$CIR = C_u - P_e$

$= 122.8 - 44.6$

$= 78.16\ cm$

Since leaching requirement not given NIR = CIR

$\therefore FIR = \frac{NIR}{\eta_a} = \frac{78.16}{0.5} = 156.32\ cm.$

$GIR = \frac{FIR}{\eta_c} = \frac{156.32}{0.75} = 20842\ cm.$

vol. of the water to be delivered in the canal $= 208.42 \times 10^{-2} \times 5000 \times 10^4$

$= 104.2 \times 10^6\ m^3.$

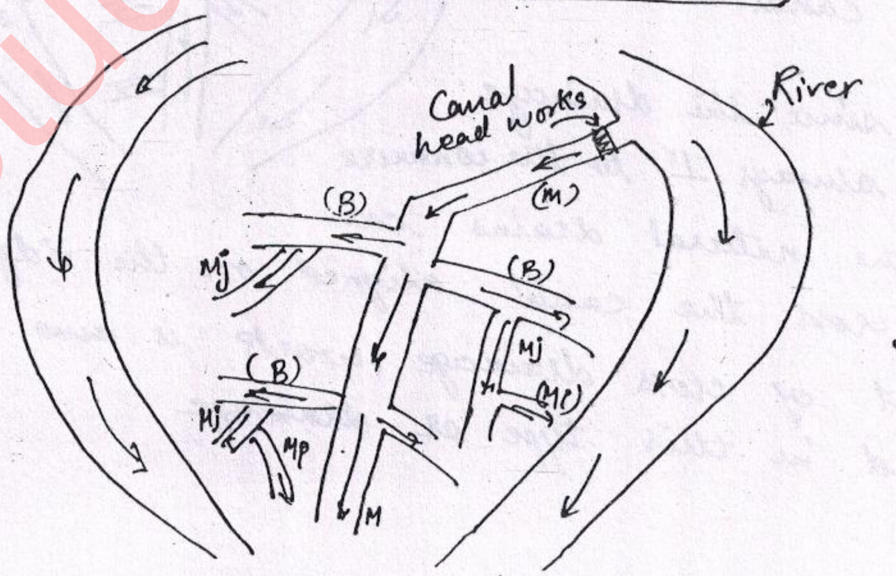
(2) **HEAGREAVES – CLASS A PAN METHOD :-**

$C_u = K_p \times$ Pan evaporation

K_p = pan coefficient = 0.3 for wheat
= 0.8 – 0.9 for Rice
= 0.621 for sugarcane

→ pan coefficient is area specific.

