Sec-B.

Flood Routing

When a river is in flood, the depth of the flow and the hydrograph at different locations along the river are not same, since the flow in the river is non-uniform and unsteady. Thus, the process of determining progressively the timing and shape of a flood wave at successive points along a river

OR.

The extent by which the inflow hydrograph gets modified due to the reservior storage can be computed by a process known as Flood Routing.

Flood Routing through Reservior :-

The Passage of a flood wave through a reservior or a river reach is an unsteady flow Phenomenon.
In such cases, the eqn of continuity is used as the primary equation states that "the difference b/w the inflow and outflow rate is equal to the rate of change of storage".

Alternatively

Mathematically –

$$I - O = \frac{ds}{dt} \quad \text{— (1)}$$

I = inflow rate, O = outflow rate
S = storage.

Alternatedly – (Alternatively –).
in a small time interval Δt, the diff b/w the total inflow volume and the total outflow volume is equal to the change in the storage volume.

Mathematically –

$$\bar{I}\Delta t - \bar{O}\Delta t = \Delta S \quad \text{— (2)}$$

(inflow vol) I (V) (outflow vol) O (V)

where
$\bar{I}$ = Average inflow (rate) in time Δt
$\bar{O}$ = Average outflow (rate) in time Δt
ΔS = change in storage during the time Δt.

Since,

$$\bar{I} = \frac{I_1 + I_2}{2} \quad \text{and} \quad \bar{O} = \frac{O_1 + O_2}{2}$$

$$\Delta S = S_2 - S_1$$

where suffixes 1 and 2 denote the begining and the end of the time interval Δt.

Eq^n (2) can be written as –

$$\left(\frac{I_1 + I_2}{2}\right)\Delta t - \left(\frac{O_1 + O_2}{2}\right)\Delta t = S_2 - S_1 \quad \text{— (3)}$$

The time interval Δt should be sufficiently short, so that the inflow and outflow hydrographs can be assumed to be in straight line, in that time interval.

Methods

① Trial and Error Method of Reservior Routing —

Trial and Error method is widely adopted to reduce the time taken in long calculations involved in this method.
This method arranges the basic routing eqn as given below —

$$\frac{I_1 + I_2}{2} \Delta t = \left(\frac{O_1 + O_2}{2}\right) \Delta t + (S_2 - S_1)$$

This method gives quite reliable results, provided the chosen time interval (Δt) is sufficiently small, so that the mean of the outflow rates at the start and the end of the given interval may be taken as the average through out the interval —

Procedure:- The following detailed procedure may be adopted in this method to complete the involved computations:

Data to be Given :-

i) The inflow hydrograph
ii) Elevation Capacity curve or Elevation area curve.
iii) Elevation outflow curve.

Page : (2)

Steps involved in computations :-

1. Divide the inflow flood hydrograph into a no. of small intervals. The time interval should be so chosen, as not to miss the peak values.
2. Fix the normal pool level at which the spillway crest is provided and the level at which the flood enters the reservior.
3. Work out the spillway and the outlet discharge rating curves, if not given.
4. Work out the elevation capacity curve for the reservior from the elevation area curve, if the former is not given, using cone formula i.e.

$$V = \sum \frac{h}{3}\left[A_1 + A_2 + \sqrt{A_1 A_2}\right]$$

where h is the contour interval.

5. Compute the total inflow during the interval by multiplying the average inflow rate at the begining and the end of the interval with the period of interval

$$I(V) = \left(\frac{I_1 + I_2}{2}\right)\Delta t$$

6. The reservior level at the start of the flood (i.e. start of 1st interval) is known.
Assume a trial value for the reservior level at the end of the interval.
7. Compute the total outflow during the interval

$$O_{(V)} = \left(\frac{O_1 + O_2}{2}\right)\Delta t$$

O_1 = outflow rate at the start of the interval
O_2 = outflow rate at the end of the interval
$O_{(V)}$ = total outflow vol. during the interval.
Δt = Duration of time interval.

(8) Using the Elevation storage curve for the reservior, determine the storage S_1 and S_2 at the begining and the end of the time interval

$$S_2 - S_1 = \Delta S.$$

(9) Add the volume of outflow $Q_{(v)}$ obtained in step (vii) to the values of ΔS obtained in step (viii) and compare it with the inflow volume $I_{(v)}$ calculated in step ~~(vii)~~ (v)

(10) All the above steps should be repeated for other time intervals, till the entire flood is routed or still further, till the reservior level returns to Pre-flood Pool level.