

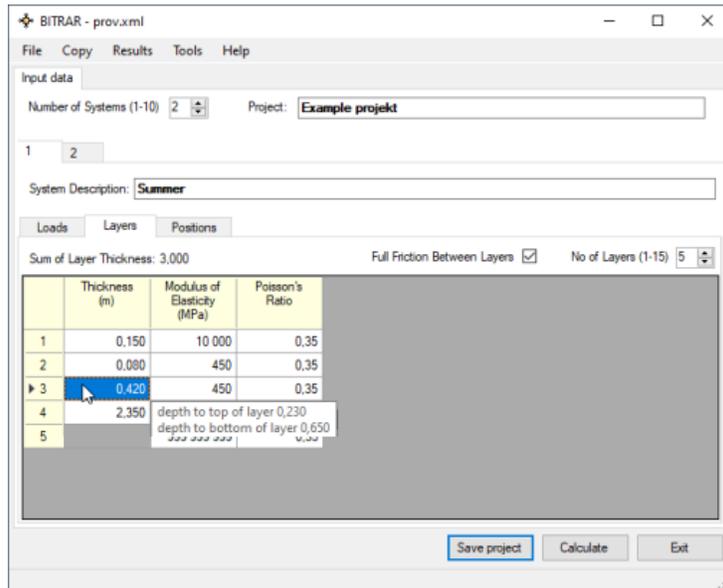
Printed Documentation

Table of Contents

General	4#
About Bitrar (BITumen Response Analyses for Roads)	4#
User Interface Description	6#
Main Form	6#
Operating	7#
Block Report	7#
Calculating	9#
Layers	10#
Loads	11#
Menus	12#
Positions.....	14#
Save and Retrieve Data.....	14#
Saving Project Files	16#
Settings	16#

General

About Bitrar (BITumen Response Analyses for Roads)



With the BITRAR program, stresses, strains, and displacements can be calculated in an elastic multi-layer system which is defined by the following configuration and material behaviour:

1. The system consists of horizontal layers of uniform thickness resting on a semi-infinite base or half space.
2. The layers extend infinitely in horizontal directions.
3. The material of each layer is homogeneous and isotropic.
4. The materials are elastic and have a linear stress-strain relationship.

The system is loaded on top of the structure by one or more circular loads, with a uniform stress distribution over the loaded area. The program offers the possibility to calculate the effect of vertical and horizontal stresses at the surface. Calculations assumes full friction between all the layers.

BITRAR calculations require the following input:

- the number of layers
- the Young's moduli of the layers
- the Poisson's ratios of the layers
- the thickness of the layers (except for the semi-infinite base layer)
- the number of loads
- the coordinates of the position of the centre of the loads
- one of the following combinations to indicate the vertical normal component of the load
 - stress and load
 - load and radius
 - stress and radius
- the coordinates of the positions for which output is required.

The centre of the loads and the positions at which stresses, strains and displacements have to be calculated are given as coordinates in a fixed Cartesian coordinate system. The actual calculations to determine the response of a particular load in terms of stresses, strains and displacements are,

however, carried out within a local cylindrical coordinate system having the centre of the load as origin. The effect of the simultaneous action of various loads is the sum of the effects due to the action of each separate load. This summation is carried out after transformation of the results with respect to the underlying Cartesian coordinate system.

The output comprises the following information for each selected position in the structure under consideration:

- for the combined action of all loads (all expressed in terms of the fixed Cartesian coordinate system:
- the components of the stress tensor
- the components of the strain tensor
- the components of the displacement vector

The stresses and strain are positive when in compression and negative in tension.

For calculations BITRAR use LEAF, a layered elastic analysis computer program developed for use as a component in Federal Aviation Administration (FAA) airport pavement design and analysis application computer programs.

Comparisons with output from Shell's BISAR seem to give same results.