⇛ CANAL IRRIGATION SYSTEM :-

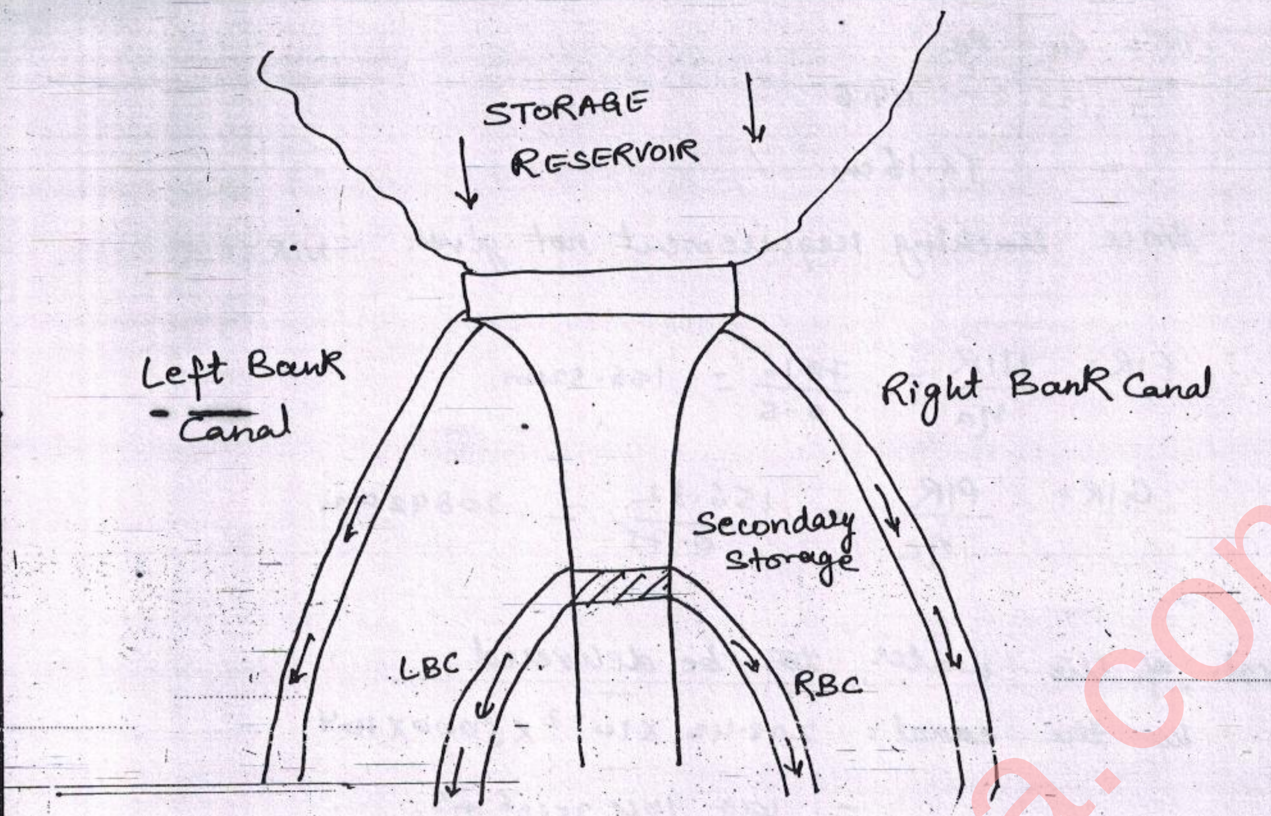


M = main canal

Mj = Major Distributory

B = Branch canal

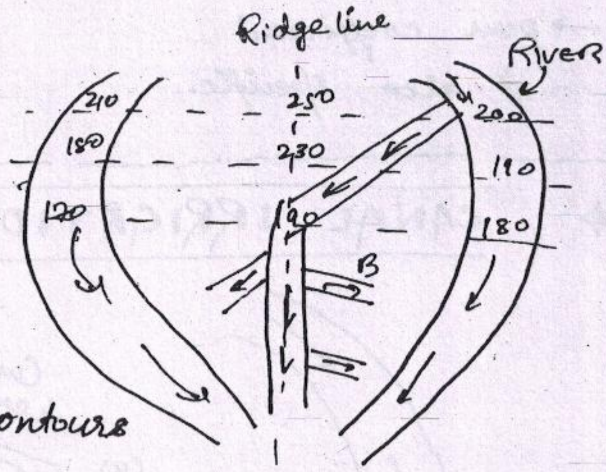
Mi = Minor Distributory



⇒ DIFFERENT TYPES OF ALIGNMENT OF CANAL :-

1) WATERSHED / RIDGE CANAL :-

- The canals which are aligned along any natural watershed are known as watershed canal.
- Aligning the canal on the watershed ensures the gravity irrigation on both sides of canal.

