RAM™ Connection Standalone CONNECT Edition

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Manual

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Introduction

Welcome to RAM Connection Standalone, a flexible and powerful program for analysis and design of steel connection for W, HSS and similar sections.

This software offers the best flexibility for the design of different shear, moment, braces, splices and base plates connection types. It is based on the AISC, ASD and LRFD codes, British Standard, Chinese code, the Eurocode, Indian Standard, Australian Standard, New Zealand Standard and the Canadian Standard. Also the software offers the flexibility to design different tubular connections (HSS truss type) based on the AISC design code.

The standalone version works independently of any other software.

Users can create their own connections and fit them to the requirements of their company.

How to learn RAM Connection Standalone?

This manual presents a brief description of RAM Connection Standalone in order to understand and use the software correctly. The last chapter of this manual includes an illustrative example.

It is recommended to read at least the first two chapters of this manual before using the software.

(LUA) Approach - RAM Connection Standalone and Windows' Least-Privileged User Account

Modern networking technology, such as connectivity to Internet, has increased the risk of been attacked by malicious software and other external intruders. Although old risks are kept under control, new risks are always discovered or even created.

A significant factor that increases the risks from malicious software is the inclination to give users administrative rights in their client computers. When a user or administrator logs on with administrative rights, any programs that they run also have administrative rights. When these programs activate harmful applications, that can be self-installed, they manipulate services such as antivirus programs and even hide from the operating system.

A security strategy to counter these threats is the least-privileged user account (LUA) approach. The LUA approach ensures that users follow the principle of least privilege and always log on with limited user accounts. This strategy offers among other benefits reduced risks from malicious software and accidental or incorrect configuration. [http://technet.microsoft.com/es-es/library/bb456992.aspx]

In previous versions, RAM Connection Standalone was installed providing all privileges to the installation folders in order to achieve compatibility with the recent versions of operating systems.

With the aim to fulfill the requirements of the newest operating systems such as Windows Vista, Windows 7 and Windows 10, RAM Connection Standalone has undergone some changes for this new version, regarding the management of the structure for program folders and user folders, so it behaves properly under the least-privileged user account approach, avoiding errors due to security restrictions and allowing a better organization of the data folders.

User files

Following the LUA described bases, the files that the user may be generate, modify or delete (sections, materials and connections databases, load combinations generators, templates and LEO files, etc.) are stored in the read/write folder “Program Data”.

The read/write folders that will contain user’s modified files are:

Path	Folder
	ComboGenerators
C:\Program Data	ConnectionToolbars
	Database
	Leos
	Templates

Chapter 1: General Overview

The purpose of this chapter is to illustrate the basic commands that are required to use RAM Connection Standalone (RCSA) (which works independently of any software). Many of these commands are applied in the example in the last chapter.

RAM Connection Standalone has adopted a constant philosophy in the way of execute the commands (actions) that are applied to the model members. Specifically, the user has to select the elements needed (i.e. joints, connections) and once selected, apply the command that will affect to the selected elements. This rule of 'Selecting and Applying' is an important feature of the software and works for all provided tools or the generated data together with the dropdown and printing options.

Design in RAM Connection Standalone

The connections can be designed in three different ways in RAM Connection Standalone (RCSA).

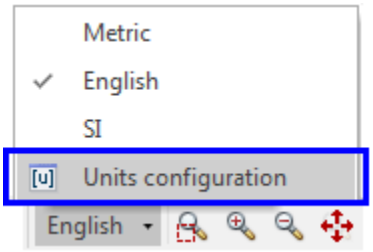
The first method can be called trial and error, in which the user defines a database with all the different connections (notice that several connections are already provided by the software) and assign them, to the joint, one by one. The software will indicate if the connection assigned is adequate or not. If the connection is not adequate, the user can assign manually another connection or adjust the initial one in such a way that fulfills all the requirements.

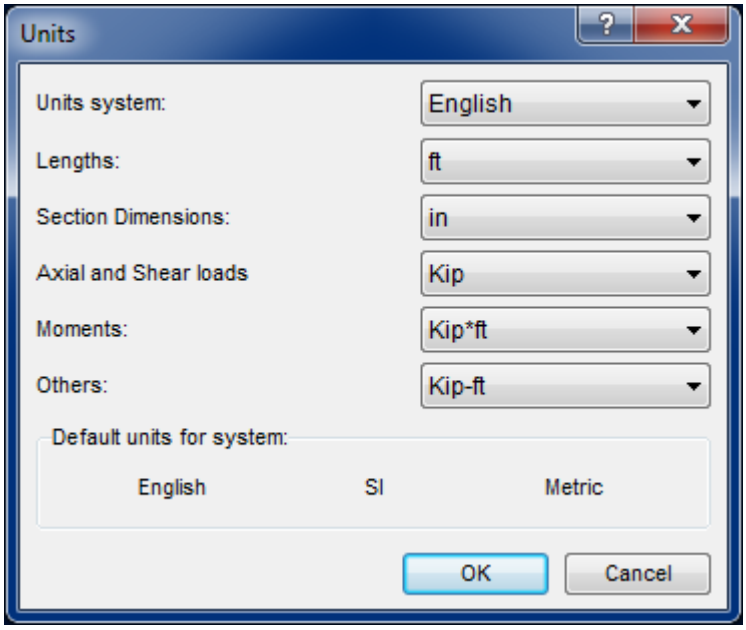
The second method consists in making the program search in a list of the connections database until it founds a connection that works well in the joint (according to geometry and loads).

The third method is similar to the second but instead of searching in a pre-defined list the software assigns a smart connection that adapts to the joint. In these connections, the design is automatically where the parameters of the connections (e.g. bolt number, weld size, plate size, etc.) are adjusted until the connection fulfills the requirements.

Available units in RAM Connection Standalone

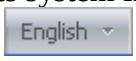
The selection of the unit system used for the graphical representation and for the reports is done normally before entering the data. All the joint loads and the connections are entered in that system. For this, choose the option *Units configuration* in the menu displayed after pressing the button at the status bar.

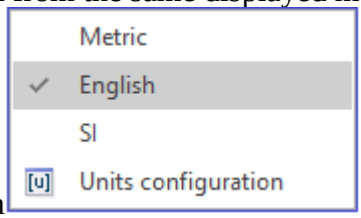




Units system and specific units for group variables configuration window.

In addition to the selection system's main units, the software allows a more detailed configuration in each unit system for the different variable groups like lengths, moments, etc. The lower buttons *English*, *SI* and *Metric* are pre-established configurations that the user may adopt.

Note that it is also possible to change the units system from the *Status* bar, selecting the desired system from the same displayed menu. Press 

and select the required unit system 

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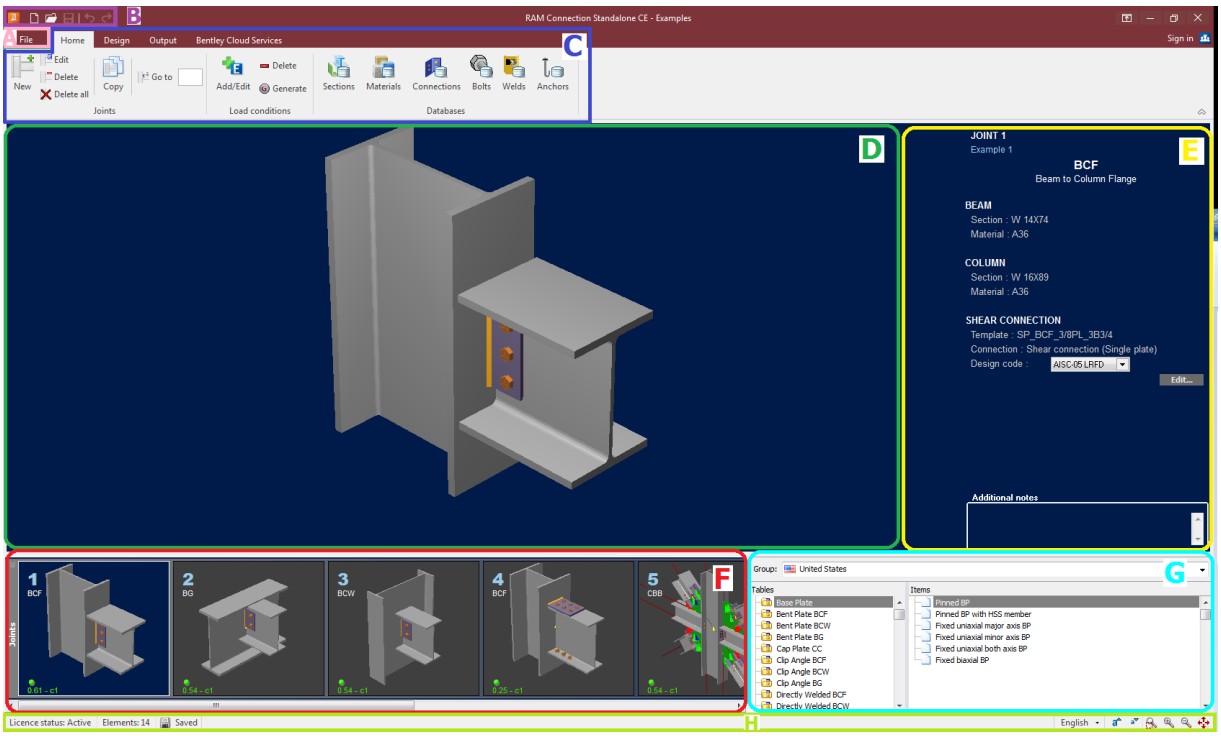
RAM Connection Standalone

Main window

The main window of RAM Connection Standalone is shown below, in the figure are presented in color boxes the different work areas.



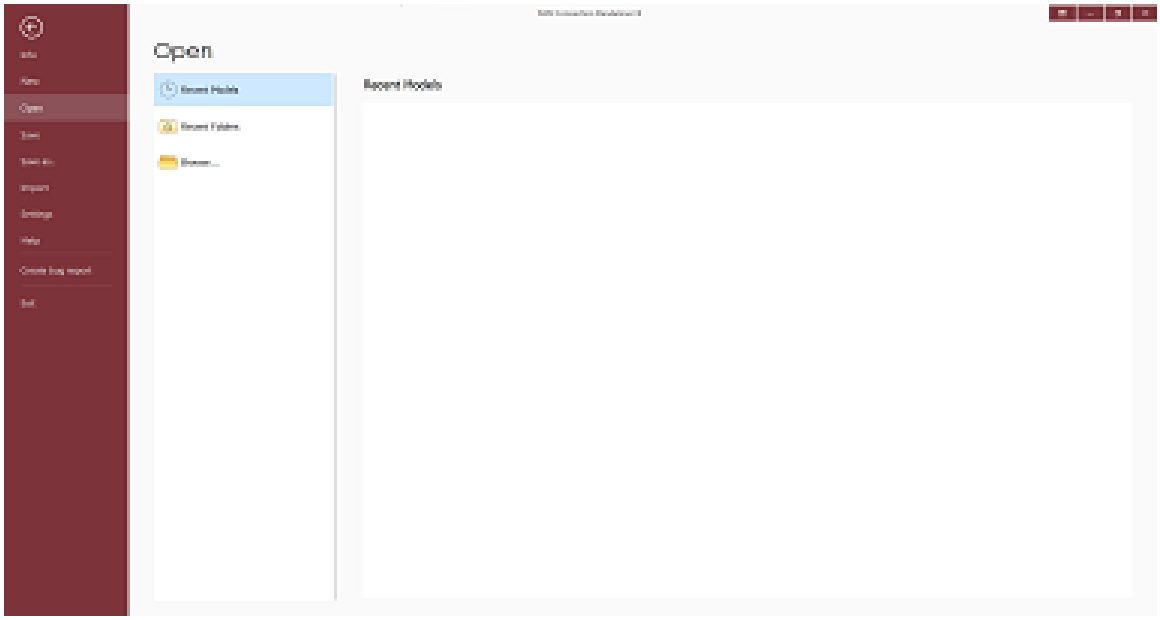
Main window of RAM Connection Standalone.

These areas are:

Work area		Function
ID	**Name**	
A	File button	Displays the backstage menu with basics commands such as Open a model, Save file, etc.
B	Quick access toolbar	Contains some commands required to be used with frequency, such as New, Open a model, Save file, Undo, etc.
C	Ribbon	Gathers all the commands for creating joints, managing load cases and databases, assigning connections, and obtaining all the results for the design of the connections. It contains tabs, groups and command buttons.
D	Graphic area	3D view of the joint, connections and members.
E	Joint data display area	Data of the selected joint (members and connections).
F	Joint selection area	View of the model joints. To select one, only click over its

		image.
G	Available connections	List of available connections to be assigned to the joints.
H	Status bar	It shows useful information about models, such as number of elements (joints and connections), units system, current load case, and some commands for font size and zoom.

File button menu

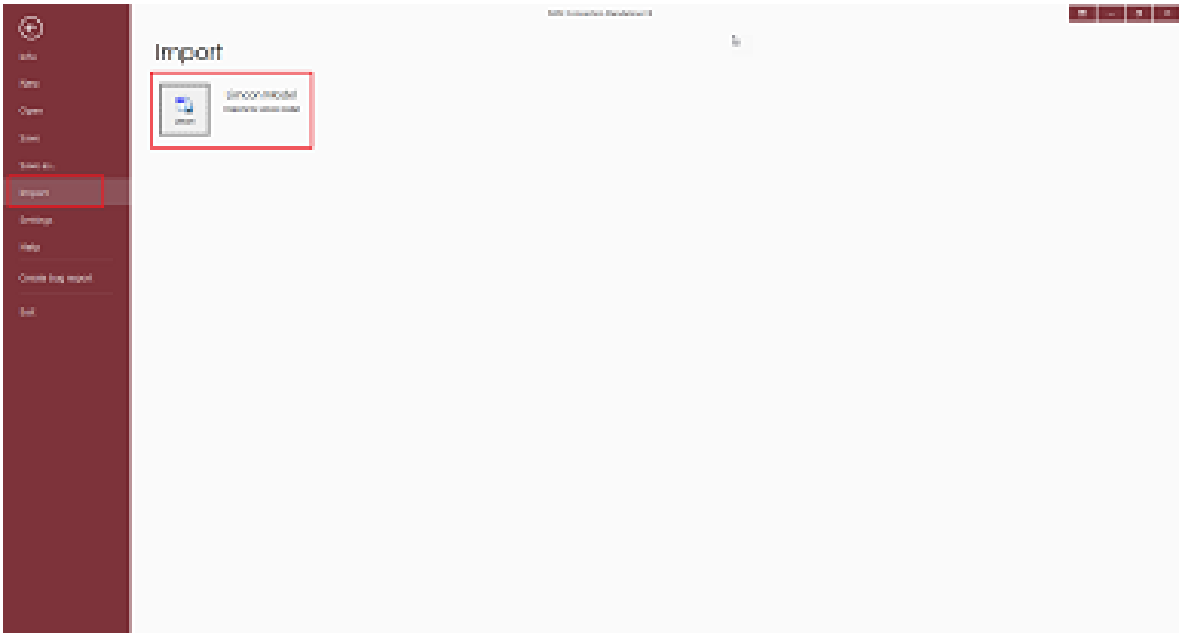


Command	Function
Info	Model file info and recent feeds*
New	Creates a new blank model*
Open	Opens an existing model*
Save	Saves the current model changes in the same model file.*
Save as	Saves the current model changes in another model file.
Import	Displays compatible import file type options
Settings	Displays the program configuration options.
Help	Displays the program help documents files and links.
Create bug report	Display bug report dialog.
Exit	Closes RAM Connection Standalone.

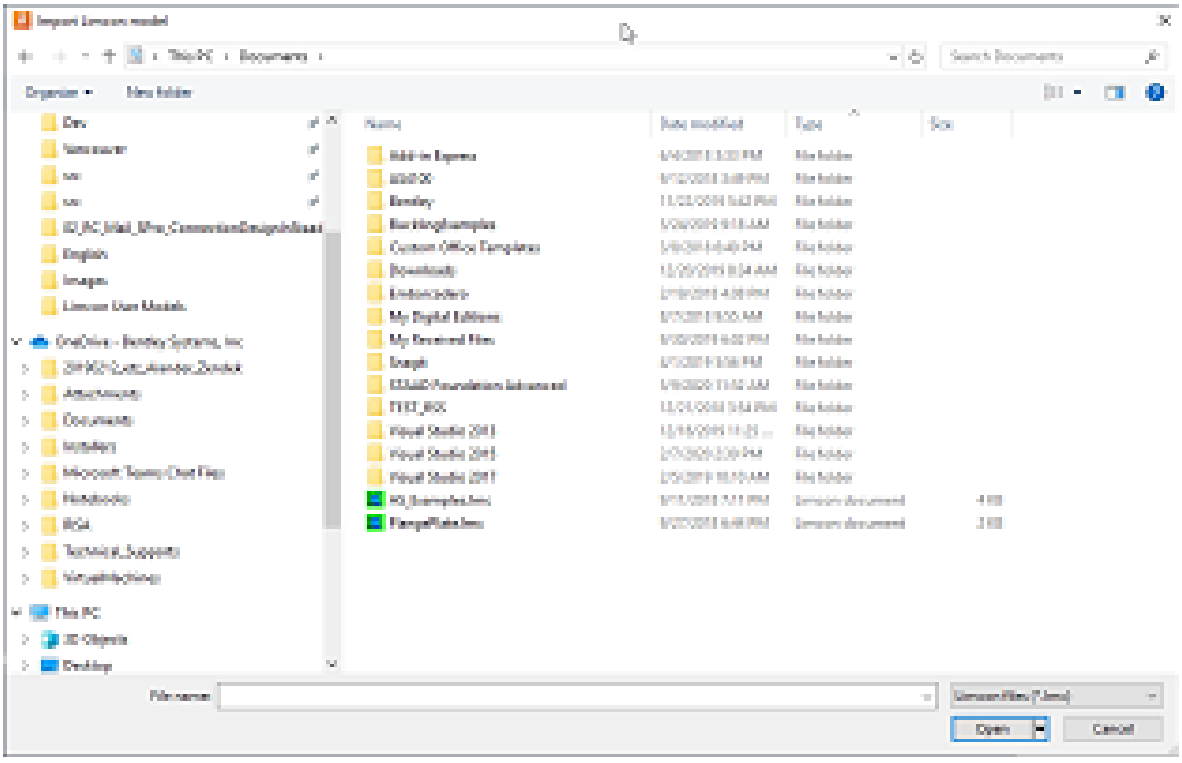
In the right side of the File button backstage menu the user may find a list of the recently opened documents with their correspondent thumbnail.

Import

This backstage option displays the supported file types that RAM Connection can import. Currently the program is only capable to import LIMCON file types.



When users select the highlighted button, the program will open the “Import Limcon model” dialog; filtering automatically all LIMCON files extension (*.lmc) in any path selected.



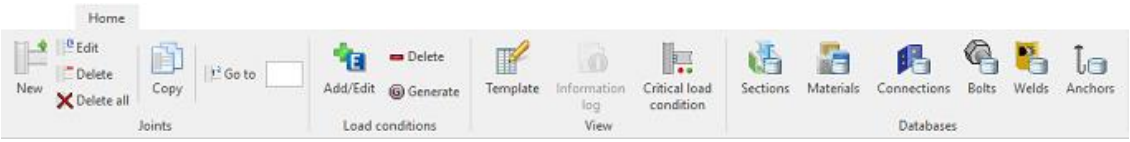
Once the user selects the desire file, the program will read and create all connections defined in the Limcon file that are compatible to the connections currently existing in RAM Connection. At the end of import process a log is displayed with all the connections imported. The log shows all the warnings and errors ocurred during the process and also provides the information of the all different parameters considered or assumed during the import.

Description of the RAM Connection Standalone commands

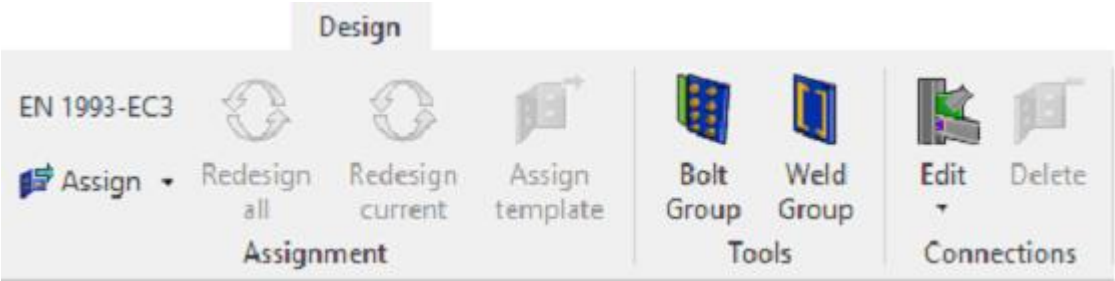
Commands are actions that are executed over the model: the design, the loads, the joints, the connections, the databases, and the graphical presentation of the model. These commands are organized in the ribbon in tabs and groups and each one is represented by a button.

Tabs

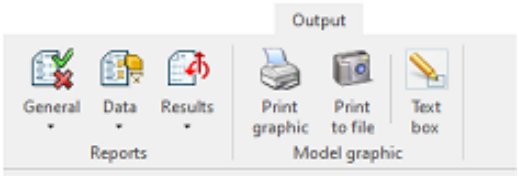
Home. Contains four groups: Joints, Load Conditions, View and Databases.



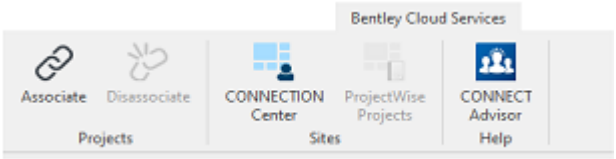
Design. Contains three groups: Assignment, Tools and Connections.



Output. Contains two groups: Reports and Model graphic.



Bentley Cloud Services: Projects, Sites and help

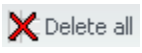


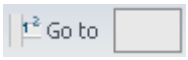
Joints group commands

- When pressing the 

button, the joint creation window will be displayed where you should enter the data of the members of the joint and the loads. See the *"Create joints"* section for more information.
- When pressing the 

button, the joint edition window will be displayed for the selected joint. In this window you could do the changes to the joint members and their loads.
- When pressing the 

button, the selected joint will be deleted.
- When pressing the 

button, all model joints will be deleted.
- With the 

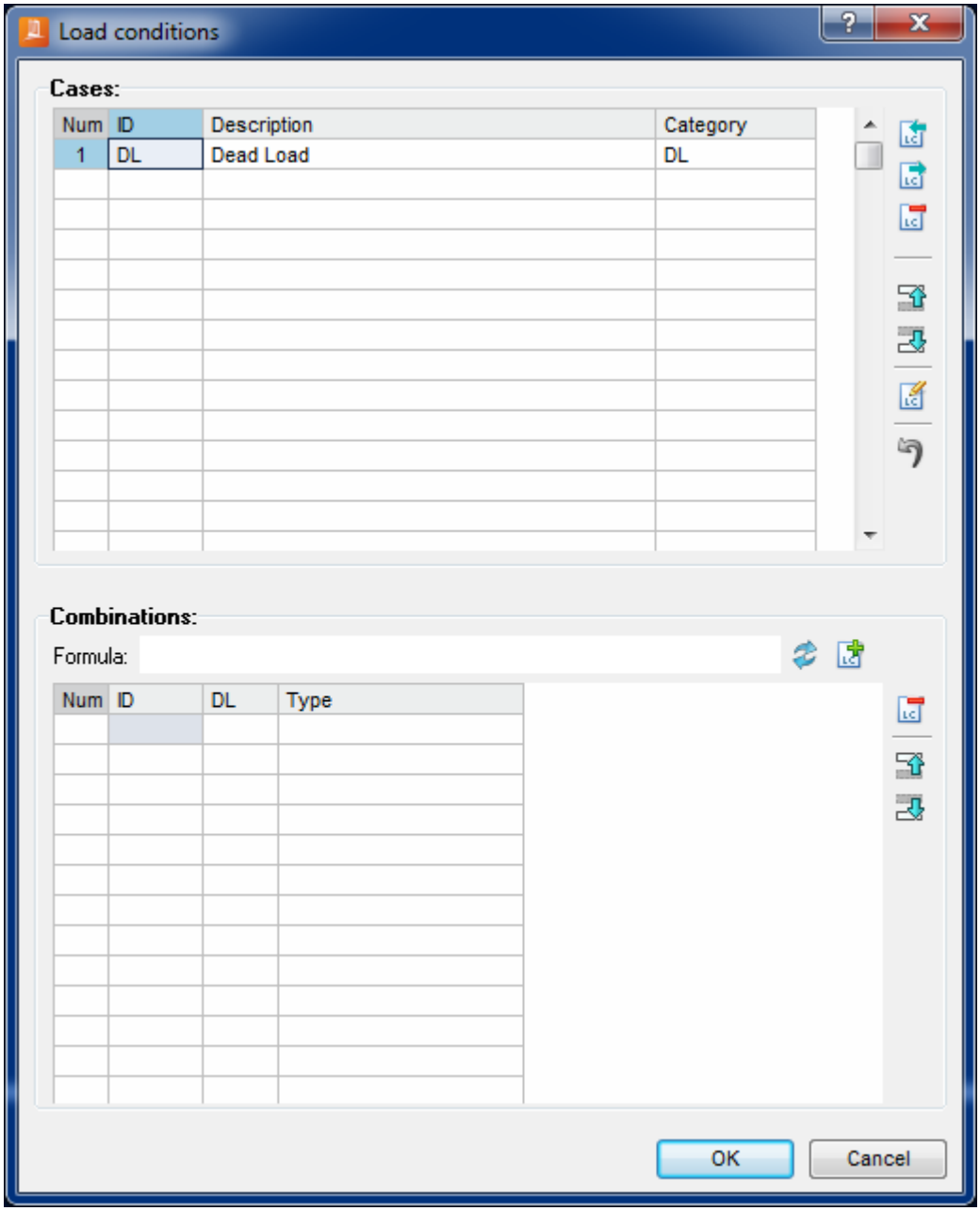
text box, the user can enter the number of the joint to be selected.
- When pressing the 

button, the selected joint will be copied.

Load conditions group commands

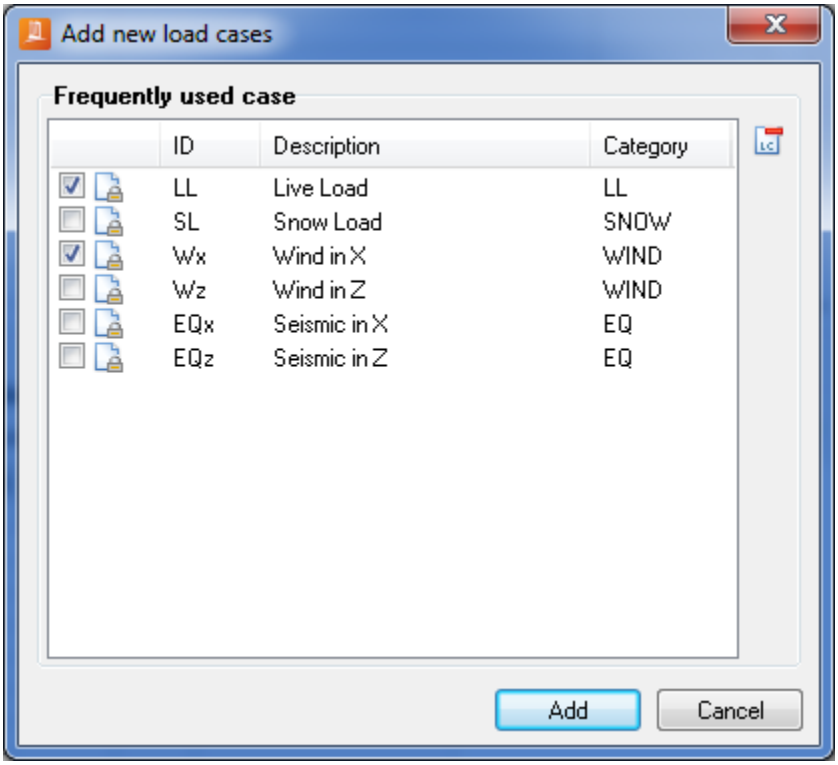
- When pressing the 

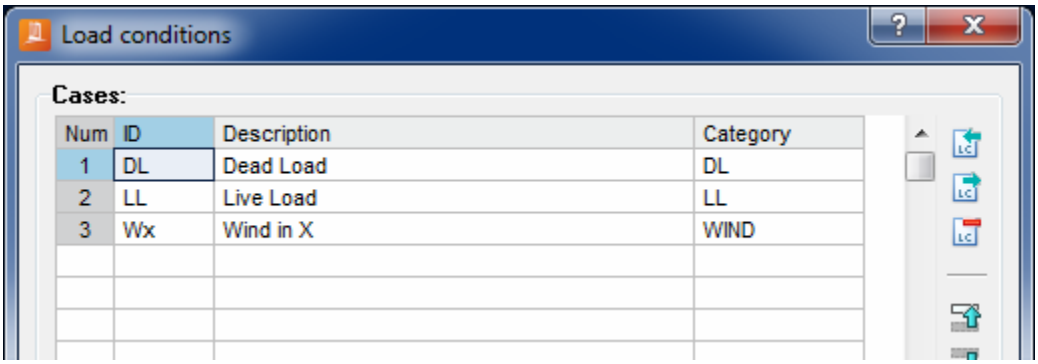
button, the load conditions management window is displayed where it is possible to create and edit load conditions and combinations.