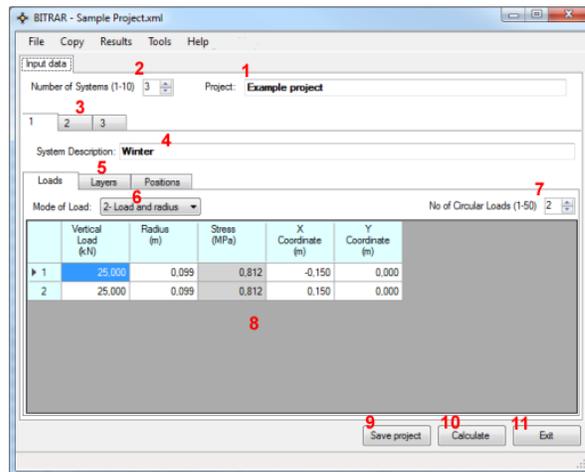
User Interface Description

Main Form

A new project is untitled as default, remember to save your project file now and then as you add data. The software does not check if you have unsaved data when closing. The default number of Systems (maximum 10) is set at 1. The number of systems in the project can be increased or decreased by pressing the up or down arrow next to the label showing the current number of systems. To select a different system for editing in a multi-system project, click on the tab of the desired system. In a multi-system project, the Copy From menu option allows data from any system in the current project to be copied into the current system.

The System Description box allows the user to enter a descriptive title for each system. Data in a system consists of details about loads; layers; and positions. Initially, a system is displayed showing details about loads. To display other details, click the corresponding tab below the system description input box.

Image below. Overview of Main form



A brief description of controls numbered in red:

1.	Project name will be printed in the Block Report (Output from calculation).
2.	Number of systems (1 to 10). Changing this will add or remove systems simultaneously. If you have added values in a system and decrease the number of system values will be lost.
3.	Tabs that give you access to all systems.
4.	System description will be printed in the Block Report (Output from calculation).
5.	Tabs that give you access to system components.
6.	Load characteristics can be given in three modes: <ul style="list-style-type: none">• Stress and Load• Load and Radius (Default)• Stress and Radius
7.	Number of Loads (Layers, Positions in other component tabs). You may enter 1 to 10. Changing this will add or remove components simultaneously. If you have added values in a component and decrease the number of components values will be lost.

8. Input grid for component values. By right clicking the mouse you get access to a function for saving or retrieving component data. These data are stored in the program folder and can be used in any project file.
9. Saves the project to a file (XML-file)
10. Calculates the project and displays the Block Report. You can also use the F5 key to calculate.
11. Closes the software (without saving. However, if not saved user will be asked)

Operating

Block Report

After calculation the report window will show in a separate window. There is no need closing this window between calculations, the software updates the report simultaneously and tries to keep current page in focus.

As an option you can set decimal or scientific type of response values in the report, this option is in the [Settings](#). You may also insert a path for a image that will be inserted in the page header of the report.

Image below. Result menu.

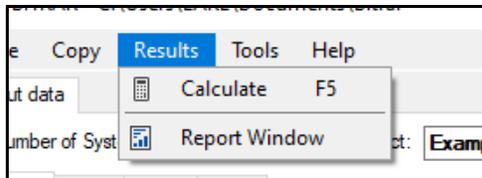


Image below. Block Report Decimal type (Default)

Result Report - Last Calculated

File Help

1 of 6

Whole Page Find Next



Block Report

Project: Example projekt

System 1: Summer

Structure (Full Friction Between Layers)				Loads					
Layer Number	Thickness (m)	Modulus of Elasticity (MPa)	Poisson's Ratio	Load Number	Vertical Load (kN)	Vertical Stress (MPa)	Radius (m)	X (m)	Y (m)
1	0.15	10000	0.35	1	500	0.071	1.5	0	-1.5
2	0.08	400	0.35	2	500	0.071	1.5	-3	-1.5
3	0.42	400	0.35	3	500	0.071	1.5	3	-1.5
4	2.35	35	0.35	4	500	0.071	1.5	0	1.5
5		99999999	0.35	5	500	0.071	1.5	-3	1.5
				6	500	0.071	1.5	3	1.5
				7	500	0.071	1.5	0	6.9
				8	500	0.071	1.5	-3	6.9
				9	500	0.071	1.5	3	6.9
				10	500	0.071	1.5	0	9.9
				11	500	0.071	1.5	-3	9.9
				12	500	0.071	1.5	3	9.9

