

MODULE – 2: Elevation-Area-Capacity (EAC) Table

Module 2 is intended for development of EAC table. For many studies sometimes EACs are not available for analysis and only salient features of the project are available or we may need a more generalized EAC for certain analysis purpose. Keeping this in mind this module is developed. The module is further branched into two submodules 1. EAC Interpolation and 2. EAC Approximation, depending upon different purposes.

2.1 EAC Interpolation

The purpose of this module is to interpolate the elevation-area-capacity values for specified range of elevation interval. Generally, the project authorities have some specific rows (say, 10 – 15 or so) in the elevation-area-capacity (EAC) table and it is sometimes desirable to have the values at closer intermediate levels. This module facilitates calculation of intermediate values in the EAC table. Using this module, project authorities can find out the area and capacity values for any elevation within the lowest and highest range.

Method of linear interpolation has been used for this purpose. All the available values of EAC table are read as input in the module. The interpolation for any elevation is carried out considering its upper and lower EAC values.

2.1.1 Data Checks

Some of the checks performed by the module include:

- a) EAC 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 EAC table for correction.
- b) The storage capacity at each level in 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.

2.1.2 Input Data Description

The file extensions for input file, output file, and graphical files are **.eii**, **.eio**, and **.eig** respectively. Various items that are input to the program are described below:

Title of the problem

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

Initial reservoir level (m)

Specify the starting reservoir level (in m) from which the interpolated values are to be computed.

Incremental level (m)

Specify the desired incremental level (in m, say 0.5 m) between successive reservoir elevations. The area and storage capacity values will be computed at the specified increments in elevation starting from the specified initial reservoir level.

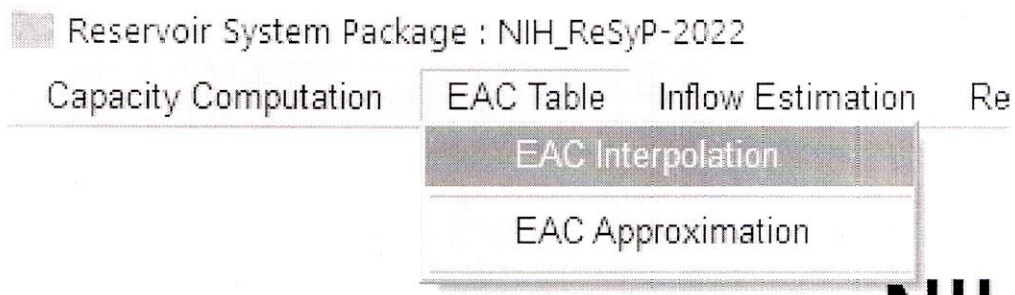
Number of data points in EAC table

Specify the number of elevations for which corresponding water spread areas and cumulative storage capacity are available in the EAC table. Based on the entered value, the form for entry of EAC table will automatically generate the specified number of empty cells for input of elevation, area, and storage capacity.

