MODULE – 8: Flood Control Operation

8.1 Flood Control Operation of a Reservoir System

Among various measures for flood control, a storage reservoir with gates to control the outflow is perhaps the most effective means. The moderation of a flood through storage is achieved by storing a part of flood volume in the rising phase of the flood hydrograph and releasing the same gradually in the receding phase. The degree of moderation or flood attenuation depends on the empty storage space available in the reservoir when the flood impinges on it. The flood control pool must be emptied as quickly as the downstream flooding conditions allow to reduce the risk of highly damaging future releases, should a major flood occur in quick succession.

In India, real-time telemetry system is under installation for most of the reservoir systems. Without such a system, the decision-making is based upon the variables that the operator can easily observe at the dam site, such as the current reservoir level, its rate of rise/fall, extent of inflow rates to the reservoir, and the nature of inflows (whether increasing or decreasing with time). Based on the procedure developed at NIH (Jain and Goel, 1996) for flood control operation of a system of reservoirs, a computer program developed under the study has been suitably modified to consider the option of pre-depletion of a gated dam and the multi-reach channel routing in the d/s river of a hydraulic structure. While developing flood control regulation policy, it is assumed that the operator has the following objectives to achieve:

a) To attain the FRL (or Upper Rule Curve Level) at the earliest and to maintain it;

b) To allow reservoir to rise above High Flood Level (HFL) for least possible time;

c) To release water at rates above the safe channel capacity in the downstream channel for the least possible time; and

d) To reasonably utilize the reservoir flood storage space before releasing water at a rate exceeding the safe downstream channel capacity.

For a diversion structure (with limited or no storage capacity), no control can be applied for flood management and inflow to the structure is released in the d/s after filling the available storage and possible diversion of water from the structure. For an ungated dam also, no control can be applied for flood management above the FRL and inflow to the structure is released in the d/s based on the available spillway release capacity at a time step after possible diversion of water from the structure. Below FRL, release can be made only for beneficial uses such as minimum flow requirement and diversion for various purposes. For a gated reservoir, the operation for flood control begins as soon as the water level exceeds the upper rule curve level for a time step (which varies and is computed for each day). The suggested flood control operation policy for a reservoir is based on the concept of emergency inflow (EI), emergency reservoir level (EL, a level in between the FRL and the HFL), and the nature of inflow (whether rising or falling with respect to the past observation). Using the concept of

simulation analysis of reservoir system, EI and EL are finalized for each reservoir so that possible attenuation of flood peak can be achieved with the judicious operation of reservoirs.

For developing the operation policy of a reservoir for flood management, two variables (EI and EL) need to be iteratively estimated which can be done by performing a number of simulation runs with the reservoir system. In the suggested policy, the reservoir operation scenario is classified in following two categories:

a) Normal Operation

Normal operation of a reservoir for flood control begins as soon as the first signs of a flood event are noticed. Specifically, normal operation policy is applicable when:

1. Initial reservoir level is below FRL (or upper rule curve level) and the inflow rate is greater or less than EI, whether increasing or decreasing, or
2. Initial reservoir level is in between FRL (or upper rule curve level) and EL and the inflow rate is less than EI, whether increasing or decreasing, or
3. Initial reservoir level is in between FRL (or upper rule curve level) and EL and inflow rate is greater than EI or spillway release capacity but decreasing, or
4. Initial reservoir level is higher than EL but inflow rate is less than EI and decreasing.

Under the normal operation, water is released at a rate which is less than or equal to the safe carrying capacity of the downstream channel. The aim is to bring the reservoir back to the FRL (or upper rule curve level) at the earliest so that the reservoir can moderate the forthcoming flood, if any.

b) Emergency Operation

This mode of operation is invoked when the flood build-up is more than anticipated and the normal operation has failed to control it. Either the reservoir level is already very high or the inflows are very large indicating the likelihood of an extreme flood endangering the safety of the structure as there is a likelihood of overtopping. The emergency operation policy is followed when:

1. Initial reservoir level is in between FRL (or upper rule curve level) and EL and the inflow rate is more than EI (or spillway release capacity) and it is increasing, or
2. Initial reservoir level is higher than or equal to the EL and inflow rate is more than EI (or spillway release capacity) whether increasing or decreasing, or
3. Initial reservoir level is higher than or equal to the EL and inflow rate is less than EI but increasing, or

In such emergent cases, it is assumed that the release at the rate of safe d/s channel capacity is likely to cause overtopping and release is made equal to the spillway release capacity at the current elevation. The objective is to bring the reservoir level

down to the safer level at the earliest and thus avoid overtopping of the dam. The minimum rate at which water will be released from the reservoir under emergency conditions is minimum of the inflow rate and the spillway release capacity.

8.1.2. Data Checks

Some of the checks performed by the module include:

h) E-A-C-Rc table of reservoir is checked. If the area (or storage capacity) at any reservoir level decreases with rising elevation, the program aborts and flags the line number in the E-A-C-Rc table for correction.

i) The storage capacity at each level in E-A-C-Rc table above the lowest level is checked by using the prismoidal formula. If the difference in the computed and specified storage capacity is greater than 10%, a message is flagged at the screen and in the result file after the presentation of Elevation-Area-Capacity-Release capacity table in the Input Data section. The program does not abort in this case.

j) If there is error in the specified time step size and routing condition () is not satisfied for a channel sub-reach, the ID of upstream structure and the segment number are communicated. The Program does not abort in this case.

8.1.3. Input Data Description

In this module, lots of data for each structure is required to be entered. Therefore, first the opening form appears in which general details of simulation and total number of structures in the system is entered. Then, each structure ID (or node number) is selected one-by-one and whole data related to the structure is entered. After entering all the data related to a structure, another structure ID (or node number) is selected for entry of its data.

The file extensions for the input and output files and for graphics files are ***.foi, .foo, and .fog*** respectively. Various items that are input to the program are described below:

Title of the analysis

Specify the title of the data file containing general details of the analysis for remembrance at a later date (not more than 100 characters).