Position Number	Layer Number	Positions			Stresses			Strains			Displacements		
		X (m)	Y (m)	Depth (m)	Sx (MPa)	Sy (MPa)	Sz (MPa)	ex (µstrain)	ey (µstrain)	ez (µstrain)	ux (µm)	uy (µm)	uz (µm)
1	4	0	0	0.65	-0.02009	-0.0204	-0.05944	112.9300	100.97584	-1173.41034	0	0.88900	2661.80445
2	4	0	4.2	0.65	-0.01298	-0.02241	-0.01819	35.2312	-328.54115	-105.88898	0	0	850.59219

Printed: 1/10/2021 10:32 AM Project File Path: C:\Users\LAVL\Documents\Bstr\proj\... BIT RAR by @garnon.se

Image below. Block Report scientific type.

Result Report - Last Calculated

File Help

1 of 6 Whole Page Find | Next



Block Report
Project Example projekt
System 1: Summer

Page 1 (8)

Structure (Full Friction Between Layers)

Layer Number	Thickness (m)	Modulus of Elasticity (MPa)	Poisson's Ratio
1	0.15	10000	0.35
2	0.08	450	0.35
3	0.42	450	0.35
4	2.35	35	0.35
5		99999999	0.35

Loads

Load Number	Vertical Load (kN)	Vertical Stress (MPa)	Radius (m)	X (m)	Y (m)
1	500	0.071	1.5	0	-1.5
2	500	0.071	1.5	-3	-1.5
3	500	0.071	1.5	3	-1.5
4	500	0.071	1.5	0	1.5
5	500	0.071	1.5	-3	1.5
6	500	0.071	1.5	3	1.5
7	500	0.071	1.5	0	6.9
8	500	0.071	1.5	-3	6.9
9	500	0.071	1.5	3	6.9
10	500	0.071	1.5	0	9.9
11	500	0.071	1.5	-3	9.9
12	500	0.071	1.5	3	9.9

Position Number	Layer Number	Positions			Stresses			Strains			Displacements		
		X (m)	Y (m)	Depth (m)	Sx (MPa)	Sy (MPa)	Sz (MPa)	ex (µstrain)	ey (µstrain)	ez (µstrain)	ux (µm)	uy (µm)	uz (µm)
1	4	0	0	0.85	-2.809E-02	-2.840E-02	-5.944E-02	1.129E+02	1.010E+02	-1.173E+03	0.000E+00	8.851E-01	2.882E+03
2	4	0	4.2	0.85	-1.298E-02	-2.241E-02	-1.819E-02	3.523E+01	-3.285E+02	-1.659E+02	0.000E+00	0.000E+00	8.506E+02

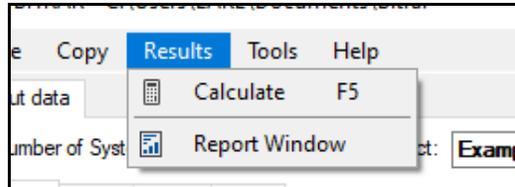
Printed: 1/10/2021 10:30 AM Project File Path: C:\Users\LAJL\Documents\BBlock\proj.xml BTRAR by @glennosae

Calculating

To calculate the project, press the "Calculate" button in the bottom of the form or use the menu "Calculate". You can also press F5 with the main form in focus.

Before calculation, the software examines all cells in all grids for data. If there are something wrong the user will be informed to correct the value. Information about the calculation process is shown in the left bottom part of the form.