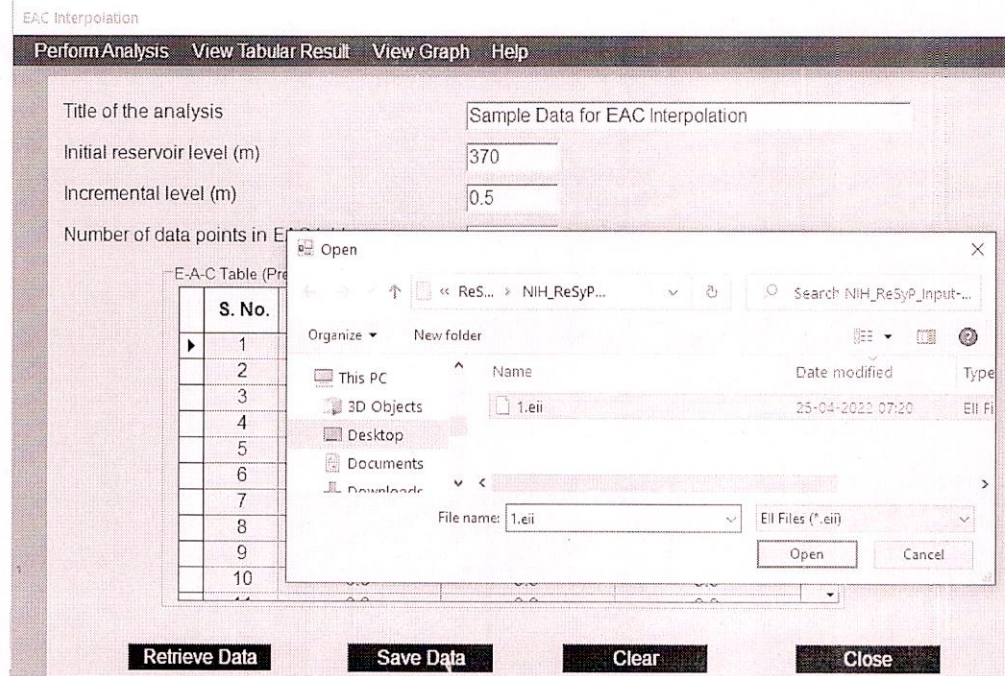
2.1.3 Steps of Analysis

The following are the steps for using EAC interpolation module:

- a) Select the ***EAC Interpolation*** sub-module of the ***EAC Table*** module. The data form will be displayed for entry of general details and tabular data.



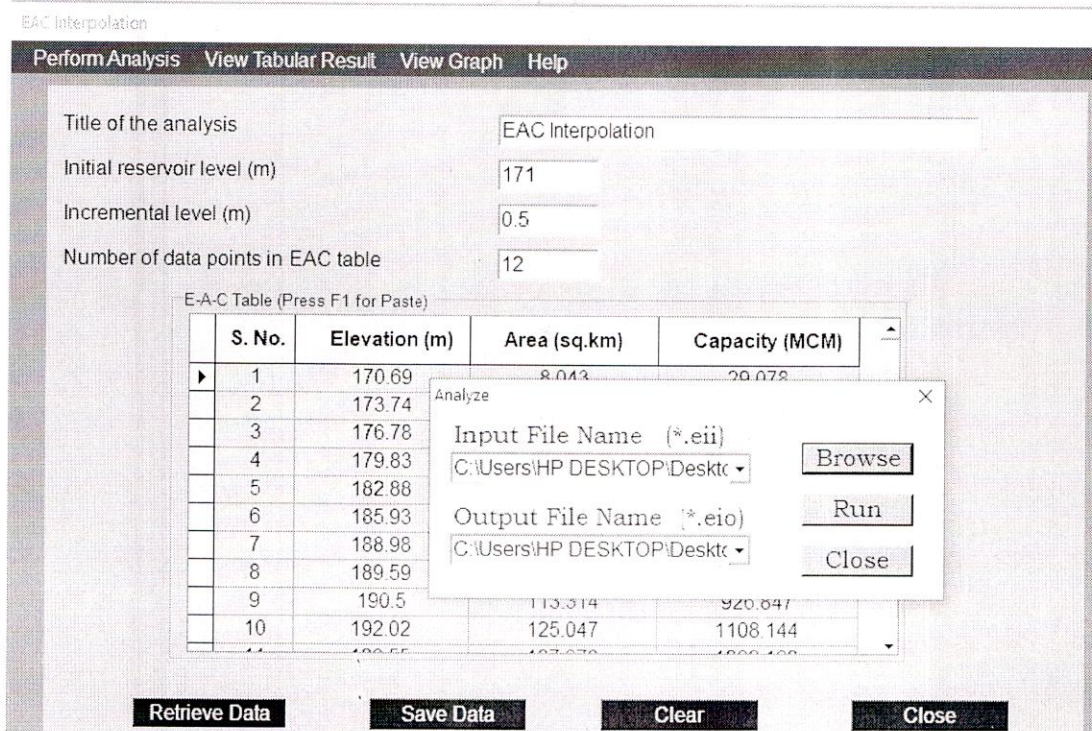
- b) Either retrieve an already existing data file by clicking on the ***Retrieve Data*** button or generate a new file by clearing the default data (by clicking on the ***Clear*** button) in the opening data form and fill all the data cells.



