MODULE – 5: Reservoir Sedimentation

Soil is eroded due to rainfall and wind, resulting in tremendous sediment movement into water courses by flood and storm waters. A great amount of sediment is annually carried by the rivers down to the reservoirs.

The sediment yield from the catchment is determined by measuring the sediment discharge at the catchment outlet. Next, depending on the trap efficiency of reservoir (computed from capacity-inflow ratio), the volume of sediment that is likely to deposit in the reservoir is found out. At the time of designing the storage capacity of a reservoir, it is important to keep some additional storage capacity for sedimentation in the reservoir so that the reservoir can perform its functions at full efficiency for an assigned number of years. This volume of storage is referred to as dead storage and is a major criterion in fixing the minimum drawdown level (MDDL) of reservoir.

At the time of designing the storage capacity of a reservoir, it is important to keep some additional storage capacity for sedimentation in the reservoir so that the reservoir can perform its functions at full efficiency for an assigned number of years. The most common methods generally used for this purpose are Empirical Area Reduction (EAR) method or the Area Increment (AI) method. This module, is based on EAR method.

5.1. Assumptions

Some of the assumptions while using the ***Reservoir Sedimentation*** module are as follows:

a) Metric system of units has been adopted and the desirable units of data have been specified at relevant places.

b) The information about the type of reservoir (1 - Plain/2 - Foot-hill/3 - Hill/4 - Gorge) and the total volume of sediment to be distributed in the reservoir is collected beforehand.

c) The Elevation-Area-Capacity (EAC) table from the river bed level at the dam site up to the FRL is available preferably at closer elevation interval.

d) The specified sediment volume to be distributed in the reservoir is more than the minimum amount of sedimentation (computed assuming various reservoir levels as NZE) in the reservoir. Otherwise, the revised EAC computations are not made and a message is flagged. For this reason, the computed sedimentation volume corresponding to various assumed NZE (from river bed level up to FRL at 1 cm interval) is written in different file with extension *.rsz*. One can refer this file for deciding the sediment volume to be deposited in reservoir.

5.2. Data Checks

Some of the checks performed by the module include:

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

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

5.3. Input Data Description

The form for input in general data section and EAC table is shown in Figure – 1. The file extensions for input file, output file, and graphical files are ***.rsi, .rso,*** and ***.rsg*** respectively. As specified earlier, one more file with extension ***.rsz*** is written as output which contains the computed sedimentation volume corresponding to various assumed NZE (from river bed level up to FRL at 1 cm interval). One can refer this file for deciding the sediment volume to be deposited in reservoir. If sediment volume to be distributed is less than the computed minimum sediment volume at any NZE, original EAC table can be used. Various items input to 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 data points in EAC table

Specify the number of elevations for which corresponding area and cumulative storage capacity are available in the E-A-C table. Based on the entered value, the form for entry of E-A-C table will automatically generate specified number of empty cell rows for the input of elevation, area, and storage capacity.

Type of reservoir

Select the type of reservoir after finding its classification.

Sediment volume deposited in reservoir (cu. m)

Specify the total sediment volume (in cubic meter) that would be deposited in the reservoir for which new zero elevation and sediment deposition profile are to be estimated by empirical area reduction method.

River bed level (m)

Specify the original river bed level (m) at the dam site. This should also correspond to the first elevation in the EAC table (if EAC table is in increasing

elevation order) or the last elevation in the EAC table (if EAC table is in decreasing elevation order).

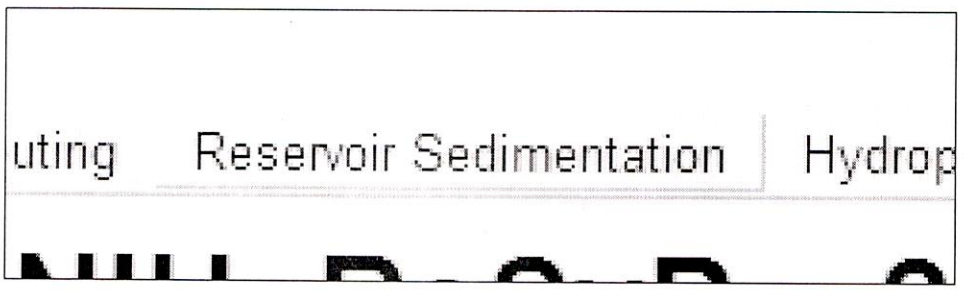
Full reservoir level (m)

Specify the full reservoir level (m). This should also correspond to the last elevation in the EAC table (if EAC table is in increasing elevation order) or the first elevation in the EAC table (if EAC table is in decreasing elevation order).