Image below. Calculate Menu

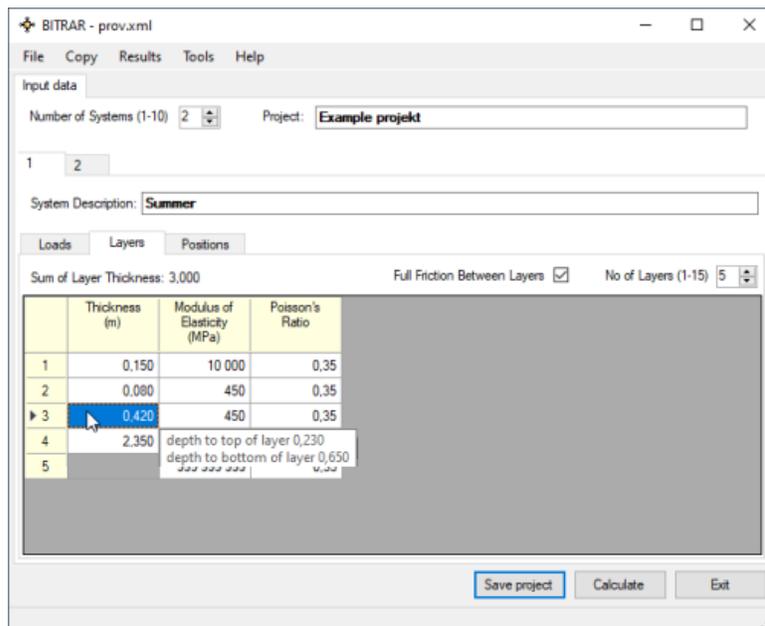


Layers

This tab includes a grid of layers for the structure in current system. You can use up to 10 layers. The last layer is infinite and therefore it has no thickness. Poisson's ratio has a default value of 0,35. Changing number of layers with the up/down control will add or remove layers. If you have entered values for a layer and reduce number of layers values will be deleted.

You can save and retrieves saved data by Right-click the mouse at the grey part of the form. [More information on Saving Data](#)

Image below. Layer input tab.



Loads

This tab includes a grid of loads for current system. You can use up to 10 loads. You can set three types of mode for the loads, only one mode can be used for the whole input grid. You can change default Load Mode in the Settings.

Available modes are:

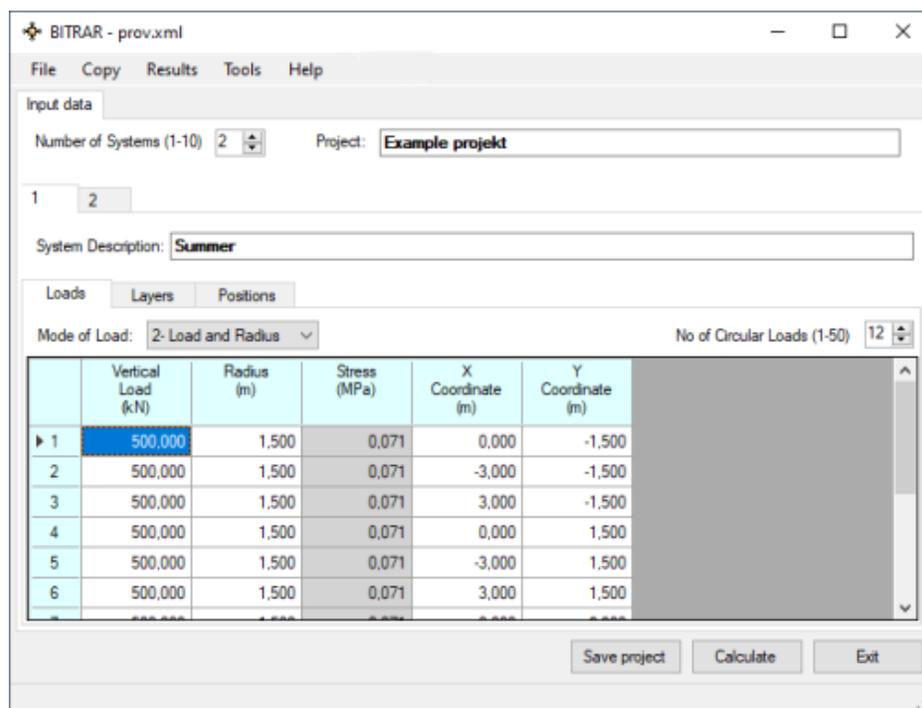
- Stress and Load
- Load and Radius (Default)
- Stress and Radius

If you change Load Mode and have values in the grid the software recalculates all values. There might be some rounding issues on the result though.

Changing number of layers with the up/down control will add or remove layers. If you have entered values for a layer and reduce number of layers values will be deleted.

You can save and retrieves saved data by Right-click the mouse at the grey part of the form. [More information on Saving Data](#)

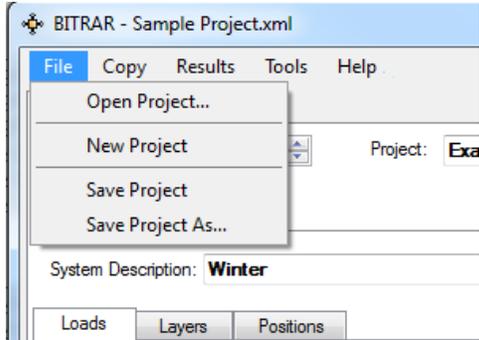
Image below. Loads input tab.