Number of structures in the system

Specify the total number of flood control structures in the system for which simulation analysis is to be carried out. Based on this information, corresponding number of numeric IDs can be opened for data entry of each structure. A maximum of 100 structures can be considered in a simulation analysis.

Time step size (hour)

Flood analysis need to be carried out at shorter time interval, say one hour or 0.5 hour or so. Select the appropriate time step based on the availability of inflow data and routing parameters.

Number of time steps of simulation

Specify the number of time steps for simulation. Inflow sequence for the specified number of time steps will be required at all structures. Using this number, the form for inflow entry will automatically generate the specified number of cells corresponding to different time steps of inflow sequence.

Starting hour of simulation

Specify the starting hour (numeric) of the inflow sequence at all structures. Concurrent inflow sequence is required at all structures.

Starting day of simulation

Specify the starting day (numeric) of the inflow sequence at all structures. Based on the hour in the time sequence, the day is changed which affects the upper rule curve level for a structure.

Starting month of simulation

Specify the starting month (numeric) of the inflow sequence. Based on the day in the time sequence, the month is changed which also affects the upper rule curve level for a structure.

After entry of these general details of the simulation, data for each hydraulic structure is entered as specified below:

Computation number in system (u/s-d/s)

Specify the computation number for each structure in the system. This is introduced such that analysis may proceed from u/s to d/s. Thus, data of various structures in the system can be specified in any order in the data form but the computation number helps in sequencing the simulation analysis so that it proceeds from u/s to d/s.

Type of structure

Specify the type of structure. 0 represents a diversion structure; 1 represents an ungated dam; and 2 represents a gated dam. Reservoir routing is performed in ungated dam to compute the release of water while flood control operation is performed in a gated dam for flood management.

Number of immediately upstream structures

Specify the number of structures that are located immediately upstream of the present structure. The spill or river release from these upstream structures will be routed up to the present structure.

IDs of immediately upstream structures (space-separated)

Specify the IDs (node numbers) of the structures that are located immediately upstream of the present structure. **These must be space-separated** and their number depends on the number of immediately upstream structures.

Gate factor

Gate factor represents the proportion of spillway release capacity that is to be considered in simulation analysis (say, a gate factor of 0.9 indicates that 90% of maximum spillway release capacity is to be considered for simulation analysis). It can take any value (less than or more than 1) and can be used to design the spillway of a new project

Maximum storage capacity at structure (MCM)

Specify the maximum storage capacity at a structure corresponding to the High Flood Level (HFL). Though it is computed internally corresponding to HFL, it needs to be specified for a diversion structure with no E-A-C-Rc table.

Initial storage capacity at structure (MCM)

Specify the initial storage of the reservoir in MCM at the start of the simulation analysis. This can be taken as FRL or upper rule curve level in the specified month or any other level.

Inflow series available (0-No; 1-Yes)

This option is used to specify whether inflow flood hydrograph is available at a project or it is to be computed from inflow hydrograph of other structure (after multiplying the same with inflow modification factor).

Str_ID whose inflow series to be used

Specify the ID (node number) of the structure whose data is to be used for computation of inflow hydrograph for the present structure.

Inflow multiplication factor

Specify the inflow modifying factor (multiplication factor) with which the inflows of the structure (with known inflows) are to be multiplied to get the inflow hydrograph for the present structure.

Channel routing in d/s (0-No; 1-Yes)

Specify whether channel routing is to be carried out in the d/s channel of the present structure or not. If channel routing is not considered, then release hydrograph from the present structure, after specified lag-time, becomes input hydrograph for the d/s structure. Otherwise, Muskingum routing method is adopted to find the routed flow at the d/s structure corresponding to the release hydrograph from the present structure.

No. of reaches in d/s river for routing

Specify the number of reaches in which the d/s river section must be split for the routing analysis. It is detailed earlier in Section 3 (b) and is required so that time step size considered in the analysis remains applicable for the routing analysis.

Approx. time lag up to d/s structure

Specify the approximate lag-time (in hours) of flow movement from the present structure up to its d/s structure. It must be an integral multiple of the time step size for the sake of computations. It is used only for the case when channel routing is not desirable.

Number of levels in E-A-C-Rc table

Specify the number of elevations for which corresponding water spread areas, cumulative storage capacity, and spillway release capacity are available in the E-A-C-Rc table. Based on the entered value, the form for entry of E-A-C-Rc table will automatically generate the specified number of empty cell rows for input of elevation, area, capacity, and spillway release capacity. For diversion structure, it is taken as 1

High Flood Level (m)

Specify the high flood level (HFL) of the reservoir (in m) up to which water is to be managed for flood regulation. HFL represents the desirable upper limit of a reservoir inundation. If the reservoir crosses above this level, the dam overtops and safety of structure is at stake. In present module, spillway release capacity above HFL is taken as infinite (assuming dam failure) and all water above HFL is released in the d/s in a single time step. A message about dam overtopping is also flagged.

Full reservoir level

Specify the full reservoir level (FRL) of the reservoir (m). This is the maximum level of conservation zone in ungated dam beyond which water is spilled from the reservoir.

Initial reservoir level

Specify the initial reservoir level in the reservoir (m) from which flood control operation simulation is started.

Pre-depletion desirable (0-No; 1-Yes)

This option specifies whether pre-depletion below the FRL is to be considered in the operation analysis or not. It is applicable only for gated dam and is considered below FRL as soon as the flood wave is likely to impinge the reservoir within the limitations of permissible depletion rate in the reservoir.

Emergency level (m)

Specify the emergency level (EL) in the reservoir (in m) in the flood control zone which is critical and one of the main factors for triggering emergency operation conditions for flood control. At/above the EL, it is assumed that the safety of the

structure is at stake and all efforts may be made to bring the reservoir back to FRL at the earliest, even at the cost of d/s flooding.