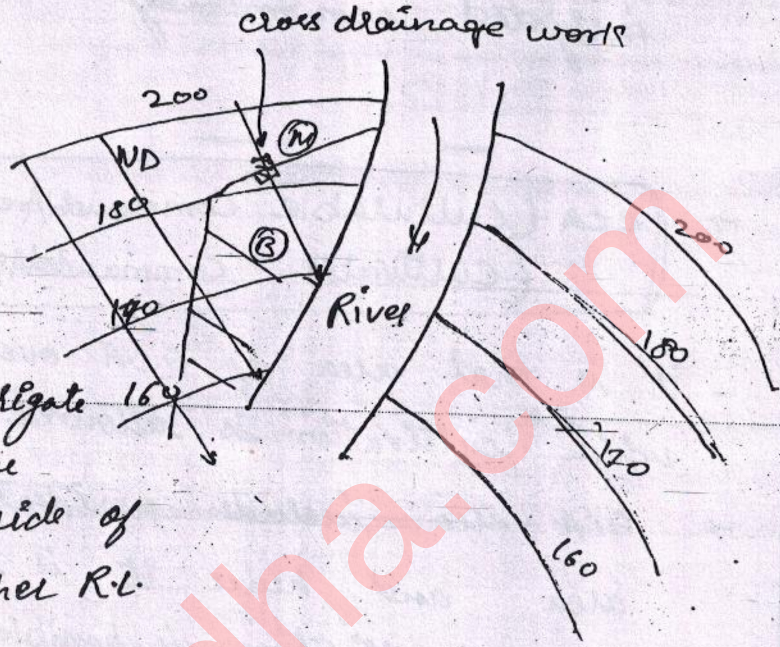


- Moreover since the drainage flow is always ⊥r to the contours Hence the natural drains can never cross the canal aligned on the ridge
- The cost of cross drainage work is avoided in this type or drainage

- These types of canals are generally provided in plain areas (In hilly areas the ridge line is very high).

➝ CONTOUR CANALS :-

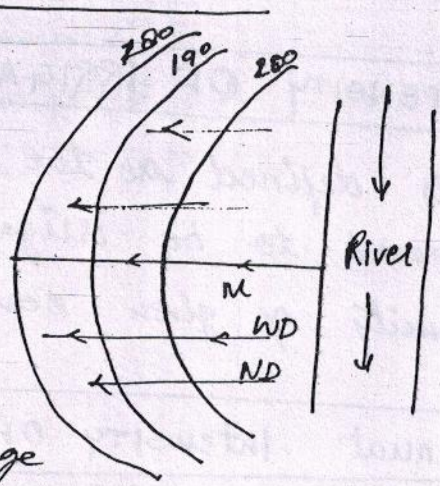
- These are the canals which are constructed across the contours in a particular area.
- Contour canal can irrigate only one side of the field as the other side of the field is at higher R.L.



- In this case natural drains also intersects the canal works and hence cross drainage construction becomes necessary increasing the cost.

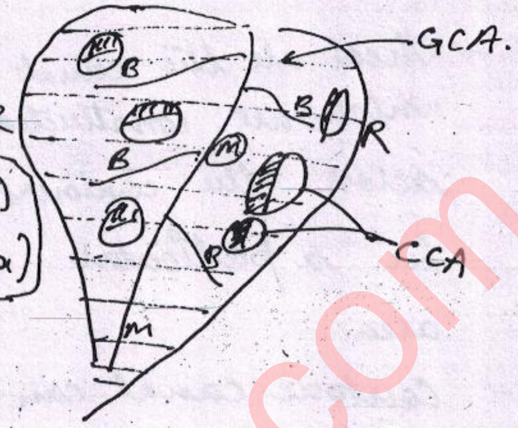
➝ CROSS SLOPE / SIDE SLOPE CANALS :-

- These are the types of canal which are aligned at right angles to the contours
- These canals run parallel to the natural drainage and hence there is no requirement of cross drainage work.



→ G.C.A. (GROSS COMMANDED AREA)

- it is the area which is bounded within the irrigation boundaries of a project which can be irrigated economically



→ CCA (culturable Commanded Area)
(Cultivable Commanded Area)

- it is that area of G.C.A over which cultivation is allowed.

→ GCA ~~area includes residential~~ area, roads & forest area and hence it is that area of GCA on which cultivation is possible

→ it is of 2 types

(a) cultivated portion of CCA.

