

MODULE 9- Gate Ratings

9.1. Gate Rating Tables

A spillway is provided at a dam site to dispose-off the surplus water from the upstream of the reservoir to the downstream without causing any harm to the dam structure. Spillway gates, when closed, also head-up the water level for specified purposes like water supply for domestic and industrial use, irrigation, hydropower generation and flood control. Gate operators require information about the release rates corresponding to different gate openings [the straight line distance (cord length) from the gate seat to the downstream side of the gate lip]. The release rate (in cumec) from a tainter spillway gate or a sluice gate depends on the flow and dimensional characteristics of the gate, the water head above the gate crest and the gate opening.

The basic purpose of this module is to develop the rating tables for the tainter/sluice gates corresponding to the current reservoir level for the specified gate opening. The flow and dimensional characteristics of the gate and the range of reservoir level variation and gate openings need to be specified in the data file. The corresponding release rates are presented in the output file as a table. Further, if one wishes to find the release rate for a particular reservoir elevation at specified gate opening, the **Instantaneous Release Rate** sub-module can be used for instantaneous on-screen visualization of results.

9.1.1. Input Data Description

The file extensions for the input and output files are **.gti** and **.gto** 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).

Type of gate (1-Tainter/2-Sluice)

Specify the number (1 or 2) to represent the type of gate through which the discharge is to be computed corresponding to a specified reservoir level and the gate opening.

Design head

Specify the design head of the gates (in m) for the tainter type gates.

Crest elevation

Specify the elevation of the crest (in m) on which the gate rests for the tainter type gates.

Maximum reservoir level

Specify the maximum reservoir level (in m) for which the gate has been designed for the tainter type gates.

Number of gates

Specify the number of gates in the spillway for the tainter type gates.

Width of gates

Specify the width of gates (in m) for the tainter type gates.

Height of gates

Specify the height of gates (in m) for the tainter type gates.

Radius of gates

Specify the radius of gates (in m) in case of tainter gates for the tainter type gates.

X-coordinate of trunnion

Specify the x-coordinate of the trunnion (the hinge or the center) of which the tainter gate is an arc with respect to the gate seat.

Y-coordinate of trunnion

Specify the y-coordinate of the trunnion (the hinge or the center) of which the tainter gate is an arc with respect to the gate seat.

Value of K of Ogee eqn. ($y = K \cdot x^P$)

Specify the value of 'K' of the ogee equation which is used to define the shape of the spillway from its crest.

Value of P of Ogee eqn. ($y = K \cdot x^P$)

Specify the value of 'P' of the ogee equation which is used to define the shape of the spillway from its crest.

Initial reservoir level (m)

Specify the lowest starting reservoir elevation (m) corresponding to which the release rates are computed corresponding to different gate openings. This is the starting reservoir elevation in the output table.

Incremental level (m)

Specify the difference between successive reservoir elevations (in m, say 0.5 m) at which release rates are to be computed for different gate openings.

Initial gate opening (m)

Specify the lowest initial gate opening (in m, say, 0.5 m) corresponding to which release rates are to be computed at different reservoir levels. Gate opening

represents the straight line distance (cord length) from the gate seat to the downstream side of the gate lip.

Incremental gate opening (m)

Specify the difference between successive gate openings (in m, say 0.1 m) for which release rates are to be computed at different reservoir levels.

All the values mentioned above are specified in the general data section for the tainter gates. For "Sluice" type gates, following information need to be specified:

Initial water head

Specify the initial water head above the crest level of the sluice gate (in m).

Initial gate opening (m)

Specify the lowest initial gate opening (in m, say, 0.1 m) corresponding to which release rates are to be computed at different water heads above sluice crest.

Tail water depth

Specify the depth of the tail water (in m) at the sluice gate.

Sluice length

Specify the length of sluice gates (in m).

Incremental gate opening (m)

Specify the difference between successive gate openings (in m, say 0.1 m) for which release rates are to be computed at different water heads above the sluice crest.

Incremental water heads (m)

Specify the difference between successive water heads above the sluice crest (in m, say 0.1 m) for which release rates are to be computed at different gate openings.