Emergency inflow rate (cumec)

Specify the emergency inflow rate (EI) in cumec which is another important factor for triggering emergency operation conditions in the reservoir for flood control.

Permissible reservoir depletion rate

The reservoir level may rise abruptly but it is not allowed to fall at higher rates. Faster lowering of reservoir levels may build-up pore water pressure on the upstream face of the earthen dam causing damage to the structure. This data controls the sudden lowering of the reservoir levels.

After the presentation of these general details, tabular data are specified for a structure as mentioned below:

Minimum flow demand (Cumec) in d/s channel

Specify the minimum flow requirement (cumec) of the d/s reach of a structure for each month of a water year. It is the top priority demand that is released from a reservoir and it becomes a part of the release hydrograph which is routed in the d/s channel.

Diversion capacity (Cumec) at structure

Specify the diversion capacity (cumec) at a structure which represents the total water release for different conservation purposes such as water supply or irrigation. This release is diverted away from the flood route and is not a part of the release hydrograph in the d/s channel. During a flood event, it is assumed that minimum flow demand and diversion capacity are met in full from a structure.

Normal monthly evaporation depths (mm/day)

Specify the normal evaporation depth rates (mm/day) from the surface of a reservoir for each month of a water year. It is used to estimate the evaporation losses from the reservoir during each time step of a flood event.

Upper rule curve levels (m)

Specify the upper rule curve levels (m) for a reservoir for each month of a water year. The flood control operation (say, for pre-depletion) is initiated as soon as the reservoir level exceeds the upper rule curve level.

Available safe d/s channel capacity (cumec)

Specify the time series of safe carrying capacity of the d/s channel (cumec) such that flood discharge of this magnitude can be safely passed without causing any flooding in the downstream. Efforts are made to release the flood water within the d/s safe channel capacity limit in the normal circumstances till the conditions worsen and safety of the structure becomes more important.

During the flood event, the rainfall may occur over a wider part of the catchment resulting in the decrease of channel capacity with the progression of flood event. Therefore, rather than considering a fixed value of safe channel capacity, a time series of safe d/s channel capacity is specified for the entire length of the flood event.

Storage-Time constant (K) of Muskingum method

Specify the storage-time constant (K) for all sub-reaches of the d/s river below a structure. If the channel routing is not carried out, one value of K is specified though it is not used in the computation. K generally represents the travel time in a sub-reach and the number of reaches are decided such that travel time in each sub-reach corresponds to one-time step size in hours.

Weighing factor (x) of Muskingum method

Specify the weighing factor (x) for all sub-reaches of the d/s river below a structure. If the channel routing is not carried out, one value of 'x' is specified though it is not used in the computation. 'x' accounts for the storage or diffusion portion of the routing which accounts for the effect of storage to reduce the peak flow and spread the hydrograph in time and it is restricted in the range of 0.0 - 0.5.

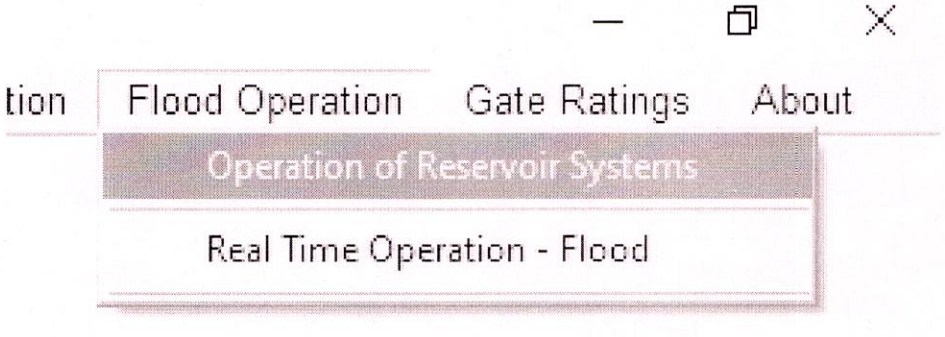
E-A-C-Rc table

Specify the E-A-C-Rc table for entry of elevation (m), area (sq. km), storage capacity (MCM), and spillway release capacity (cumec) of the reservoir. The number of cell rows depends on the data specified in the cell corresponding to number of levels in E-A-C-Rc table.

8.1.4. Steps of Analysis

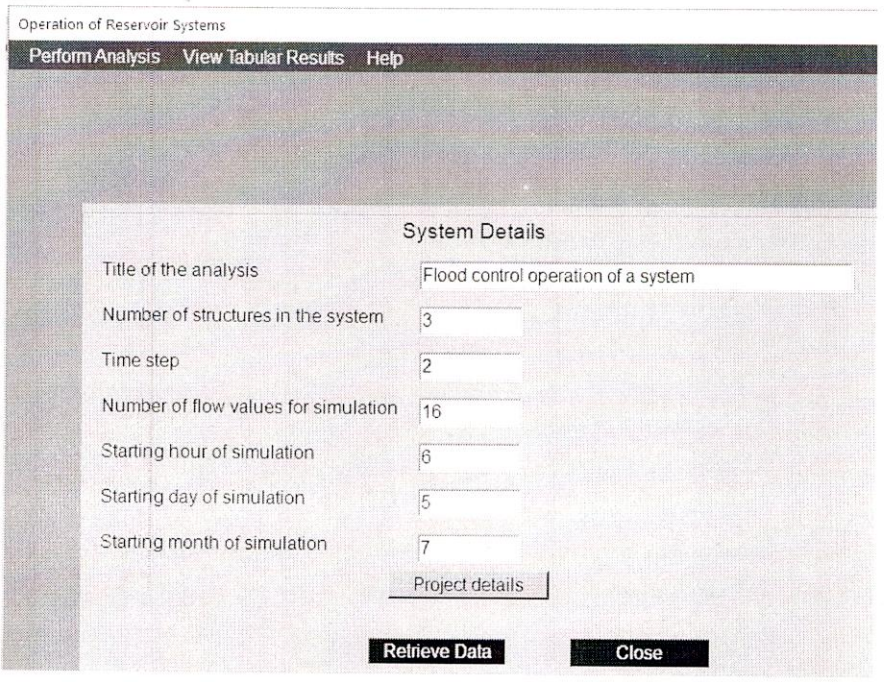
The following are the steps for using the flood control operation module:

a) Go to the ***Flood Operation*** module and select Operation of reservoir systems submodule. The data form will be displayed for entry of general details about the simulation. Fill the form and then click on the ***'Project Details'*** button for entry of data for individual structures in the system.