(b) Non Cultivated portion of CCA.

→ INTENSITY OF IRRIGATION

it is defined as the portion of CCA which is proposed to be irrigated in a given season. (it is called as Intensity of given season.)

⇒ Annual Intensity of Irrigation :-

→ %age of CCA irrigated annually ; is called as annual intensity of irrigation

K=54% R=40% A_2=20%

All = 54+40+20 = 114%

⇒ GIA = NIA + Area irrigated ~~once~~ twice in a year.

. GIA = Gross irrigated area.

NIA = Net irrigated area = area irrigated once in year.

(*) Gross irrigated area can be greater than CCA ~~if no area is under~~ ~~non~~ ~~cultivated~~ ~~area~~.

(*) Canals are designed for the max of GIA or CCA.

→ $GIA = A.I.I \times C.C.A$

⇒ $A.I.I = \frac{GIA}{CCA} \times 100$

⇒ **TIME FACTOR**

↳ it is defined as the ratio of Actual operating time of distributory to the crop period of a particular crop.

- The actual operating time of the distributory is always kept less than the crop period to avoid the danger of intensive irrigation which may lead to water logging.
- Time factor is always less than 1.

→ Capacity factor:-

Defined as the ratio of mean supply discharge of the distributory to the full supply discharge of the distributory

Q) The culturable command area ~~of~~ the water course is 1200 ha. Intensity of sugarcane and wheat crops are 20% & 40% respectively. The duties of the crop at the head of water course are 730 & 1800 ha/cumecs find the discharge at the head of water course. Determine the ~~discharge at the outlet~~ assuming a time factor of 0.8.

Sol. ① if one crop is prenial and one is seasonal than the design is done for the addition of both duties.

② if seasonal crops are there, than the designing is done for the maxm of two.

→ Area of sugarcane under irrigation = 20% CCA

$$= \frac{20}{100} \times 1200 = 240 \text{ ha.}$$

→ " " wheat " " $= \frac{40}{100} \times 1200 = 480$ ha.

→ Discharge reqd for sugarcane $= \frac{A_s}{D_s} = \frac{240}{730} = 0.329 \, m^3/s.$

→ " " " wheat $= \frac{A_w}{D_w} = \frac{480}{1800} = 0.267 \, m^3/s.$

→ Since sugarcane is prinial croop.

Design discharge in canal $= Q_w + Q_s$

$= 0.329 + 0.267 = 0.596 \, m^3/s$

→ Discharge at outlet = $\frac{0.596}{\text{Time factor}} = \frac{0.596}{0.8} = 0.745\ m^3/s$

Q The culturable command area for a distributory is 15000 ha. The intensity of irrigation for rabi wheat is 40% and Kharif rice is 15%. If the total water requirement of two crops are 37.5 and 120 cm and their period of growth are 160 days and 140 days respectively. Determine the outlet discharge from avg. discharge demand consideration.

Also determine the peak demand discharge assuming the Kor water depth for 2 crops to be 13.5 and 19 cm. and Kor period of 4 weeks & two weeks.

Sol:-

(i) Average discharge

$D_W = 8.64 \frac{B}{\Delta}$

$\Delta_W = .375\ m.$

$\Delta_R = 1.2\ m$

$D_W = 8.64 \times \frac{160}{.375} = 3686.4\ ha/cumec$

$\Delta_W = 160$

$\Delta_R = 140$

$D_R = 8.64 \times \frac{140}{1.2} = 1008\ ha/cumec$

$Q_W = \frac{A_W}{D_W} = \frac{\text{Intensity} \times CCA}{D_W} = \frac{40\% \times 15000}{3686.4} = 1.62\ m^3/s.$

$Q_R = \frac{A_R}{D_R} = \frac{15}{100} \times \frac{15000}{1008} = 2.23\ m^3/s.$