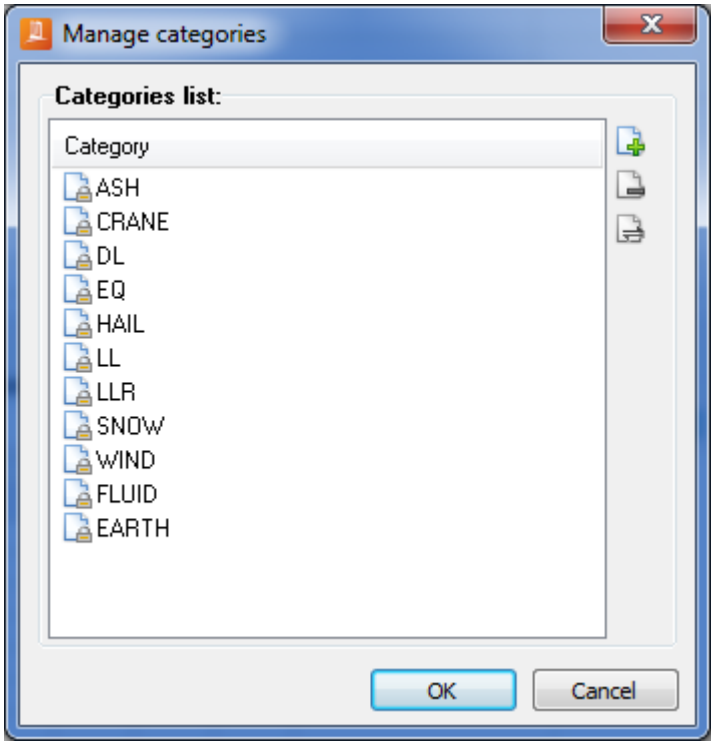
Load conditions manager window

It is possible to add load conditions automatically with the  button. This action displays a new dialog window to choose the load condition:





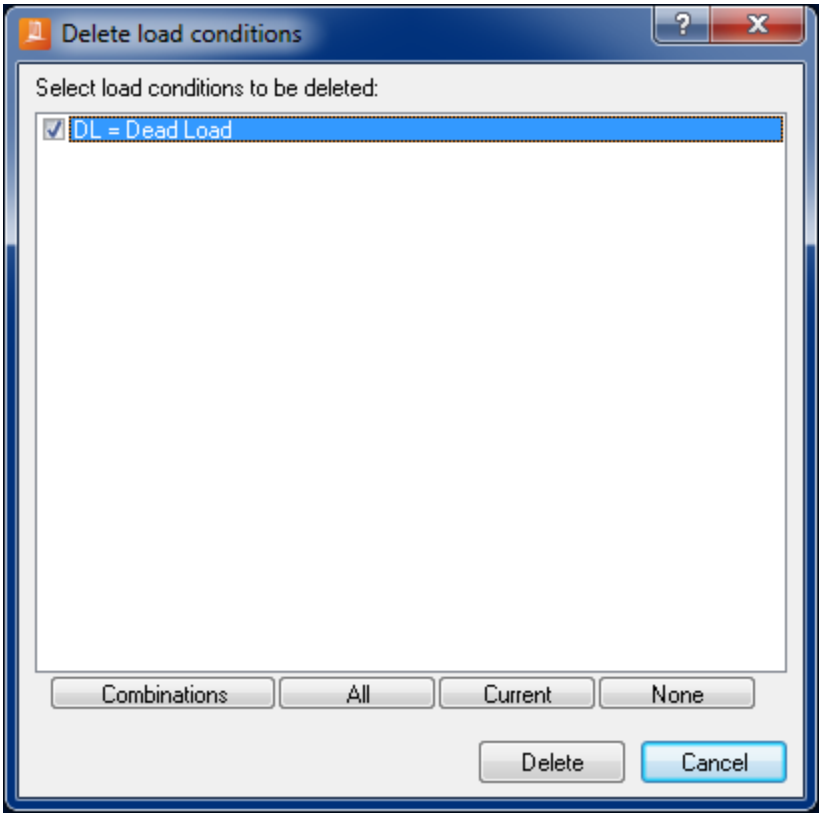
With the  button the user may access to the categories manager:



Note that the categories included in the list are set by default by the program and the user cannot modify them. However, it is possible to create user's own categories with the  button; the user may rename them with the  button or delete them pressing the  button.

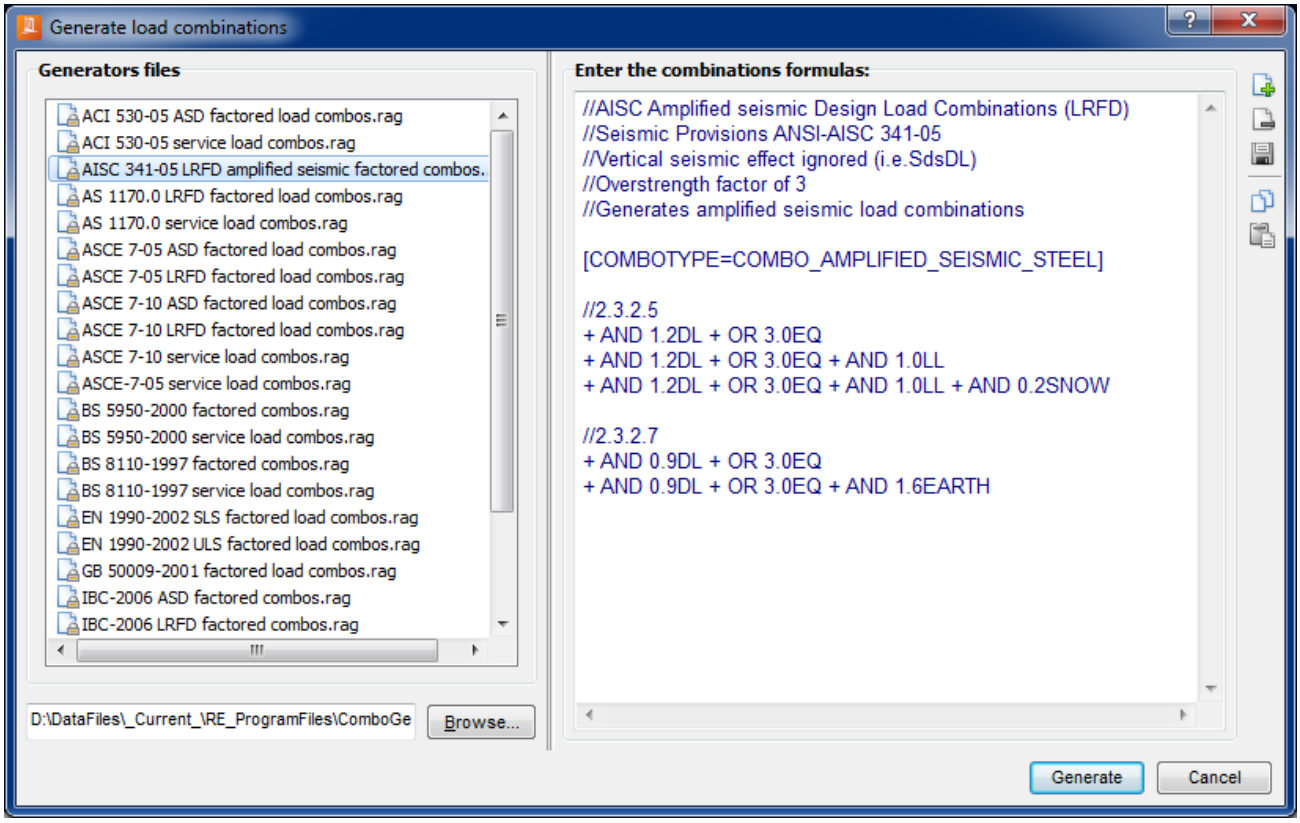
- When pressing the 

button, the delete load condition window is displayed where it is possible to select several load conditions to be deleted.



Delete load conditions window

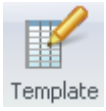
- When pressing the Generate button, the generate loads combination window will be displayed where load combinations can be imported from preexisting files.



Generate load combinations window

The user cannot modify the generator files that are installed by the program, which are identified by the icon , but the user can create generation files from the program files or simply write equations for load combinations in the text editor of the dialog window. For this purpose, use the button that creates or adds a new generation file, after that, press the button to copy the formulae and paste it with the for the new generation file. Pressing the button will save the changes for the new file and using the button, the files created by the user may be deleted.

View group commands

- When pressing the 

button, the list of available connection templates will be displayed in the lower right corner of the main window.
- When pressing the 

button, the information log will be displayed in the main window. All assign, redesign and import data of each joint will be displayed.

- When pressing the 

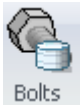
button, the critical load condition for each joint will be shown in each model joint image.

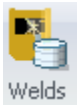
Databases group commands

- When pressing 

button, a window is displayed where the connections database can be updated.
- When pressing 

button, a window is displayed where the sections database can be updated.
- When pressing 

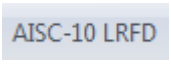
button, a window is displayed where the materials database can be updated.
- When pressing 

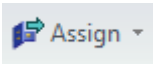
button, a window is displayed where the bolts database can be updated.
- When pressing 

button, a window is displayed where the welds database can be updated.
- When pressing 

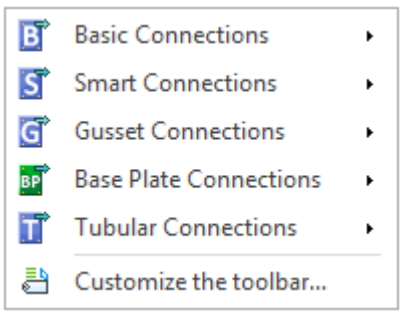
button, a window displayed where the anchors database can be updated

Assignment group commands

- When pressing the 

button, a dialog is displayed showing the “Design configuration” options. Before connections are designed the user should set this.
- When pressing the 

button, a menu is displayed showing the following options for assigning connections



- When pressing the 

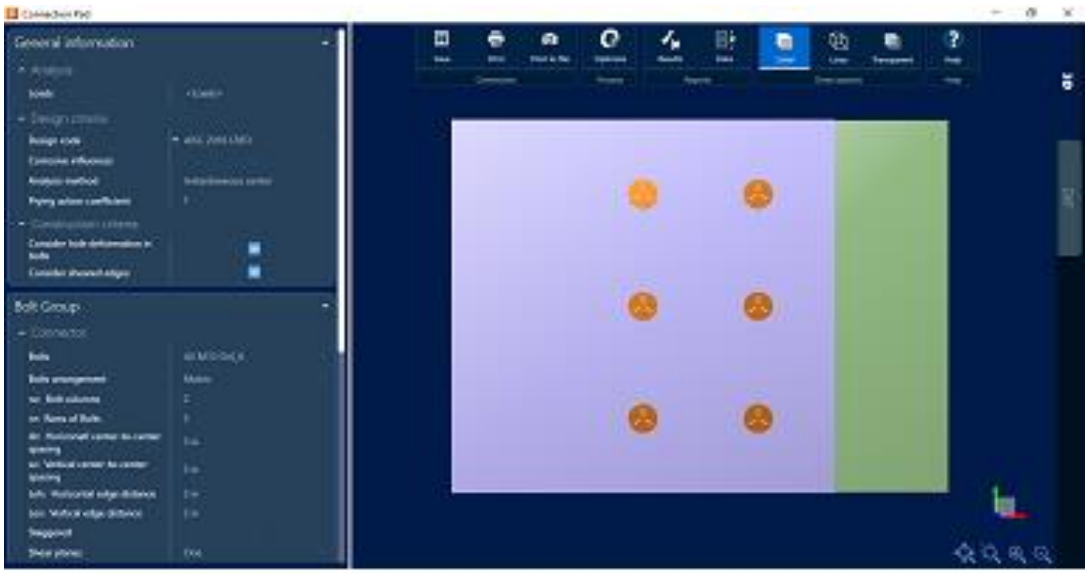
button, all the connections in the model are redesigned.
- When pressing the 

button, the connections assigned to the current joint are redesigned.
- When pressing the 

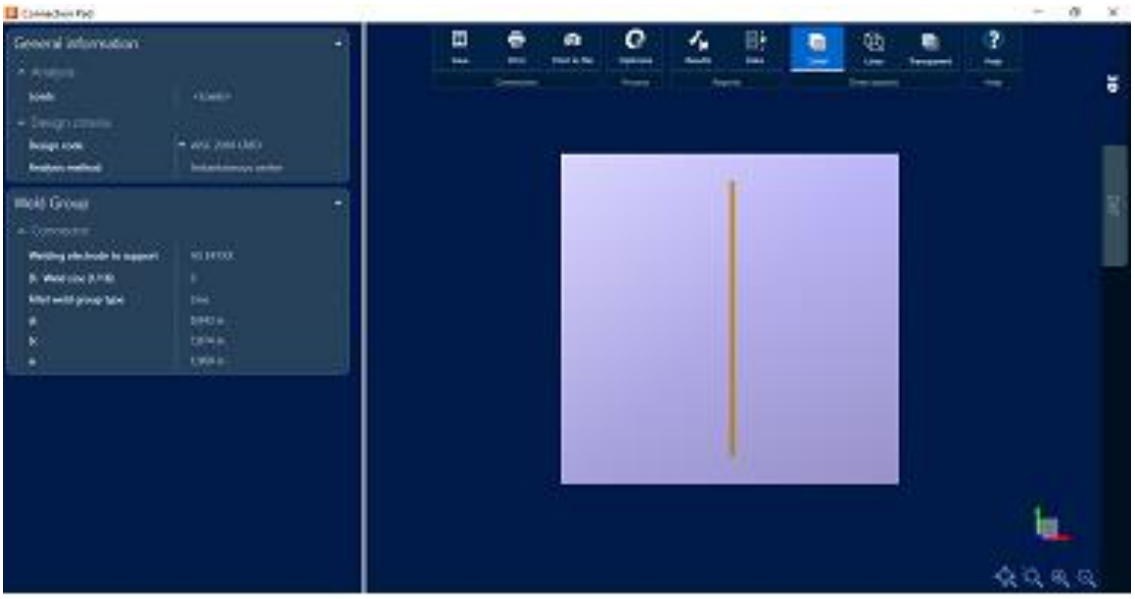
button, the selected connection from the list of available connection templates will be assigned to the current joint. Note that this button is enabled only if the list of templates is displayed.

Tools group commands

- When pressing the  button, the program will lead directly to the connection PAD in order to create and design a cuztomize bolt group without taking in consideration any member involved; no joint data is necessary, it is just the bolt group design analysis. A powerfull tool in order to review or test the design of a customized bolt group.



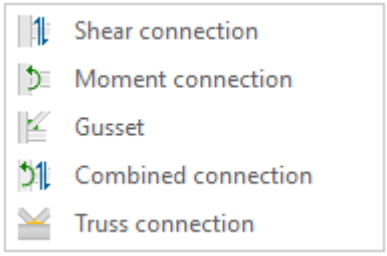
- When pressing the  button, the program will lead directly to the connection PAD in order to create and design a cuztomize weld group without taking in consideration any member involved; no joint data is necessary, it is just the weld group design analysis. A powerfull tool in order to review or test the design of a customized weld group.



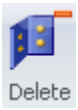
Connections group commands

- When pressing the 

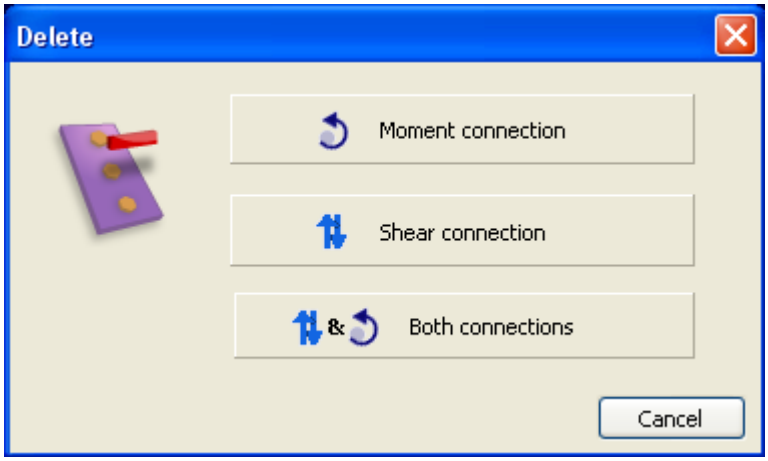
button, a menu is displayed showing four types of connections handled by RAM Connection Standalone: shear, moment, gussets and combined



  In case there is more than one connection for the current joint (e.g. shear and moment) the adequate options will be enabled. Each one of these options will open the connection dialog window, where the connection can be edited.

- When pressing the 

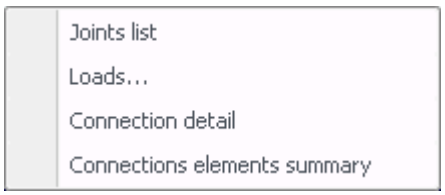
button, the connection assigned to the joint will be deleted, in case there is more than one connection, this command will display a dialog box where the connection to be deleted can be selected.

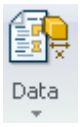


Reports group commands

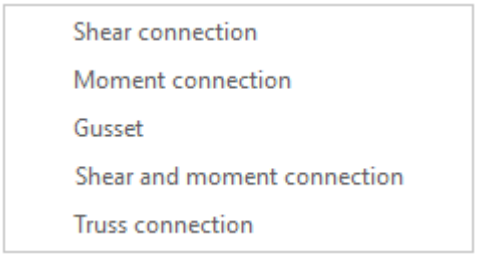
- When pressing the 

button, the list of available general reports will be displayed



- When pressing the 

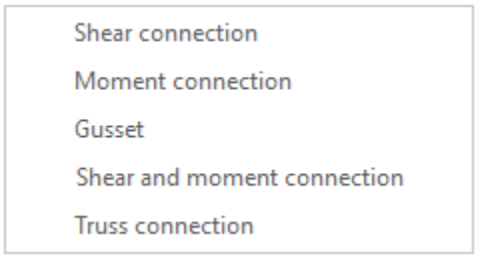
button, the list of available types of connections will be shown to select the desired data report



Only the options that match with the type of connections for the current joint will be enabled in the menu. Choosing any of them, a data report will be displayed.

- When pressing the 

button, the list of available types of connections will be shown.

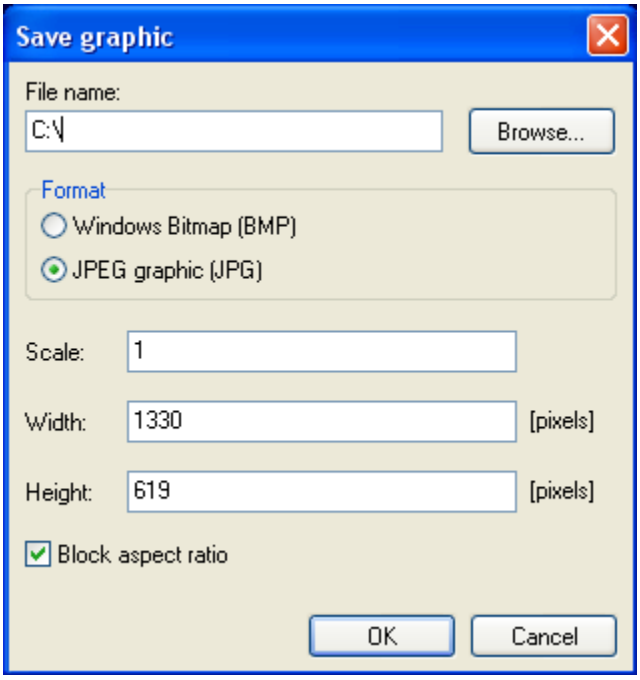


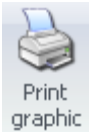
Only the options that match with the type of connections for the current joint will be enabled in the menu. Choosing any of them, a data report will be displayed.

Model graphic group commands

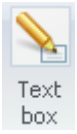
- When pressing the 

button, the dialog to save the current graphic display will be shown



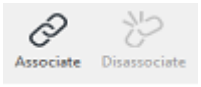
- When pressing the 

button, the dialog to print the current graphic will be displayed.

- When pressing the 

button, a text box will appear in the graphic area where the user may type notes or any desired text.

Projects group commands

- When pressing the 

buttons, the user model can be associated or disassociate with any public project allowing work the same model with other firm colleagues at the same time.

Sites group commands

- When pressing the 

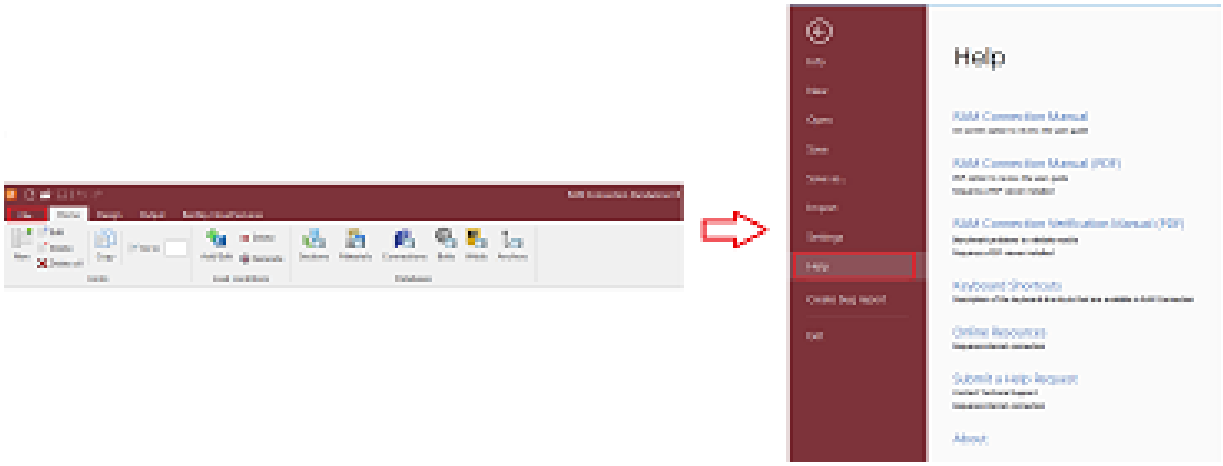
buttons, the user has a direct link access to Connection Center or Project Wise Projects.

Help group commands

- When pressing the 

button, the user has a direct link access to Connect Advisor in order to obtain any required help information.

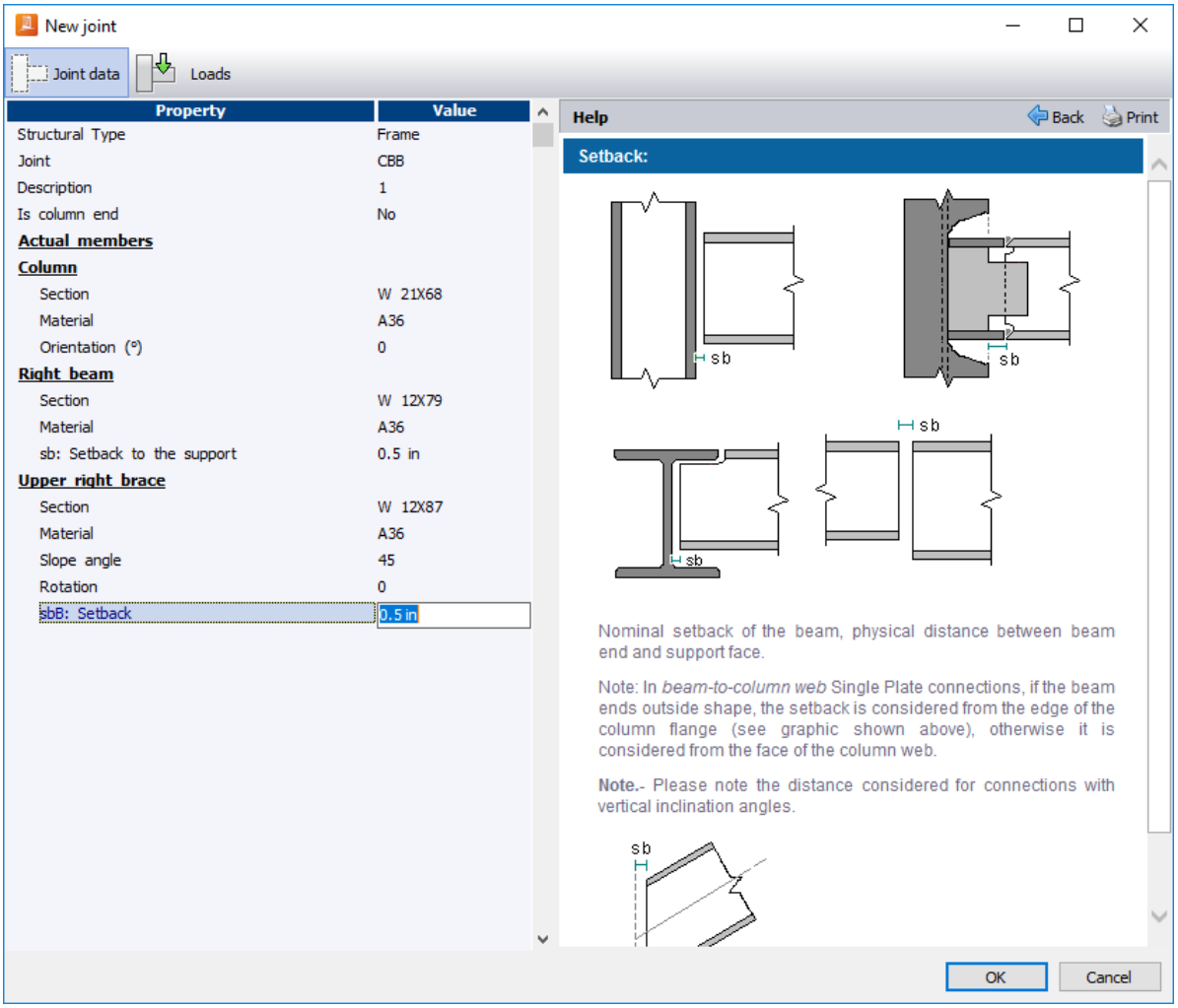
The help access is in backstage options; the access is in the upper left part from the menu options ("File" button). By pressing the button the program display several new options, one of those is the highlighted "Help" button which shows access to enter the manual, connection design verification manual, list of the keyboard shortcuts, online resources, a sight of how the user may submit a help request and finally information about the program (EULA, module version and legal notices).



Joint Creation and Edition

To create a new joint, press the 

button and the next window will be displayed where all the data of the members and loads should be entered.



New joint window

First, the joint structural type should be selected. The available structural types are:

- Frame
- Truss

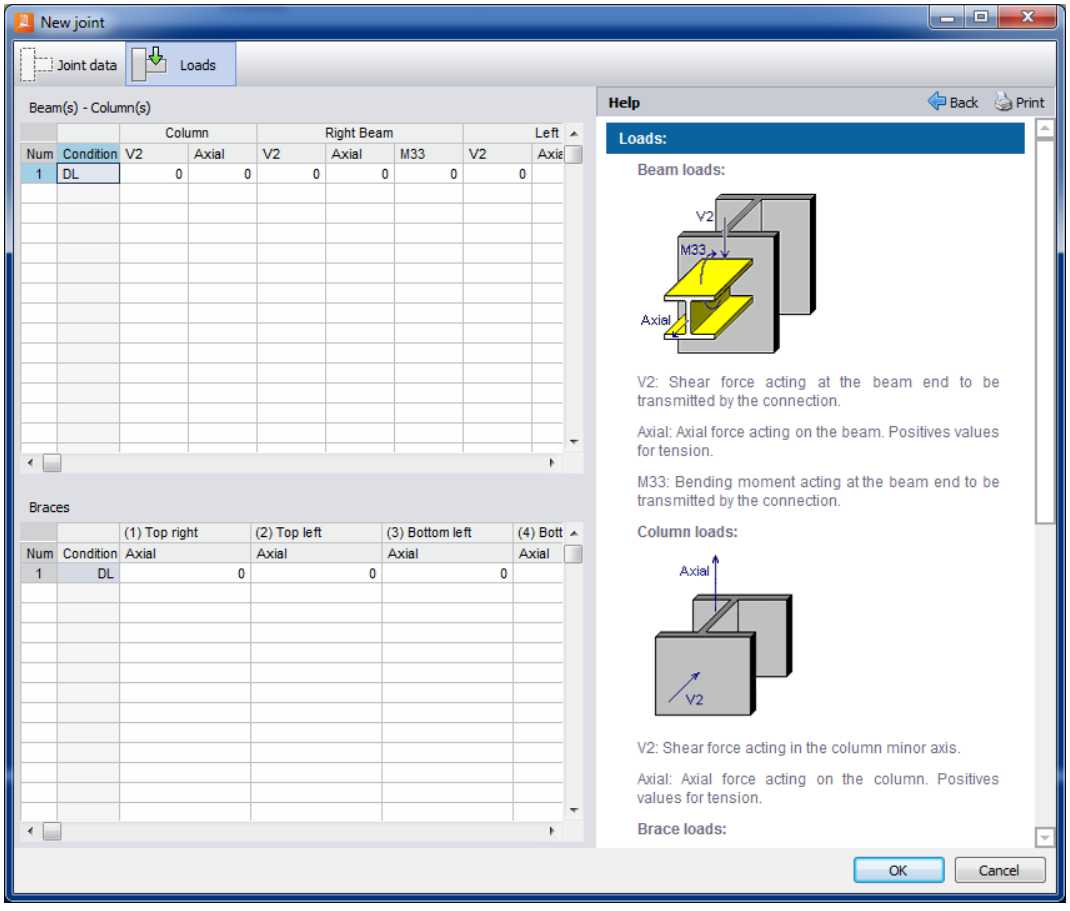
Second, the type of joint should be selected. The available joint types in RCSA for frame structural type are:

Frame structural type	
Joint Type	Description
BCF	Beam to Column Flange
BCW	Beam to Column Web
BG	Beam to Girder
BS	Beam Splice
CS	Column Splice
CC	Column Cap

CBB	Column Beam Braces
CVR	Chevron Braces
VXB	Vertical X Braces
CB	Column to Base Plate
HCBB	Horizontal Column Beam Braces
HBBB	Horizontal Girder Beam Braces
HXB	Horizontal X Braces

Note: For Truss type connections there is just “Chord – Branches (CHB)” joint type.