Menus

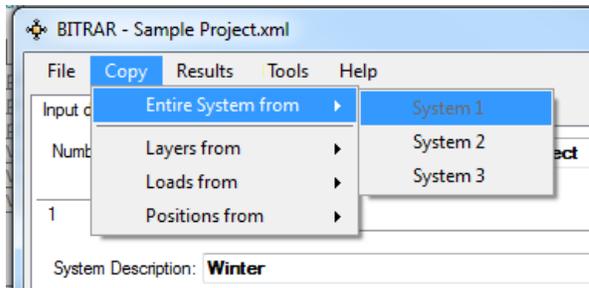
With the file menu you can open existing project files (XML-files). If you click on "New Project" all input fields will be cleared and number of system and layers, loads and positions will all be set to 1. Default Load Mode is governed by a user setting ([Settings](#))
Clicking "Save Project" saves the opened project file. This can also be done by clicking the Save button in the bottom part of the form.

Image below. File Menu



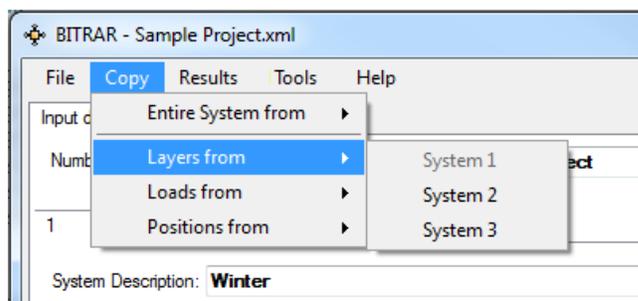
Copy a complete system to another system can be done by using the Copy menu. To copy, go to the system tab where you want to paste the copied system and use the menu Copy, Entire System from. Select the system you want to copy from in the menu. Your current system will be disabled because you cannot copy and paste to same system.

Image below. Copy Entire Systems Menu



You may also copy Layers, Loads and Positions from a system to another by using "Copy Layers from", "Copy Loads from" or "Copy Positions from" in same manner as described earlier.

Image below. Copy Layers, Loads or Positions Menu



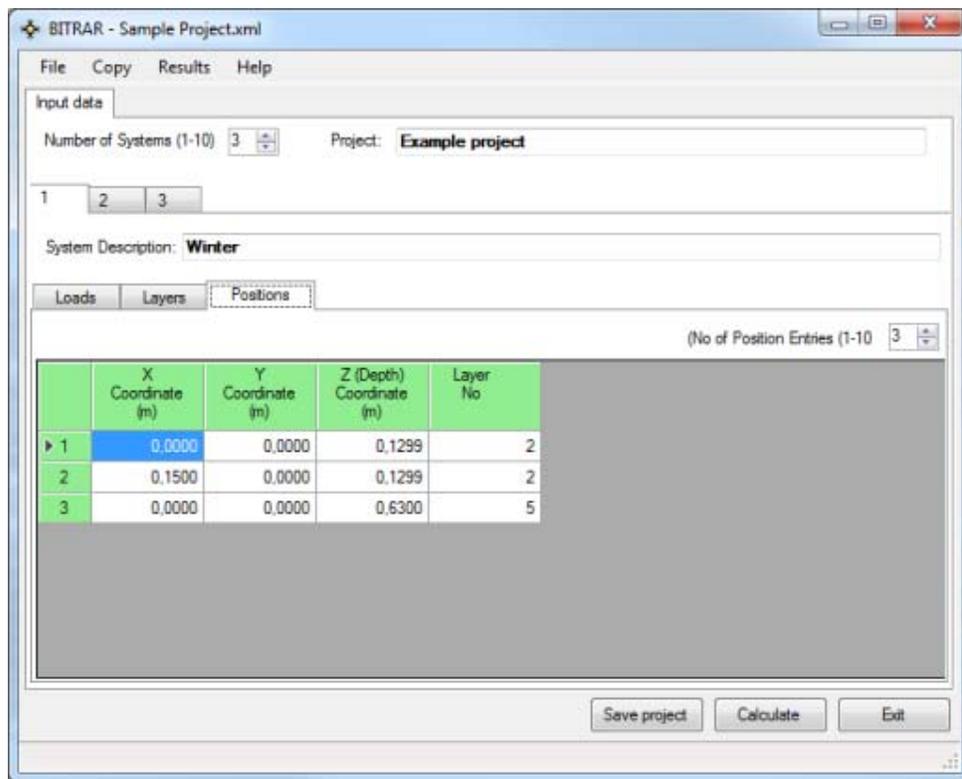
You can also save and retrieve typical loads, layers and positions and use it in any project by using "Saving data". [More information on Saving data](#)