(ii) Peak discharge

$D_W = 8.64 \cdot \frac{B_K}{\Delta_K} = 8.64 \times \frac{4 \times 7}{13.5 \times 10^{-2}} = 1792\ ha/cumec.$

$D_R = 8.64 \times \frac{B_R}{\Delta_R} = \frac{8.64 \times 2 \times 7}{0.19} = 636.63\ ha/cumec$

$$Q_W = \frac{A_W}{D_W} = \frac{40 \times 15000}{100 \times 1792} = 3.34 \text{ m}^3/\text{sec}.$$

$$Q_R = \frac{A_R}{D_R} = \frac{15 \times 15000}{100 \times 636.63} = 3.93 \text{ m}^3/\text{sec}.$$

➤ NOMINAL DUTY :-

- it is defined as the ratio actual area irrigated to the the mean supply discharge.

Eg. x m³/sec ⟶ 125 days

∴ than for 150 days.

$$\text{Mean discharge} = \frac{125 \times x}{150} = 0.8x.$$

Now let the area irrigated by water be (A).

$$\therefore \text{Nominal duty} = \frac{A}{0.8x}$$

Q. Moisture holding Capacity of the soil in 100 ha farm is 18cm/m. The field is to be irrigated when 50% of the available moisture in the root zone is depleted. The irrigation water is to be supplied working 10 hours a day. Water application efficiency is 75%. Details of the crops planned for the cultivation are as follows.

Crop	Root zone(m)	Peak rate of moisture use (mm/day)
X	1.0	5
Y	0.8	4.

1) The capacity of the irrigation system reqd. to irrigate the crop in 36 ha is?

2) The area of the crop Y that can be irrigated

when the when the capacity of the irrigation system is 40 l/s.

Sol: for crop x

→ moisture holding capacity $= \frac{18cm}{1m} = 18cm$.

→ allowable depletion $= 0.5 \times 18 = 9cm$.

→ $FIR = \frac{9}{0.75} = 12cm$.

→ Area irrigated = 36 ha.

→ Vol of water $= \frac{12}{100} \times 36 \times 10^4$

$= 43200\ m^3$

→ frequency of irrigation $= \frac{NIR}{Cu} = \frac{9 \times 10}{5} = 18 days$

→ Capacity = 43200.

→ $Q \times 18 \times 10 \times 60 \times 60 = 43200$

$Q = 0.067\ m^3/s.$

$Q = 67\ l/s.$

for crop (y)

moisture holding capacity $= \frac{18cm}{m} \times 0.8m = 14.4cm.$

allowable depletion $= 0.5 \times 14.4 = 7.2m.$

$FIR = \frac{7.2}{0.75} = 9.6m.$

Area irrigated = ?