Depending on the selected frame and joint, the necessary data will be shown. In this window it is also shown the tab to enter the joint loads.



Joint creation window, introducing loads. Notice that if the joint that is being created does not have braces, the second spreadsheet in the lower part of the window will not be shown.

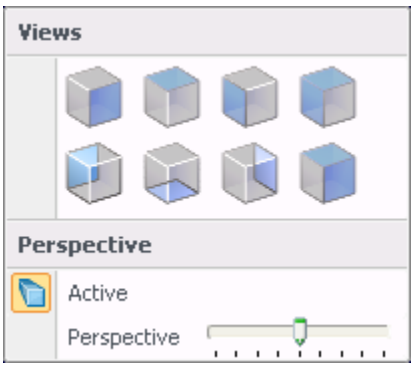
In order to edit the selected joint, press the 

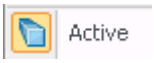
button. This command will display the Joint edition window where the joint and the loads can be modified.

Work Areas

As it was stated before, there are eight work areas in RCSA. Then main window, RCSA button and the ribbon buttons were described previously.

The graphical area is referred to the area in the main screen where the 3D joint view is shown. In this area the joint view can be rotated, a perspective can be added and the view can be increased or reduced. Right click on the graphic area displays a popup menu with view options

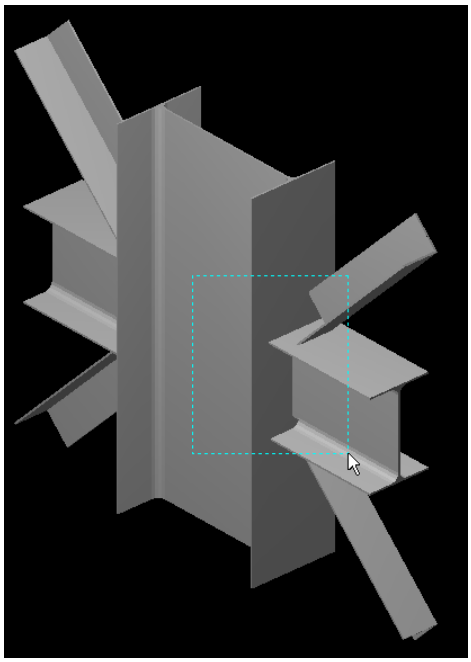


- The  button activates a front YZ view.
- The  button activates a front XZ view.
- The  button activates a front XY view.
- The  button activates a back YZ view.
- The  button activates a back XZ view.
- The  button activates a back XY view.
- The  button activates an isometric -XZ view.
- The  button activates an isometric XZ view.
- The  button activates the perspective. When the button is not pressed the view is shown with no perspective.
- The  slider bar will indicate the percentage of perspective applied to the view.

Other commands that affect the view in the graphic area belong to the status bar.

A brief description of these commands is presented as follows:

- The  button sets the original joint view.
- Press the  button and drag a rectangle to select the area of the graphic to amplify the view.



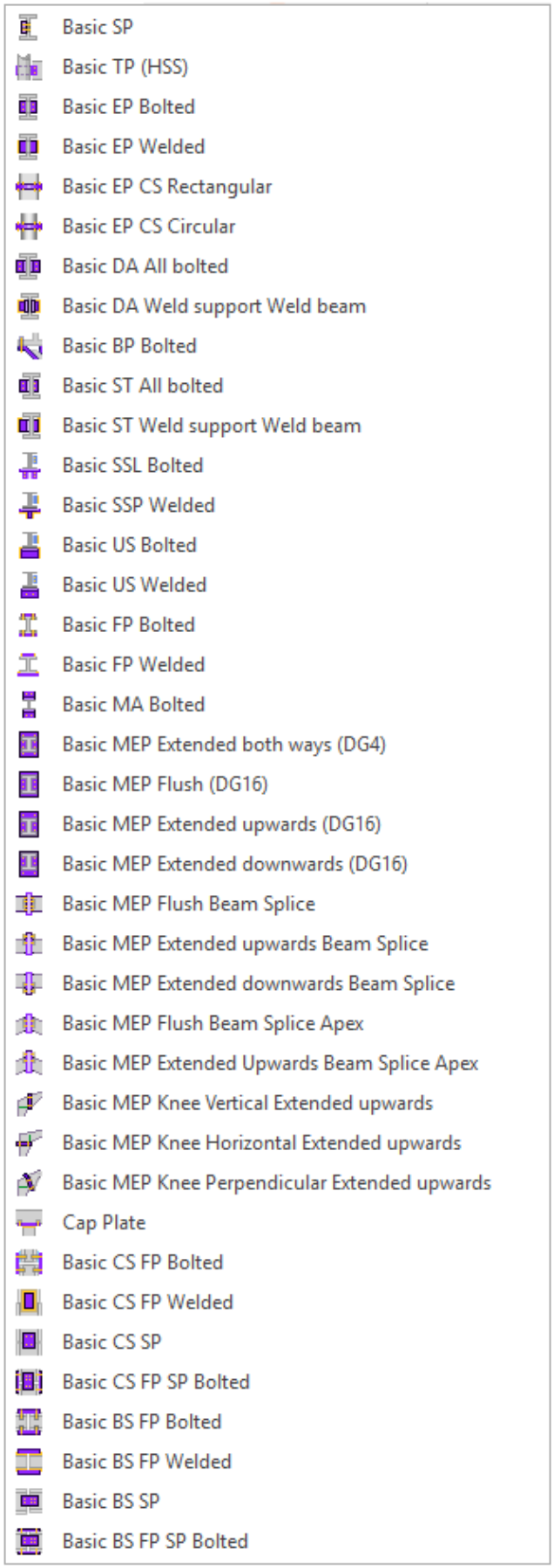
Example of area zoom

-  Zoom in button.
-  Zoom out button.

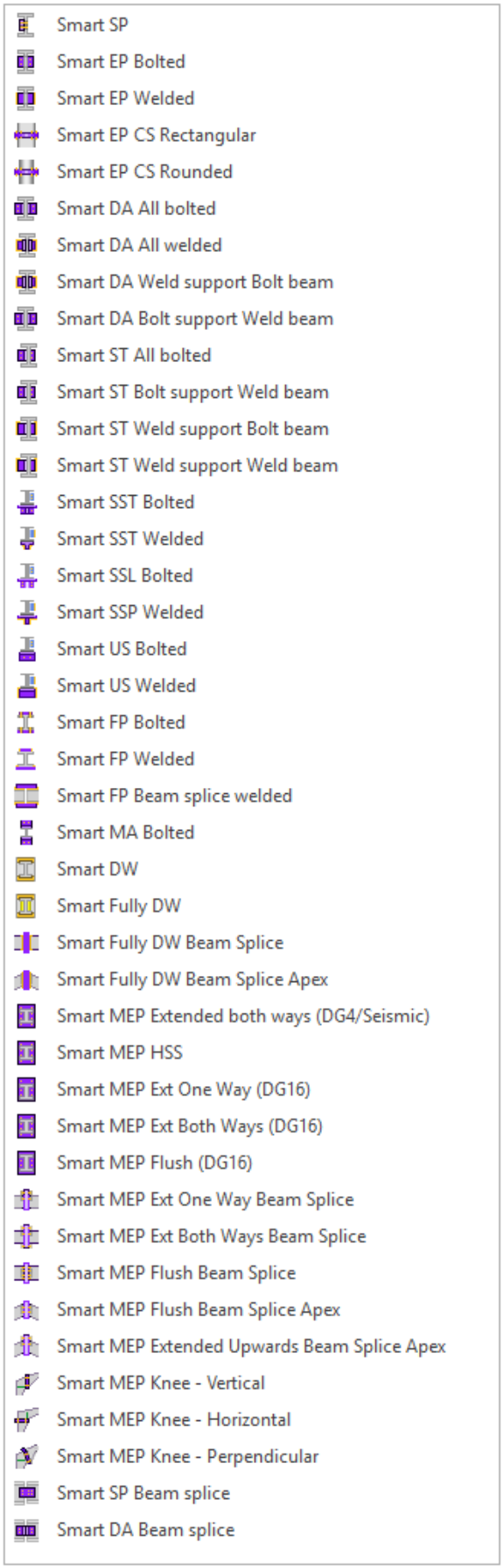
Available Connections

The connections are displayed according to the type they belong; therefore:

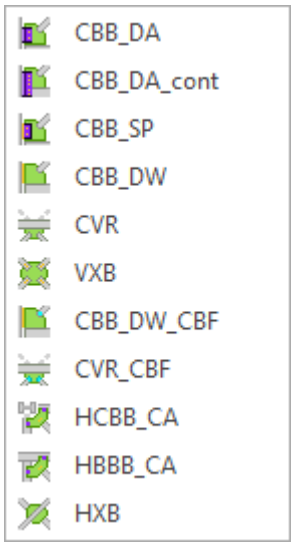
-  displays the basic connections.


Basic SP
Basic TP (HSS)
Basic EP Bolted
Basic EP Welded
Basic EP CS Rectangular
Basic EP CS Circular
Basic DA All bolted
Basic DA Weld support Weld beam
Basic BP Bolted
Basic ST All bolted
Basic ST Weld support Weld beam
Basic SSL Bolted
Basic SSP Welded
Basic US Bolted
Basic US Welded
Basic FP Bolted
Basic FP Welded
Basic MA Bolted
Basic MEP Extended both ways (DG4)
Basic MEP Flush (DG16)
Basic MEP Extended upwards (DG16)
Basic MEP Extended downwards (DG16)
Basic MEP Flush Beam Splice
Basic MEP Extended upwards Beam Splice
Basic MEP Extended downwards Beam Splice
Basic MEP Flush Beam Splice Apex
Basic MEP Extended Upwards Beam Splice Apex
Basic MEP Knee Vertical Extended upwards
Basic MEP Knee Horizontal Extended upwards
Basic MEP Knee Perpendicular Extended upwards
Cap Plate
Basic CS FP Bolted
Basic CS FP Welded
Basic CS SP
Basic CS FP SP Bolted
Basic BS FP Bolted
Basic BS FP Welded
Basic BS SP
Basic BS FP SP Bolted

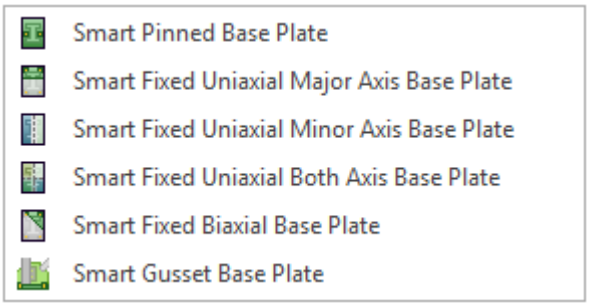
-  displays the smart connections.


Smart SP
Smart EP Bolted
Smart EP Welded
Smart EP CS Rectangular
Smart EP CS Rounded
Smart DA All bolted
Smart DA All welded
Smart DA Weld support Bolt beam
Smart DA Bolt support Weld beam
Smart ST All bolted
Smart ST Bolt support Weld beam
Smart ST Weld support Bolt beam
Smart ST Weld support Weld beam
Smart SST Bolted
Smart SST Welded
Smart SSL Bolted
Smart SSP Welded
Smart US Bolted
Smart US Welded
Smart FP Bolted
Smart FP Welded
Smart FP Beam splice welded
Smart MA Bolted
Smart DW
Smart Fully DW
Smart Fully DW Beam Splice
Smart Fully DW Beam Splice Apex
Smart MEP Extended both ways (DG4/Seismic)
Smart MEP HSS
Smart MEP Ext One Way (DG16)
Smart MEP Ext Both Ways (DG16)
Smart MEP Flush (DG16)
Smart MEP Ext One Way Beam Splice
Smart MEP Ext Both Ways Beam Splice
Smart MEP Flush Beam Splice
Smart MEP Flush Beam Splice Apex
Smart MEP Extended Upwards Beam Splice Apex
Smart MEP Knee - Vertical
Smart MEP Knee - Horizontal
Smart MEP Knee - Perpendicular
Smart SP Beam splice
Smart DA Beam splice

- displays the gusset connections

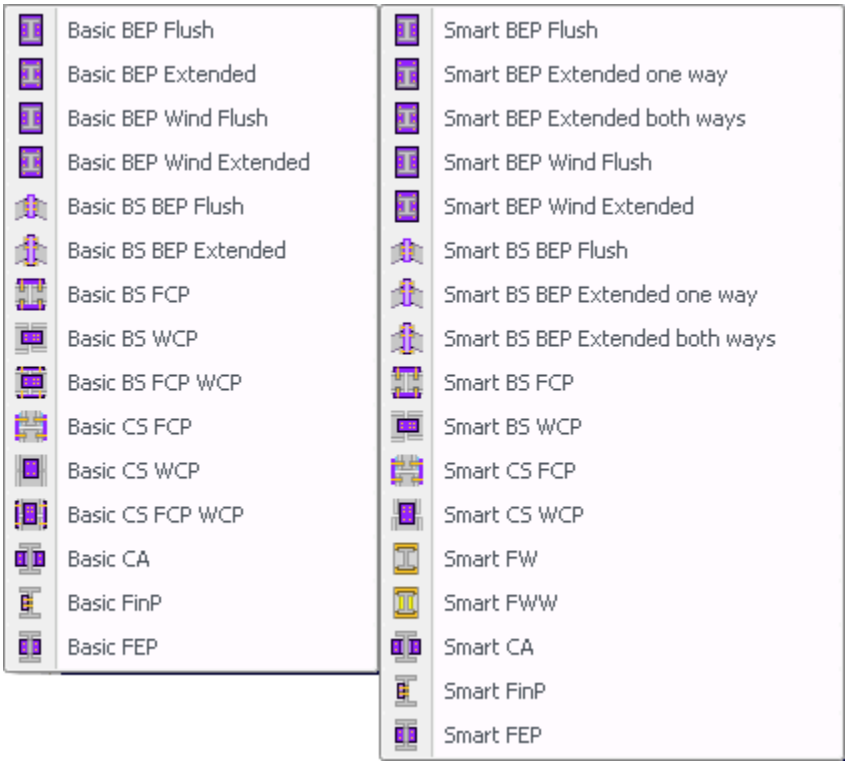


- displays the base plate connections

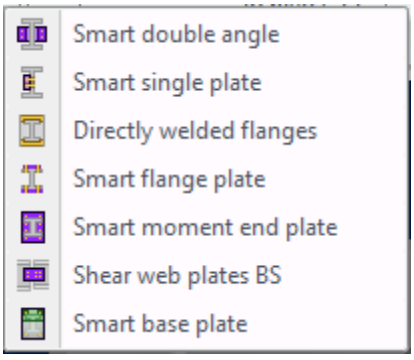


- displays the tubular connections (only available for AISC 360-16)

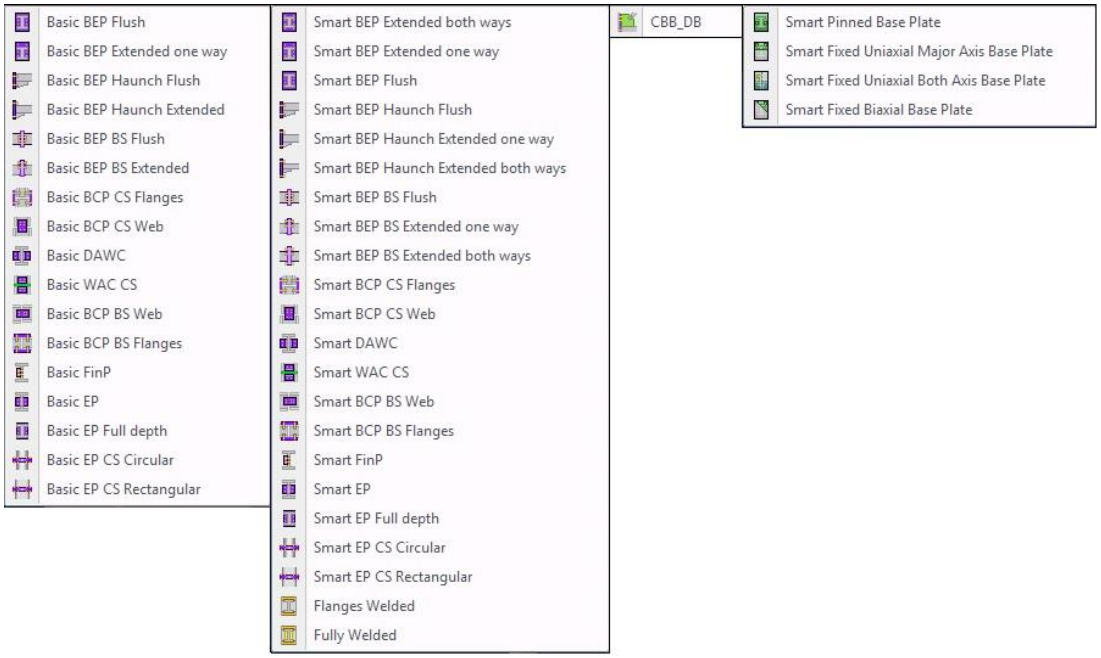
The last figures show the available connections for AISC 360. Note that those menus will change if the selected design standard is BS 5950-00, GB 50017-03, EN 1993-2005, IS 800-2007, AS 4100-1998, NZS 3404-1997 or CSA S16-14.



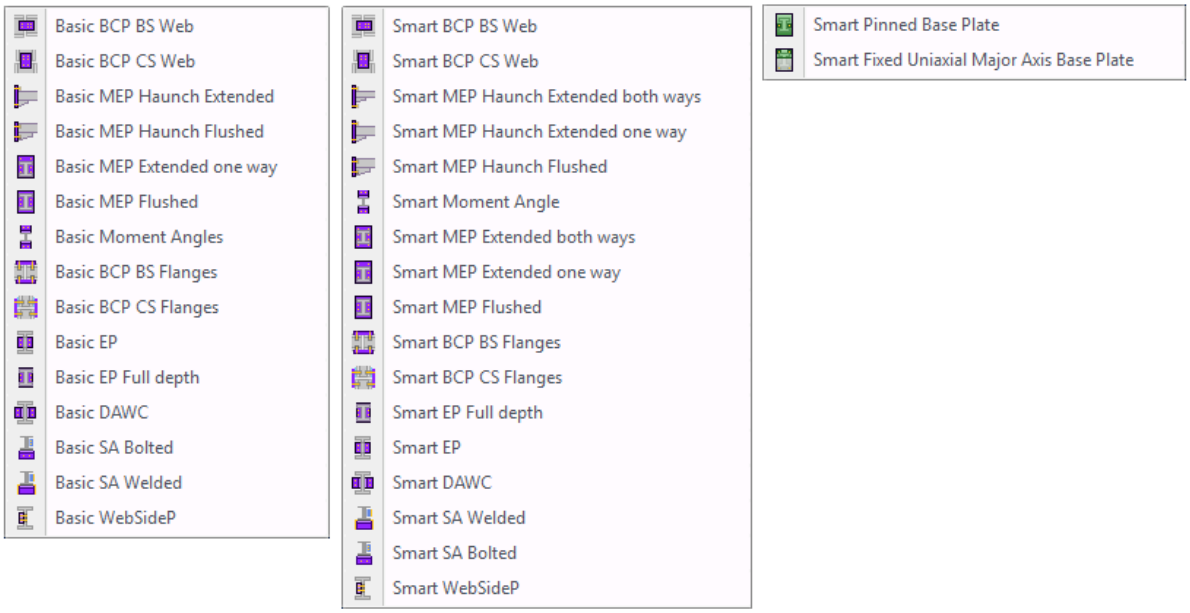
Basic and Smart connections assignment buttons menu for BS 5950 design code.



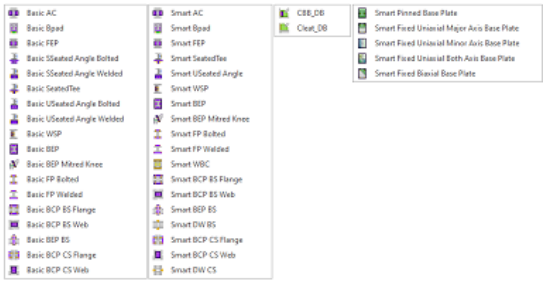
Smart connections assignment buttons menu for GB 50017-03.



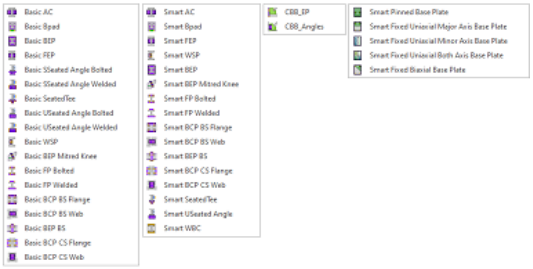
Basic, Smart, Bracing and Base Plate connections assignment buttons menu for EN 1993-2005 design code.



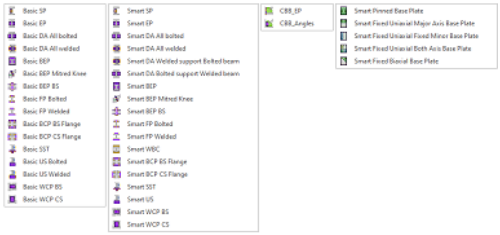
Basic, Smart and Base Plate connections assignment buttons menu for IS 800-2007 design code.



Basic, Smart, Gusset and Base Plate connections assignment buttons menu for AS 4100-1998 design code.



Basic, Smart, Gusset and Base Plate connections assignment buttons menu for NZS 3404-1997 design code.

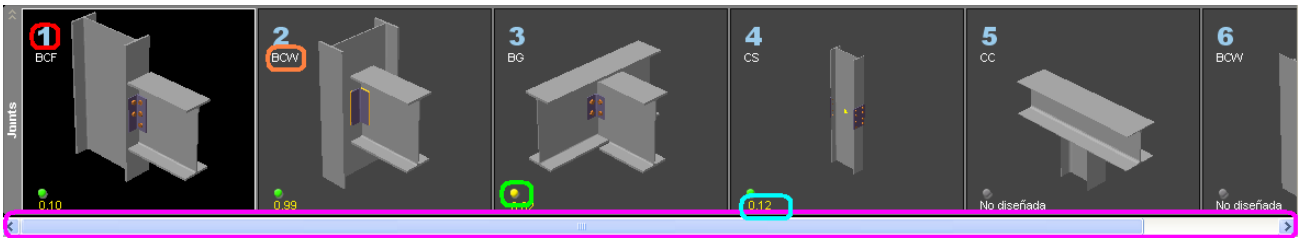


Basic, Smart and Base Plate connections assignment buttons menu for CSA 3404-1997 design code.

Joint selection area

In this area, the joints are displayed, and one joint can be selected at a time clicking over its image. The joints are shown shadowed in order to highlight the selected joint.

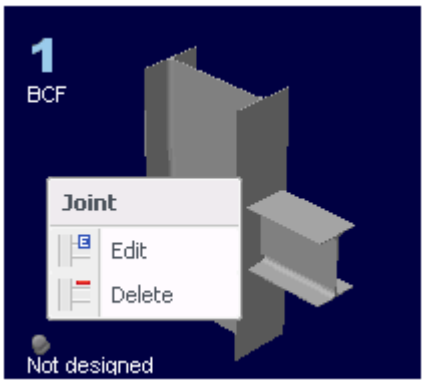
The joints views show the number of every joint (red box), the family to whom it belong (orange box), the status of the joint according to its connections (green box), if the status is gray, the joint is not designed, if it is yellow, the joint has some design warnings, if it is red, the design presents errors, and if it is green, the design was successfully.



Joints selector

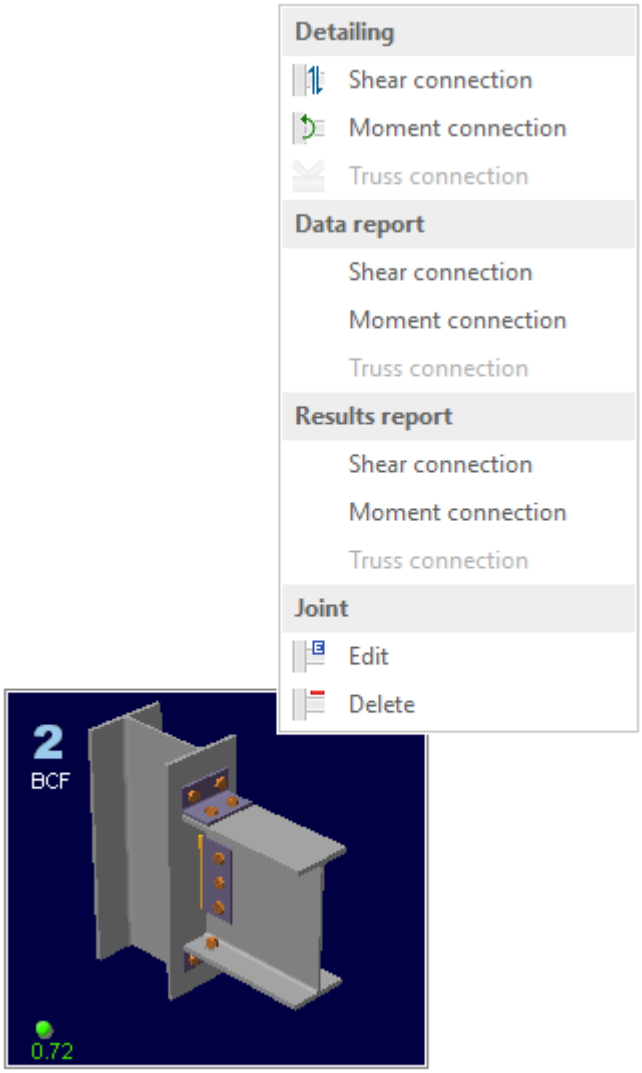
The ratio of the joint according with its connections is also shown in every joint view (light blue box). If the joint does not have yet any assigned connection, the text “Not designed” will be shown, but if the joint has already a connection assigned, the critical ratio of the connection will be shown.

If the joint does not have any assigned connection, when pressing the right mouse button over the joint view, only two options will be shown: edit and delete the joint.



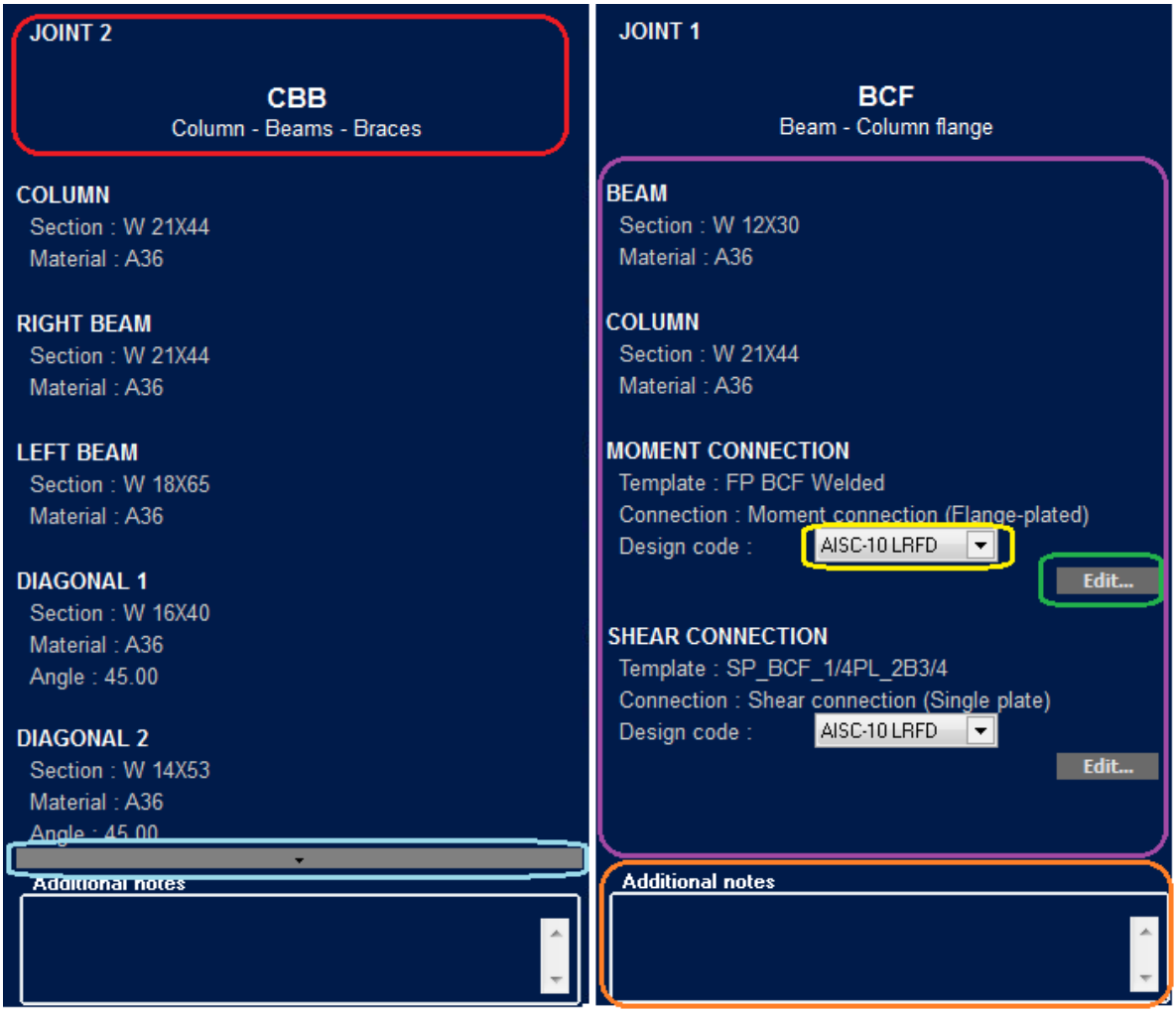
If the joint has a connection assigned, the joint options will be shown together with the connection options. Basically, the connection option are three for each connection type, the first is to display the connection detailing (See the section of “Reports in RAM Connection Standalone” for more details. The second is to see the data report of the connection data, the third is to see the report of the connection results.