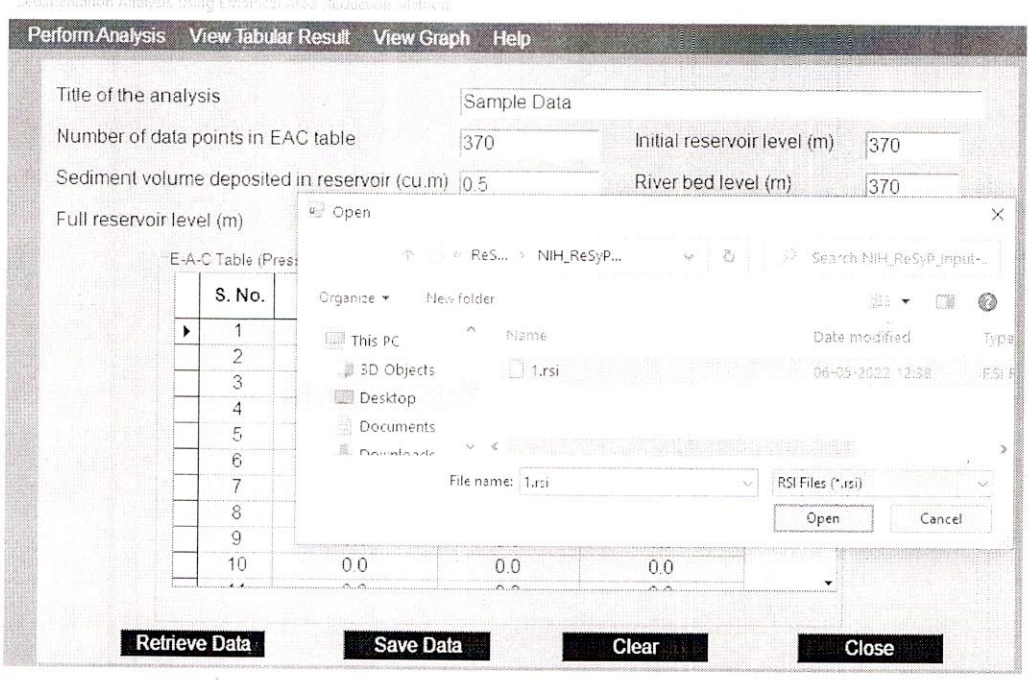
5.4. Steps of Analysis

The following are the steps for using the ***Reservoir Sedimentation*** module:

a) Invoke the ***Reservoir Sedimentation*** 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.



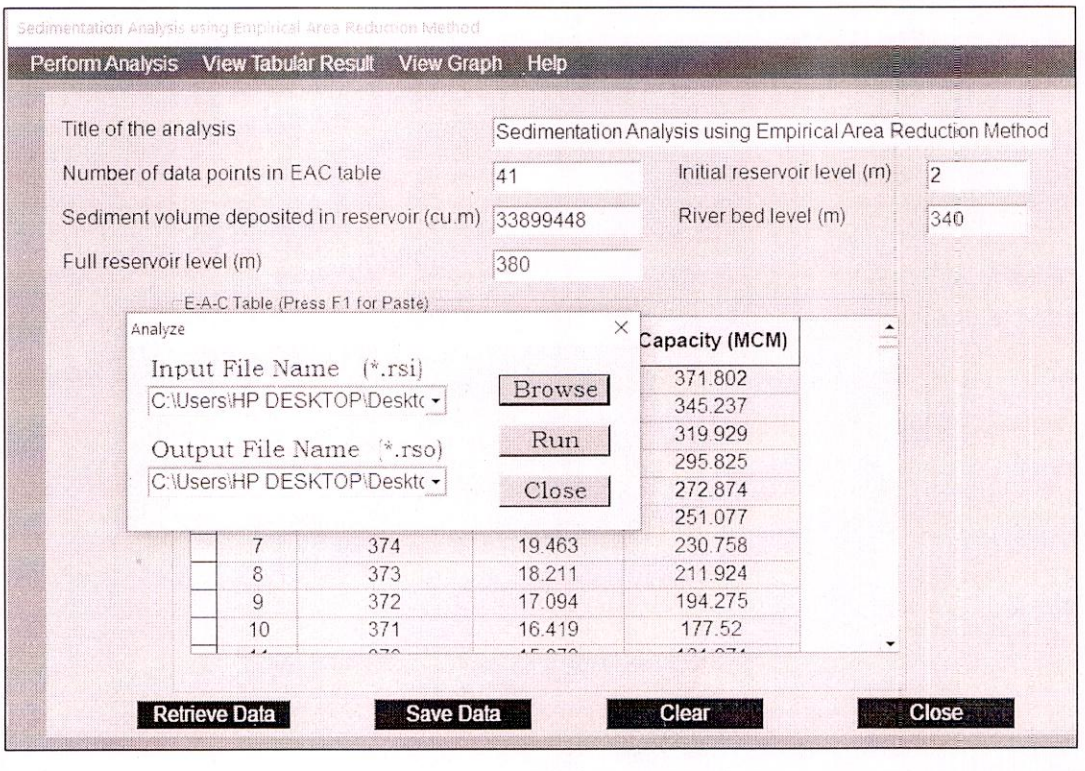
c) After entry of all data cells in the general data section, a blank **E-A-C Table** form appears in the lower part of the form for input of elevation, area, and storage

capacity values. Fill all the values in the table **in specified units**.