Vol. of water reqd for irrig $= 9.6 \times 10^{-2} \times A \times 10^4$

$= 9.6 \times 10^2 \times A\ m^3$

$f = \frac{NIR}{Cu} = \frac{7.2 \times 10^4}{4} = 18 days$

$0.04 \times 18 \times 10 \times 60 \times 60 = 9.6 \times 10^2 \times A$

→ LOSSES IN CANAL

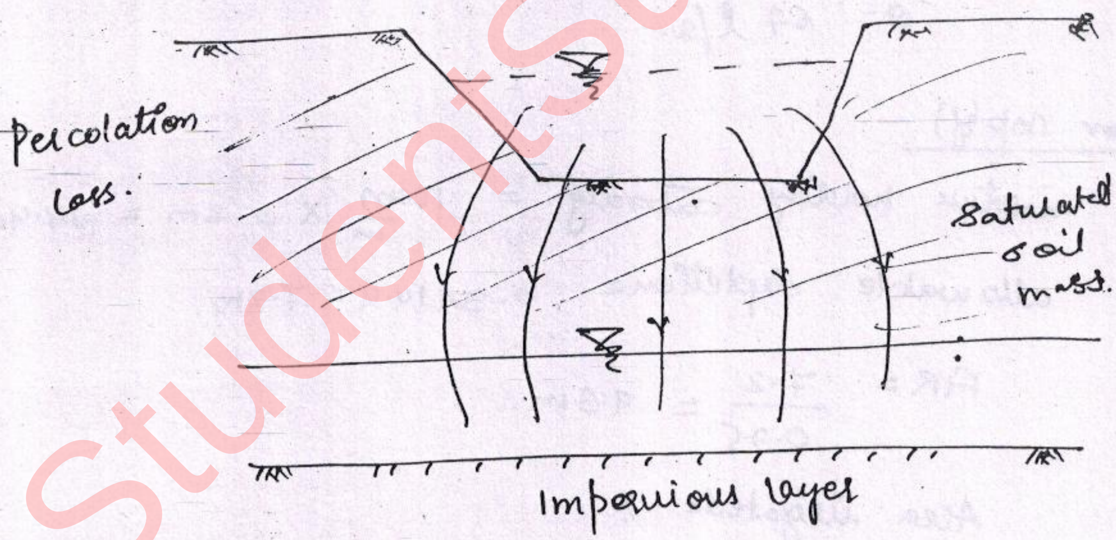
- Losses in canals accounts to 20 to 25% and may be upto the value of 50% of total water carried by it.

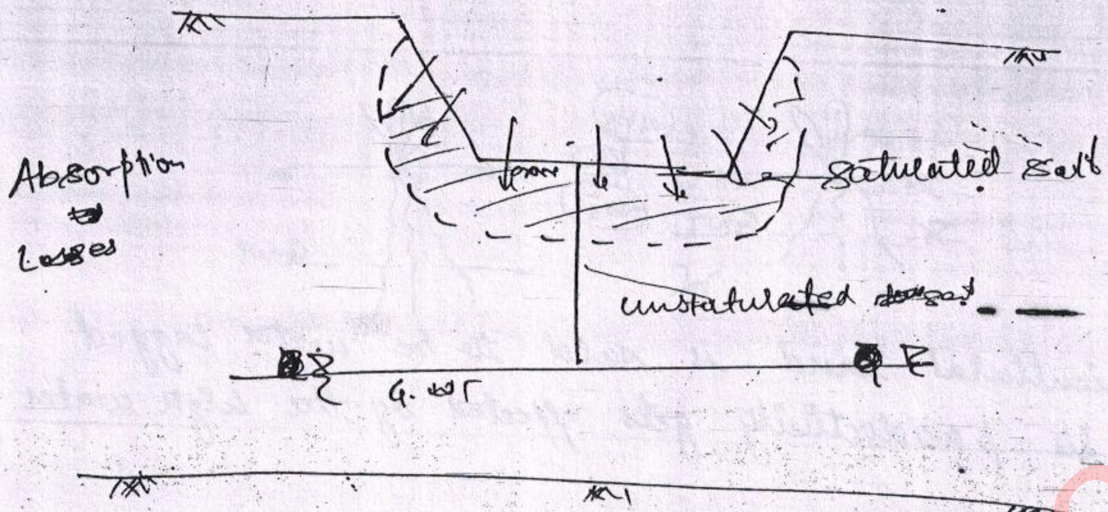
— Losses in canals are 2 types
  - → Evaporation (2 - 3%)
  - → seepage

1) Evaporation Losses —

. losses taking place in the canal are in the range (2-3%)

2) SEEPAGE LOSSES:-
  - → percolation loss.
  - → Absorption loss.





→ PERCOLATION LOSS:-

– In percolation loss there exist. ~~a zone of continuous~~ saturation from the canal to the bottom of ground water table.

– Hence there is the direct flow of water from the canal to the ground water table.

→ The extend of percolation zone is more than absorption zone.

→ The degree of saturation of the soil mass between the canal and GWT is 1.

→ ABSORPTION ZONE:-

→ In this type of zone, there is a small saturated zone below the canal which is surrounded by the unsaturated zone.

→ The degree of saturation decreases in this unsaturated zone