Doing double click over the joint view it is possible to enter to the joint edition dialog directly.



Joint data display area

In this area, the data of the members and connections of the selected joint are displayed.



a) Joint data display area without connections, b) Joint data display area with connections

In this area the next sections are highlighted: in the red box the joint identification section is located where the number of the joint, its description and its type are shown.

The purple box is where the joint data is displayed that contains its members and the connection. Besides, there is the connection edition button (green box) that displays the connection dialog (See the “Connection Dialog” for more information). Also there is the design code edition button (yellow box).

When the information that it is displayed in this section is more extend the assigned screen height, a displacement bar will be shown (light blue box) in order to be able to see all the information about the members and connections that contain the joint.

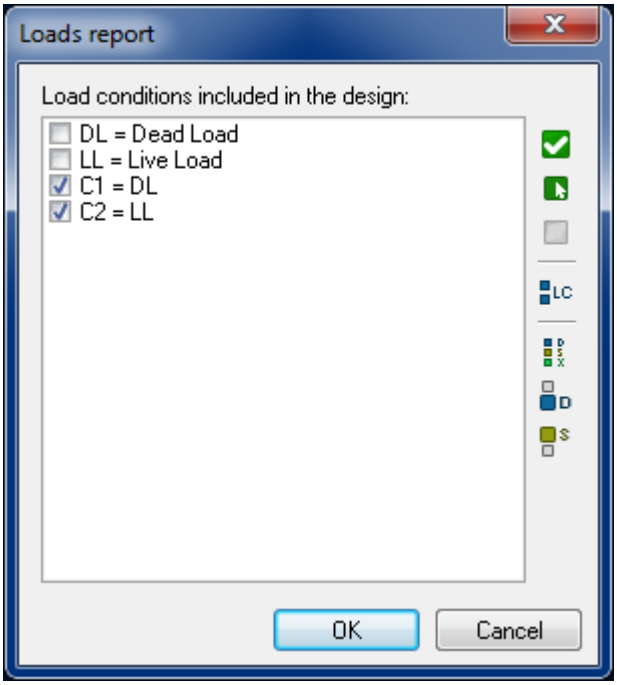
Finally, the additional notes section (orange box) that allows writing all the information required about the selected joint. In order to write the information, double click in this section.

Notice that a box will be displayed where the user should write the information. The box will be closed when changing the joint and all the changes will be saved.

Reports of RAM Connection Standalone

RCSA is able to report the next:

- Joints list: Displays a list of the model joints.
- Loads: Displays a window where the user should select the load conditions for which the results will be reported.

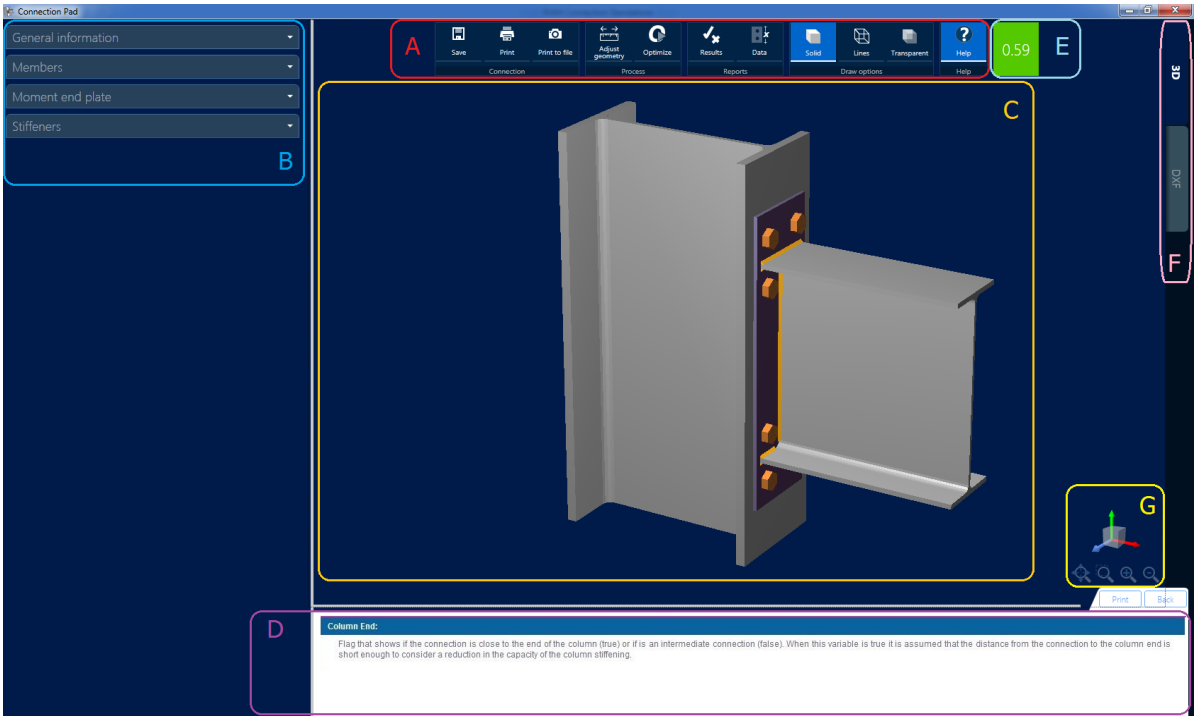


Load condition selection window

- Connection detail: Shows a report with de geometric data and design results for all the model joints.
- Connections elements summary: Displays a list of all the elements that are parts of the connection for all the model joints.

Connection Dialog

It can also be called as Connection pad. This window allows entering or changing the data of a connection.



Connections dialog

In the next table, the highlighted areas are described.

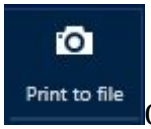
Area		Function
ID	**Name**	
A	Toolbar	General commands for saving, printing and accessing to data and result reports, modifying tridimensional and DXF model view.
B	Edition area	In this area the user may enter or modify the required data for the connection.
C	Graphic area	Shows the 3D and DXF view of the connection.
D	Sensitive help area	Displays helpful information about the data for the connection.
E	Traffic light	Shows the design status of the connection.
F	Tab	Choose the 3D and DXF view of the connection.
G	Navigation control	Tool that rotates, translate the model and also contain tools to change to default view models.

In the main toolbar (A) of this window the following commands are included:

- 

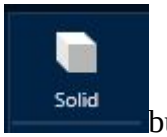
Saves the changes made over the connection.

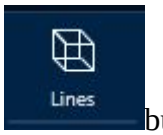
- 

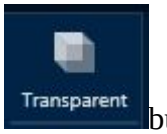
Opens a dialog window to print the graphic.
- 

Opens a dialog window to print to a file the graphic.
- 

button displays the results report of the connection.
- 

button displays the data report of the connection.
- 

button allows seeing the 3D image as solid.
- 

button allows seeing the 3d image only with lines (This view is different
- 

button allows seeing the 3D image as transparency.
- to the DXF).
- 

button allows seeing or hiding the sensitive help area (D).

Note that changing the *View tab* to *DXF* some of the described buttons are present in the toolbar but other commands appear and are the following:

- 

Exports the current bidimensional connection drawing to DXF format. Only visible when DXF view is active.
- 

displays the DXF drawing layers.
- 

increases font size for the graphic in the screen.

- 

decreases font size for the graphic in the screen.

Another buttons the user may find in this dialog are:

- 

shows the last topic in the help area.
- 

opens de dialog to print the current topic in the help area.

More information about the Connections Dialog can be found in Chapter 2

Chapter 2: Connections

RAM Connection Standalone allows the user to rapidly design, optimize or verify connections.

Connections are designed and verified according to:

- ANSI/AISC 360-2005 (American standard)
- ANSI/AISC 360-2010 (American standard)
- ANSI/AISC 360-2016 (American standard)
- BS 5950-2000 (British standard)
- GB 50017-2003 (Chinese standard)
- EN 1993-2005 (Europe standard)
- IS 800-2007 (Indian standard)
- AS 4100-1998 (Australian standard)
- NZS 3404-1997 (New Zealand standard)
- CSA S16-14 (Canadian Standard)

Tubular connections are designed and verified according to:

- ANSI/AISC 360-2016 (American standard)

In first place the term “Connection” is defined within the context of RAM Connection Standalone. After that, the user will be able to know how to use the program. Following this section more detail the features of RAM Connection including the Connection Database are described, as well as Connection Assignment/Optimization, Connection Output and how to customize the connection designs. It is recommended for the user to read at least the first two sections of this chapter to understand how the application works.

What is a Connection?

RCSA defines a Single Connection as all the parameters that completely define the quantities and dimensions of the pieces that make up a connection. It includes the information related to the Connection Family (beam to column flange, beam to column web, beam-girder, etc.), the type of connection (shear, moment, bracing, splice or combined), as well as the number of bolts, size of bolts, welds, geometry and material of the connecting pieces.

Before creating a connection, a template is required to define the connection characteristics. The templates are defined in the connections database that can be accessed in the *Home tab, Databases* group and pressing the *Connections button*. The RCSA database contains an extensive database of predefined templates.

How to find technical information about a specific connection?

When entering or reviewing the different parameters of a connection the help context may be read, in this document the user will find a detailed description of the data and checks that are performed for

each connection type. At the end of this chapter the list of the main references used in the development of the program is given where the user can find more information.

How to Use RAM Connection?

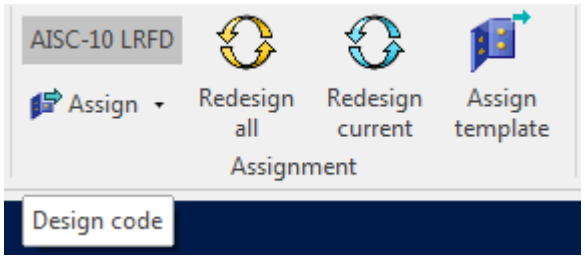
RAM Connection is designed to give extensive flexibility in the way the user designs and manages the connections. However, it is also set up to allow productivity without requiring significant work on user's part.

Using RAM Connection Standalone

Individual connections are designed for the forces and member sizes at a specific joint. No consideration is given to any other joint force or connection design. This allows for each connection to be designed for its own forces and geometry, providing the most efficient use of material.

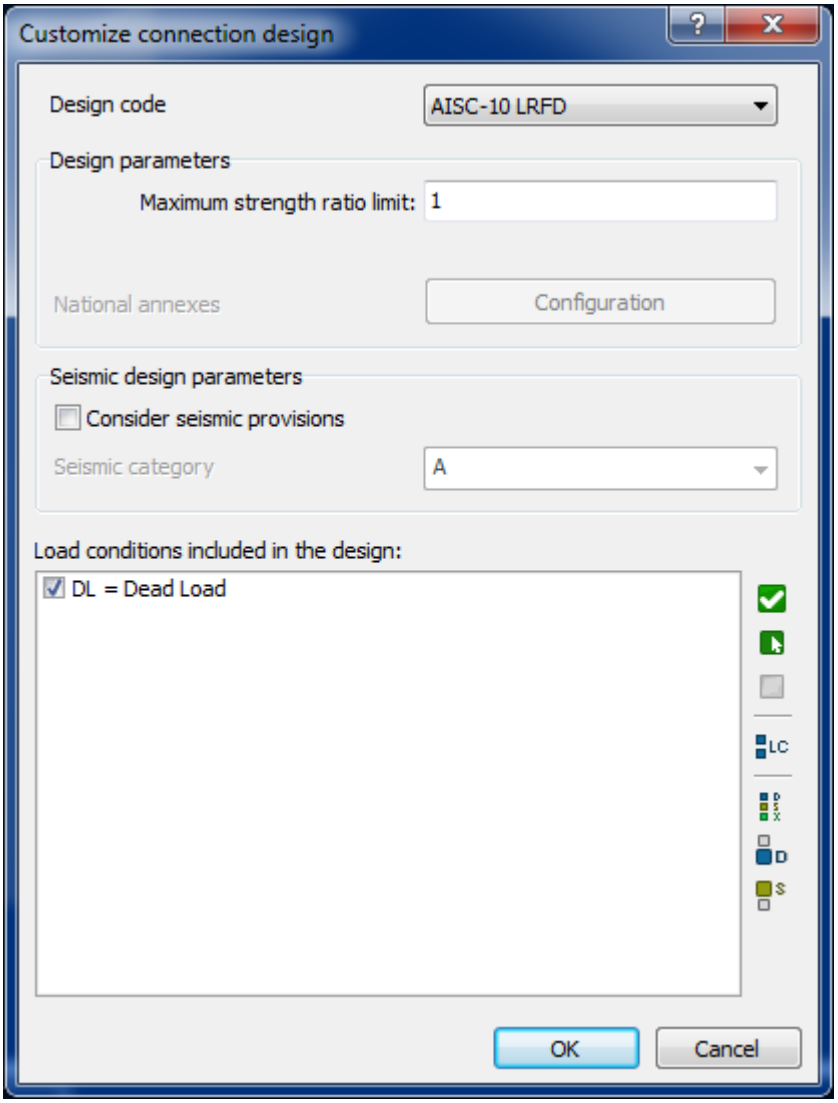
Before connections are designed the user should configure the Connection Design criteria to establish the top limit of the strength ratio and the load conditions to be used during the connection design.

1) Before connections are designed the user should set the Design Configuration options. The dialog is showed up when the user clicks in the dialog box launcher located at the upper left corner of the *Assignment group* in the *Design tab*.



RAM Connection Standalone design configuration launcher.

The user should set the connections design standard (i.e. AISC-360, BS 5950, GB 50017, EN 1993-2005, IS 800-2007, AS 4100-1998, NZS 3404-1997 and CSA S16-14), the design method (i.e. ASD or LRFD) when applies, some connections design parameters according to the selected design standard.

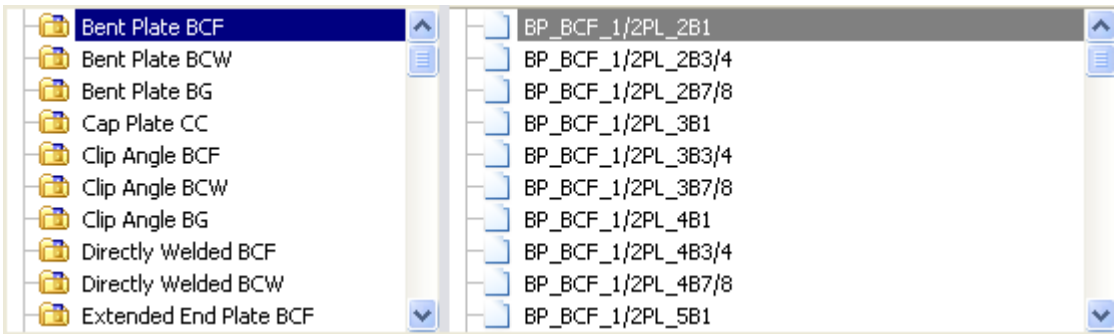


RAM Connection Standalone configuration design dialog

For the design, all the load conditions introduced by the user will be taken into account. To see or modify the load of a condition, press the 

button located in the *Home tab, Load conditions group*.

2) To add a new connection, the user can use any of the assignment buttons from the *Design tab, Assignment group*. This action will add a connection based on the template.



Once the connection was assigned, it can be edited to fit it the user's requirements. In order to do this, open the Connection Pad window (connection dialog, described in the previous chapter). This method is simpler and allows having all the joint information in only one window.

Notice that it is not possible to change the type of joint after assigning the connection. The process of assignment should be repeated in order to consider a new joint type.

Notice that many connection parameters will be determined by the template. The user may select three connection types ("basic", "gusset", "smart") from the database.

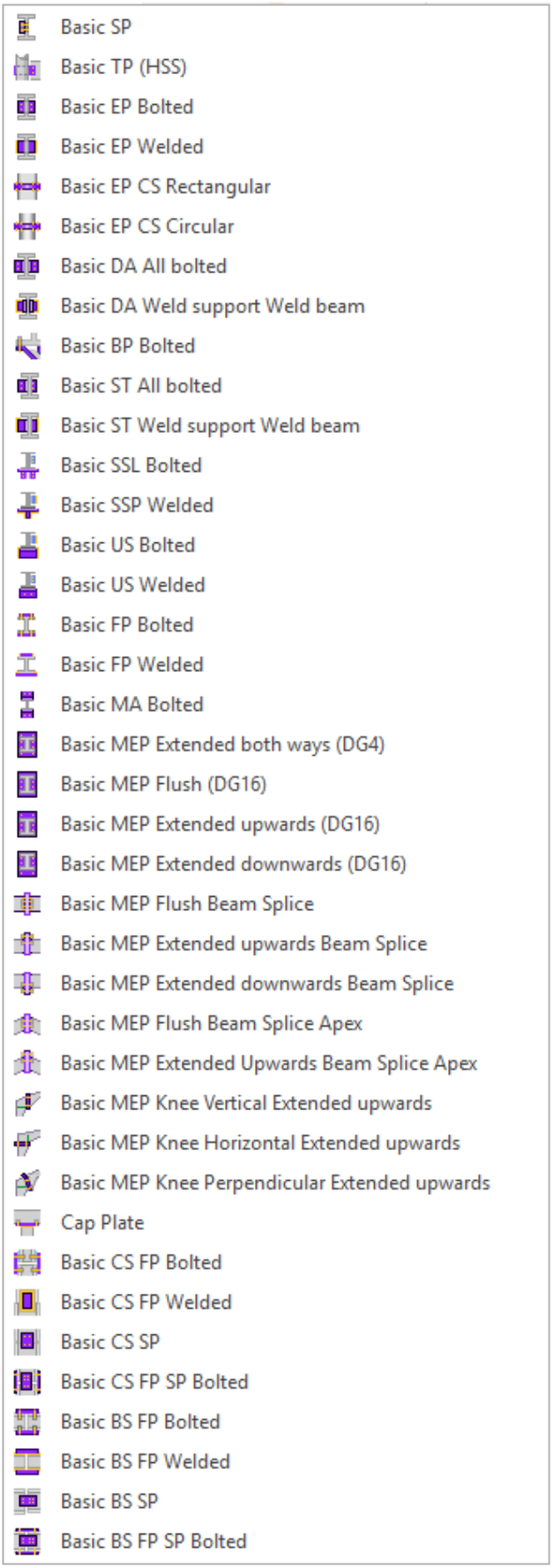
Also notice that it is possible to assign templates (one at a time) directly from the database. To do this press the button *Assign template* from the *Assignment group*, *Design tab*.

When assigning connections directly from the database, the joint type is defined automatically.

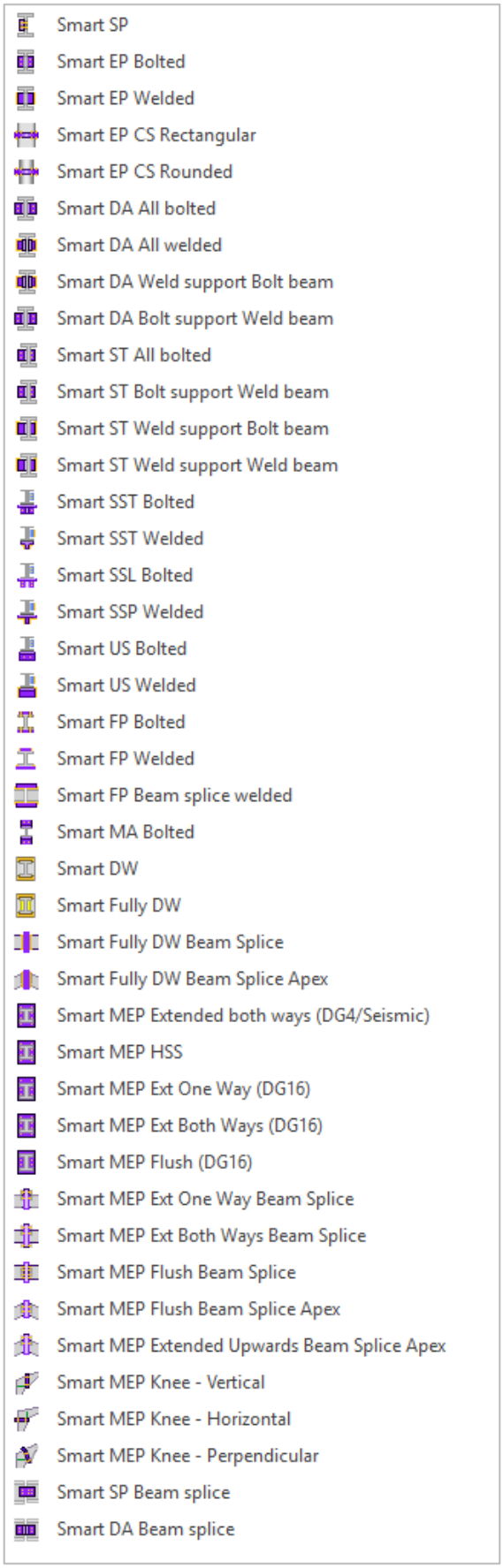
When assigning connections using the standard buttons, the user should select if the connection to be assigned is a smart connection  , a basic connection  , a gusset connection  , base plate connection  or tubular connections  . Then, the connection type should be selected.

Pressing the standard buttons, the available connections displayed are:

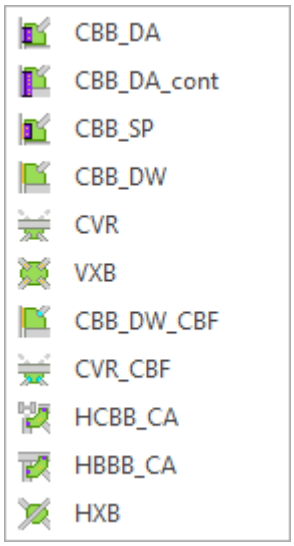
-  Basic connections.


Basic SP
Basic TP (HSS)
Basic EP Bolted
Basic EP Welded
Basic EP CS Rectangular
Basic EP CS Circular
Basic DA All bolted
Basic DA Weld support Weld beam
Basic BP Bolted
Basic ST All bolted
Basic ST Weld support Weld beam
Basic SSL Bolted
Basic SSP Welded
Basic US Bolted
Basic US Welded
Basic FP Bolted
Basic FP Welded
Basic MA Bolted
Basic MEP Extended both ways (DG4)
Basic MEP Flush (DG16)
Basic MEP Extended upwards (DG16)
Basic MEP Extended downwards (DG16)
Basic MEP Flush Beam Splice
Basic MEP Extended upwards Beam Splice
Basic MEP Extended downwards Beam Splice
Basic MEP Flush Beam Splice Apex
Basic MEP Extended Upwards Beam Splice Apex
Basic MEP Knee Vertical Extended upwards
Basic MEP Knee Horizontal Extended upwards
Basic MEP Knee Perpendicular Extended upwards
Cap Plate
Basic CS FP Bolted
Basic CS FP Welded
Basic CS SP
Basic CS FP SP Bolted
Basic BS FP Bolted
Basic BS FP Welded
Basic BS SP
Basic BS FP SP Bolted

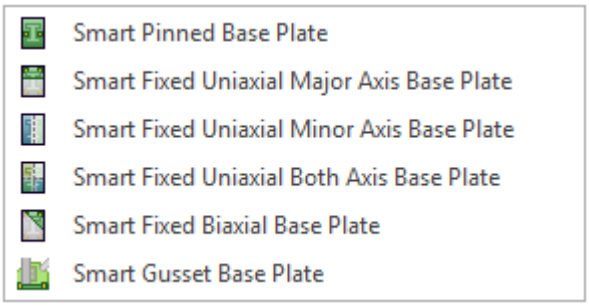
-  Smart connections.


Smart SP
Smart EP Bolted
Smart EP Welded
Smart EP CS Rectangular
Smart EP CS Rounded
Smart DA All bolted
Smart DA All welded
Smart DA Weld support Bolt beam
Smart DA Bolt support Weld beam
Smart ST All bolted
Smart ST Bolt support Weld beam
Smart ST Weld support Bolt beam
Smart ST Weld support Weld beam
Smart SST Bolted
Smart SST Welded
Smart SSL Bolted
Smart SSP Welded
Smart US Bolted
Smart US Welded
Smart FP Bolted
Smart FP Welded
Smart FP Beam splice welded
Smart MA Bolted
Smart DW
Smart Fully DW
Smart Fully DW Beam Splice
Smart Fully DW Beam Splice Apex
Smart MEP Extended both ways (DG4/Seismic)
Smart MEP HSS
Smart MEP Ext One Way (DG16)
Smart MEP Ext Both Ways (DG16)
Smart MEP Flush (DG16)
Smart MEP Ext One Way Beam Splice
Smart MEP Ext Both Ways Beam Splice
Smart MEP Flush Beam Splice
Smart MEP Flush Beam Splice Apex
Smart MEP Extended Upwards Beam Splice Apex
Smart MEP Knee - Vertical
Smart MEP Knee - Horizontal
Smart MEP Knee - Perpendicular
Smart SP Beam splice
Smart DA Beam splice

- Gusset connections.

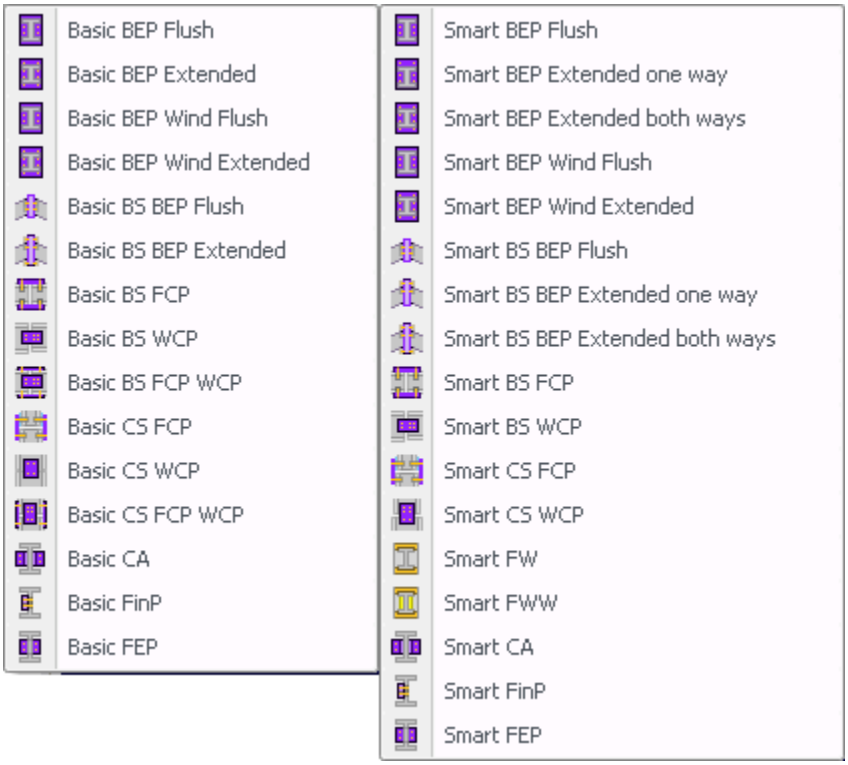


- Base Plate connections.