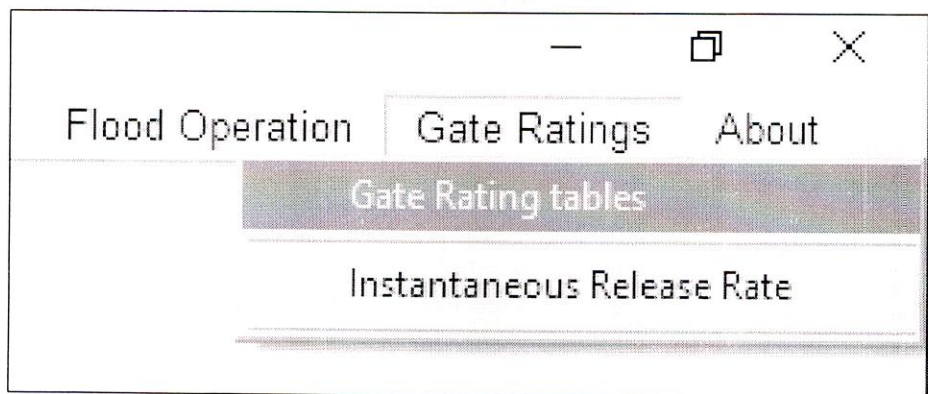
Maximum water head (m)

Specify the maximum water head above the sluice crest (in m) for which release rates are to be computed at different gate openings.

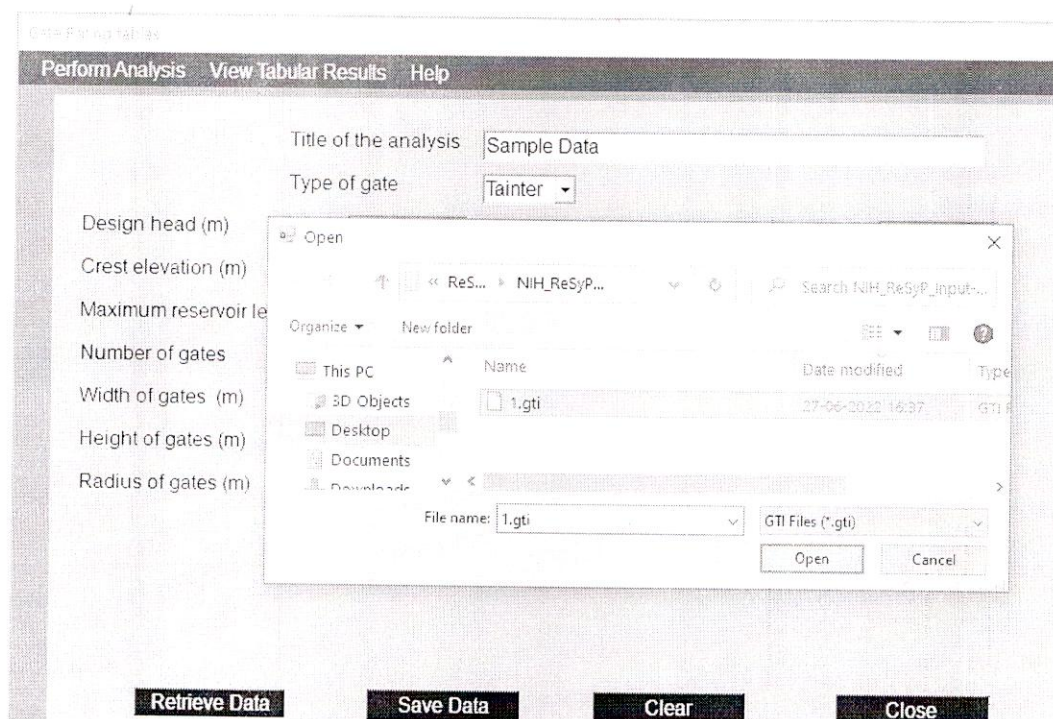
9.1.2. Steps of Analysis

The following are the steps for using the ***Gate Rating Tables*** module:

- a) Go to the ***Gate Rating Tables*** sub-module of the ***Gate Ratings*** module. The data form will be displayed for entry of general details.



- 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 cells in the general data 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 **.gti** file. There is no need to specify the extension in the filename. It will be automatically attached with the filename.
- d) 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.

- e) 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.

Gate Rating tables

Perform Analysis View Tabular Results Help

Title of the analysis DISCHARGE THROUGH ONE GATE OF SPILLWAY OF A

Type of gate Tainter

Design head (m)	10.686	X-coordinate of trunnion (m)	13.868
Crest elevation (m)	178.918	Y-coordinate of trunnion (m)	3.444
Maximum reservoir level (m)	193.8	Value of K of Ogee eqn ($y = Kx^P$)	0.0304
Number of			1.85
Width of gate			185
Height of gate			1.5
Radius of gate			0.5
			0.5

Input File Name (*.gti) C:\Users\HP\Desktop\Desktop

Output File Name (*.gto) C:\Users\HP\Desktop\Desktop

Buttons: Browse, Run, Close

Successful Analysis completed OK

Buttons: Retrieve Data, Save Data, Clear, Close

- f) The program runs in a window which closes automatically after the program execution is complete and the result is written in the specified output file.
- 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 **.gti** or **.gto** will be displayed. Select the desired filename and click on the **Open** button. The file will be displayed in the **Notepad**.