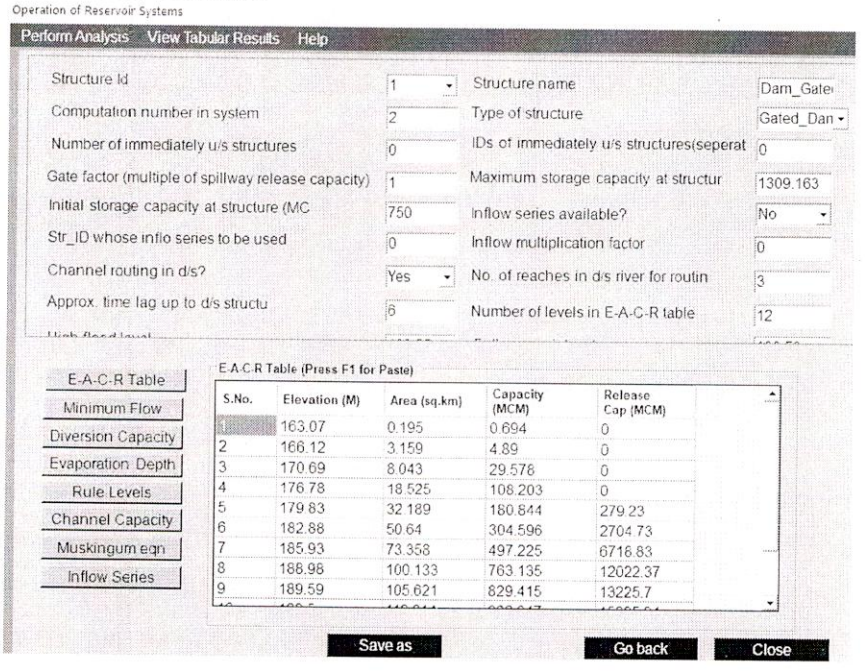
b) It is also possible to retrieve an already existing data file by clicking on the

Retrieve Data button or generate a new file by clearing the default data (by clicking on the ***Clear*** button) in the opening data form and fill all the data cells.



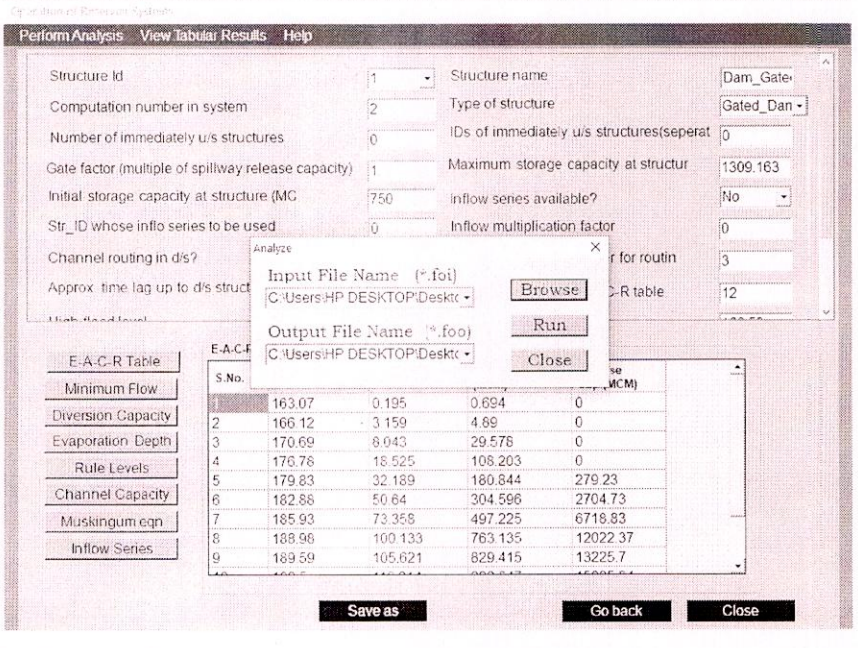
c) In the table, check that data are present in all cells of the table **in specified units**. Next, select the ***Structure ID*** and then enter all the general details and tabular data for the selected structure. It is important to fill all the values in the form cells **in specified units**.

d) In various tabular data, it is also possible to ***Copy-Paste*** the data of all columns from MS-Excel. In that case, copy the data of all columns together from MS-Excel and bring the cursor to the first row in the table and press F1 (function key). Data will get pasted in all columns



e) After entry of all data cells in the form for a structure, click on the ***Save Data*** button. A separate window for saving the data file will appear. First select the desired directory and then specify the desired filename for the data file. The file will be saved as ***.foi*** file. The extension will be automatically attached with the filename. If one wants to add the data for another structure, then he/she can select the Structure_ID. This will also automatically save the entered data for the previous structure.

f) After entering the data for all structures in a system, click on the ***Perform Analysis*** button which will open-up a form for the specification of input and output files before the execution of the related program. First click on the ***Input File Name*** cell and then click on the ***Browse*** button. This will open a window for selecting the input file. Go to the desired directory and select the requisite data file. Click on the ***Open*** button to select the file. The file along with the path will appear in the ***Input File Name*** cell. Next, click on the ***Output File Name*** cell and repeat above steps. The filename along with the path will appear in the ***Output File Name*** cell.