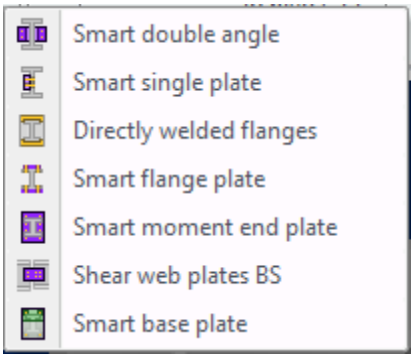


- Tubular connections (only available for AISC 360-16)

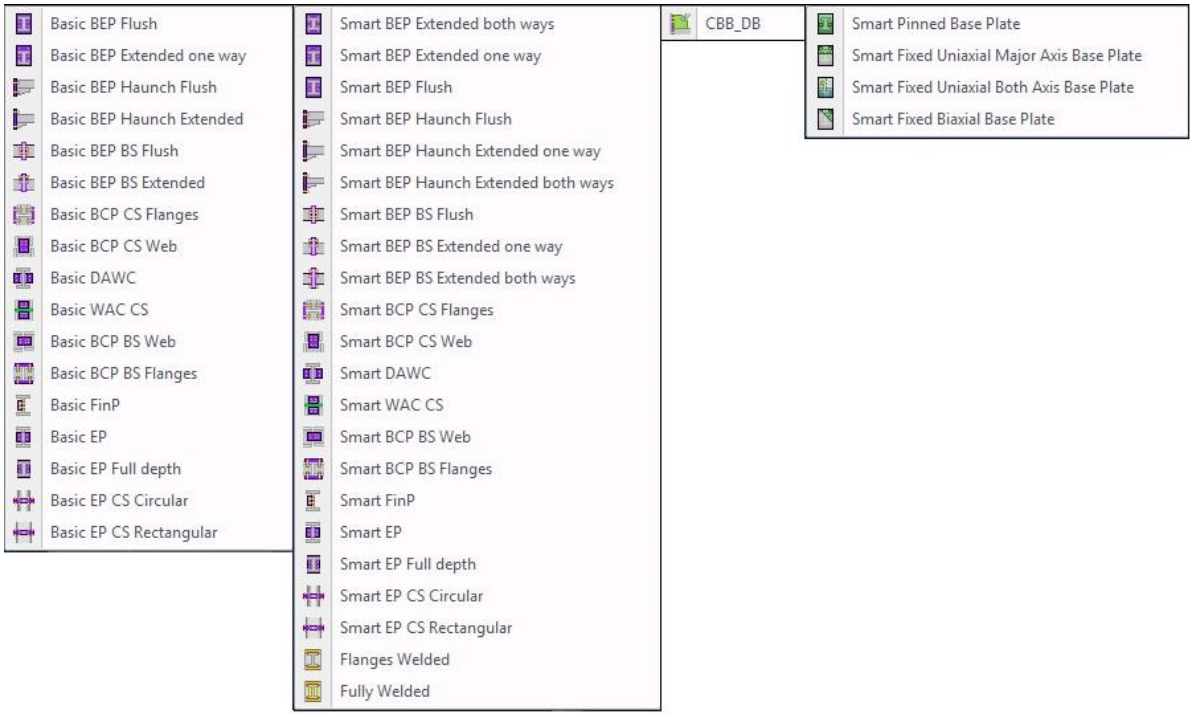
The last figures show the available connections for AISC 360. Note that those menus will change if the selected design standard is BS 5950-00, GB 50017-03, EN 1993-2005, IS 800-2007, AS 4100-1998, NZS 3404-1997 or CSA S16-14.



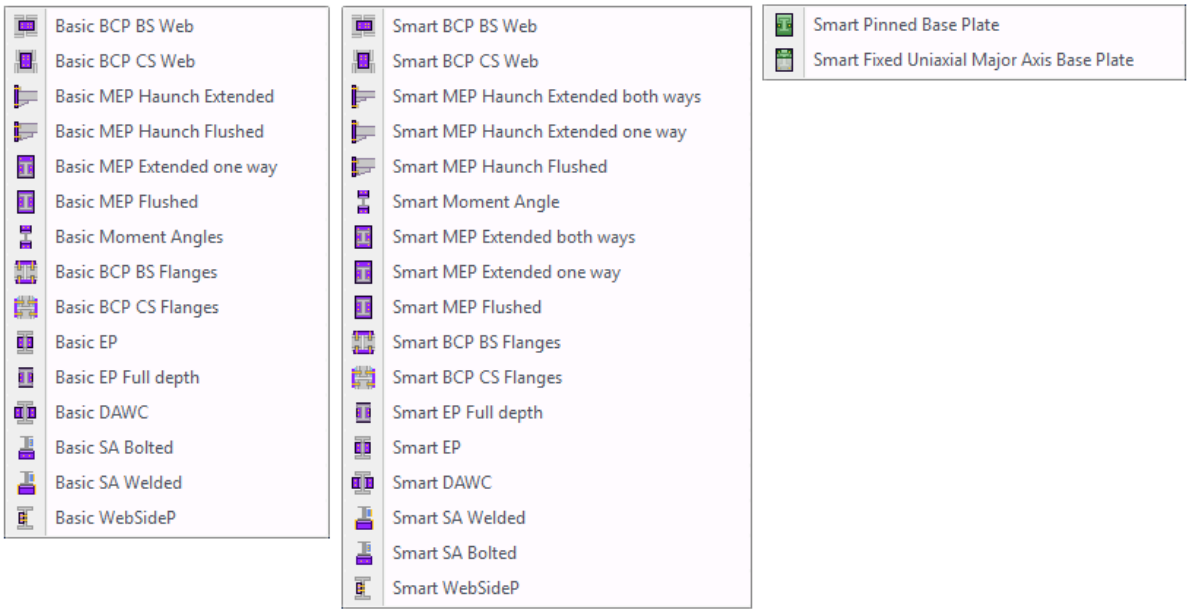
Basic and Smart connections assignment buttons menu for BS 5950 design code.



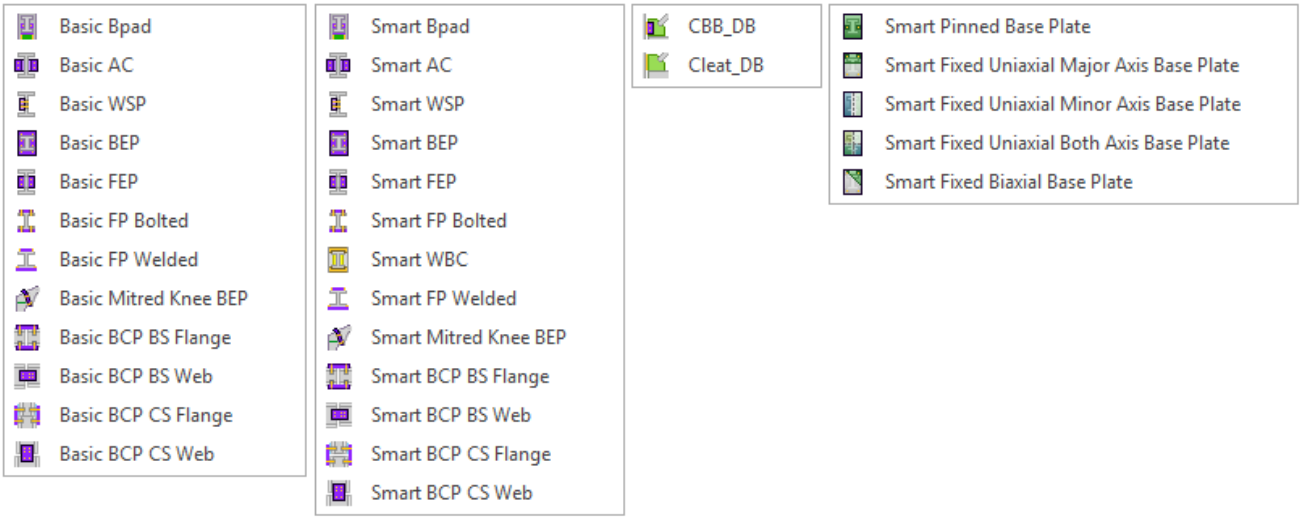
Smart connections assignment buttons menu for GB 50017-03.



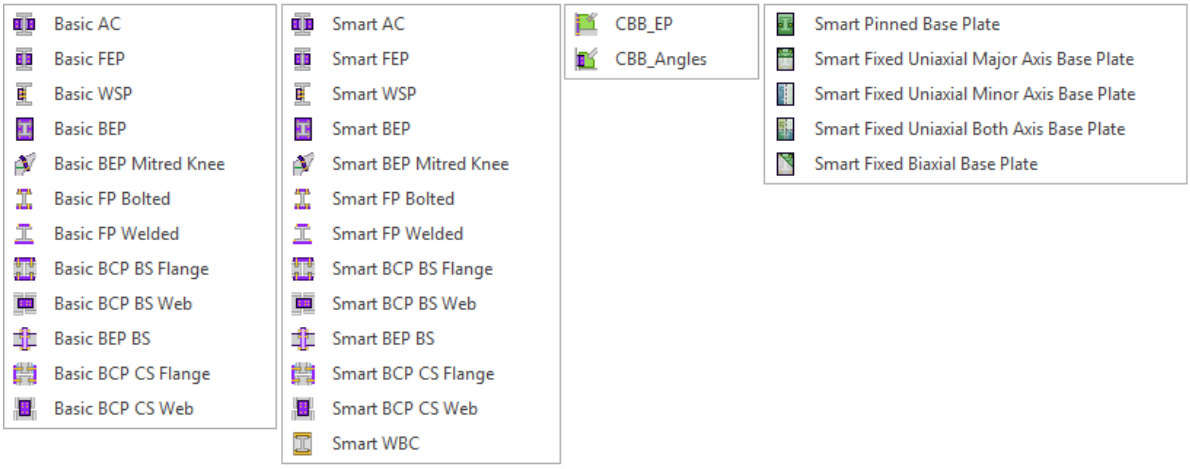
Basic, Smart, Bracing and Base Plate connections assignment buttons menu for EN 1993-2005.



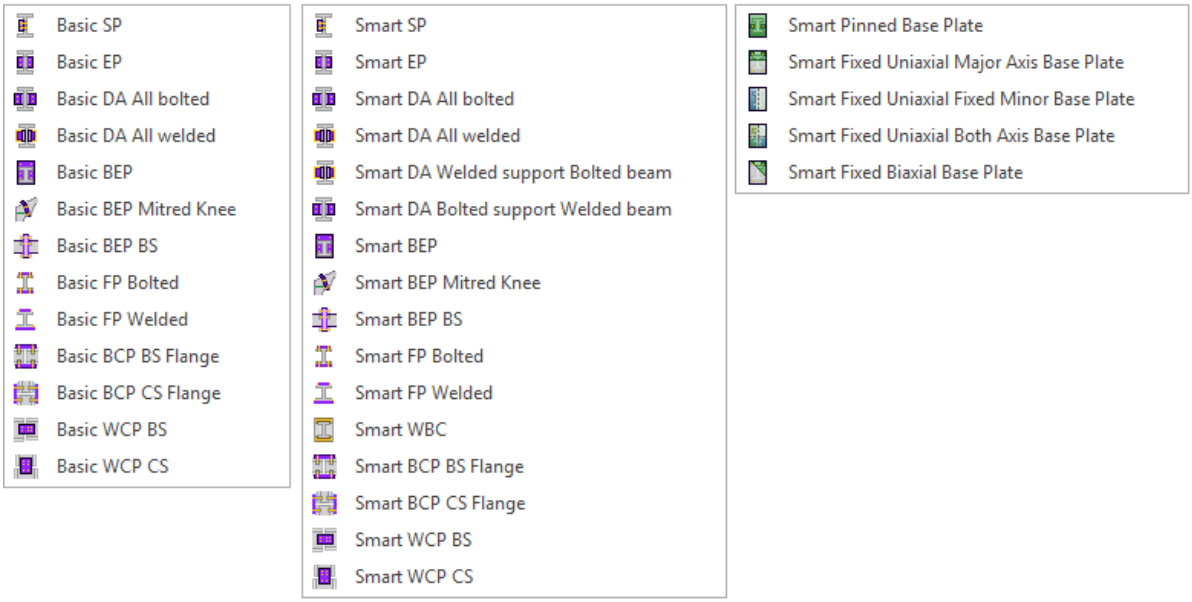
Basic, Smart, and Base Plate connections assignment buttons menu for IS 800-2007.



Basic, Smart, Gusset, and Base Plate connections assignment buttons menu for AS 4100-1998.



Basic, Smart, Gusset and Base Plate connections assignment buttons menu for NZS 3404-1997.



Basic, Smart, and Base Plate connections assignment buttons menu for CSA S16-14.

Name Convention

The following connection name convention has been adopted:

<Connection Type – Connection Family – Connection Characteristic – Design Parameter>

Smart Connection example: DA BCF Weld support Bolt beam

Basic Connection example: DA_BCF_L 3x3x1/4_3B3/4

Connection types

AISC 360 connections:

DA = Shear angle(s)

SP = Shear single plate

EP = Shear end plate

EndPlate_CS = End plate column splice

SSL = Stiffened seated with angle connection

SSP = Stiffened seated with plate connection

US = Unstiffened seated connection

ST = Shear tee

TP = Through plate (only HSS supports)

BP = Bent plate(s)

DW = Directly welded moment connection

FullyDW = Fully directly welded moment connection

MEP = Moment end plate (ex – EEP)

MEPBS = Moment end plate beam splice

MEPKnee = Moment end plate for tapered members (Knee)

FP = Flange plates

MA = moment angles

MT = Moment tees

CP = Cap plate

4A = Four angles beam splice

PBr = Plate bracket

TBr = Tee bracket

BPl = Column base plate

CBB = Column-beam-brace gusset plate

CVR = Beam-braces gusset plate

VXB = Gusset plate-braces

HCBB = Horizontal column-beam-brace gusset plate

HBBB = Horizontal beam-beam-brace gusset plate

HXB = Horizontal gusset plate-braces

Gusset BP = Gusset base plate

CHB = Tubular chord-branches

BS 5950 Connections:

BEP = Bolted end plate

FCP = Flange cover plates

WCP = Web cover plates

DAWC = Double angle web cleats

FinP = Fin Plate

FEP = Flexible end plate

FW = Flanges welded

FWW = Flanges and web welded

GB50017 Connections:

CA = Shear clip angle(s)

SP = Shear single plate

FW = Flanges welded

BPl = Base plate

DW = Directly welded moment connection

MEP = Moment end plate

EN 1993-2005 connections:

BEP = Bolted end plate

BCP Beam splice = Bolted flange cover plates for beam splice

BCP Column splice = Bolted flange cover plates for column splice

DAWC = Double cleat web cleat

WAC = Web cleat angle for column splice

BCP Beam splice = Bolted web cover plates for beam splice

BCP Column splice = Bolted web cover plates for column splice

FinP = Fin plate

EP = Flexible end plate

FEP_CS = Flexible end plate for column splice

CBB = Column-beam-brace gusset plate

BPl = Base plate

IS 800-2007 connections:

DAWC = Cleat angles

WebSideP = Web side plate

EP = End plate

SA = Seating angles

MA = Flange angles

BCP flange splice = Bolted cover flange plates for column and beam splices

BCP web splice = Bolted cover web plates for column and beam splices

MEP = Moment end plate

MEP BS = Moment end plate beam Splice

BPl = Base plate

AS 4100-1998 connections:

AC = Angle cleat

WSP = Web side plate

EP = End plate

SC = Seating connections

FP = Flange plate (bolted/welded)

FP CS = Flange plates for column splices

FP BS = Flange plates for beam splices

BCP Web BS = Bolted cover web plates for beam splices

BCP Web CS = Bolted cover web plates for column splices

BEP = Bolted end plate

BEP BS = Bolted end plate for beam splice

Mitred Knee = Bolted end plate for mitred knee

Bpad = Bearing pad

DW BS = Directly welded flanges for beam splice

DW CS = Directly welded flanges for column splice

WBC = Welded beam to column

CBB = Column-beam-brace gusset connection

BPl = Base plate

NZS 3404-1997 connections:

AC = Angle cleat

WSP = Web side plate

FEP = Flexible end plate

FP = Flange plate (bolted/welded)

FP BS = Flange plates for beam splices

FP CS = Flange plates for column splices

BCP Web BS = Bolted cover web plates for beam splices

BCP Web CS = Bolted cover web plates for column splices

BEP = Bolted end plate

BEP BS = Bolted end plate for beam splices

Mitred Knee = Bolted end plate for mitred knee

WBC = Welded beam to column

CBB = Column-beam-brace gusset plate connections

BPl = Base plate

Design Standard: CSA S16-14

DA = Angle cleat

SP = Single plate

EP = End plate

FP = Flange plate (bolted/welded)

FP BS = Flange plates for beam splices

FP CS = Flange plates for column splices

WCP BS = Web cover plates for beam splices

WCP CS = Web cover plates for column splices

BEP = Bolted end plate

BEP BS = Bolted end plate for beam splices

Mitred Knee = Bolted end plate for mitred knee

WBC = Welded beam to column

BPl = Base plate

Connection families

BCF = Beam - Column flange

BCW = Beam - Column web

BG = Beam - Girder

BS = Beam splice

CS = Column splice

CC = Continuous beam over column

CBB = Column, beams and braces

CVR = Chevron braces

VXB = Vertical X braces

CB = Column – Base

HCBB = Column – Beam – Horizontal braces

HBBB = Girder – Beam – Horizontal braces

HXB = Horizontal X braces

CHB = Tubular truss (Tubular chord–branches)

Remark: In the detailed connection reports, all the capacity values calculated to evaluate the strength ratio and the status of the connections are included. Any supplemental verification required is responsibility of the user.

Connection characteristics

Bolted = all-bolted connection

Welded = all-welded connection

Bolt support = bolted to support

Weld support = welded to support

Bolt beam = bolted to the beam

Weld beam = welded to the beam

n = number of bolts

l = connector length

Note that it is possible to assign more than one connection to a joint. For example the user can assign a shear connection and a moment connection to one joint.

In the case that member size or loads are modified, there is the need to redesign the connections by clicking on the redesign button in the *Design tab, Assignment group*, 

. The command will redesign all of the connections. This consists essentially in repeat the assignment process.

As can be seen, the connection design in RCSA is easy and fast. However, the program has flexibility on how the connections are assigned and designed. The next sections describe in more detail these aspects.

Inclination angles of members (Skew and Slope)

Many of the connections allow beam inclination angles, either horizontal and/or vertical. The list of the connections that allow inclination angles are as follows:

AISC 360 connections:

Connection	Family	Inclination angles		
		Skew	Slope	Both
DA	BCF	Yes	Yes	Yes
Clip (shear)	BCW	Yes	Yes	Yes

Angle/s	BG	Yes	Yes	Yes
SP Shear Plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	Yes	Yes
	BS	No	No	No
	CS	No	No	No
EP End Plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	Yes	Yes
SS Stiffened Shear	BCF	No	No	No
	BCW	No	No	No
US Unstiffened Shear	BCF	No	No	No
	BCW	No	No	No
ST Shear Tee	BCF	No	No	No
	BCW	No	No	No
	BG	No	No	No
TP Through Plate	BCF	No	No	No
	BCW	No	No	No
BP Bent Plate	BCF	Yes	No	No
	BCW	Yes	No	No
	BG	Yes	No	No
DW Direct Weld	BCF	Yes	Yes	No
	BCW	Yes	Yes	No
FullyDW Directly welded	BCF BS	Yes No	Yes Yes	Yes No
MEP Moment End Plate	BCF	No	Yes	No
	BCW BS	No No	Yes Yes	No No
MEPKnee Moment end plate	BCF	No	Yes	No

(Knee)				
FP Flange Plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	No
	BG	Yes	No	No
	BS	No	No	No
	CS	No	No	No
MA Moment Angles	BCF	No	No	No
MT Moment Tee	BCF	No	No	No
CP Cap Plate	CC	No	No	No
4A Four Angles Splice	BS	No	No	No
PBr Plate Bracket	BCW	No	No	No
TBr Tee Bracket	BCF	No	No	No
Bracing connections beams	CBB CVR	No	No	No
Bracing connections braces	CBB, CVR, VXB	No	Yes (20°-70°)	No
Horizontal Bracing connections braces	HCBB, HBBB, HXB	Yes (25 ° - 75°)	No	No
BPl Base Plate: Column	CB	No	No	No
GBP	CB	No	Yes (20°-70°)	No

Base Plate: Braces				
Tubular truss connections	CHB	No	Yes (30°-70°)	No

The CA connection has a 15º skew limit imposed by the AISC code. Each BP template connection has the skew angle limits specified as data in the template.

BS 5950 connections:

Connection	Family	Inclination angles		
		Horizontal	Vertical	Both
Cleat Angles	BCF	No	Yes	No
	BCW	No	Yes	No
	BG	No	Yes	No
Fin Plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	Yes	Yes
Flexible End Plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	No	No
Web Cover Plate	BS	No	No	No
	CS	No	No	No
Bolted End Plate	BCF	No	Yes	No
Directly Flanges Welded	BCF	No	Yes	No
	BCW	No	Yes	No
Directly Flanges and Web Welded	BCF	No	Yes	No
	BCW	No	Yes	No
Flange Cover Plate	BS	No	No	No
	CS	No	No	No

GB 50017 connections:

Connection	Family	Inclination angles		
		Skew	Slope	Both
CA Clip (shear) Angle/s	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	Yes	Yes
SP Shear Plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	Yes	Yes
DW	BCF	Yes	Yes	No
	BCW	Yes	Yes	No
MEP Moment End Plate	BCF	No	Yes	No
	BCW	No	Yes	No
FP Flange Plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	No
	BG	Yes	No	No
	BS	No	No	No
	CS	No	No	No
BPl Base Plate: Column	CB	No	No	No

EN 1993-2005 connections:

Connection	Family	Inclination angles		
		Skew	Skew	Skew
Double angle cleats	BCF	No	Yes	No
	BCW	No	Yes	No
	BG	No	Yes	No
Fin plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes

	BG	Yes	Yes	Yes
Bolted end plate	BCF	No	Yes	No
	BS	No	Yes	No
Web cover plates	BS	No	No	No
	CS	No	No	No
Flexible end plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	Yes	Yes
Directly flanges and web welded	BCF	Yes	Yes	No
	BCW	Yes	Si	No
Flange cover plates	BS	No	No	No
	CS	No	No	No
Bracing connections: beams	CBB	No	No	No
Bracing connections: braces	CBB	No	Yes	No
Base plate: Column	CB	No	No	No

IS 800-2007 connections:

Connection	Family	Inclination angles		
		Skew	Slope	Both
Cleat angle	BCF	No	Yes	No
	BCW	No	Yes	No
	BG	No	Yes	No
Web side plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	Yes	Yes
Moment end plate	BCF	No	Yes	No
	BS	No	Yes	No

Bolted splice web plates	BS	No	No	No
	CS	No	No	No
Flexible end plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	No	No
Flange angles	BCF	No	No	No
Seating angles	BCF	No	No	No
	BCW	No	No	No
Bolted splice flange plates	BS	No	No	No
	CS	No	No	No
Base plate: Column	BP	No	No	No

For Design Standard AS 4100-1998:

Connection	Family	Inclination angles		
		Skew	Slope	Both
Angle cleat	BCF	No	No	No
	BCW	No	No	No
	BG	No	No	No
Web side plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	Yes	Yes
Flexible end plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	No	No
Bolted flange plate splices	BS	No	No	No
	CS	No	No	No
Bolted web plates splices	BS	No	No	No
	CS	No	No	No
Bolted end plate	BCF	No	Yes	No
	BS	No	Yes	No
Mitred knee	BCF	No	No	No
Bearing pad	BCF	No	No	No

	BCW	No	No	No
Seating connections	BCF	No	No	No
	BCW	No	No	No
Directly welded splices	BS	No	No	No
	CS	No	No	No
Welded beam to column	BCF	No	Yes	No
Gusset plate	CBB	No	No	No
Base plate	CB	No	No	No

For Design Standard NZS 3404-1997:

Connection	Family	Inclination angles		
		Skew	Slope	Both
Angle cleat	BCF	No	No	No
	BCW	No	No	No
	BG	No	No	No
Web side plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	Yes	Yes
Flexible end plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	No	No
Bolted flange plate splices	BS	No	No	No
	CS	No	No	No
Bolted web plates splices	BS	No	No	No
	CS	No	No	No
Bolted end plate	BCF	No	Yes	No
	BS	No	Yes	No
Mitred knee	BCF	No	No	No
Welded beam to column	BCF	No	Yes	No
Base plate	CB	No	No	No

For Design Standard CSA S16-14:

Connection	Family	Inclination angles		
		Skew	Slope	Both
Angle cleat	BCF	No	No	No
	BCW	No	No	No
	BG	No	No	No
Web side plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	Yes	Yes
End plate	BCF	Yes	Yes	Yes
	BCW	Yes	Yes	Yes
	BG	Yes	No	No
Flange cover plate	BCF	No	No	No
	BCW	No	No	No
	BS	No	No	No
	CS	No	No	No
Web cover plates splices	BS	No	No	No
	CS	No	No	No
Bolted end plate	BCF	No	Yes	No
	BS	No	Yes	No
Mitred knee	BCF	No	Yes	No
Welded beam to column	BCF	No	Yes	No
Bracing connections: Beams	CBB	No	No	No
Bracing connections: Braces	CBB	No	Si	No
Base plate	CB	No	No	No

HSS Section Supports

The connections can be assigned to HSS section supports. This includes some specific and other modified capacity verifications in reference to I shape supports.

The following connections allow square or rectangular HSS supports:

AISC 360 connections:

Connection	Family	Characteristics	
		to beam	to support
DA	BCF,BCW	bolted/welded	welded
SP	BCF,BCW	bolted	welded
TP	BCF,BCW	bolted	welded
ST	BCF,BCW	bolted/welded	welded
US	BCF,BCW	bolted/welded	welded
SS	BCF,BCW	bolted/welded	welded
DW	BCF,BCW	welded	welded
MEP	BCF,BCW,BS	welded	Bolted to a connection plate (welded to support)
FP	BCF, BCW	bolted/welded	welded
Bracing	CBB	Bolted (CA, SP), /welded	welded
Horizontal Bracing	HCBB	Bolted (CA, SP), /welded	welded
BPl	CB	-	welded
GBP	CB	-	welded

The following connections allow circular HSS supports:

Connection	Family	Characteristics	
		to beam	to support
SP	BCF,BCW	bolted	welded
TP	BCF,BCW	bolted	welded
BPl	CB	-	welded

The following connections allow square or rectangular HSS supports:

BS 5950 connections:

Connection	Family	Characteristics	
		to beam	to support
DAWC	BCF,BCW	bolted	bolted
FinP	BCF,BCW	bolted	welded
FEP	BCF,BCW	bolted	bolted

The following connection allows circular HSS supports:

Connection	Family	Characteristics	
		to beam	to support
FinP	BCF, BCW	bolted	welded

The following connections allow square or rectangular HSS supports:

GB 500017 connections:

Connection	Family	Characteristics	
		to beam	to support
SP	BCF,BCW	bolted	welded
CA	BCF,BCW	bolted/welded	welded
DW	BCF,BCW	welded	welded
FP	BCF, BCW	bolted/welded	welded
BPl	CB	-	welded

The following connections allow square or rectangular HSS supports:

EN 1993-2005 connections:

Connection	Family	Characteristics	
		to beam	to support
BPl	CB	-	welded
FinP	BCF,BCW	bolted	bolted
DAWC	BCF,BCW	bolted	bolted
EP	BCF,BCW	bolted	bolted

The following connections allow circular HSS supports:

Connection	Family	Type of union	
		to beam	to support
FinP	BCF, BCW	bolted	welded

The following connections allow square or rectangular hollow section supports for the designs standard IS 800-2007:

Connection	Family	Characteristics	
		to beam	to support

BPl	CB	-	welded
WebSideP	BCF, BCW	bolted	welded
DAWC	BCF, BCW	bolted	bolted
EP	BCF, BCW	Bolted	bolted

The following connections allow circular hollow section supports for the designs standard IS 800-2007:

Connection	Family	Characteristics	
		to beam	to support
WebSideP	BCF, BCW	bolted	welded

The following connections allow square or rectangular hollow section supports for the design standard AS 4100-1998:

Connection	Family	Characteristics	
		to beam	to support
BPl	CB	-	welded
WSP	BCF, BCW	bolted	welded
AC	BCW	bolted	bolted
EP	BCF, BCW	Bolted	bolted
Bpad	BCF, BCW	-	-
Column beam braces connections	CBB	bolted, welded	bolted, welded
SC	BCF, BCW	bolted, welded	bolted, welded

The following connections allow circular hollow section supports for the design standard AS 4100-1998:

Connection	Family	Characteristics	
		to beam	to support
BPl	CB	-	welded
WSP	BCF, BCW	bolted	welded

The following connections allow square or rectangular hollow section supports for the design standard NZS 3404-1997:

Connection	Family	Characteristics	
		to beam	to support
BPl	CB	-	welded
WSP	BCF, BCW	bolted	welded
Column beam braces	CBB	bolted/welded	bolted/welded

The following connections allow circular hollow section supports for the design standard NZS 3404 - 1997:

Connection	Family	Characteristics	
		to beam	to support
BPl	CB	-	welded
WSP	BCF, BCW	bolted	welded

The following connections allow square or rectangular hollow section supports for the design standard CSA S16-14:

Connection	Family	Characteristics	
		to beam	to support
BPl	CB	-	welded
WSP	BCF, BCW	bolted	welded

The following connections allow circular hollow section supports for the design standard CSA S16 - 14:

Connection	Family	Characteristics	
		to beam	to support
BPl	CB	-	welded
WSP	BCF, BCW	bolted	welded

Tubular truss connections

AISC 360-16 connections:

The following connections allow tubular members:

Connection	Family	Characteristics	
		to chord	to branch
Tubular truss	CHB (Tubular	welded	welded

connections	chord-branches)		

Allowable member types per connections

AISC 360 connections:

CONNECTION	FAMILY	MEMBER TYPES	BUILT UP SYMMETRIC	BUILT UP UNSYMMETRIC	MEMBER FLANGE ROTATION	SECTIONS ALLOWED
Base plate	CB	Prismatic	YES	YES	NO	I, I2C, HSS_RECT, HSS_CIRC
	CB	Tapered	YES	YES	NO	I
Bent plate	BCF	Prismatic	YES	NO	NO	I
	BCW	Prismatic	YES	NO	NO	I
	BG	Prismatic	YES	NO	NO	I
Bracket	Bracket plate	Prismatic	YES	NO	NO	I
	Tee bracket	Prismatic	YES	NO	NO	T
BS4Angles	BS	Prismatic	YES	YES	NO	I
Cap plate	CP	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
Clip angle	BCF	Prismatic	YES	YES	Column "YES"	Beam "I" - Column "I, HSS_RECT"
	BCW	Prismatic	YES	YES	NO	Beam "I" - Column "I, HSS_RECT"
	BG	Prismatic	YES	YES	NO	I
Directly welded	BCF	Prismatic	YES	YES	Column "YES"	Beam "I" - Column "I, HSS_RECT"
	BCW	Prismatic	YES	YES	NO	Beam "I" - Column "I, HSS_RECT"

Fully directly welded	BCF	Column, Beam "Prismatic"	YES	YES	Column " YES "	Beam "I" - Column "I,
	BCF	Tapered member "Beam"	YES	YES	Column " YES "	Beam "I"
	BCF	Haunched member "Beam"	YES	YES	Column " YES "	Haunch "I, T"
	BS	Prismatic	YES	YES	NO	I
	BS	Tapered member	YES	YES	NO	I
	BS	Haunched member	YES	YES	NO	I, T
End plate	BCF	Prismatic	YES	YES	Column "YES"	I
	BCW	Prismatic	YES	YES	NO	I
	BG	Prismatic	YES	YES	NO	I
Flange plate	CS	Prismatic	YES	YES	Top Column "YES"	I
	BCF	Prismatic	YES	YES	NO	Beam "I" - Column "I, HSS_RECT"
	BCW	Prismatic	YES	YES	NO	Beam "I" - Column "I, HSS_RECT"
	BG	Prismatic	YES	YES	NO	I
	BS	Prismatic	YES	YES	NO	I
Gusset base plate	GBP	Prismatic	YES	Column "YES" - Braces "NO"	Column "YES"	Column "I, HSS_RECT" - Braces "I, T, C, I2C, L, T2L, HSS_RECT, HSS_CIRC"
Gusset chevron	CVR	Prismatic	YES	BEAM "YES" - Braces "NO"	NO	Beam "I" - Braces "I, T, C, I2C, L, T2L,

						HSS_RECT, HSS_CIRC"
Gusset column beam brace	CBB	Prismatic	YES	Column "YES" - Beams "YES" - Braces "NO"	Column "YES"	Column "I, HSS_RECT" - Beam "I" - Braces "I, T, C, I2C, L, T2L, HSS_RECT, HSS_CIRC"
Gusset VXB	VXB	Prismatic	YES	NO	NO	Braces "I, T, C, I2C, L, T2L, HSS_RECT, HSS_CIRC"
Horizontal gusset column beam brace	HCBB	Prismatic	YES	Column "YES" - Beams "YES" - Braces "NO"	Column "YES"	Column "I, HSS_RECT" - Beam "I" - Braces "T, C, L, T2L "
Horizontal gusset girder beam	HBBB	Prismatic	YES	Girder - Beam "YES" - Braces "NO"	NO	Girder "I " - Beam "I" - Braces " T, C, L, T2L"
Horizontal gusset	HXB	Prismatic	NO	NO	NO	Braces " T, C, L, T2L"
Moment end plate	BS	Prismatic	YES	YES	NO	I
	BS	Tapered	YES	YES	NO	I
	BS	Haunched	YES	YES	NO	I, T
	BCF	Column, Beam "Prismatic"	YES	YES	Column "YES"	Beam "I" - Column "I, HSS_RECT"
	BCF	Tapered "Beam"	YES	YES	Column "YES"	Beam "I"
	BCF	Haunched "Beam"	YES	YES	Column "YES"	Haunch "I, T"
	BCW	Column, Beam "Prismatic"	YES	YES	NO	Beam "I" - Column "HSS_RECT "

	BCW	Tapered "Beam"	YES	YES	NO	Beam "I"
	BCW	Haunched "Beam"	YES	YES	NO	Haunch "I, T"
Moment end plate Knee	BCF	Tapered	YES	YES	Column "YES"	I
PRConnector	PR	Prismatic	YES	NO	NO	I
Single plate	BS	Prismatic	YES	YES	NO	I
	BCF	Prismatic	YES	YES	Column "YES"	Beam "I" - Column "I, HSS_RECT, HSS_CIRC"
	BCW	Prismatic	YES	YES	NO	Beam "I" - Column "I, HSS_RECT, HSS_CIRC"
	BG	Prismatic	YES	YES	NO	I
	CS	Prismatic	YES	YES	Top Column "YES"	I
Standard tee	BCF	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
	BCW	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
	BG	Prismatic	YES	NO	NO	I
Stiffened seated	BCF	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
	BCW	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
Through plate	BCF	Prismatic	YES	NO	NO	Beam "I" - Column "HSS_RECT, HSS_CIRC"

	BCW	Prismatic	YES	NO	NO	Beam "I" - Column "HSS_RECT, HSS_CIRC"
Unstiffened seated	BCF	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
	BCW	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
Tubular truss connections	CHB	Prismatic	NO	NO	NO	“HSS_RECT, HSS_CIRC”

BS 5950 connections:

CONNECTION	**FAMILY**	**MEMBER TYPES**	**BUILT UP SYMMETRIC**	**BUILT UP UNSYMMETRIC**	**MEMBER FLANGE ROTATION**	**SECTIONS ALLOW**
Bolted end plate	BS	Prismatic	YES	NO	NO	I
	BS	Tapered	YES	NO	NO	I
	BS	Haunched	YES	NO	NO	I, T
Cleat angle	BCF	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
	BCW	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
	BG	Prismatic	YES	NO	NO	I
Fully welded	BCF	Prismatic	YES	NO	NO	I
	BCW	Prismatic	YES	NO	NO	I
Flanges welded	BCF	Prismatic	YES	NO	NO	I
	BCW	Prismatic	YES	NO	NO	I
Fin plate	BCF	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT, HSS_CIRC"

	BCW	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT, HSS_CIRC"
	BG	Prismatic	YES	NO	NO	I
Flange cover plate	BS	Prismatic	YES	NO	NO	I
	CS	Prismatic	YES	NO	NO	I
Flexible end plate	BCF	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
	BCW	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
	BG	Prismatic	YES	NO	NO	I
Moment end plate	BCF	Prismatic	YES	NO	NO	Beam "I" - Column "I" - Haunch "I, T"
	BCF	Haunched	YES	NO	NO	Beam "I" - Column "I" - Haunch "I, T"
Web cover plate	BS	Prismatic	YES	NO	NO	I
	CS	Prismatic	YES	NO	NO	I

GB 500017 connections:

CONNECTION	FAMILY	MEMBER TYPES	BUILT UP SYMMETRIC	BUILT UP UNSYMMETRIC	MEMBER FLANGE ROTATION	SECTIONS ALLOW
Base plate	CB	Prismatic	YES	NO	NO	Column "I, I2C, HSS_RECT, HSS_CIRC"
		Tapered	YES	NO	NO	I
Clip angle	BCF	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
	BCW	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"

	BG	Prismatic	YES	NO	NO	Beam "I" - Girder "I, HSS_RECT"
Directly welded	BCF	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
	BCW	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT"
Flange plate	BCF	Prismatic	YES	NO	NO	I
	BCW	Prismatic	YES	NO	NO	I
	BG	Prismatic	YES	NO	NO	I
Moment end plate	BCF	Column, Beam "Prismatic"	YES	YES	NO	Beam "I" - Column "I, HSS_RECT"
	BCF	Tapered "Beam"	YES	YES	NO	Beam "I"
	BCF	Haunched "Beam"	YES	YES	NO	Haunch "I, T"
	BCW	Column, Beam "Prismatic"	YES	YES	NO	Beam "I" - Column "HSS_RECT"
	BCW	Tapered "Beam"	YES	YES	NO	Beam "I"
	BCW	Haunched "Beam"	YES	YES	NO	Haunch "I, T"
Single plate	BS	Prismatic	YES	NO	NO	I
	BCF	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT, HSS_CIRC"
	BCW	Prismatic	YES	NO	NO	Beam "I" - Column "I, HSS_RECT, HSS_CIRC"
	BG	Prismatic	YES	NO	NO	I

EN 1993-2005 connections:

CONNECTION	FAMILY	MEMBER TYPES	BUILT UP SYMMETRIC	BUILT UP UNSYMMETRIC	MEMBER FLANGE ROTATION	SECTIONS ALLOW
Base plate	CB	Prismatic	YES	YES	NO	Column "I, I2C, HSS_RECT, HSS_CIRC"
Bolted end plate	BS	Prismatic	YES	YES	NO	I
	BS	Haunched	YES	YES	NO	I, T
	BCF	Column, Beam "Prismatic"	YES	YES	Column "YES"	I
	BCF	Haunched "Beam"	YES	YES	Column "YES"	Haunch "I, T"
Cleat angle	BCF	Prismatic	YES	YES	Column "YES"	Beam "I" - Column "I, HSS_RECT"
	BCW	Prismatic	YES	YES		Beam "I" - Column "I, HSS_RECT"
	BG	Prismatic	YES	YES		I
Cleat angle	CS	Prismatic	YES	YES	Top Column "YES"	I
Fully welded BCF	BCF	Prismatic	YES	YES	Column "YES"	I
Fully welded BCW	BCW	Prismatic	YES	YES		I
Flanges welded BCF	BCF	Prismatic	YES	YES	Column "YES"	I
Flanges welded BCW	BCW	Prismatic	YES	YES		I
End plate	BCF	Prismatic	YES	YES	Column "YES"	Beam "I" - Column "I, HSS_RECT"
	BCW	Prismatic	YES	YES		Beam "I" - Column "I, HSS_RECT"

	BG	Prismatic	YES	YES		I
	CS	Prismatic	YES	NO		HSS_RECT, HSS_CIRC
Fin plate	BCF	Prismatic	YES	YES	Column "YES"	Beam "I" - Column "I, HSS_RECT, HSS_CIRC"
	BCW	Prismatic	YES	YES		Beam "I" - Column "I, HSS_RECT, HSS_CIRC"
	BG	Prismatic	YES	YES		I
Flange cover plate	BS	Prismatic	YES	YES		I
	CS	Prismatic	YES	YES	Top Column "YES"	I
Gusset column beam brace	CBB	Prismatic	YES	Column "YES" - Beams "YES" - Braces "NO"	Column "YES"	Column "I" - Beam "I" - Braces "C, I2C, L, T2L, HSS_RECT, HSS_CIRC"
Web cover plate	BS	Prismatic	YES	YES		I
	CS	Prismatic	YES	YES	Top Column "YES"	I

IS 800-2007 connections:

CONNECTION	**FAMILY**	**MEMBER TYPES**	**BUILT UP SYMMETRIC**	**BUILT UP ASYMMETRIC**	**MEMBER FLANGE ROTATION**	**SECTIONS ALLOWED**
Base plate	CB	Prismatic	YES	YES	NO	I, I2C, HSS_RECT, HSS_CIRC (Column)
Moment end plate	BS	Prismatic	YES	YES	NO	I
	BS	Haunched	YES	YES	NO	I, T

	BCF	Prismatic (Column, Beam)	YES	YES	YES (Column)	I
	BCF	Haunched (Beam)	YES	YES	YES (Column)	I, T (Haunch)
Cleat angle	BCF	Prismatic	YES	YES	YES (Column)	I (Beam) I, HSS_RECT (Column)
	BCW	Prismatic	YES	YES	NO	I (Beam) I, HSS_RECT (Column)
	BG	Prismatic	YES	YES	NO	I
Flange angles	BCF	Prismatic	YES	YES	YES (Column)	I
Seating angles	BCF	Prismatic	YES	YES	YES (Column)	I
	BCW	Prismatic	YES	YES	NO	I
End plate	BCF	Prismatic	YES	YES	YES (Column)	I (Beam) I, HSS_RECT (Column)
	BCW	Prismatic	YES	YES	NO	I (Beam) I, HSS_RECT (Column)
	BG	Prismatic	YES	YES	NO	I
Web side plate	BCF	Prismatic	YES	YES	YES (Column)	I (Beam) I, HSS_RECT, HSS_CIRC (Column)
	BCW	Prismatic	YES	YES	NO	I (Beam) I, HSS_RECT, HSS_CIRC (Column)
	BG	Prismatic	YES	YES	NO	I
Flange cover plates	BS	Prismatic	YES	YES	NO	I
	CS	Prismatic	YES	YES	YES (Top Column)	I

Web cover plates	BS	Prismatic	YES	YES	NO	I
	CS	Prismatic	YES	YES	YES (Top Column)	I

AS 4100-1998 connections:

CONNECTION	FAMILY	MEMBER TYPES	BUILT UP SYMMETRIC	BUILT UP ASYMMETRIC	MEMBER FLANGE ROTATION	SECTIONS ALLOWED
Base plate	CB	Prismatic	YES	YES	NO	I, I2C, HSS_RECT, HSS_CIRC (Column)
Bolted end plate	BS	Prismatic	YES	YES	NO	I
	BS	Haunched	YES	YES	NO	I, T
	BCF	Prismatic (Column, Beam)	YES	YES	YES (Column)	I
	BCF	Haunched (Beam)	YES	YES	YES (Column)	I, T (Haunch)
Mitred Knee	BCF	Prismatic	Yes	Yes	YES (Column)	I
Angle cleat	BCF	Prismatic	YES	YES	YES (Column)	I
	BCW	Prismatic	YES	YES	NO	I
	BG	Prismatic	YES	YES	NO	I
Flange plate	BCF	Prismatic	YES	YES	YES (Column)	I
	BCW	Prismatic	YES	YES	NO	I
Seating connections	BCF	Prismatic	YES	YES	YES (Column)	I, HSS_RECT (Column)
	BCW	Prismatic	YES	YES	NO	I, HSS_RECT (Column)
End plate	BCF	Prismatic	YES	YES	YES (Column)	I

	BCW	Prismatic	YES	YES	NO	I
	BG	Prismatic	YES	YES	NO	I
Web side plate	BCF	Prismatic	YES	YES	YES (Column)	I (Beam) I, HSS_RECT, HSS_CIRC (Column)
	BCW	Prismatic	YES	YES	NO	I (Beam) I, HSS_RECT, HSS_CIRC (Column)
	BG	Prismatic	YES	YES	NO	I
Bolted flange plates	BS	Prismatic	YES	YES	NO	I
	CS	Prismatic	YES	YES	YES (Top Column)	I
Bolted web plates	BS	Prismatic	YES	YES	NO	I
	CS	Prismatic	YES	YES	YES (Top Column)	I
Bearing pad	BCF	Prismatic	YES	YES	YES (Top Column)	I (Beam) I, HSS_RECT, HSS_CIRC (Column)
	BCW	Prismatic	YES	YES	YES (Top Column)	I (Beam) I, HSS_RECT, HSS_CIRC (Column)
Directly welded splices	BS	Prismatic	YES	YES	NO	I
	CS	Prismatic	YES	YES	YES (Top Column)	I
Welded beam to column	BCF	Prismatic	Yes	Yes	YES (Column)	I
Column beam braces	CBB	Prismatic	YES	Column "YES" - Beams	Column "YES"	Column "I, HSS_RECT"

connections				"YES" - Braces "NO"		- Beam "I" - Braces "I, I2C, L, T2L, HSS_RECT, HSS_CIRC"

NZS 3404-1997 connections:

CONNECTION	FAMILY	MEMBER TYPES	BUILT UP SYMMETRIC	BUILT UP ASYMMETRIC	MEMBER FLANGE ROTATION	SECTIONS ALLOWED
Base plate	CB	Prismatic	YES	YES	NO	I, I2C, HSS_RECT, HSS_CIRC (Column)
Bolted end plate	BS	Prismatic	YES	YES	NO	I
	BS	Haunched	YES	YES	NO	I, T
	BCF	Prismatic (Column, Beam)	YES	YES	YES (Column)	I
	BCF	Haunched (Beam)	YES	YES	YES (Column)	I, T (Haunch)
Mitred Knee	BCF	Prismatic	Yes	Yes	YES (Column)	I
Angle cleat	BCF	Prismatic	YES	YES	YES (Column)	I
	BCW	Prismatic	YES	YES	NO	I
	BG	Prismatic	YES	YES	NO	I
Flange plate	BCF	Prismatic	YES	YES	YES (Column)	I
	BCW	Prismatic	YES	YES	NO	I
End plate	BCF	Prismatic	YES	YES	YES (Column)	I
	BCW	Prismatic	YES	YES	NO	I
	BG	Prismatic	YES	YES	NO	I

Web side plate	BCF	Prismatic	YES	YES	YES (Column)	I (Beam) I, HSS_RECT, HSS_CIRC (Column)
	BCW	Prismatic	YES	YES	NO	I (Beam) I, HSS_RECT, HSS_CIRC (Column)
	BG	Prismatic	YES	YES	NO	I
Bolted flange plates	BS	Prismatic	YES	YES	NO	I
	CS	Prismatic	YES	YES	YES (Top Column)	I
Bolted web plates	BS	Prismatic	YES	YES	NO	I
	CS	Prismatic	YES	YES	YES (Top Column)	I
Welded beam to column	BCF	Prismatic	Yes	Yes	YES (Column)	I

CSA S16-14 connections:

CONNECTION	**FAMILY**	**MEMBER TYPES**	**BUILT UP SYMMETRIC**	**BUILT UP ASYMMETRIC**	**MEMBER FLANGE ROTATION**	**SECTIONS ALLOWED**
Base plate	CB	Prismatic	YES	YES	NO	I, I2C, HSS_RECT, HSS_CIRC (Column)
Bolted end plate	BS	Prismatic	YES	YES	NO	I
	BS	Haunched	YES	YES	NO	I, T
	BCF	Prismatic (Column, Beam)	YES	YES	YES (Column)	I
	BCF	Haunched (Beam)	YES	YES	YES (Column)	I, T (Haunch)
Mitred Knee	BCF	Prismatic	Yes	Yes	YES (Column)	I

Angle cleat	BCF	Prismatic	YES	YES	YES (Column)	I
	BCW	Prismatic	YES	YES	NO	I
	BG	Prismatic	YES	YES	NO	I
Flange plate	BCF	Prismatic	YES	YES	YES (Column)	I
	BCW	Prismatic	YES	YES	NO	I
End plate	BCF	Prismatic	YES	YES	YES (Column)	I
	BCW	Prismatic	YES	YES	NO	I
	BG	Prismatic	YES	YES	NO	I
Web side plate	BCF	Prismatic	YES	YES	YES (Column)	I (Beam) I, HSS_RECT, HSS_CIRC (Column)
	BCW	Prismatic	YES	YES	NO	I (Beam) I, HSS_RECT, HSS_CIRC (Column)
	BG	Prismatic	YES	YES	NO	I
Flange plate splices	BS	Prismatic	YES	YES	NO	I
	CS	Prismatic	YES	YES	YES (Top Column)	I
Web cover plates splices	BS	Prismatic	YES	YES	NO	I
	CS	Prismatic	YES	YES	YES (Top Column)	I
Welded beam to column	BCF	Prismatic	Yes	Yes	YES (Column)	I

Design Criteria

It is important for the user to know exactly how the design process is performed. Each assignment button (either from the Smart, Basic or Gusset connections) is associated with a list of connections templates.

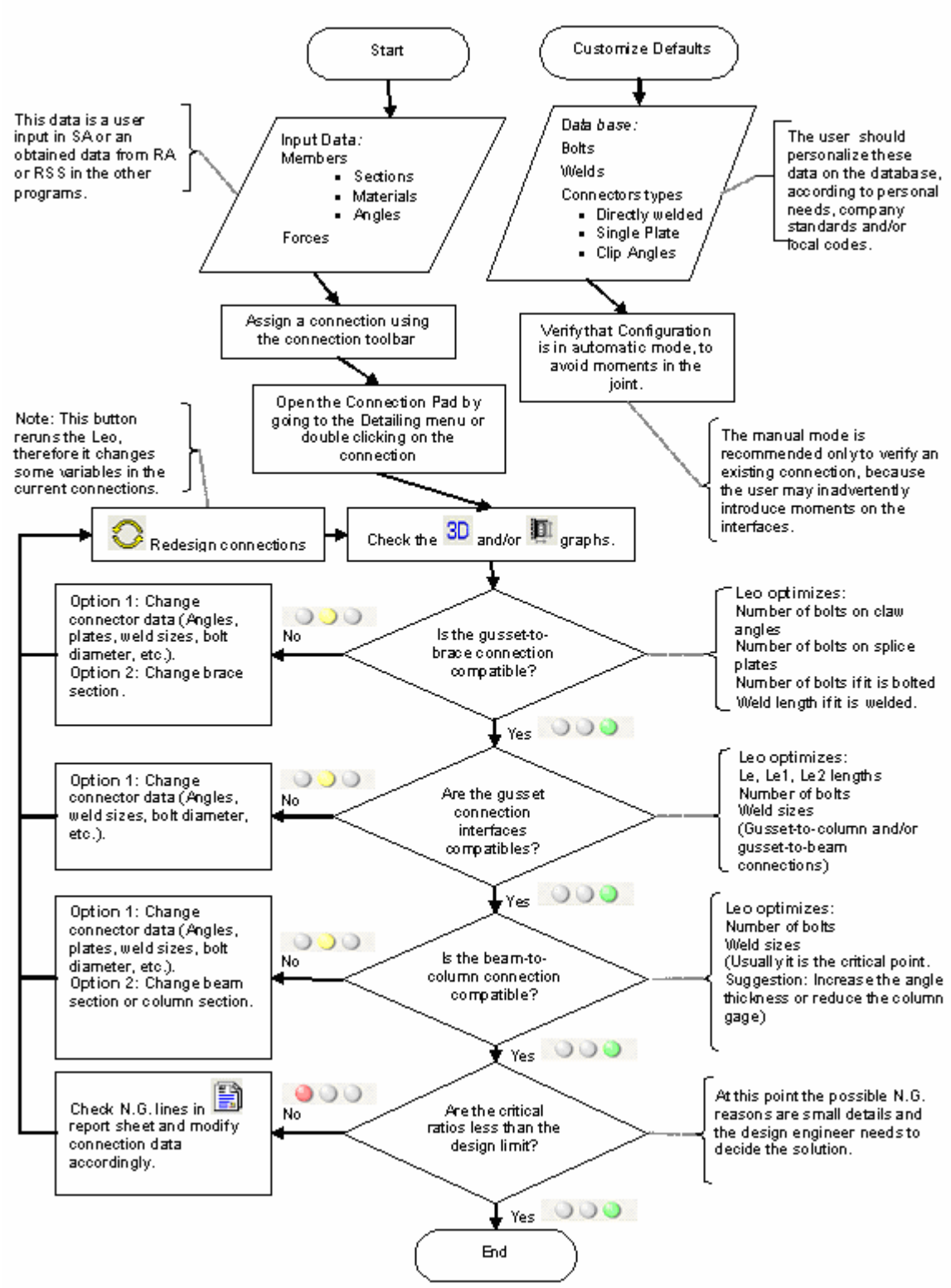
Design criteria for RCSA

When a connection template is assigned, after introducing loads, materials and members, the program will check the templates in the list order. As soon as it finds a connection template that complies with the strength requirements and geometrical conditions, it will be assigned. Note that the order of the list will give the hierarchy and preference for the connection assignment. If any connection meets all the requirements, the last checked connection in the list would be assigned even if it does not satisfy the requirements. The user has to verify the results to accept or dismiss the proposed connection.

However, it could be the case that an assignment button does not assign any connection. This may happen because at least one validation check was not satisfied. The connection validation checks are conditions that have to be met in order to avoid the invalidation of the connection. For example, according to the AISC code, the maximum skew for a shear connection must not be more than 15º. If a joint has more than 15º and the connection is tried to be assigned, a message will be shown that was not possible to assign any connection. Besides, if in an assigned connection the skew angle or the section type of the members is modified with a value that invalidates the connection, the graph of the connection will disappear.

Any database connection template may be included in the list of an assignment button. When an assignment button is applied to the model, the resultant connections are based on one of the specified connection templates, but the model connection itself is stored with the structure and is not linked to the template after assignment.

Suggested steps for bracing connection design



The Connection Database

RAM Connection ships with an extensive collection of predefined connections templates. The user is free to add, remove or modify connections from this provided list of connections.

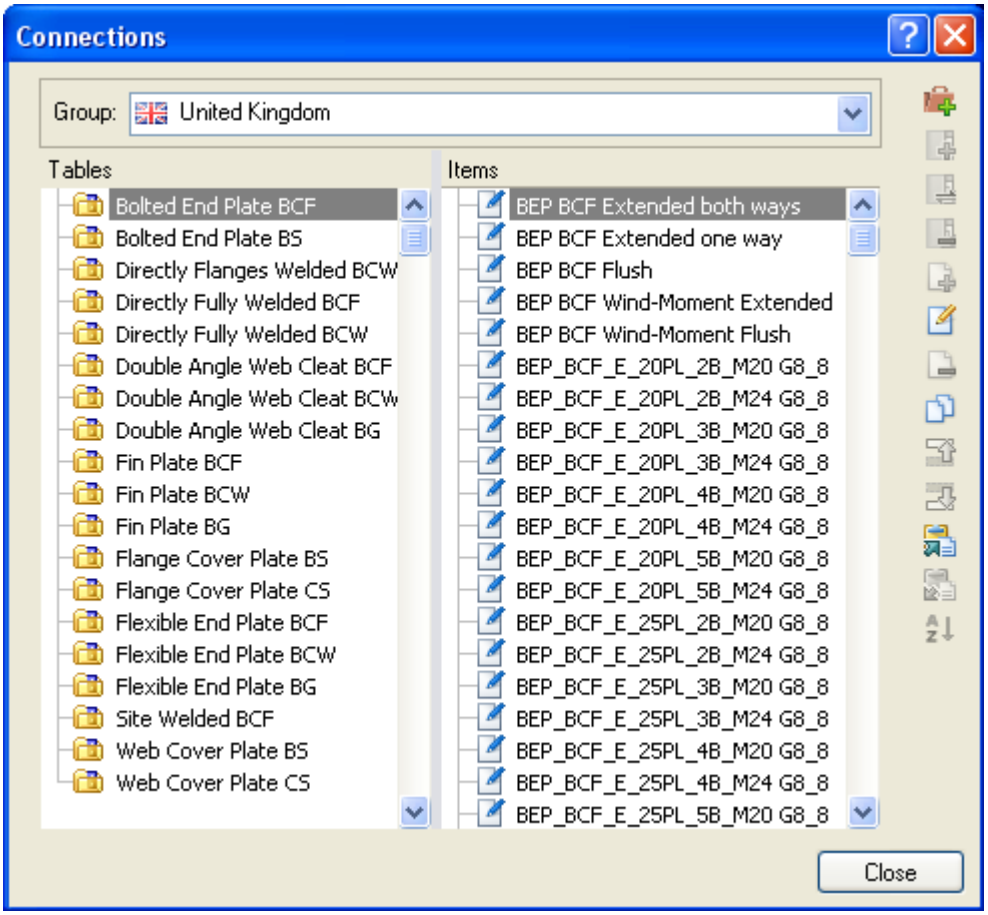
Database Organization

Each connection in the database is categorized according to the family to which it belongs. RAM Connection currently offers users the following families of connections; the connection families are:

1. Beam – Column Flange (BCF)
2. Beam – Column Web (BCW)
3. Beam – Girder (BG)
4. Beam Splice (BS)
5. Column Splice (CS)
6. Continuous beam over column (CC)
7. Column, beams and braces (CBB)
8. Chevron braces (CVR)
9. Vertical X braces (VXB)
10. Column – Base (CB)
11. Column – Base – Braces (CB)
12. Column – Beam – Horizontal braces (HCBB)
13. Girder – Beam – Horizontal braces (HBBB)
14. Horizontal X braces (HXB)
15. Tubular truss connections (CHB)

Press the 

button in the *Database group – Home tab*. This action will open the connection templates window.



The window that is displayed is the connection-database window.

Each connection template in the database can be considered a 'Basic' or a 'Smart' connection.

Basic Connection: A connection template that can automatically adjust the geometry (position or dimensions) of the connection pieces to fit the connecting members. It does not calculate the quantity or dimensions of the connecting pieces (bolts, plates etc.) to resist the applied forces.

Smart Connection: A connection template that can automatically calculate the quantity and dimensions of the connecting pieces (bolts, welds, plate sizes, etc.) to resist the applied forces.

Within each folder in the left side is a list of single connection templates shown in the right side of the window. Two templates with the same name are not allowed, even in different folders. It is the user's prerogative how to group the templates within a folder. The folder name should be used as an organizational tool to assist in grouping connections according to user's own practice. The connection templates that are installed with RAM Connection are grouped in two main groups (Smart and Basic connections) and subdivided according to function (Shear, Moment or Bracing) and type (Single plate, End plate, etc.). This classification keeps the shear, moment and bracing connections separate. However, the user can also create folders where the bracing, moment and shear connection templates are in one folder and even in one connection template (combined connection template, only for moment and shear connections).

The templates tables may contain a set of basic templates and smart templates for each family and type. The smart connections have the capability to design some of its own properties based on the forces and members to which it is assigned. The 'Basic' connections contain a simple macro that adjusts the dimensions and location of the connection pieces according to the joint members. Once

again it should be noticed that this organizational structure (separating the smart connection templates from the other connection templates) is not significant in terms of how RAM Connection works. However, before creating a new connections database, the way of organizing it should be conceived in order to rapidly locate the connections desired to be considered for design.

It is very important to note that in the case of Smart Connections, while some of the connection parameters are designed based on the required forces, others may be designed according to geometry. If a smart connection template does not design the connection according to user's convenience, copies of the smart connection may be created with variations on the desired parameter.

