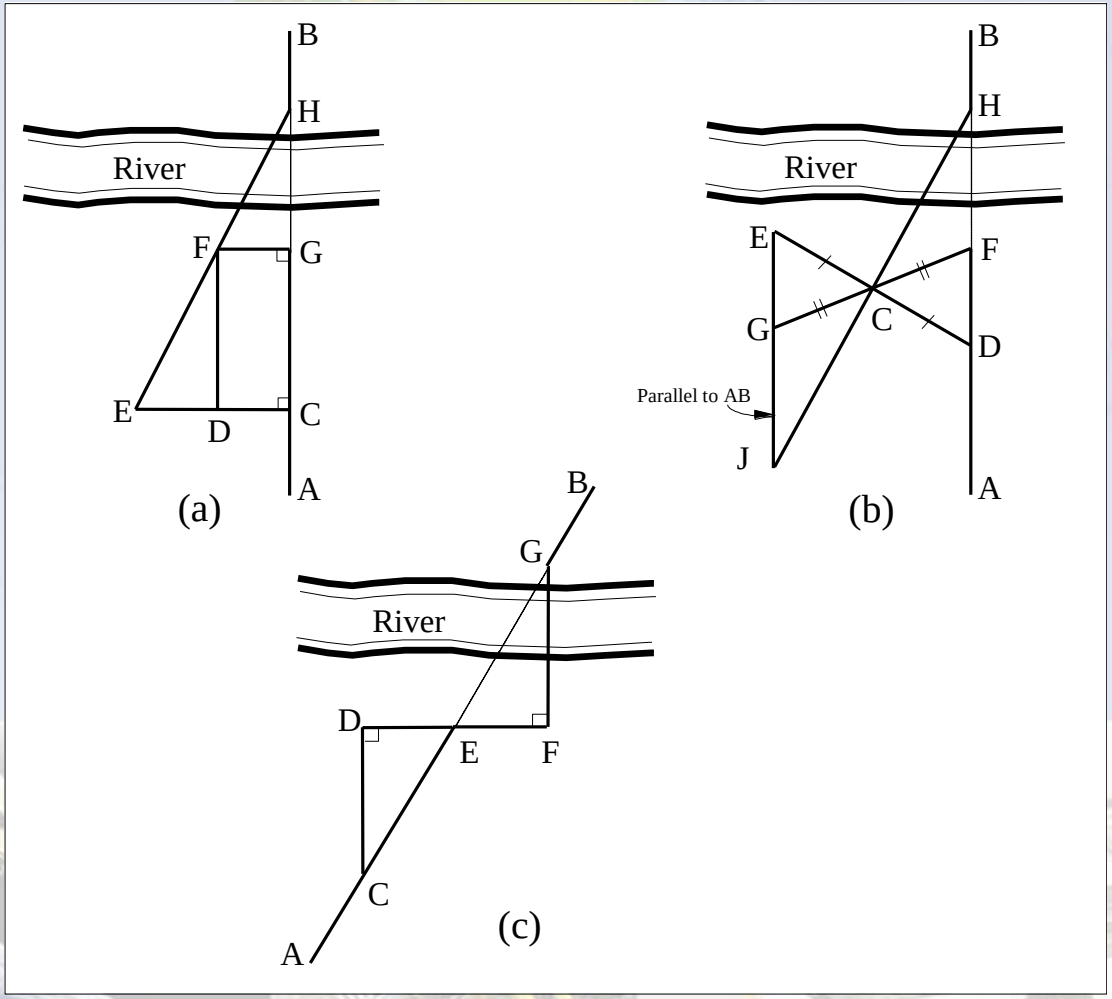


FIGURE 3.26: A river obstacle.

c) Both chaining and vision prevented:

1. Measuring a distance obstructed by a building:

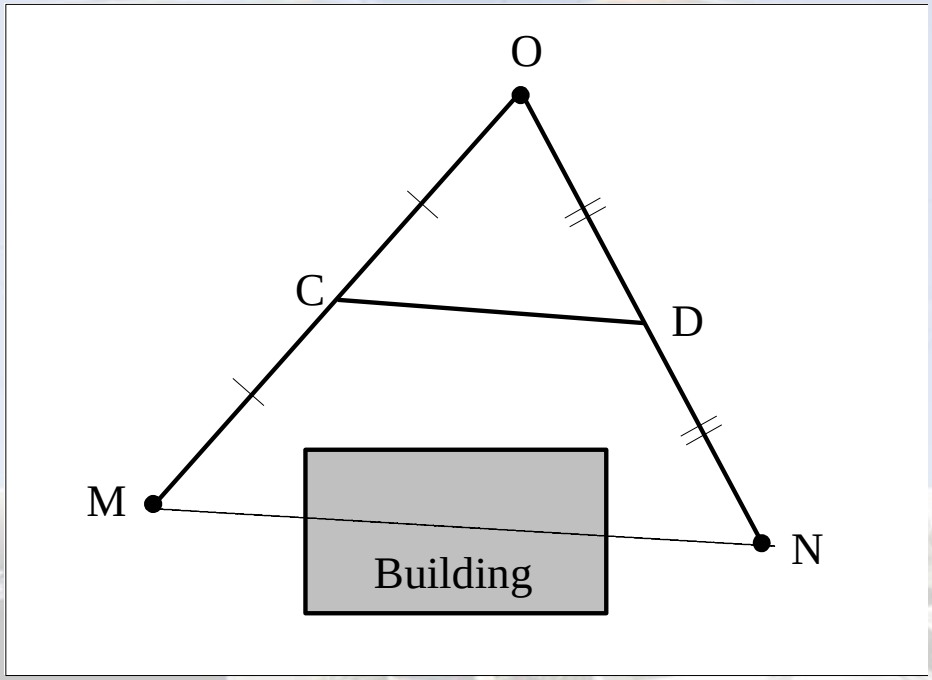


FIGURE 3.29: The letter (A) method.