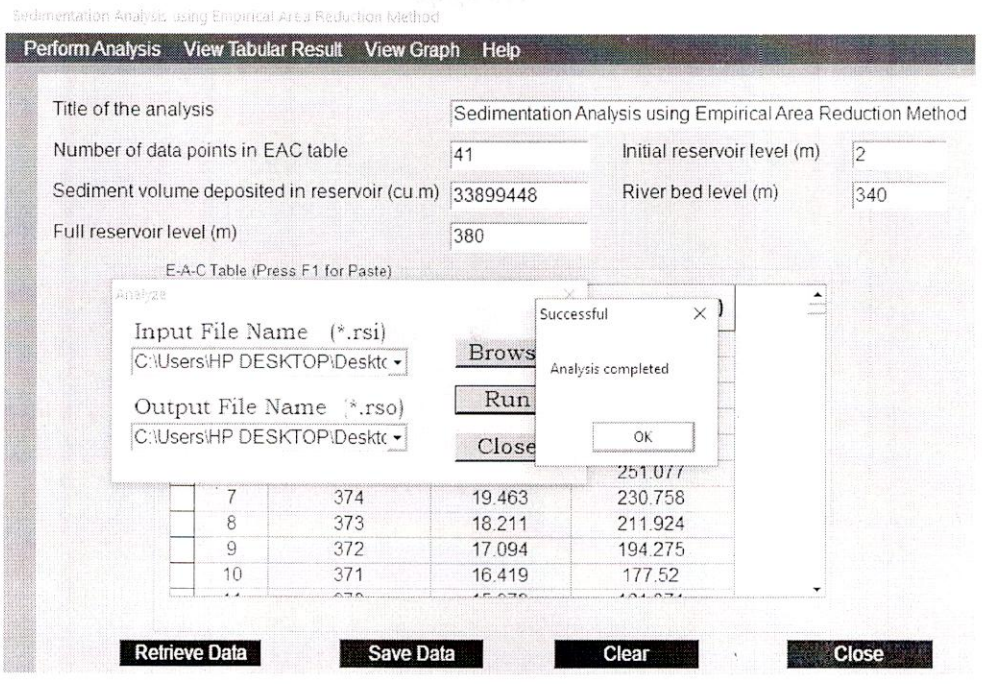
In the tabular data, it is also possible to ***Copy-Paste*** the data of all columns from MS-Excel. In that case, copy the data of all columns together from MS-Excel and bring the cursor to the first row in the table and press F1 (function key). Data will get pasted in all columns in the table. Check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

d) 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 ***.rsi*** file. There is no need to specify the extension in the filename. It will be automatically attached with the filename.

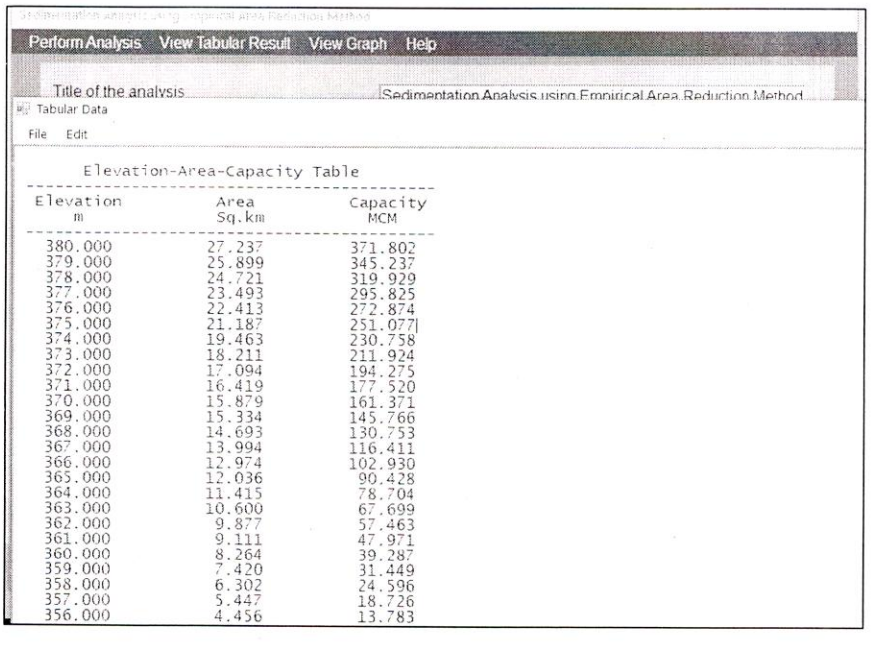
e) Click on the ***Perform Analysis*** button which will open-up a form for the specification of input and output files before the execution of the related program. First click on the ***Input File Name*** cell and then click on the ***Browse*** button. This will open a window for selecting the input 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.