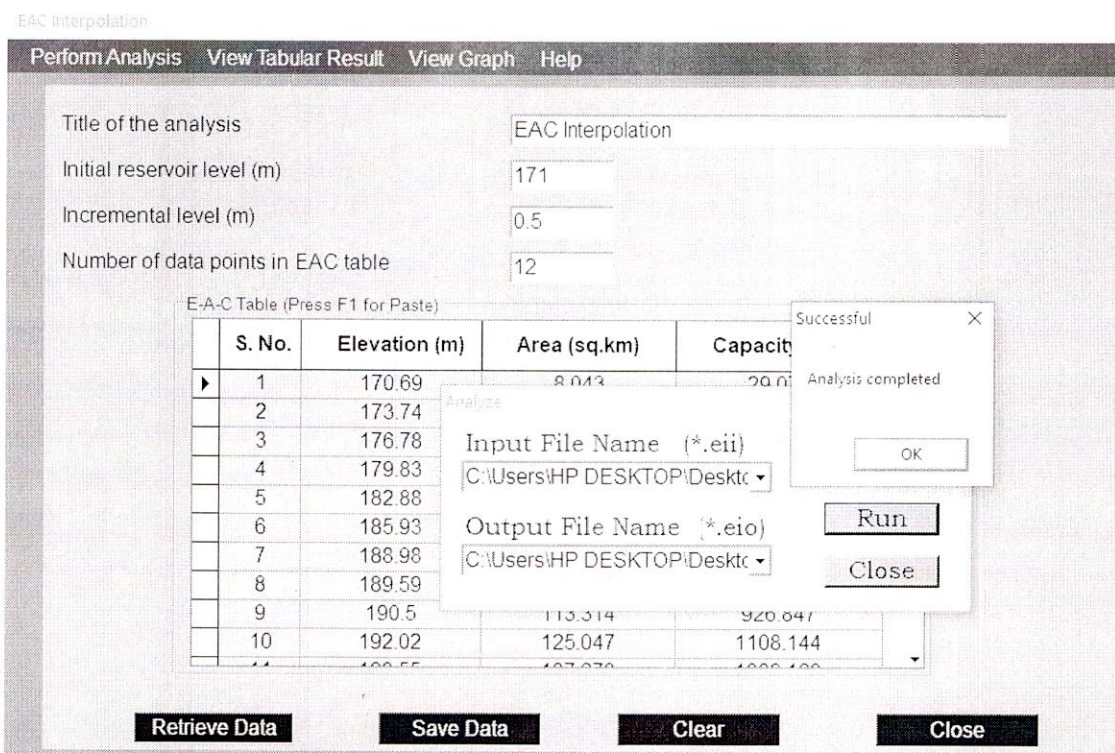
- c) After entry of all data cells in the general data section, a blank **E-A-C Table** appears in the lower part of the form for input of elevation, area, and storage capacity values. Fill all the values in the table in specified units.

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.

- d) After entry of all data cells in the general data section and the tabular data, 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 **.eii** 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 **.eii** or **.eio** will be displayed. Select the desired filename and click on the **Open** button. The file will be displayed in the **Notepad**.

EAC Interpolation

Perform Analysis View Tabular Result View Graph Help

Tabular Data

File Edit

EAC Interpolation

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

Initial reservoir level = 171.000 m
Incremental level = .500 m
No. of data points in EAC table = 12

Elevation-Area-Capacity Table

Elevation m	Area Sq.km	Capacity MCM
170.690	8.043	29.078
173.740	11.929	58.898
176.780	18.525	103.203
179.830	32.189	180.844
182.880	50.640	304.596
185.930	73.358	497.225
188.980	100.133	763.135
189.590	105.621	829.415
190.500	113.314	926.847
192.020	125.047	1108.144
193.550	137.673	1309.163
194.000	142.001	1420.001