Gate Rating Tables

Perform Analysis View Tabular Results Help

Tabular Data

File Edit

DISCHARGE THROUGH ONE GATE OF SPILLWAY OF A RESERVOIR

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

Type of gate (1-Tainter/2-Sluice) = 1
 Design head = 10.686 m
 Crest elevation = 178.918 m
 Maximum reservoir level = 193.800 m
 Number of gates = 12
 Width of gates = 14.935 m
 Height of gates = 10.668 m
 Radius of gates = 12.192 m
 X-coordinate of trunnion = 13.868 m
 Y-coordinate of trunnion = 3.444 m
 Value of K of Ogee eqn. ($y=K \cdot x^{1/P}$) = .030
 Value of P of Ogee eqn. ($y=K \cdot x^{1/P}$) = 1.850
 Initial reservoir level = 185.000 m
 Incremental reservoir level = .500 m
 Initial gate opening = 1.500 m
 Incremental gate opening = .500 m

***** Results *****

Spillway Discharge (cumec) from One Gate for Different Gate Opening (m)

Elev. (m)	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
185.00	137.80	182.92	227.19	270.25	311.84	351.53	389.30	424.7
185.50	143.76	191.22	238.01	283.80	328.32	371.19	412.41	451.5

h) Close the **Gate Rating Tables** sub-module of the **Gate Ratings** module by clicking on the **Close** button.

9.2. Instantaneous Release Rate

The release rate (in cumec) from a tainter spillway gate or a sluice gate depends on the flow and dimensional characteristics of the gate, the water head above the gate crest and the gate opening. A module has been developed in the software to develop a rating tables for estimation of release rates from a gate with different reservoir levels for various gate openings. The program developed and presented in the HEC manual "Spillway Rating - Partial tainter gate opening" (HEC, 1966) has been used in the present module with suitable modifications. The details of the methodology, one can refer to NIH status report (SR-43) entitled "Spillway Gate Regulation".

The basic purpose of this module is to compute the instantaneous release rate from a tainter/sluice gate corresponding to the current reservoir level and for the specified gate opening. The flow and dimensional characteristics of the gate need to be specified in the data file while the reservoir level and gate opening are specified on the screen. The corresponding release rates are also displayed on the screen.

9.2.1. Input Data Description

The form for input in general data section is shown in Figure – 1. The file extensions for the input and output files are **.gii** and **.gio** 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).

Type of gate (1-Tainter/2-Sluice)

Specify the number (1 or 2) to represent the type of gate through which the discharge is to be computed corresponding to a specified reservoir level and the gate opening.

Design head

Specify the design head of the gates (in m) for the tainter type gates.

Crest elevation

Specify the elevation of the crest (in m) on which the gate rests for the tainter type gates.

Maximum reservoir level

Specify the maximum reservoir level (in m) for which the gate has been designed for the tainter type gates.

Number of gates

Specify the number of gates in the spillway for the tainter type gates.

Width of gates

Specify the width of gates (in m) for the tainter type gates.

Height of gates

Specify the height of gates (in m) for the tainter type gates.

Radius of gates

Specify the radius of gates (in m) in case of tainter gates for the tainter type gates.

X-coordinate of trunnion

Specify the x-coordinate of the trunnion (the hinge or the center) of which the tainter gate is an arc with respect to the gate seat.

Y-coordinate of trunnion

Specify the y-coordinate of the trunnion (the hinge or the center) of which the tainter gate is an arc with respect to the gate seat.

Value of K of Ogee eqn. ($y = K \cdot x^P$)

Specify the value of 'K' of the ogee equation which is used to define the shape of the spillway from its crest.

Value of P of Ogee eqn. ($y = K \cdot x^P$)

Specify the value of 'P' of the ogee equation which is used to define the shape of the spillway from its crest.

All the values mentioned above are specified in the general data section for the tainter gates. For "Sluice" type gates, following information need to be specified.

Tail water depth

Specify the depth of the tail water (in m) at the sluice gate.

Sluice length

Specify the length of sluice gates (in m).

After entry of these above mentioned data in general data section, following two details are entered on the screen as per the current situation at the reservoir:

Reservoir elevation

Specify the reservoir level (in m) which is used to find the water head above the gate.