f) After specifying the input and output filenames along with their location, the ***Run*** button gets **activated**. Click on the ***Run*** button to execute the related program with the specified input and output filenames. The program runs (in a window which closes automatically after the program execution is complete).



g) 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 ***.rsi*** or ***.rso*** will be displayed. Select the desired filename and click on the ***Open*** button. The file will be displayed in the **Notepad**.

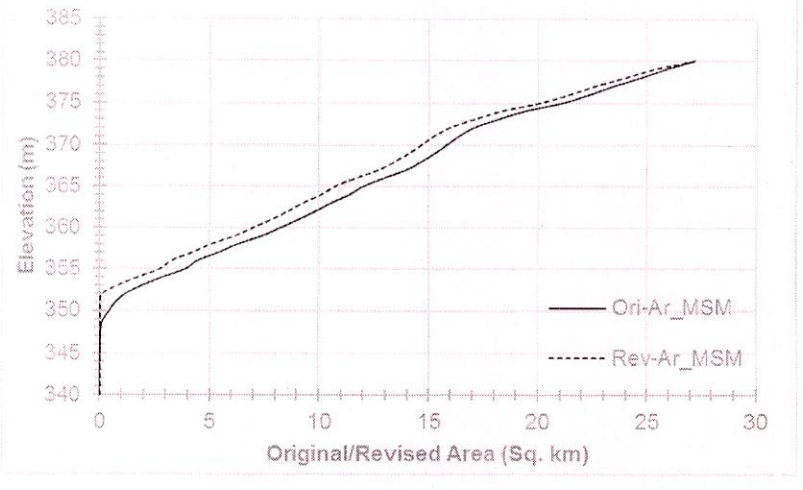


h) To view the results in graphical form, click on the ***View Graphs*** button. A window with following graphical option will invoke:

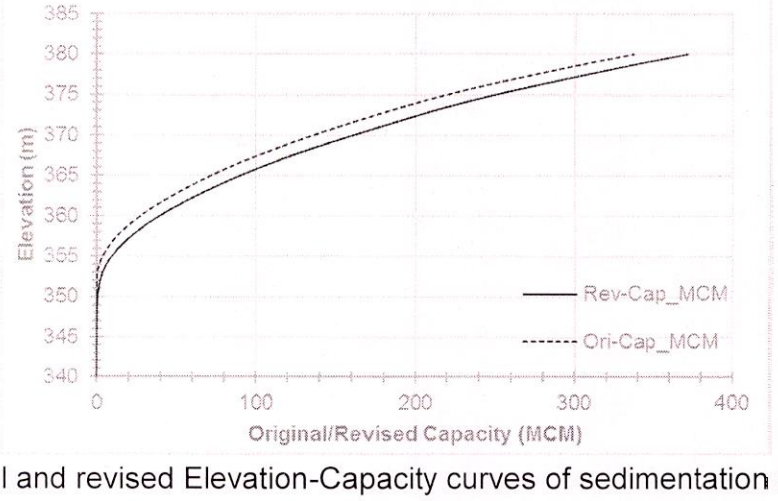
- Original and Revised Elevation – Area curves, and
- Original and Revised Elevation – Capacity curves.

Select the option and then click on the ***View Graph*** button. The corresponding graph will be displayed which can be copy-pasted in a document.

i) It is also possible to prepare the graphs in MS-Excel only with specific requirements. For this purpose, ready-made graphs have been prepared in MS-Excel which can be modified. Open the graphical file (*.rsg) 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 ***"Res-Sed_Graph.xlsx"*** file of MS-Excel which is already built in. The graphs can be copied and pasted anywhere in a document. The graph for the sample analysis are shown in Figures below.



Original and revised Elevation-Area curves of sedimentation analysis



Original and revised Elevation-Capacity curves of sedimentation analysis

j) Close the ***Reservoir Sedimentation*** module by clicking on the ***Close*** button.