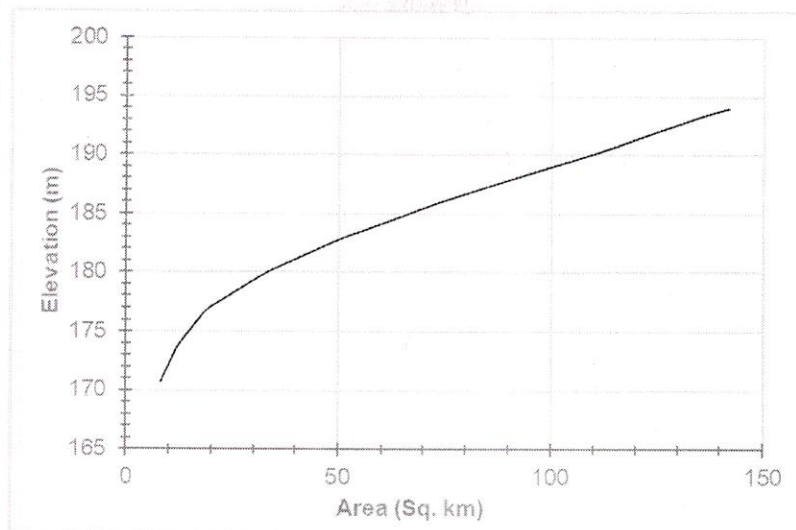
***** Results *****

Interpolated EAC Table

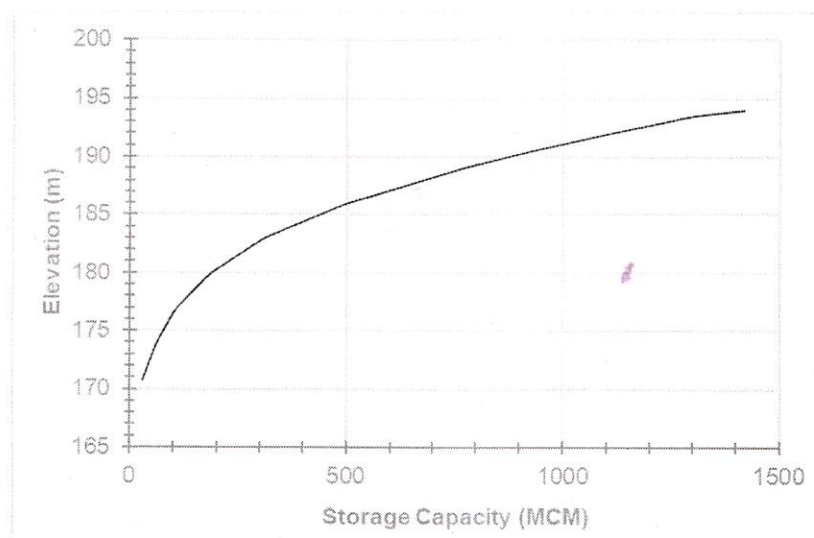
h) It is possible to prepare the graphs in MS-Excel with specific requirements. For this purpose, ready-made graphs have been prepared in MS-Excel which can be modified. Open the graphical file (*.eig) in MS-Excel as **"Delimited"** file with **"Space"** delimiters and with column data format as **"General"**. The file will open in a separate MS-Excel sheet. Select and copy the whole worksheet and paste it in **"Input"** worksheet of **"EAC-Int_Graph.xlsx"** file of MS-Excel which is already built in. Following two graphs are generated:

- Elevation – Area Curve, and
- Elevation – Capacity Curve.

The two graphs for the sample analysis are shown in Figures below.



Elevation – Area curve



Elevation – Capacity curve

- i) Close the **EAC Interpolation** sub-module by clicking on the **Close** button.

2.2 EAC Approximation

This submodule is developed to approximate the Elevation-Area and Elevation-Capacity curves within the full range of reservoir depth. Data requirement for the method includes river bed level (m) at the dam site, reservoir area (sq. km) and storage capacity (MCM) at FRL. This method has been applied to a number of Indian reservoirs and observed and computed areas and capacities have been compared. In a number of cases, the method closely approximates the intermediate areas and capacities as compared to the observed values.

2.2.1 Input Data Description

The form for input in general data section is shown in Figure – 1. The file extensions for input file, output file, and graphical files are **.eai**, **.eao**, and **.eag** respectively. Various items that are input to the program are described below:

Title of the problem

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

River bed level (m)

Specify the river bed level (in m) at the dam site at which water spread area and the reservoir storage capacity are zero.

Full reservoir level (m)

Specify the Full reservoir level (FRL) of the reservoir (in m).

Area at FRL (sq. km)

Specify the water spread area of the reservoir at FRL (in sq. km).

Capacity at FRL (MCM)

Specify the storage capacity of the reservoir at FRL (in million cubic meter).