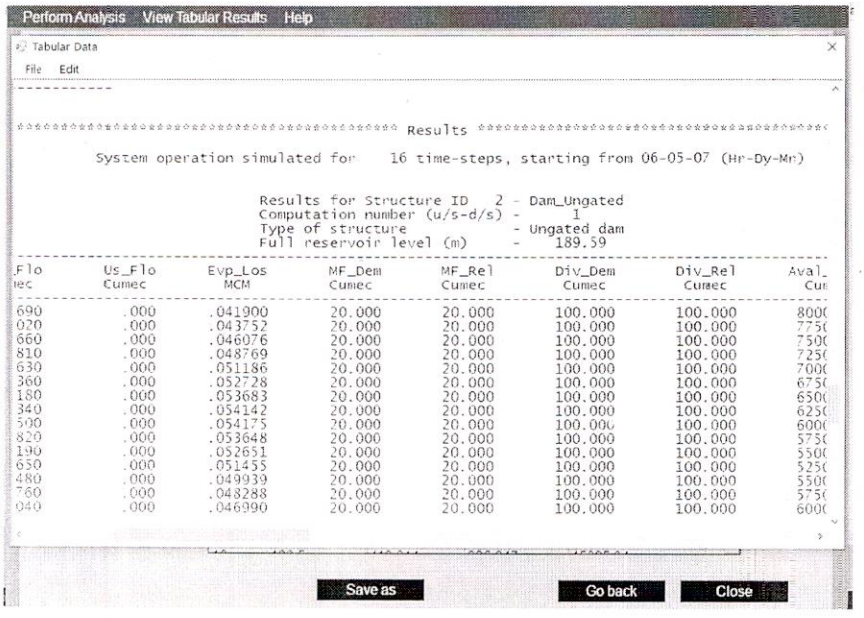


g) <u>After specifying the input and output filenames along with their location, the ***Run*** button gets **activated**</u>. Click on the ***Run*** button to execute the related program with the specified input and output filenames.

h) The program runs in a window which closes automatically after the program execution is complete and the results of simulation analysis are saved in the output file.

i) Click on the ***View Tabular Results*** button. To view data/results in tabular form, click on the ***Tabular*** button which will invoke the ***Notepad***. Click on the ***File*** and then ***Open*** and a window for file selection will appear. Go to the desired directory and select the requisite Input/Output filenames to see Input/Output files. It needs to be mentioned here that in this window, only files with extension ***.foi*** or ***.foo*** will

be displayed. Select the desired filename and click on the ***Open*** button. The file will be displayed in the **Notepad**.



s) Since the varied results of a number of structures are involved in the output file, the presentation of results in the software in graphical form is avoided. However, built-in graphs have been prepared in MS-Excel for presentation of various outcomes for different structures which can be modified as per the requirement. Open the graphical file (*.fog) in MS-Excel as ***"Delimited"*** file with ***"Space"*** delimiters and with column data format as ***"General"***. The file will open in a separate MS-Excel sheet. Select and copy the whole worksheet and paste it in ***"Input"*** worksheet of ***"FLD_Graph.xlsx"*** file of MS-Excel which is already built in. The graphs can be copied and pasted anywhere in a document. Following graphs can be prepared:

- Variation of reservoir inflow and outflow with time
- Variation of reservoir level with time
- Variation of reservoir storage with time
- Reservoir release and routed flow at the d/s

t) Close the ***Flood Control Operation*** module by clicking on the ***Close*** button.