Positions

This tab includes a grid of positions for current system. You can use up to 10 positions. When you input a value for the depth the software calculates what layer that point will be placed in. It is a good idea to input positions last, if no layer is presenting this calculation will not execute.

Changing number of positions with the up/down control will add or remove positions. If you have entered values for a position and reduce number of positions values will be deleted. You can save and retrieves saved data by Right-click the mouse at the grey part of the form. [More information on Saving Data](#)

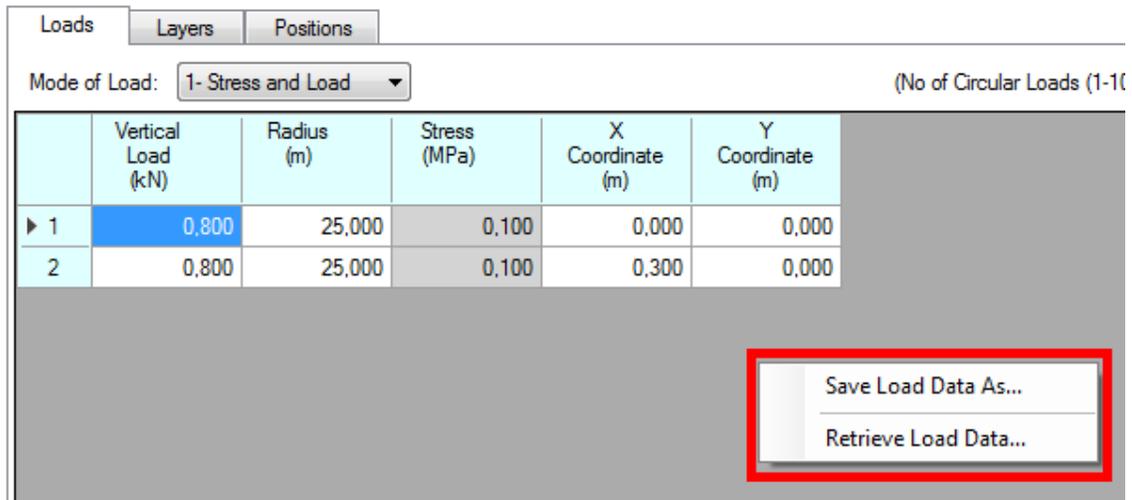
Image below. Position input tab.



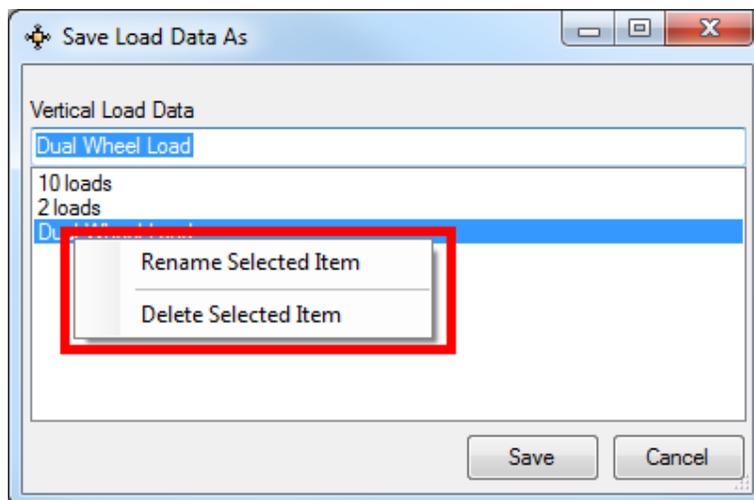
Save and Retrieve Data

This function is a powerful tool to set up a new project in swift way. By opening a previous project and save Loads, Layers or Positions and saving them you can retrieve the data in any project. You can build your own library with e.g., standard loads. The function can be activated in any of the three windows by right clicking the mouse in the grey part in the form. After clicking a new dialog-box will open with a design depending on Save or Retrieve process.