To identify basic templates from smart templates watch for the template name. The name of basic templates has the information of connection elements dimensions such as thicknesses, bolt diameters, angles sizes, weld sizes, etc. Smart templates do not have this information contained in the name. For example, select the "United States" group, "Clip Angle BCF" table and look at the names "DA BCF All bolted" and "DA_BCF_L 3x3x1/2_2B1". The first one is a smart template and the second one, a basic template.

The following smart connection templates are included in the program. Note that the items that are optimized in each template are listed, if an item is not listed then there is a default value associated with the connection that can be modified as required to suit the particular requirements:

AISC 360 connections:

Type of connections (Folder name)	**Family and Description**	**Optimization of the following parameters**
DA	BCF, BCW, BG double angle connections	number of bolts for bolted connections, weld size for welded connections and angle size
DA Beam splice	BS double angle bolted connections	number of bolts and angle size
SP	BCF, BCW, BG, single plate angle connections	number of bolts, plate size, weld size to support
SP Beam splice	BS single plate angle connections	number of bolts, plate size
EP	BCF, BCW, BG end plate connections	number of bolts, plate size, weld size to beam for bolted connections and plate size and welds sizes for welded connections
ST	BCF, BG shear tee connections	tee size, number of bolts for bolted and weld size for welded connections
SS	BCF, BCW stiffened seated connections, type SST, SSP, SS2L	bolts rows , weld size and connector size
US	BCF, BCW unstiffened seated	angle size bolts rows or weld

	connections	size
DW	BCF, BCW, BG directly welded connections	extended plate size for BCW connections
FullyDW	BCF, BS fully directly welded connections	Fillet welds
FP	BCF, BCW, BG bolted flange plate connections	bolts rows, distances between bolts, top and bottom plate thickness, weld size to support
FP	BCF, BCW, BG welded flange plate connections	welds sizes, top and bottom plate sizes
MEP, MEPKnee	BCF Moment end plate connections	bolts sizes, Weld sizes , bolt rows, plate thickness
MA	BCF bolted moment angle	bolt rows and angle size
Base Plate: Pinned, Fixed uniaxial, Fixed biaxial	Column base plate connections	The Thickness, length and width of the base plate, the length and diameter of the anchors, and the support's weld size
Gusset base plate	Column and braces base plate connections	The Thickness, length and width of the base plate, the length and diameter of the anchors, and the support's weld size. See the following table for gussets details
Gussets and Horizontal gussets	CBB, CVR, VXB, HCBB, HBBB, HXB connections	See the following tables for details

Gusset	**Gusset-to-Brace**		**Gusset-to-Beam or Column**		
All	*For W and WT sections*	*For L, T2L, C, I2C y HSS sections*	*Directly Welded*	*Single Plate*	*Double Angles*
Le, Le1 and Le2 distances to let the gusset be	Number of bolts on claw angles	Weld length (toe and heel) – if it is welded	Required weld size	Required weld size	Number of bolts on support – if it is bolted

compatible with the connectors geometry	Number of bolts on splice plates	Number of bolts – if it is bolted		Number of bolts	Number of bolts on beam/gusset – if it is bolted
				Plate thickness	Support weld size – if it is welded
					Beam/gusset weld size – if it is welded

Gusset-to-Brace	**Gusset-to-Girder or Beam**	
For WT, L, T2L, C sections	*Directly Bolted*	*Double Angles*
Number of bolts.	Number of bolts.	Number of bolts on support and Angle section – if it is bolted
Number of bolts.	Number of bolts.	Number of bolts and Angle section – if it is bolted
		Support weld size and Angle section – if it is welded

Type of connections (Folder name)	**Family and Description**	**Optimization of the following parameters**
Tubular connections	CHB	Weld size.

BS 5950 connections:

Type of connections (Folder name)	**Family and Description**	**Optimization of the following parameters**
BEP	BCF, Bolted End Plate connections	Number of bolts, Weld Size, Plate thickness
FEP	BCF, BCW, BG, Flexible end plate connections	Number of bolts, Weld Size, Plate thickness

DAWC	BCF, BCW, BG Cleats angles connections	Number of bolts, Angle section
FW	BCF, BCW Flanges welded connections	Weld size, Plate thickness
FWW	BCF, BCW Flanges and web welded connections	Weld size, Plate thickness
FinP	BCF, BCW, BG Fin Plate connections	Number of bolts, Plate thickness
FCP Beam splice	BS bolted flange plate connections	Number of bolts and plate thickness for top and bottom plate
FCP Column splice	CS bolted flange plate connections	Number of bolts and plate thickness for front and back plate
WCP Beam Splice	BS bolted web plate connections	Number of bolts and plate thickness
WCP Column splice	CS bolted web plate connections	Number of bolts and plate thickness

GB 50017:03 Connections:

Type of connections (Folder name)	**Family and Description**	**Optimization of the following parameters**
CA	BCF, BCW, BG double angle connections	Number of bolts for bolted connections and angle size
SP	BCF, BCW, BG, single plate angle connections	Number of bolts, plate size and weld size.
DW	BCF, BCW, BG directly welded connections	
FP	BCF, BCW, BG bolted flange plate connections	Bolts rows, distances between bolts, top and bottom plate thickness, weld size to support
FP	BCF, BCW, BG bolted flange plate connections	Welds sizes, top and bottom plate sizes
MEP	BCF Moment end plate connections	Bolts sizes, Weld sizes , bolt rows, plate thickness
Base plate	Column base plate connections	Thickness, length and width of the base plate, the length and diameter of the anchors

EN 1993-2005 Connections:

Type of connections (Folder name)	**Family and Description**	**Optimization of the following parameters**
Smart BEP	BCF, Bolted End Plate connections	Bolt sizes, Weld sizes, plate Thickness, Flush extension distance
Smart BEP BS	BS, Bolted End Plate connections	Bolt sizes, Weld sizes, plate Thickness, Flush extension distance
Smart BCP Flanges	BS, CS, bolted flange plate connections	Bolt sizes, plate Thickness.
Smart BCP web	BS, CS, bolted web plate connections	Bolt sizes, plate Thickness.
Smart DAWC	BCF, BCW, BG Cleats angles connections	Angle section, bolt number to beam and support.
Smart WAC CS		Bolt number in plate and support
Smart FinP	BCF, BCW, BG Fin Plate connections	Bolt sizes, Weld Sizes, plate Thickness
Smart EP	BCF, BCW, BG, Flexible end plate connections	Bolt number, Weld sizes, plate Thickness
Smart DW	BCF, BCW, Directly welded beam to column connections	Weld sizes, plate Thickness
Base plate: Pinned, Fixed uniaxial, Fixed biaxial	Column base plate connections	Thickness, length and width of the base plate, the length and diameter of the anchors and the support's weld size
Bracing	Connections CBB_DB	See the following table for details

Gusset	**Gusset-Brace**	**Gusset-Beam or Column**
All	*To sections L, C, I2C y HSS*	*Directly welded*
Le, Le1 and Le2 distances to let the gusset be compatible with	Weld length (toe and heel) – if it is welded	Weld sizes

the connectors geometry	Bolt number if it is bolted connection	

For the Design standard IS 800-2007:

Type of connections (Folder name)	Family and Description	Optimization of the following parameters
Smart MEP	BCF, Moment End Plate connections	Bolt number, weld sizes, plate thickness, and flush extension distance.
Smart MEP BS	BS, Moment End Plate connections	Bolt number, weld sizes, plate thickness, and flush extension distance.
Smart BCP Flanges	BS, CS, bolted flange splice plates connections	Bolt number, plate thickness.
Smart BCP web	BS, CS, bolted web splice plates connections	Bolt number, plate thickness.
Smart DAWC	BCF, BCW, BG Cleats angles connections	Angle section, bolt number to beam and support.
Smart WebSideP	BCF, BCW, BG Web side plate connections	Bolt number, weld sizes, plate thickness.
Smart EP	BCF, BCW, BG, Flexible end plate connections	Bolt number, weld sizes, plate thickness.
Seating angles	BCF, BCW, seating angle connections	Angle section, bolt number, and weld sizes.
Flange angles	BCF, flange moment angles	Angle section, bolt number.
Base plate: Pinned, Fixed uniaxial, Fixed biaxial	Column base plate connections	Thickness, length and width of the base plate, the length and diameter of the anchors and the support's weld size.

For the Design standard AS 4100-1998:

Type of connections (Folder name)	Family and Description	Optimization of the following parameters
Smart BEP	BCF, Bolted End Plate connections	Bolt number, weld sizes, plate thickness, bolt diameter

		and flush extension distance.
Smart BEP BS	BS, Bolted End Plate connections	Bolt number, weld sizes, plate thickness, bolt diameter and flush extension distance.
Smart BCP Flanges	BS, CS, bolted flange splice plates connections	Bolt number, plate thickness, weld sizes.
Smart BCP web	BS, CS, bolted web splice plates connections	Bolt number, plate thickness, weld sizes.
Smart AC	BCF, BCW, BG Cleats angles connections	Angle section, bolt number to beam and support.
Smart WebSideP	BCF, BCW, BG Web side plate connections	Bolt number, weld sizes, plate thickness.
Smart EP	BCF, BCW, BG, Flexible end plate connections	Bolt number, weld sizes, plate thickness.
Seating connections	BCF, BCW, seating angle connections	Angle section, angle length and bolts number.
Flange plate	BCF, flange moment angles	Plate thickness, bolts number and weld sizes.
Mitred Knee	BCF, Bolted End Plate connections	Bolt number, weld sizes, plate thickness, bolt diameter and flush extension distance.
Smart WBC	BCF, Welded beam to column	Weld sizes
Directly welded splices	BS, CS, directly welded members for splices	Weld sizes
Base plate: Pinned, Fixed uniaxial, Fixed biaxial	Column base plate connections	Thickness, length and width of the base plate, the length and diameter of the anchors and the support's weld size.
Smart CBB	CBB, column beam braces connections	See the following table for details

Gusset	**Gusset-Brace**	**Gusset-Beam or Column**
All	*To sections L, C, I2C y HSS*	*Directly welded*
Le, Le1 and Le2 distances to let the gusset be compatible with	Weld length (toe and heel) – if it is welded	Weld sizes

the connectors geometry	Bolt number if it is bolted connection	

For the Design standard NZS 3404-1997:

Type of connections (Folder name)	Family and Description	Optimization of the following parameters
Smart BEP	BCF, Bolted End Plate connections	Bolt number, weld sizes, plate thickness, bolt diameter and flush extension distance.
Smart BEP BS	BS, Bolted End Plate connections	Bolt number, weld sizes, plate thickness, bolt diameter and flush extension distance.
Smart BCP Flanges	BS, CS, bolted flange splice plates connections	Bolt number, plate thickness, weld sizes.
Smart BCP web	BS, CS, bolted web splice plates connections	Bolt number, plate thickness, weld sizes.
Smart AC	BCF, BCW, BG Cleats angles connections	Angle section, bolt number to beam and support.
Smart WebSideP	BCF, BCW, BG Web side plate connections	Bolt number, weld sizes, plate thickness.
Smart EP	BCF, BCW, BG, Flexible end plate connections	Bolt number, weld sizes, plate thickness.
Flange plate	BCF, flange moment angles	Plate thickness, bolts number and weld sizes.
Mitred Knee	BCF, Bolted End Plate connections	Bolt number, weld sizes, plate thickness, bolt diameter and flush extension distance.
Smart WBC	BCF, Welded beam to column	Weld sizes
Base plate: Pinned, Fixed uniaxial, Fixed biaxial	Column base plate connections	Thickness, length and width of the base plate, the length and diameter of the anchors and the support's weld size.

For the Design standard CSA S16-14:

Type of connections	Family and Description	Optimization of the following parameters

(Folder name)		
Smart BEP	BCF, Bolted End Plate connections	Bolt number, weld sizes, plate thickness, bolt diameter and flush extension distance.
Smart BEP BS	BS, Bolted End Plate connections	Bolt number, weld sizes, plate thickness, bolt diameter and flush extension distance.
Smart BCP Flanges	BS, CS, bolted flange splice plates connections	Bolt number, plate thickness, weld sizes.
Smart BCP web	BS, CS, bolted web splice plates connections	Bolt number, plate thickness, weld sizes.
Smart AC	BCF, BCW, BG Cleats angles connections	Angle section, bolt number to beam and support.
Smart WebSideP	BCF, BCW, BG Web side plate connections	Bolt number, weld sizes, plate thickness.
Smart EP	BCF, BCW, BG, Flexible end plate connections	Bolt number, weld sizes, plate thickness.
Flange plate	BCF, flange moment angles	Plate thickness, bolts number and weld sizes.
Mitred Knee	BCF, Bolted End Plate connections	Bolt number, weld sizes, plate thickness, bolt diameter and flush extension distance.
Smart WBC	BCF, Welded beam to column	Weld sizes
Base plate: Pinned, Fixed uniaxial, Fixed biaxial	Column base plate connections	Thickness, length and width of the base plate, the length and diameter of the anchors and the support's weld size.

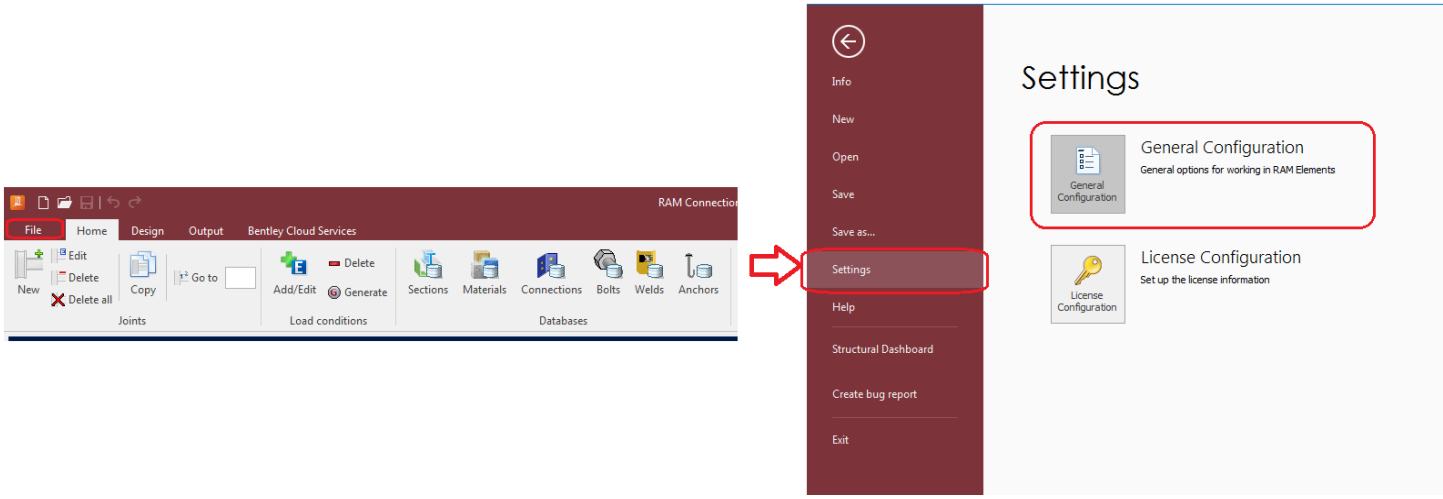
The following connection name convention has been adopted:

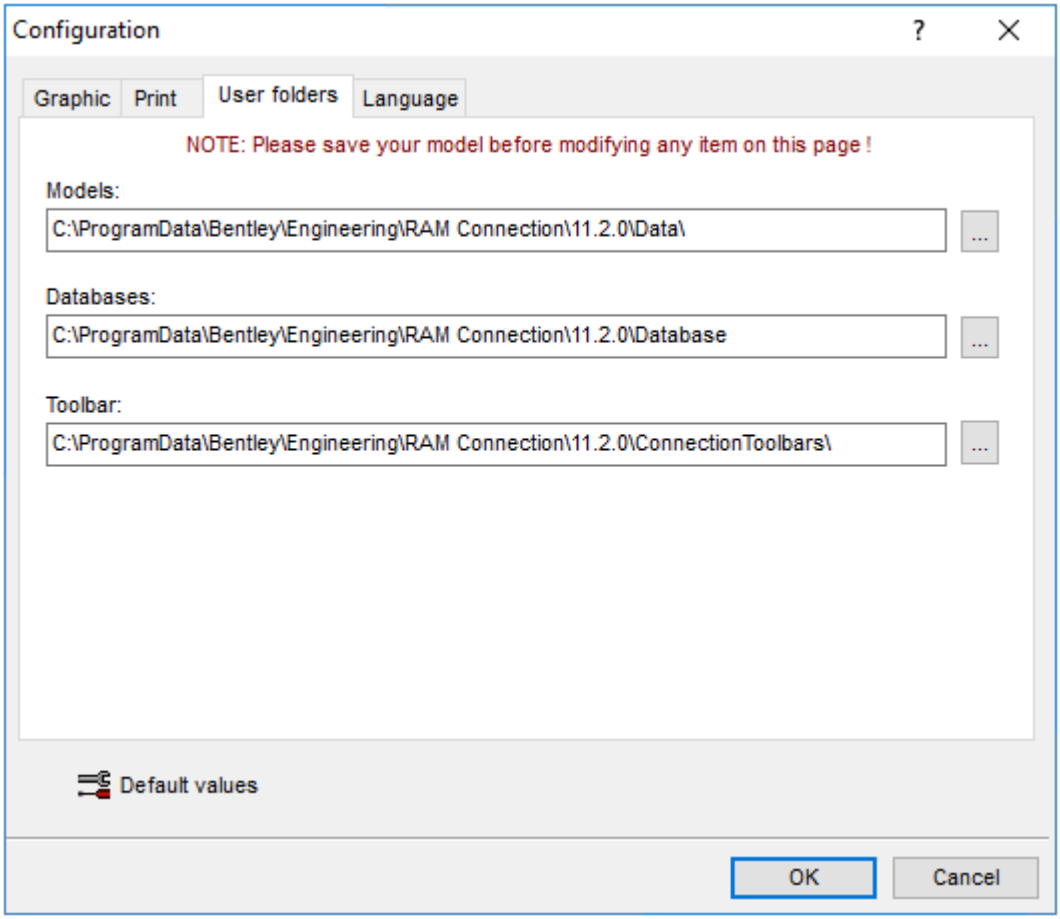
<Connection Type – Connection Family -Connection Characteristic – Design Parameter>

Smart Connection example: DA BCF Weld support Bolt beam

Basic Connection example: DA_BCF_L 3x3x1/4_3B3/4

Remark: The folders where the Connection Database, the LEO files and the Toolbar are located could be configured, by choosing any required directory, even a network directory. To do this, select the page *Default folders* after pressing the option *General configuration* in the File button menu.



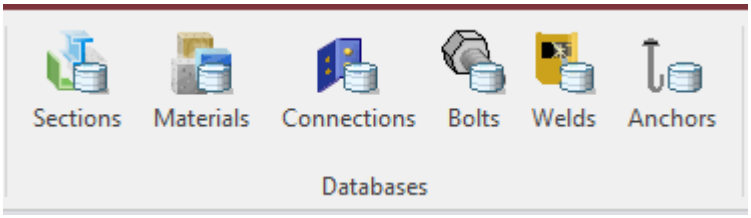


Directories configuration window

Creation of a new connection

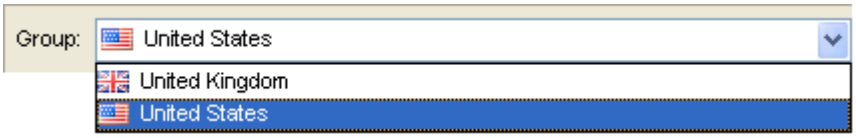
The steps to create and add templates to the connection database are discussed next.

To add a new folder proceeds as follows in the database dialog window:



Go to the Home tab, Databases group and press the Connections button. A dialog window will appear.

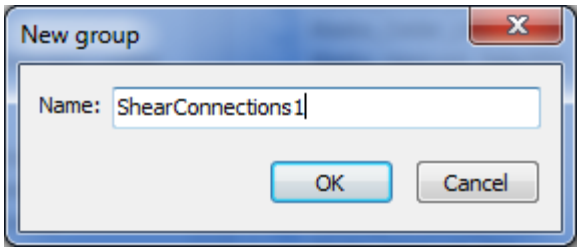
The dialog window shows a combo box with the label "Group", as can be seen in the following figure:



The program installs connections databases by group and regions. In the left side of the window the Tables for the current group are located, and they are determined by type of connection contained in the group. In the right side of the window there is the items list for each table.

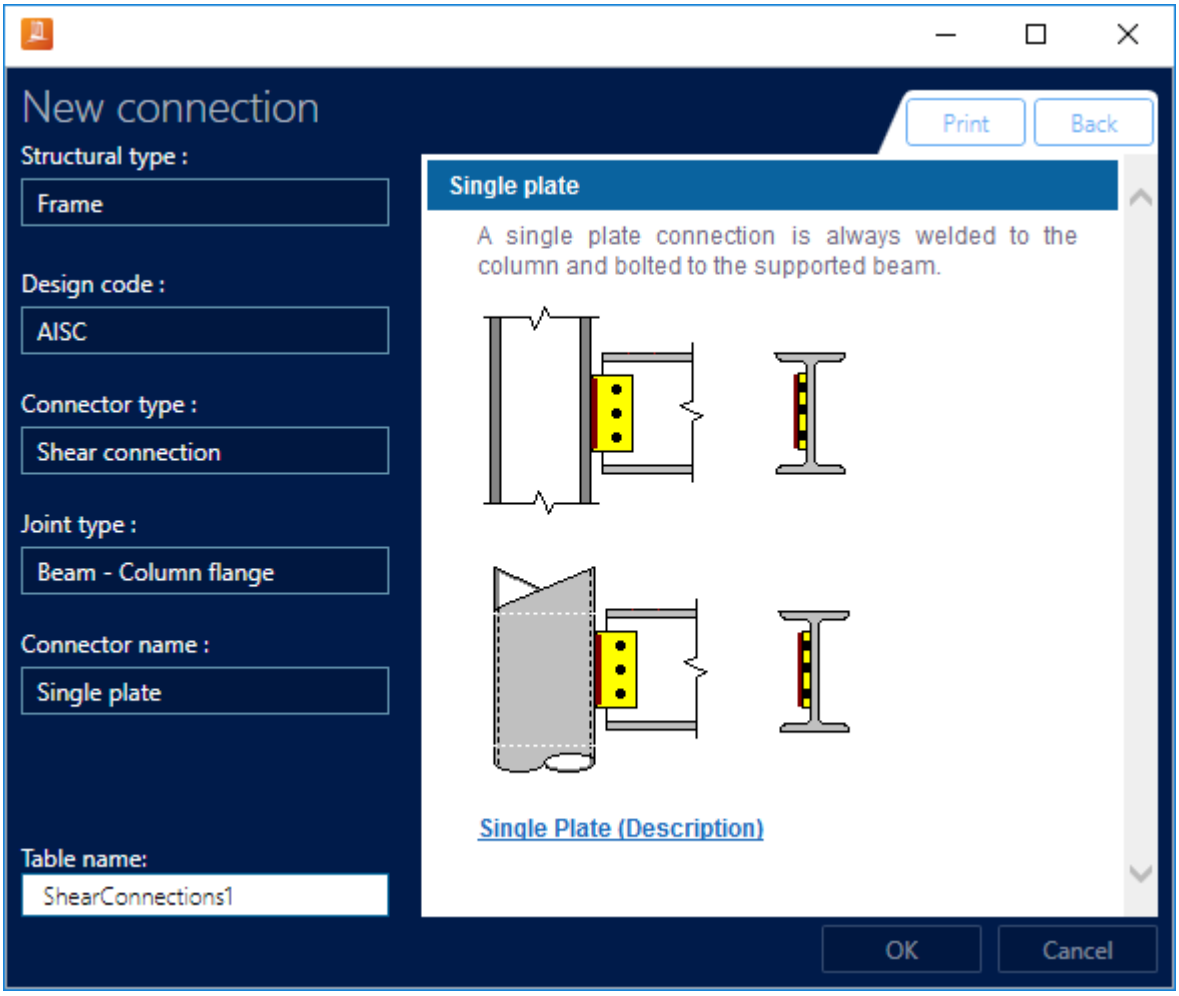
The user cannot modify the databases (items, tables and groups) that are installed by the program. It is possible to access to see items data and properties with the edition button , but without the chance to modify this information. However, this dialog allows the user to create and edit own groups, tables and items. The procedure to execute this is described as follows:

Press the button to add a New group to the database. After that, a name for the new group is required in the displayed window:



Enter a name for the New group to define the connections.

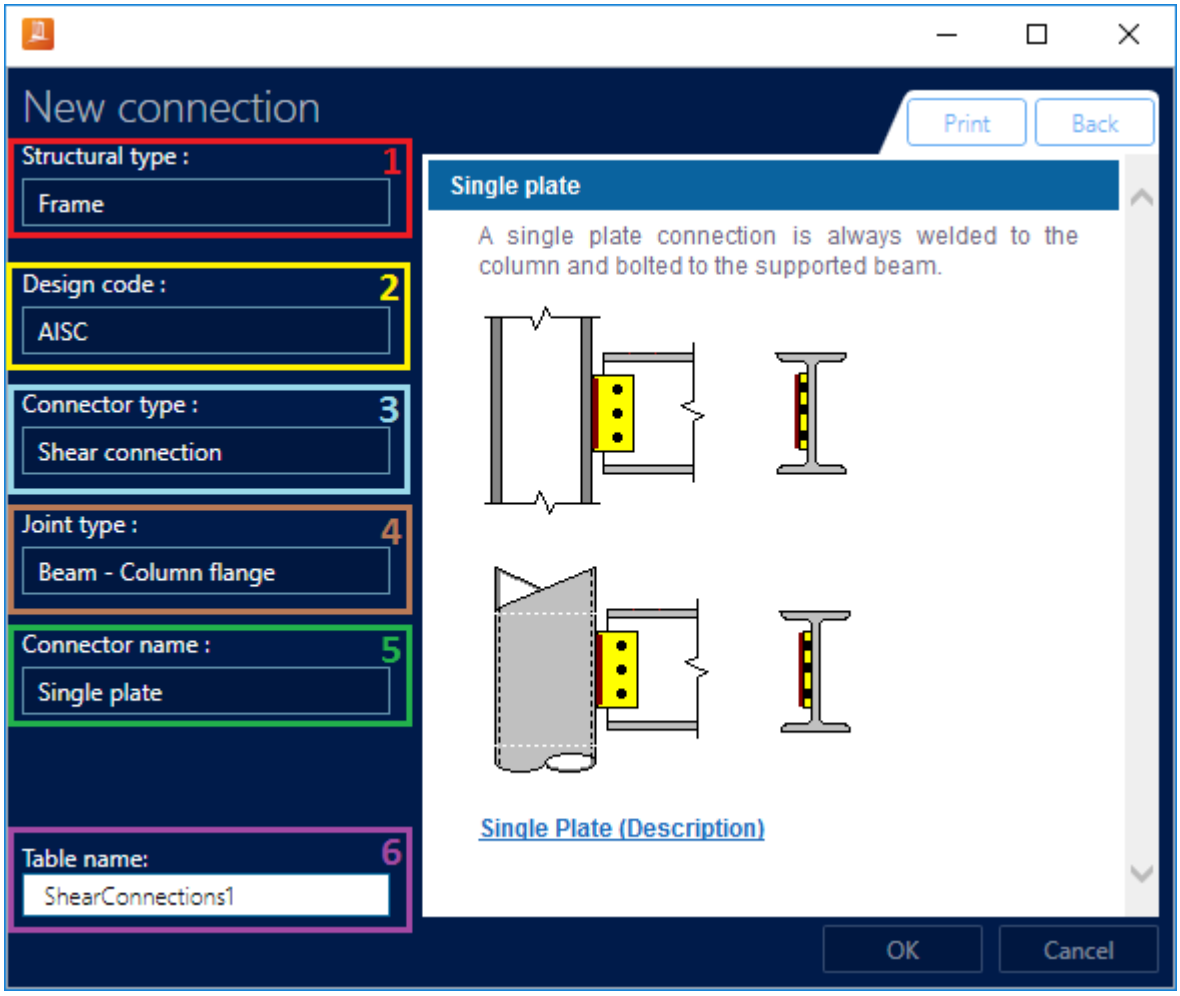
Then, add a new Table by pressing the button. A new dialog will be displayed to enter the name for the new table. It is also required to select the type of table. The following dialog will be shown:



Enter a descriptive name for the template. The name is used to identify the template and has to be unique in the whole database. Then choose if you want to define a shear, moment, combined or a gusset connection. Also, define the design code, joint family and connection type.

A single connection is comprised of either a shear or a moment connection. A combined connection is comprised of both a shear and a moment connection type. For example, the extended end plate connection is considered a combined connection.

Note: It is possible to enter a new connection in the *Application Data\ Bentley\Engineering\RAM Connection* folder. Note that the program will not allow you to enter a template in the directory where the program files were installed.



For any connection, first define a shear, moment, combined or gusset connection, after that, select the design code, then select the joint family type and finally choose the connection type.

(1) Structural type: Frame, Truss, etc. must be selected.

(2) Design code: Define the design standard. RAM Connection designs connections according to the ANSI/AISC 360-05 (American standard), ANSI/AISC 360-10 (American standard), ANSI/AISC 360-16 (American standard), BS 5950-00 (British standard), GB 50017-2003 (Chinese standard), EN 1993-2005 (Europe standard), IS 800-2007 (Indian standard), AS 4100-1998 (Australian standard), NZS 3404-1997 (New Zealand standard) and CSA S14-16 (Canadian standard).