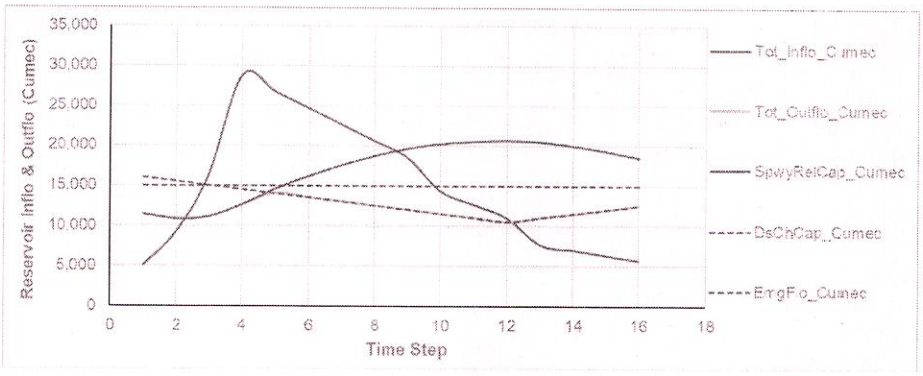


Figure – Plot of reservoir inflow and outflow with other specified flow values

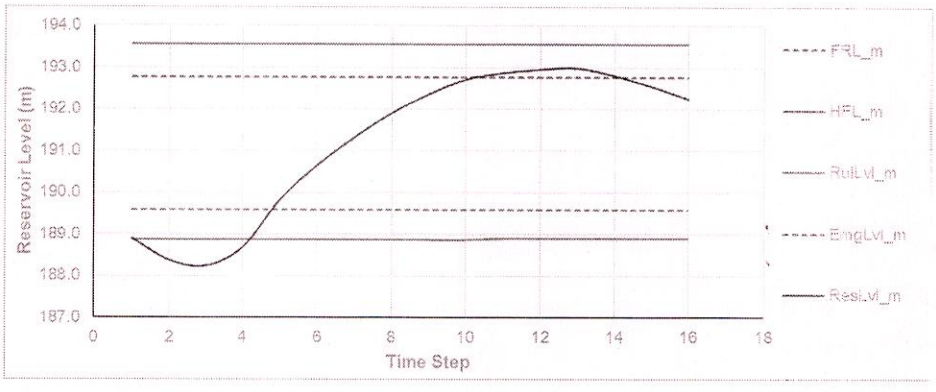


Figure – Plot of reservoir level with time with other specified level values

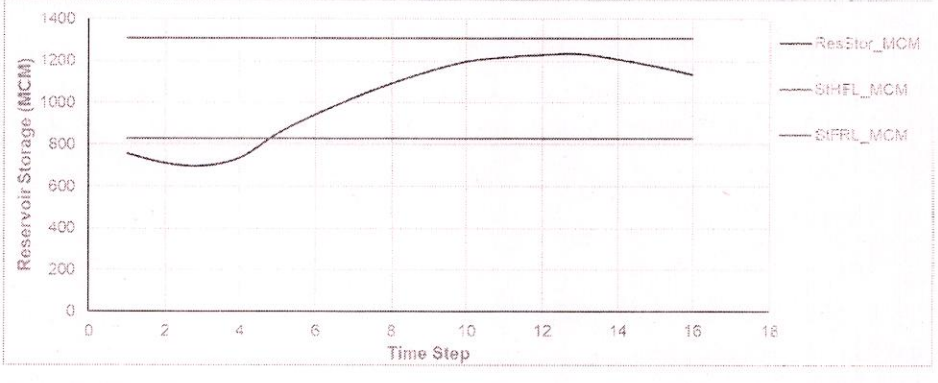


Figure – Plot of reservoir storage with time with other specified storage values

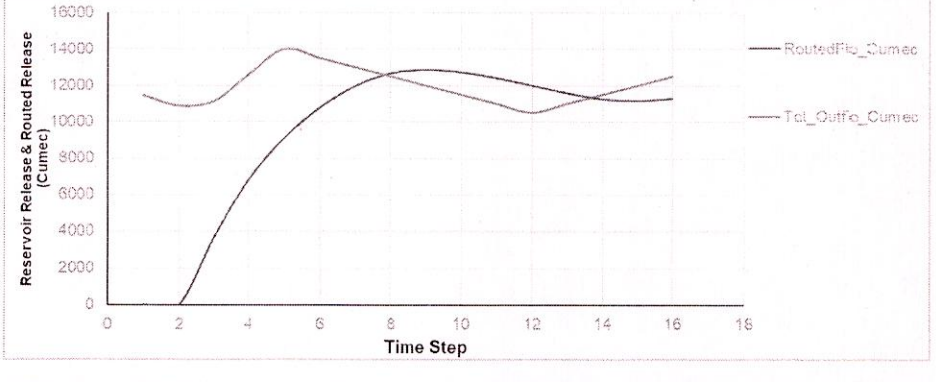


Figure – Plot of reservoir release and routed release at d/s structure

8.2. Real-Time Flood Operation

In the NIH_ReSyP package, a module has been developed for finalizing the flood management policy for a reservoir or a system of multiple reservoirs. The policy is based on the specification of emergency level (EL) and emergency inflow (EI) rate for a reservoir. The basic aim of the flood operation policy is to control the rise of reservoir level above the FRL to the extent possible (or the upper rule curve (URC) level) and to attain FRL (or URC level) at the earliest and to maintain it.

Basic purpose of this module is to help the operator in deciding the releases from reservoir in the d/s channel for flood control purpose depending on the current month and day and information about the current reservoir level, inflow rate (cumec), and the nature of inflow (rising or falling in comparison to the previous inflow rates). Based the current day of a month, URC levels (specified at the beginning and end of a month) are linearly interpolated and corresponding storages are worked out so that releases for flood control can be initiated above the interpolated URC level. Thus linear variation of the URC level within a month is taken into account.

8.2.1. Data Checks

Some of the checks performed by the module include:

a) EACRc table of reservoir is checked. If the area (or storage capacity) at any reservoir level decreases with rising elevation, the program aborts and flags the line number in the EACRc table for correction.

b) The storage capacity at each level in EACRc table above the lowest level is checked by using the prismoidal formula. If the difference in the computed and specified storage capacity is greater than 10%, a message is flagged at the screen and in the result file after the presentation of Elevation-Area-Capacity-Release capacity table in the Input Data section. The program does not abort in this case.

c) If there is error in the entered current Month, or Day, a message is flagged and the program aborts. Maximum limits of month and day are 12 and 31 respectively. If the day exceeds the maximum number of days in the specified month, the program aborts.

d) If there is error in the entered current reservoir level for the day, a message is flagged and the program aborts. The reservoir level must be within the lowest of upper rule curve levels and the HFL.

8.2.2. Input Data Description

The file extensions for the input and output files are ***.fri*** and ***.fro*** respectively. Various items that are input to the program are described below:

Title of the analysis

Specify the title of the data file containing general details of the analysis for remembrance at a later date (not more than 100 characters).

Full reservoir level

Specify the full reservoir level (FRL) of the reservoir (m). This is the maximum level of conservation zone beyond which water is spilled from the reservoir.

High Flood Level (m)

Specify the high flood level (HFL) in m up to which water is to be managed for flood regulation. HFL represents the desirable upper limit of a reservoir inundation. If the reservoir crosses above this level, the dam overtops and safety of the structure is at stake.

Number of levels in E-A-C-Rc table

Specify the number of elevations for which corresponding water spread areas sq. km), cumulative storage capacity (MCM), and the release capacity (cumec) are available in the EACRc table. Based on the entered value, the form for entry of EACRc table will automatically generate the specified number of empty rows for input of E-A-C-Rc values.

Emergency reservoir level (m)

Specify the finalized emergency reservoir level (EL) in m in the flood zone which is critical and one of the factors for triggering emergency operation conditions in the reservoir for flood control. At/above the EL, if the inflow rate exceeds the emergency inflow (EI) rate or if inflow is rising, emergency conditions are declared and releases are made to bring the reservoir level below EL at the earliest possible.

Emergency reservoir inflow (cumec)

Specify the finalized emergency inflow rate (EI) in cumec which is another important factor for triggering emergency operation conditions. in the reservoir for flood control. At any reservoir level, if the inflow rate exceeds the emergency inflow (EI) rate and it is rising, emergency conditions are declared and releases are made equal to the spillway release capacity at that level. Further, if the reservoir level exceeds the EL and inflow is more than EI (though it may be decreasing), emergency conditions are triggered.

