

Sprinkler system design and Microirrigation

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Exercise 1 - Design of a sprinkler irrigation system

Consider a more or less flat plot of 540×250 m to be irrigated from a water supply whose adduction pipeline enters the plot in the middle of its short side, and extends crossing the plot parallel to the long side (Figure 1).

The effective water requirements for the peak month (30 days) are $1300 \text{ m}^3/\text{ha}$ and the gross irrigation dose is $450 \text{ m}^3/\text{ha}$. Irrigation is done by rotation, with 16 hours of irrigation daily. The maximum allowable precipitation rate is 8 mm/h ; it is desired to use sprinklers with an average precipitation rate greater than 3 mm/h .

1. Calculate the basic irrigation parameters (number of irrigations per month, frequency, actual dose, required flow rate at the network head).
2. Define the number of daily stations that allow to satisfy the constraints above.
3. Choose the most appropriate sprinkler layout between solutions of $24 \text{ m} \times 24 \text{ m}$ and $18 \text{ m} \times 18 \text{ m}$, knowing that the first sprinkler of the ramps should be placed at a distance $e/2$ from the supply pipeline (where e is the spacing between sprinklers).
4. Define:
 - the theoretical area covered by one sprinkler,
 - the number of sprinklers per station,
 - the number of ramps per station,
 - the actual area of the station,
 - the range of the sprinklers,
 - the flow rate of the sprinklers,
 - the average precipitation rate of the sprinklers.

Exercise 2

We aim to irrigate a crop using a drip irrigation system where the rows are spaced 1.5 m apart, with single-orifice drippers spaced 1 m apart along the drip lines, delivering a nominal flow rate of 4 l/h. The plot has the shape shown below and a uniform slope of 1%. The drip lines are supplied with a pressure of about 1.5 bar by a main pipeline running parallel to the contour lines across the plot.

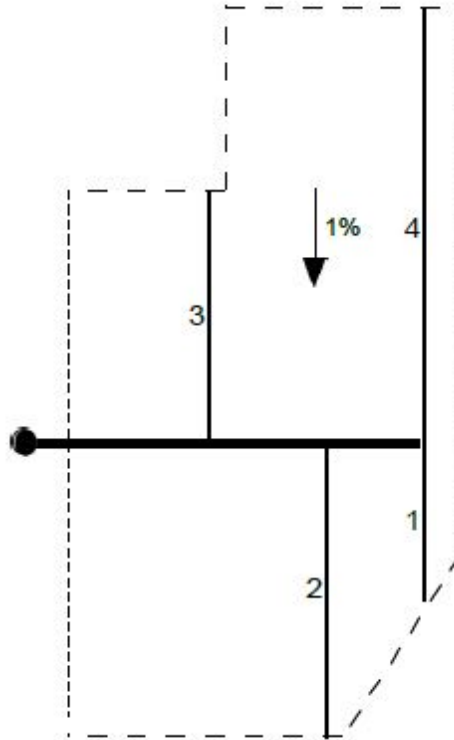


Figure 1: Schematic of the drip irrigation plot

1. Calculation of the diameter of the drip lines:

- Drip line 1: 40 m
- Drip line 2: 80 m
- Drip line 3: 80 m
- Drip line 4: 140 m

Assume that the flow rate of the drippers on each line should not vary by more than 10% (which corresponds to an allowable head variation of 20%). The head loss coefficient for the drip lines is estimated to be 130.

2. Calculation of the diameter of the dripper orifices: Given that the contraction coefficient is 0.6.

Note: The sizing of the drip lines will be based on the use of the Hazen-Williams formula.