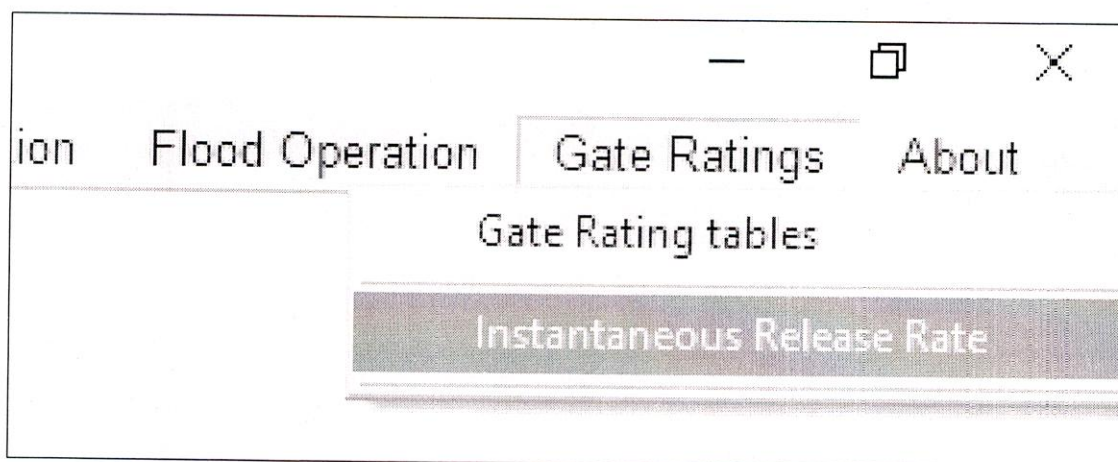
Gate opening

Specify the gate opening (in m) which represents the straight line distance (cord length) from the gate seat to the downstream side of the gate lip.

9.2.3. Steps of Analysis

The following are the steps for using the **Instantaneous Release Rate** module:

- Go to the **Instantaneous Release Rate** sub-module of the **Gate Ratings** module. The data form will be displayed for entry of general details.



- 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 cells in the general data 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 **.gii** file. There is no need to specify the extension in the filename. It will be automatically attached with the filename.
- d) 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.

Next, enter the empty cells corresponding to reservoir elevation (m) and the gate opening (m).

Perform Analysis View Tabular Results Help

Title of the analysis DISCHARGE THROUGH ONE TAITER SPILLWAY GATE

Type of gate Tainter

Design head (m) 10.686

Crest elevation (m) 178.918

Maximum reservoir level (m) 193.8

Number of gates 12

Width of gates (m) 14.935

Height of gates (m) 10.668

Analyze

Input File Name (*.gii) C:\Users\HP DESKTOP\Desktop

Output File Name (*.gio) Browse

C:\Users\HP DESKTOP\Desktop

Reservoir Elevation (m) 10.35

Gate Opening (m) 1.97

Run

Close

Retrieve Data Save Data Clear Close

- e) After specifying the input and output filenames along with their location and after filling the current details of reservoir elevation and gate opening in empty cells, the **Run** button gets activated. Click on the **Run** button to execute the related program with the specified input and output filenames.
- f) The program runs in a window which closes automatically after the program execution is complete and the instantaneous value of release rate (cumec) is displayed on the screen.
- 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 **.gii** or **.gio** will be displayed. Select the desired filename and click on the **Open** button. The file will be displayed in the **Notepad**.

Perform Analysis View Tabular Results Help	
Tabular Data	
File Edit	
DISCHARGE THROUGH ONE TAINTER SPILLWAY GATE OF A RESERVOIR	
Type of gate (1-Tainter/2-Sluice)	= 1
Design head	= 10.686 m
Crest elevation	= 178.918 m
Maximum reservoir level	= 193.800 m
Number of gates	= 12
Width of gates	= 14.935 m
Height of gates	= 10.668 m
Radius of gates	= 12.192 m
X-coordinate of trunnion	= 13.868 m
Y-coordinate of trunnion	= 3.444 m
Value of K of Ogee eqn ($y=Kx^{\Delta P}$)	= .030
Value of P of Ogee eqn ($y=Kx^{\Delta P}$)	= 1.850

Reservoir level	= 10.350 m
Gate opening	= 1.970 m

Discharge thru one spillway gate	= .000 Cumec

Thanks for using the module! Have a nice day!!	

- h) Close the **Instantaneous Partial Gate Discharge Estimation** module by clicking on the **Close** button.