Safe capacity of d/s channel

Specify the safe capacity of the d/s channel (cumec) such that flood discharge of this magnitude can be passed safely without causing any flooding in the downstream. Efforts are made to release the flood water within the d/s safe channel capacity limit in the normal circumstances till the conditions worsen and reach emergency to safeguard the structure.

E-A-C-Rc table

Clicking on the ***E-A-C-Rc Table*** button opens a table for entry of elevation (m), area (sq. km), storage capacity (MCM), and spillway release capacity (cumec) of the reservoir. The number of cells depends on the data specified in the cell corresponding to number of levels in EACRc table.

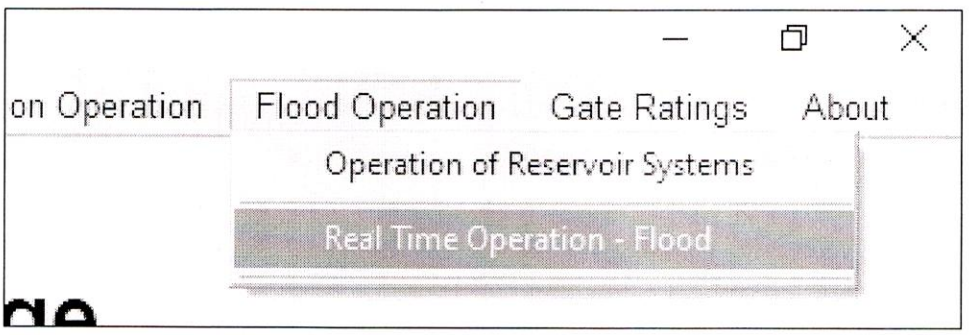
Upper Rule curve levels (m)

Clicking on the ***Upper Rule Curve Levels*** button opens a table for entry of upper rule curve levels in different months. If the reservoir level crosses above this level in any month, spill can be made so as to bring the reservoir back to URC level.

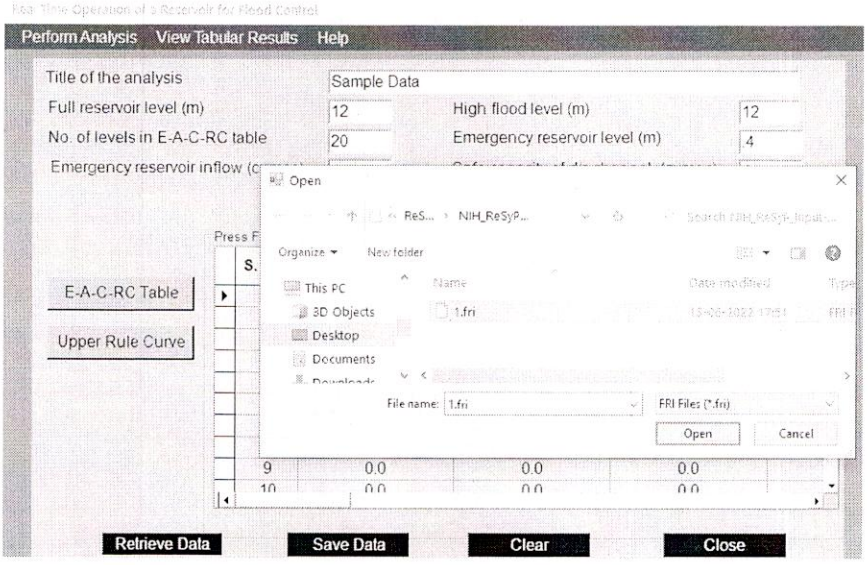
8.2.3. Steps of Analysis

The following are the steps for using the ***Flood Operation*** module:

a) Go to the submodule ***Real-Time Operation-Flood*** in the ***Flood Operation*** module. The data form will be displayed for entry of general details and tabular data.



b) Either retrieve an already existing data file by clicking on the ***Retrieve Data*** button or generate a new file by clearing the default data (by clicking on the ***Clear*** button) in the opening data form and fill all the data cells.



c) After entry of all data cells in the general data section, a blank **E-A-C-Rc Table** form appears in the lower part of the form for input of elevation, area, and storage capacity values. Click on the ***E-A-C-Rc Table*** button and fill all the values in the table **in specified units**.

d) Click on the ***Upper Rule Curve Levels*** button. A blank table appears in the lower part of the form for input of upper rule curve levels for different months. Fill all the values in the table **in specified units**.

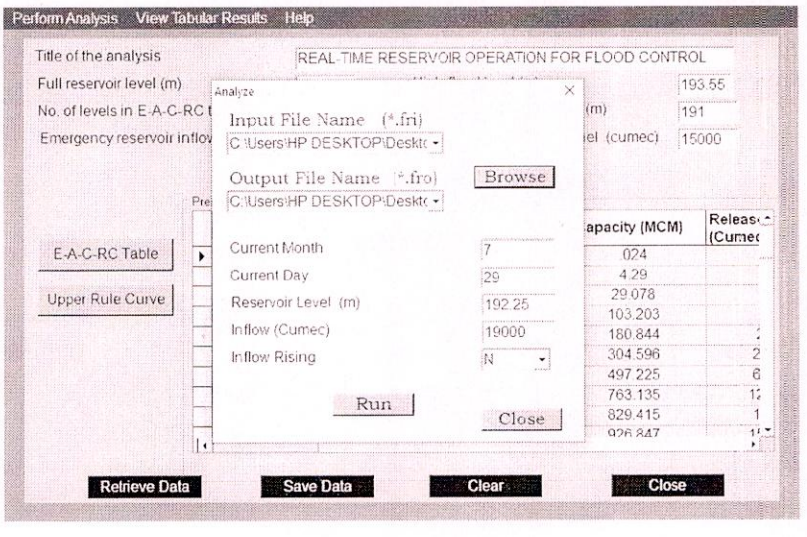
e) In various tabular data, it is also possible to ***Copy-Paste*** the data of all columns from MS-Excel. In that case, copy the data of all columns together from MS-Excel and bring the cursor to the first row in the table and press F1 (function key). Data will get pasted in all columns in the table. Check that data are present in all cells of the table **in specified units**.