2. Prolonging a line past a building:

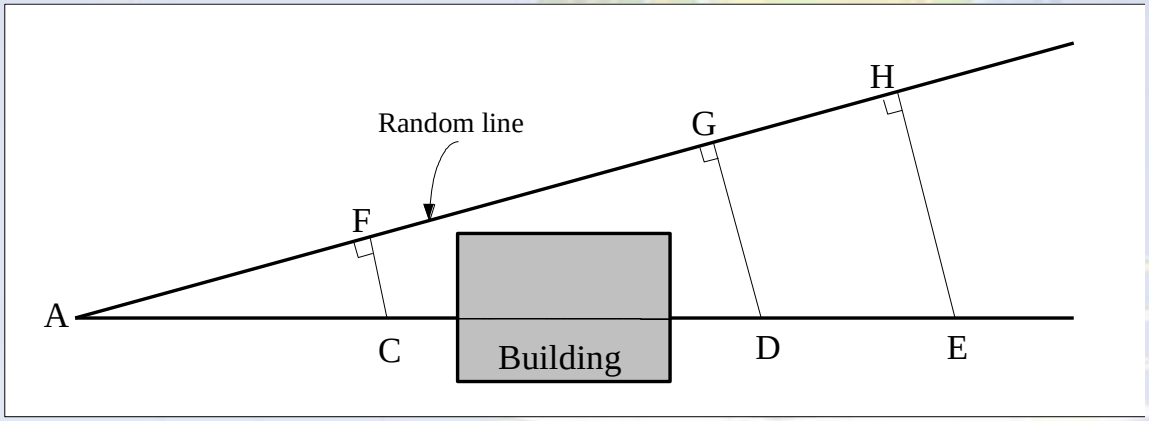


FIGURE 3.27: The random line method for prolonging a chain line past a building.

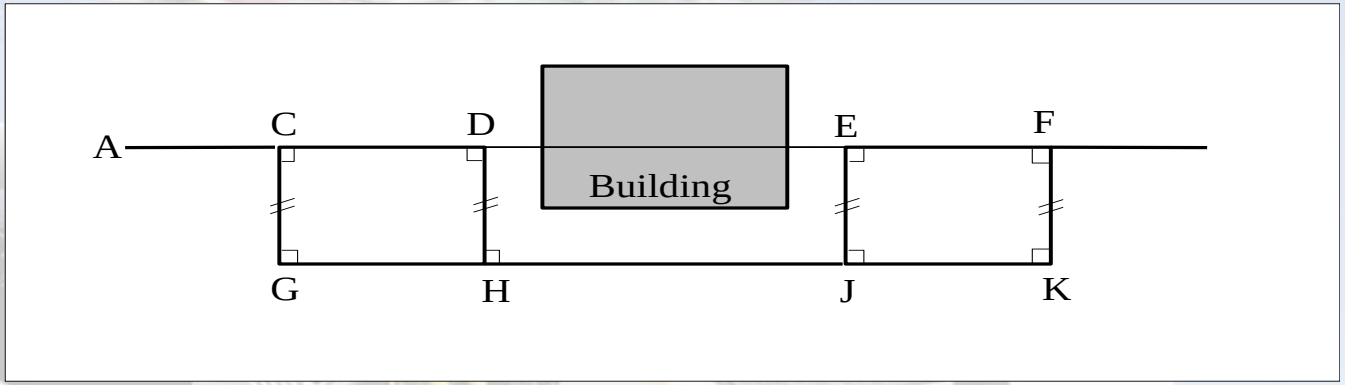


FIGURE 3.28: Prolonging a line past a building using equal offsets.

3.7 ERRORS IN CHAINING AND THEIR CORRECTION

- Blunders
- Random Errors
- Systematic Errors – Corrections:
  - Temperature correction
  - Sag correction
  - Tension correction
  - Length correction.

$$L_c = L_m + C_t + C_s + C_p + C_\ell$$

Note: When the length correction is the only correction to be considered, an alternative direct way to correct for lines and areas is as follows:

$$L_c = L_m + C_\ell = L_m + (\ell_a - \ell_0)\frac{L_m}{\ell_0} = L_m \cdot \frac{\ell_a}{\ell_0}$$

That is,

Correct line length = measured length . $\dfrac{\text{actual length of the tape}}{\text{nominal length of the tape}}$

Similarly,

Correct area = measured area . $\left(\dfrac{\text{actual length of the tape}}{\text{nominal length of the tape}}\right)^2$