Initial reservoir level (m)

Specify the starting lowest reservoir level (in m) from which the elevation – area - capacity values are to be computed in increasing order of elevation.

Incremental level (m)

Specify the incremental level (in m, say 2 m) between successive reservoir elevations. The area and capacity values will be computed at specified increments in elevation starting from the specified initial reservoir level.

2.2.2. Steps of Analysis

The following are the steps for using the EAC Approximation module:

- a) Go to the **EAC Table** module and select the **EAC Approximation** sub-module.

Reservoir System Package : NIH_ReSyP-2022

Capacity Computation

EAC Table

Inflow Estimation

Reservoir Routing

F

EAC Interpolation

EAC Approximation

NIH

NIH_Rese

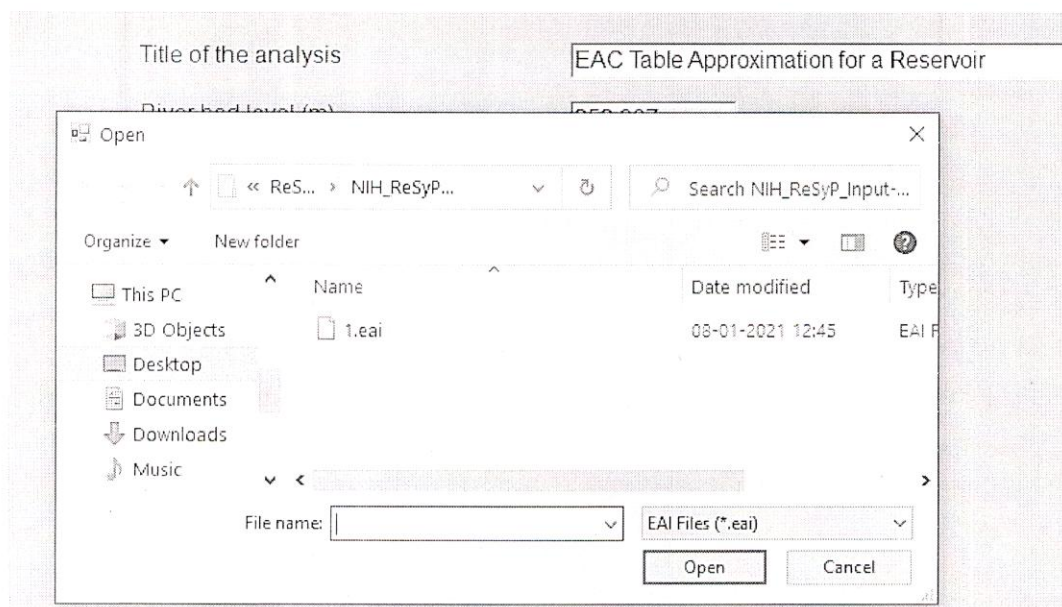
- b) The data form will be displayed for entry of general details and tabular data.

The screenshot shows the 'EAC Approximation' window with the following data entered:

Field	Value
Title of the analysis	Sample Data for EAC Approximation
River bed level (m)	252.978
Full reservoir level (m)	280.419
Area at FRL (sq.km)	81.024
Capacity at FRL (MCM)	580.648
Initial elevation of EAC table (m)	254.000
Incremental elevation (m)	2.000