f) After entry of all data cells in the form, click on the ***Save Data*** button. A separate window for saving the data file will appear. First select the desired directory and then specify the desired filename for the data file. The file will be saved as ***.fri*** file. The extension will be automatically attached with the filename.

g) Click on the ***Perform Analysis*** button which will open-up a form for the specification of input and output files before the execution of the related program. First click on the ***Input File Name*** cell and then click on the ***Browse*** button. This will open a window for selecting the input file. Go to the desired directory and select the requisite data file.

h) Click on the ***Open*** button to select the file. The file along with the path will appear in the ***Input File Name*** cell. Next, click on the ***Output File Name*** cell and repeat above steps. The filename along with the path will appear in the ***Output File Name*** cell.

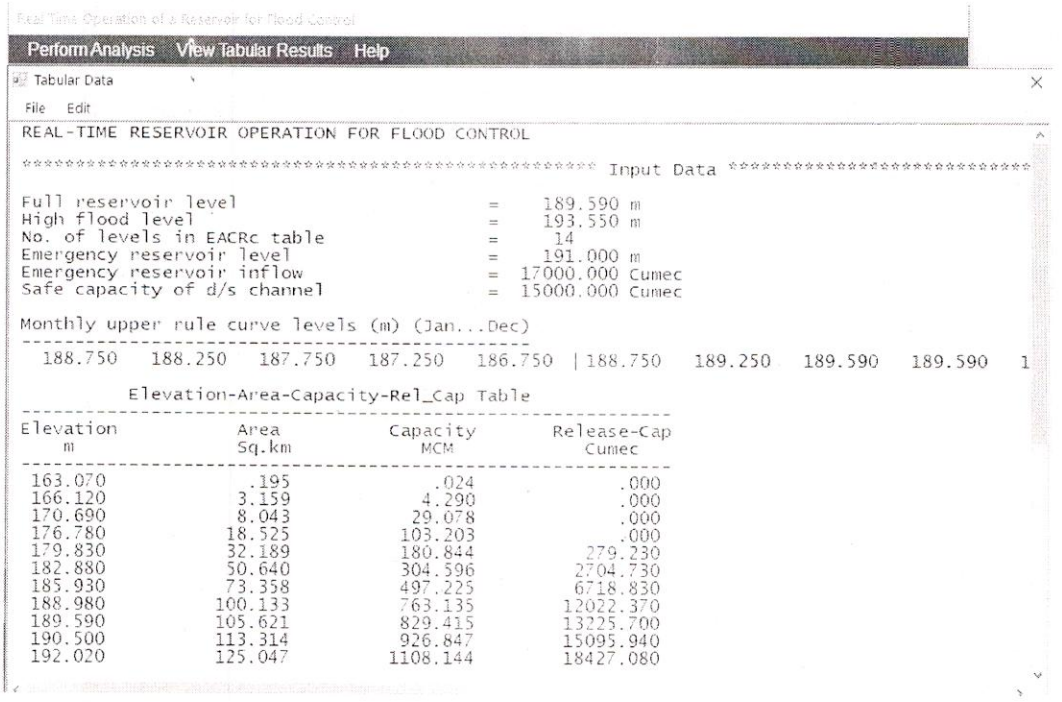
i) Next, enter the empty cells corresponding to the Month, and Day and the Reservoir level (m), inflow rate (cumec), and whether inflow is rising in comparison to the previous observations. The form for entry of instantaneous values is displayed in a window as shown in Figure below.



j) After specifying the input and output filenames along with their location and after filling the details of month, and day and the reservoir level, inflow rate, and nature of inflow for the day, the ***Run*** button gets **activated**. Click on the ***Run*** button to execute the related program with the specified input and output filenames.

k) The program runs in a window which closes automatically after the program execution is complete and the instantaneous values of release for various demands is displayed in a window.

u) Click on the ***View Tabular Results*** button. To view data/results in tabular form, click on the ***Tabular*** button which will invoke the ***Notepad***. Click on the ***File*** and then ***Open*** and a window for file selection will appear. Go to the desired directory and select the requisite Input/Output filenames to see Input/Output files. It needs to be mentioned here that in this window, only files with extension ***.cri*** or ***.cro*** will be displayed. Select the desired filename and click on the ***Open*** button. The file will be displayed in the **Notepad**.




```
REAL-TIME RESERVOIR OPERATION FOR FLOOD CONTROL

********************************************************* Input Data ****************************

Full reservoir level                        =    189.590 m
High flood level                            =    193.550 m
No. of levels in EACRc table                =     14
Emergency reservoir level                   =    191.000 m
Emergency reservoir inflow                  =  17000.000 Cumec
Safe capacity of d/s channel                =  15000.000 Cumec

Monthly upper rule curve levels (m) (Jan...Dec)
-----------------------------------------------
  188.750   188.250   187.750   187.250   186.750 | 188.750   189.250   189.590   189.590   1

          Elevation-Area-Capacity-Rel_Cap Table
-------------------------------------------------------------
Elevation          Area          Capacity       Release-Cap
    m              Sq.km           MCM             Cumec
-------------------------------------------------------------
 163.070            .195            .024            .000
 166.120           3.159           4.290            .000
 170.690           8.043          29.078            .000
 176.780          18.525         103.203            .000
 179.830          32.189         180.844          279.230
 182.880          50.640         304.596         2704.730
 185.930          73.358         497.225         6718.830
 188.980         100.133         763.135        12022.370
 189.590         105.621         829.415        13225.700
 190.500         113.314         926.847        15095.940
 192.020         125.047        1108.144        18427.080
```

v) Close the ***Real-Time Flood Operation*** module by clicking on the ***Close*** button.