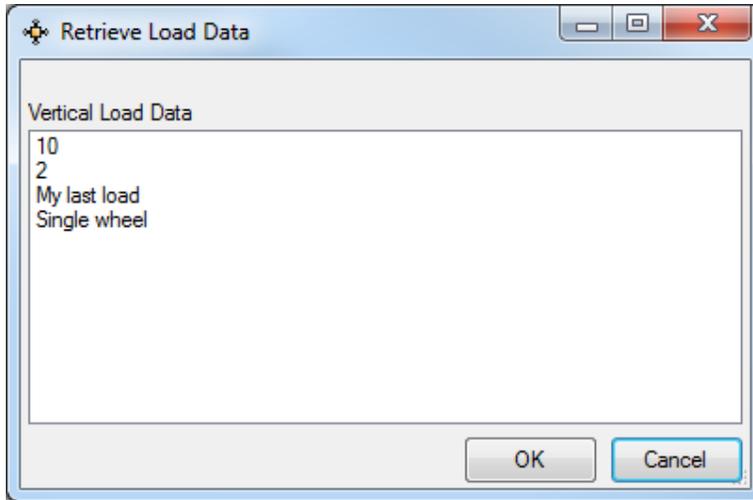
Image below. Right-click menus for save and Retrieve Data



The "Save As" dialog lets you enter a name for the saved data. You may also rename or delete previous saved data by selecting a item and then right-clicking your mouse. Renaming and deleting are followed by a automatic saving.



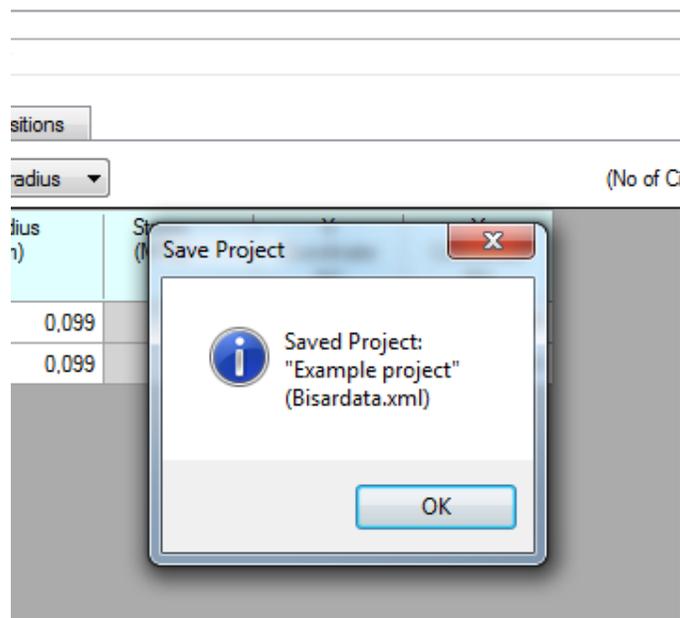
Retrieve data by selecting an item in the list and then press OK. Retrieving data replaces all previous data in your current data grid.



Saving Project Files

If you have opened a project from file or used save project and press the "Save" button you will get a notification of the saving process. Both project name (if any) and file name will be in the dialog box. Using the "Save As" menu will pop up a dialog box where you enter a location and name for the file.

Image below, confirmation of saving project to file



Settings

Default Load Mode is used when you create a new project or add new system to an existing project. This setting is only for your convenience while setting up new projects and systems.

Printed Report can present response values (the lower part of the report) in two manners, Decimal or Scientific. You can also set a path for an image file that will be inserted in the header of the report. To delete the path (exclude image) use your keyboard to delete the path by deleting all letters.