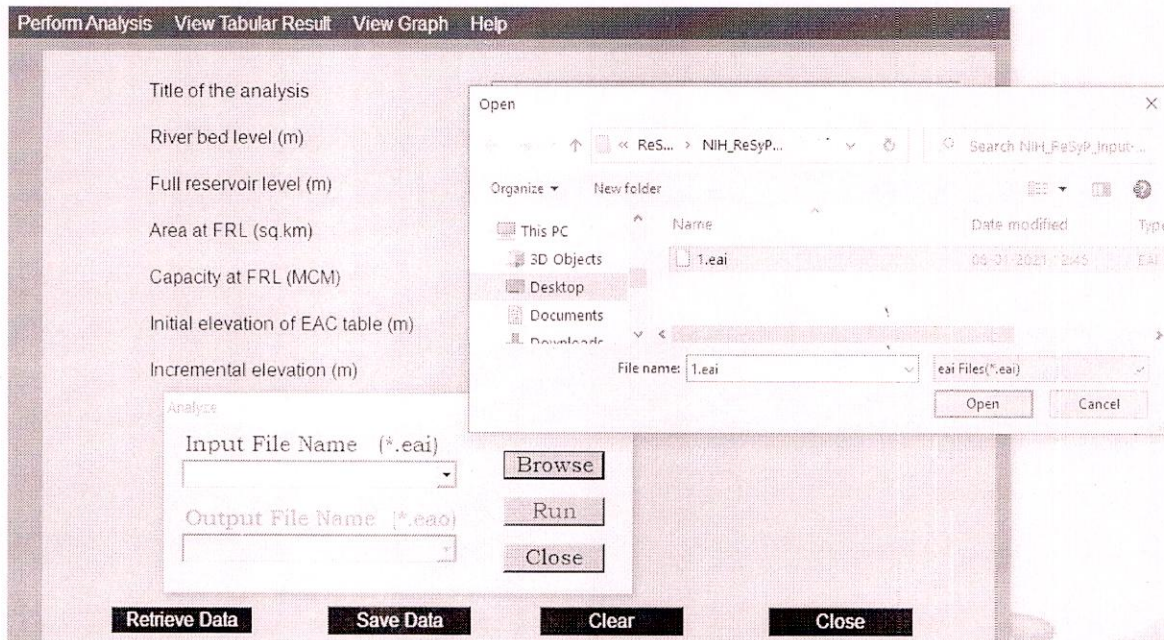
Buttons at the bottom: Retrieve Data, Save Data, Clear, Close.

- c) 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.

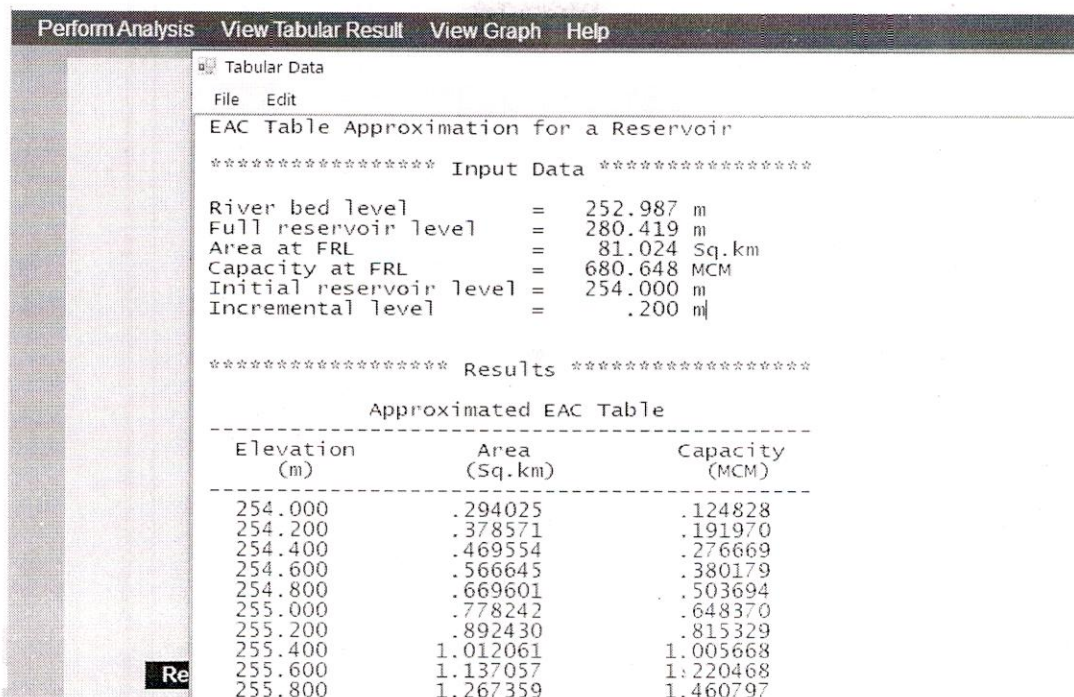


- d) After entry of all data cells in the form, click on the **Save Data** button. A separate window for saving the data file will appear. First select the desired directory and then specify the desired filename for the data file. The file will be saved as **.eai** file. There is no need to specify the 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 **.eai** or **.eao** 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 two graphical options will invoke:

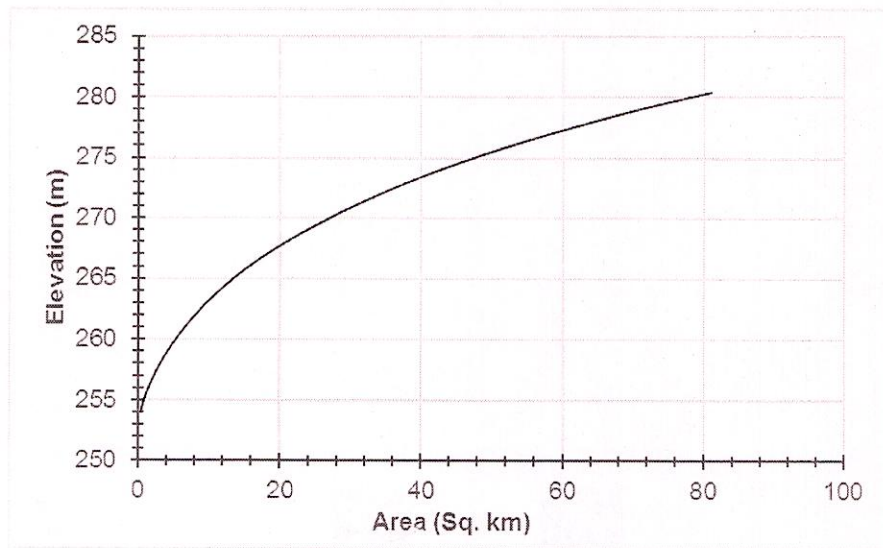
- Elevation – Area Curve, and
- Elevation – Capacity Curve.

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

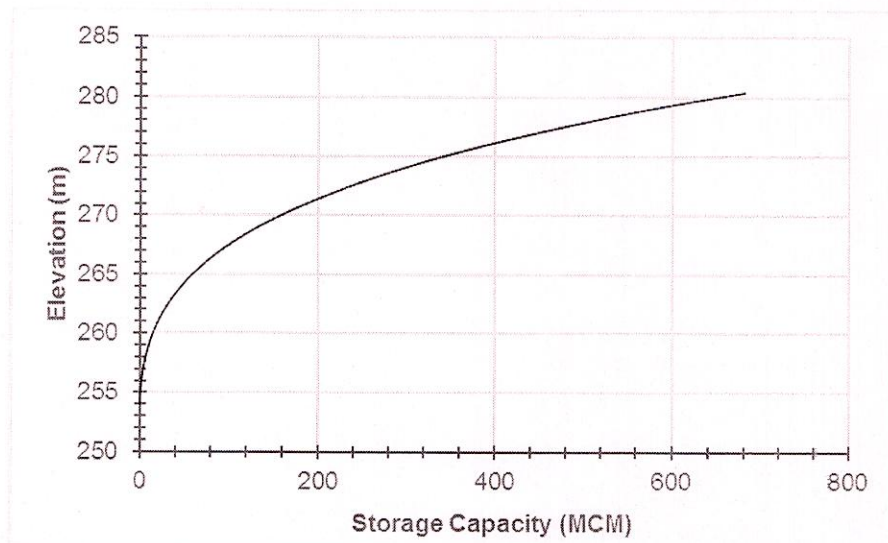
i) It is also possible to prepare the graphs in MS-Excel with specific requirements. For this purpose, ready-made graphs have been prepared in MS-Excel which can be modified. Open the graphical file (*.eag) in MS-Excel as **“Delimited”** file with **“Space”** delimiters and with column data format as **“General”**. The file will open in a separate MS-Excel sheet. Select and copy the whole worksheet and paste it in **“Input”** worksheet of **“EAC-App_Graph.xlsx”** file of MS-Excel which is already built in. Following two graphs are generated:

- Elevation – Area Curve, and
- Elevation – Capacity Curve.

The graphs can be copied and pasted anywhere in a document. The two graphs for the sample analysis are shown in Figures below.



Elevation – Area curve generated by EAC Approximation module



Elevation – Capacity curve generated by EAC Approximation module

- j) Close the **EAC Approximation** sub-module by clicking on the **Close** button.