(3) Connector type: According to the structural type; shear, moment, combined or gusset connections must be selected for "Frame" type and tubular truss connections for "Truss" type.

(4) Joint type: Describes the type of joint, beam-to-girder, beam-to-column-flange, etc. The available families according to the structural type are the following:

Frame type:

1. Beam - Column Flange
2. Beam - Column Web
3. Beam - Girder
4. Beam Splice

5. Column Splice

6. Continuous beam over column

7. Column, beams and braces

8. Chevron braces

9. Vertical X braces

10. Column – Base

11. Column – Base – Braces

12. Column – Beam – Horizontal braces

13. Girder – Beam – Horizontal braces

14. Horizontal X braces

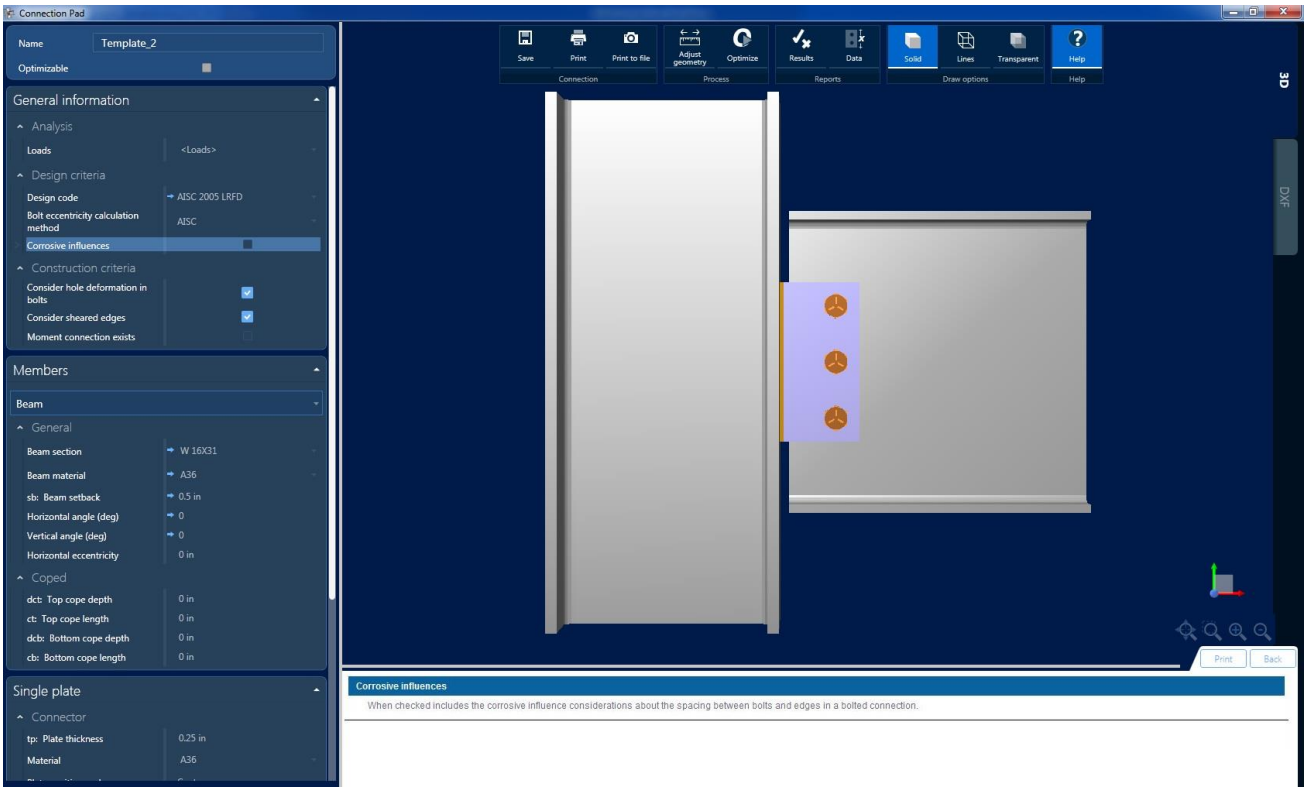
Truss type:

1. Tubular chord-branches

(5) Connector name: The combo contains all available connections according to the connector type chosen. Example, Single plate.

(6) Table name: Enter the name of the new table template.

To finish the connection template definition, press the  *button to create a new item (template) for the current table. The connection dialog (pad) with all the connection data will be displayed.*



After pressing the OK button the connection pad is open.

The user must notice that when it is desired to add more items to the current table, the program automatically uses the same type of connection for the defined table. That is to say, for the example shown in the previous figures, after adding a new material for the table “ShearConnection1”, the new item will be defined with the same type and similar data will be required.

Note: To create a connection copy, place the cursor at the desired connection to copy and press the  button and the program will export the data to the clipboard.

The following tools to manage the database are available in the window:

 Creates a new template.

 Copies the current template.

 Edits the current template.

 Deletes the current template.

 Moves the current folder or template to an upper position.

 Moves the current folder or template to a lower position.

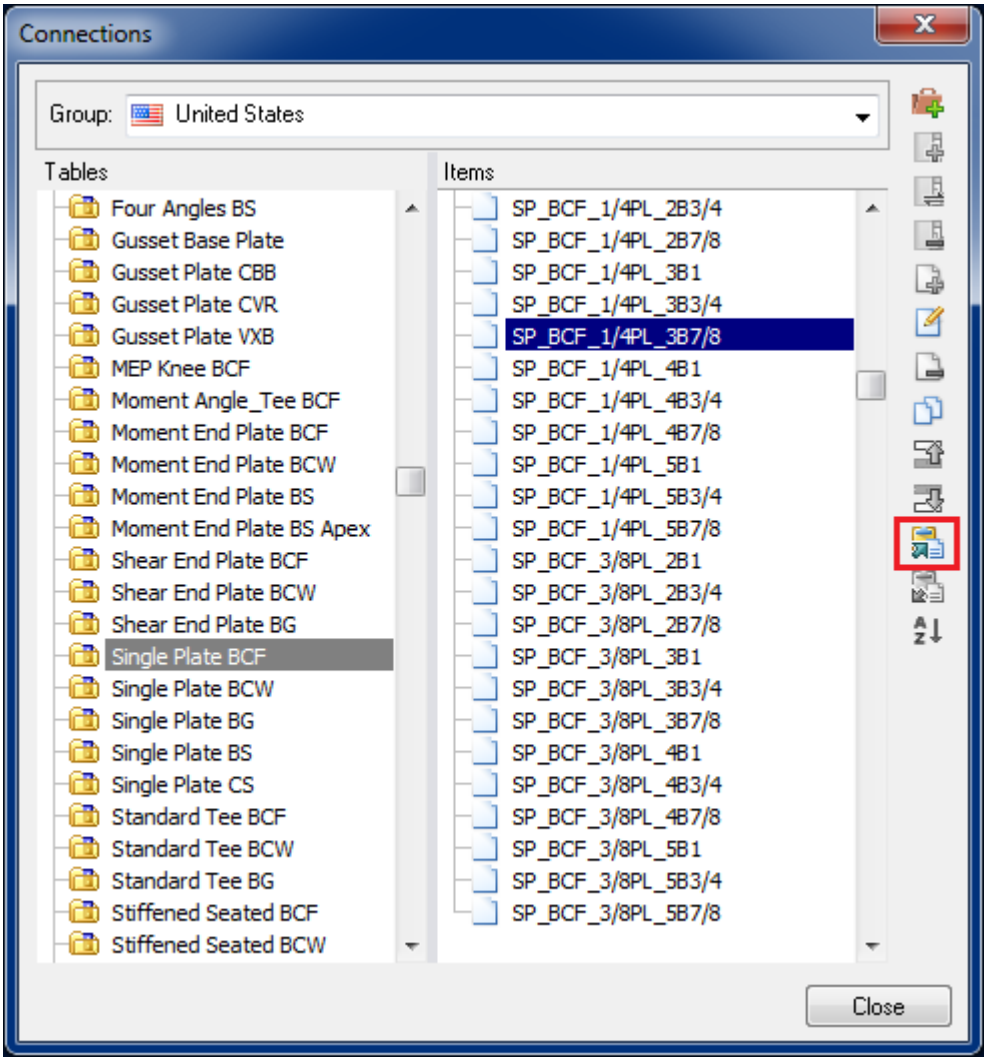
 Exports all the templates data of the current folder to the clipboard.

 Imports the template data from the clipboard to the database.

 Orders alphabetically all folders.

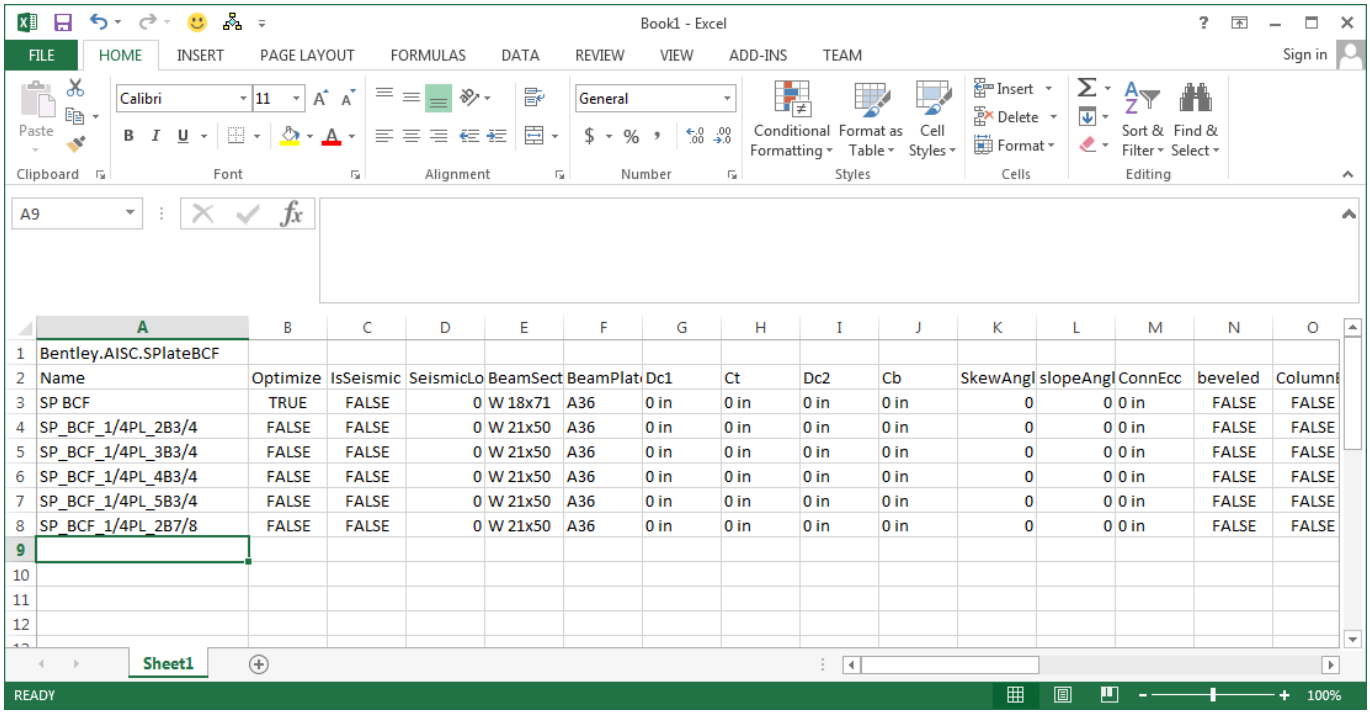
To create multiple connections that are similar except for one or few parameters (number of bolts or size of plates, etc.) then it may be more convenient to use the ability to generate connections in Excel™ as illustrated below.

1) Select the folder to copy to Excel.



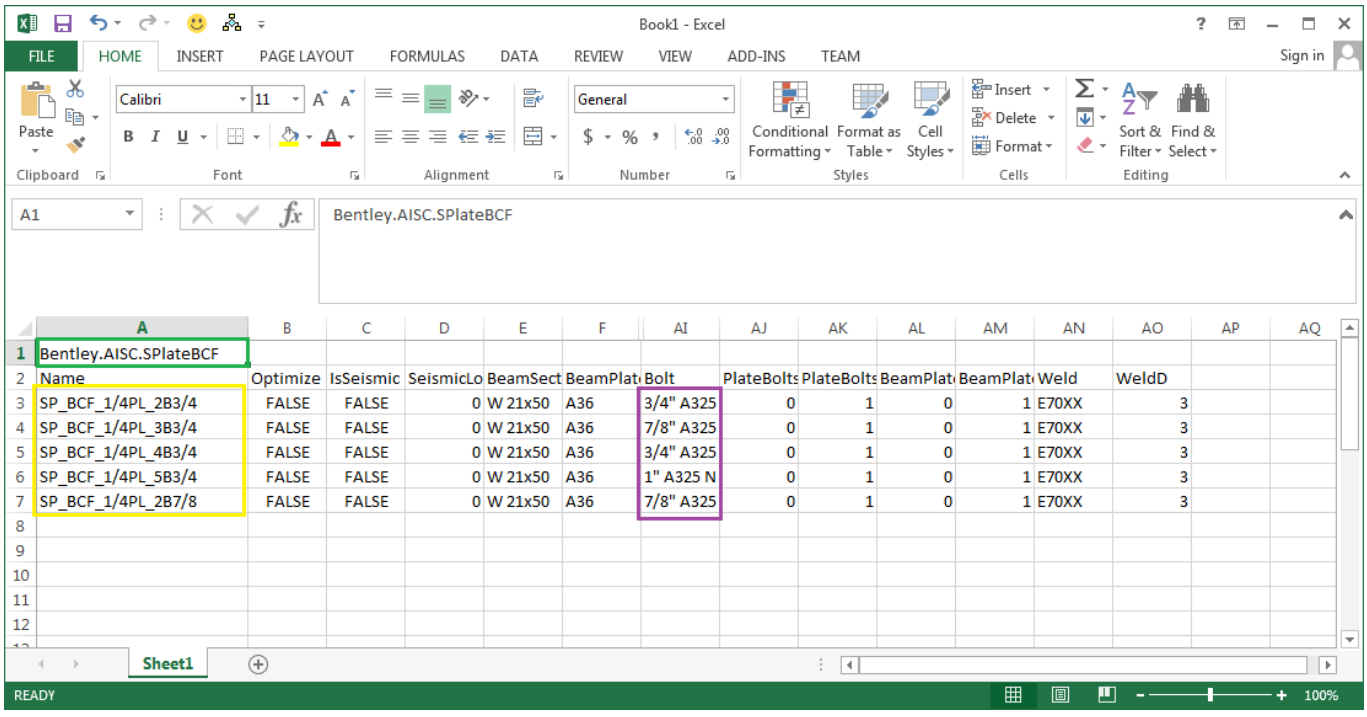
2) As illustrated above, press the button “Copy items to clipboard”. Open Excel and paste the information in a spreadsheet.

In Excel appear the templates and its variables names. Each template data corresponds to one table row.



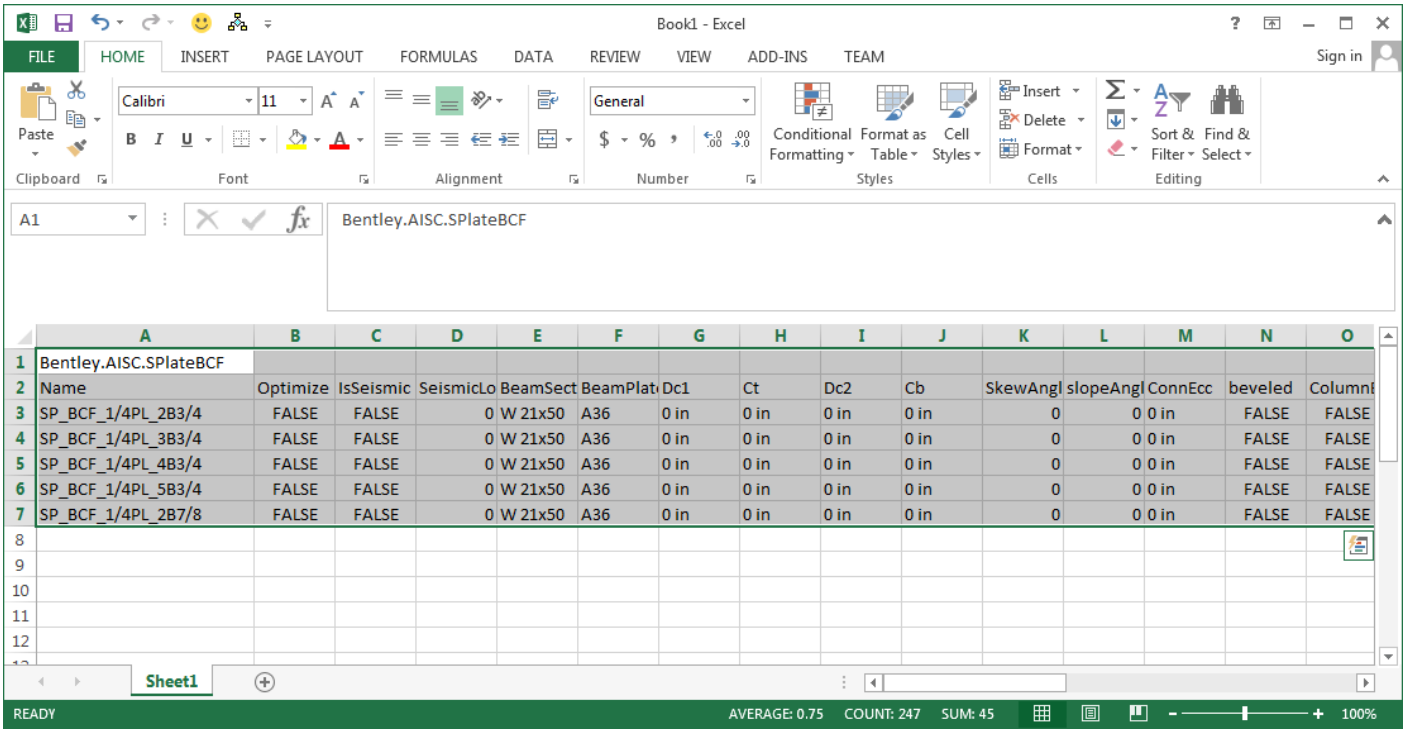
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Bentley.AISC.SPlateBCF														
2	Name	Optimize	IsSeismic	SeismicLo	BeamSect	BeamPlat	Dc1	Ct	Dc2	Cb	SkewAngl	slopeAngl	ConnEcc	beveled	Columnt
3	SP BCF	TRUE	FALSE	0	W 18x71	A36	0 in	0 in	0 in	0 in	0	0	0 in	FALSE	FALSE
4	SP_BCF_1/4PL_2B3/4	FALSE	FALSE	0	W 21x50	A36	0 in	0 in	0 in	0 in	0	0	0 in	FALSE	FALSE
5	SP_BCF_1/4PL_3B3/4	FALSE	FALSE	0	W 21x50	A36	0 in	0 in	0 in	0 in	0	0	0 in	FALSE	FALSE
6	SP_BCF_1/4PL_4B3/4	FALSE	FALSE	0	W 21x50	A36	0 in	0 in	0 in	0 in	0	0	0 in	FALSE	FALSE
7	SP_BCF_1/4PL_5B3/4	FALSE	FALSE	0	W 21x50	A36	0 in	0 in	0 in	0 in	0	0	0 in	FALSE	FALSE
8	SP_BCF_1/4PL_2B7/8	FALSE	FALSE	0	W 21x50	A36	0 in	0 in	0 in	0 in	0	0	0 in	FALSE	FALSE
9															
10															
11															
12															

3) Modify the desired data. Remember to name the connections uniquely (keep the folder name at the beginning of the name).



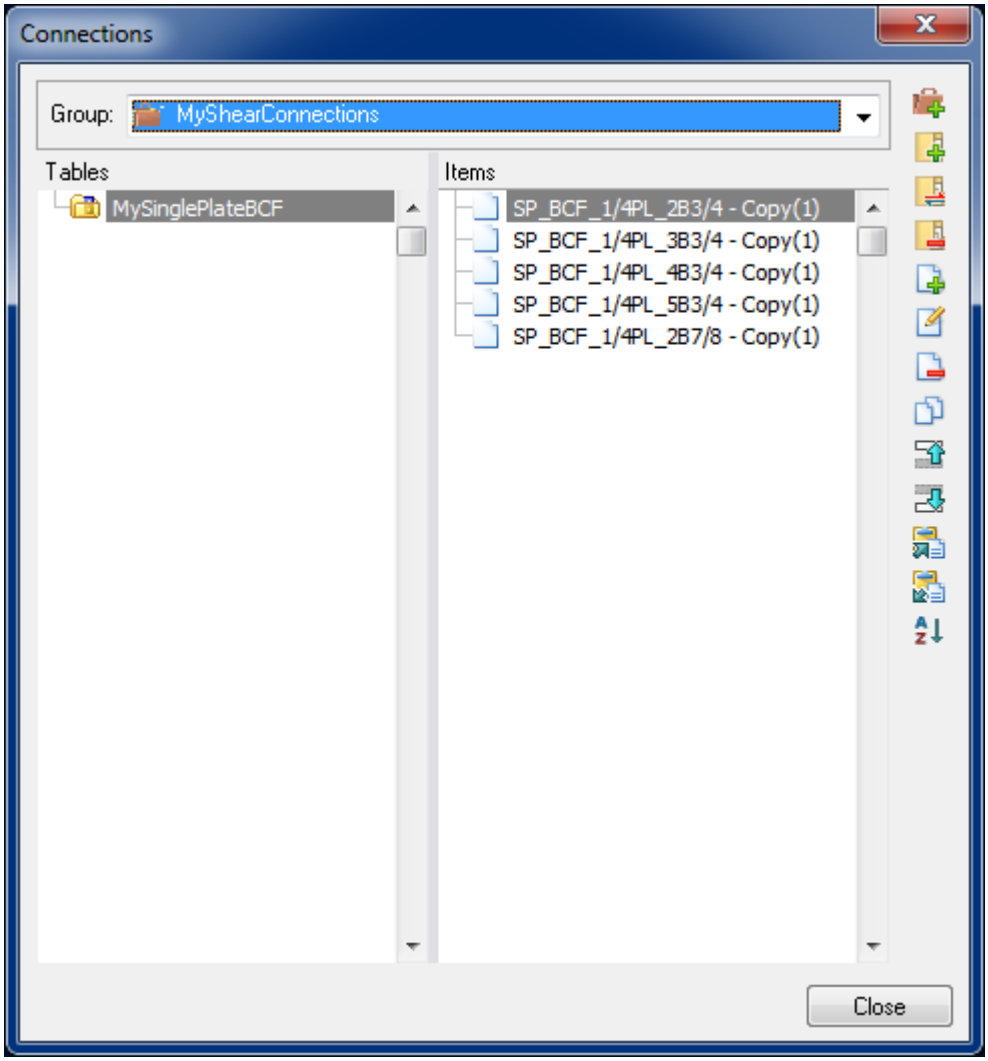
	A	B	C	D	E	F	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
1	Bentley.AISC.SPlateBCF														
2	Name	Optimize	IsSeismic	SeismicLo	BeamSect	BeamPlat	Bolt	PlateBolts	PlateBolts	BeamPlat	BeamPlat	Weld	WeldD		
3	SP_BCF_1/4PL_2B3/4	FALSE	FALSE	0	W 21x50	A36	3/4" A325	0	1	0	1	E70XX	3		
4	SP_BCF_1/4PL_3B3/4	FALSE	FALSE	0	W 21x50	A36	7/8" A325	0	1	0	1	E70XX	3		
5	SP_BCF_1/4PL_4B3/4	FALSE	FALSE	0	W 21x50	A36	3/4" A325	0	1	0	1	E70XX	3		
6	SP_BCF_1/4PL_5B3/4	FALSE	FALSE	0	W 21x50	A36	1" A325 N	0	1	0	1	E70XX	3		
7	SP_BCF_1/4PL_2B7/8	FALSE	FALSE	0	W 21x50	A36	7/8" A325	0	1	0	1	E70XX	3		
8															
9															
10															
11															
12															

4) Then select all the information and copy the data to the clipboard (Ctrl+C)



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Bentley.AISC.SPlateBCF														
2	Name	Optimize	IsSeismic	SeismicLo	BeamSect	BeamPlat	Dc1	Ct	Dc2	Cb	SkewAngl	slopeAngl	ConnEcc	beveled	ColumnI
3	SP_BCF_1/4PL_2B3/4	FALSE	FALSE	0	W 21x50	A36	0 in	0 in	0 in	0 in	0	0	0 in	FALSE	FALSE
4	SP_BCF_1/4PL_3B3/4	FALSE	FALSE	0	W 21x50	A36	0 in	0 in	0 in	0 in	0	0	0 in	FALSE	FALSE
5	SP_BCF_1/4PL_4B3/4	FALSE	FALSE	0	W 21x50	A36	0 in	0 in	0 in	0 in	0	0	0 in	FALSE	FALSE
6	SP_BCF_1/4PL_5B3/4	FALSE	FALSE	0	W 21x50	A36	0 in	0 in	0 in	0 in	0	0	0 in	FALSE	FALSE
7	SP_BCF_1/4PL_2B7/8	FALSE	FALSE	0	W 21x50	A36	0 in	0 in	0 in	0 in	0	0	0 in	FALSE	FALSE
8															
9															
10															
11															
12															

5) In RAM Connection paste the connection templates to the desired folder in the database by pressing the “Paste items from clipboard” button.

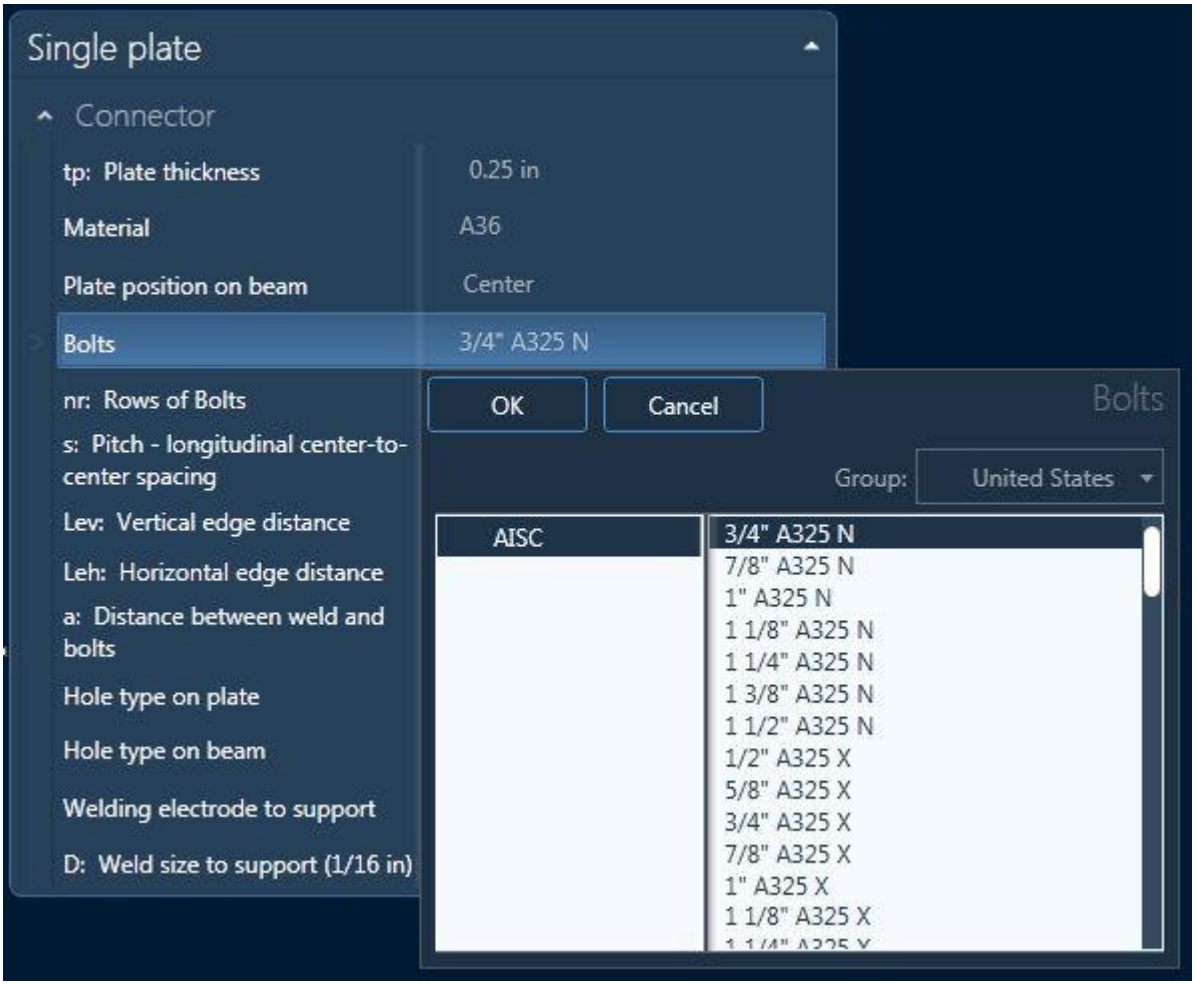


The new connection templates will be imported.

Note: The process to import several connection templates may take some time.

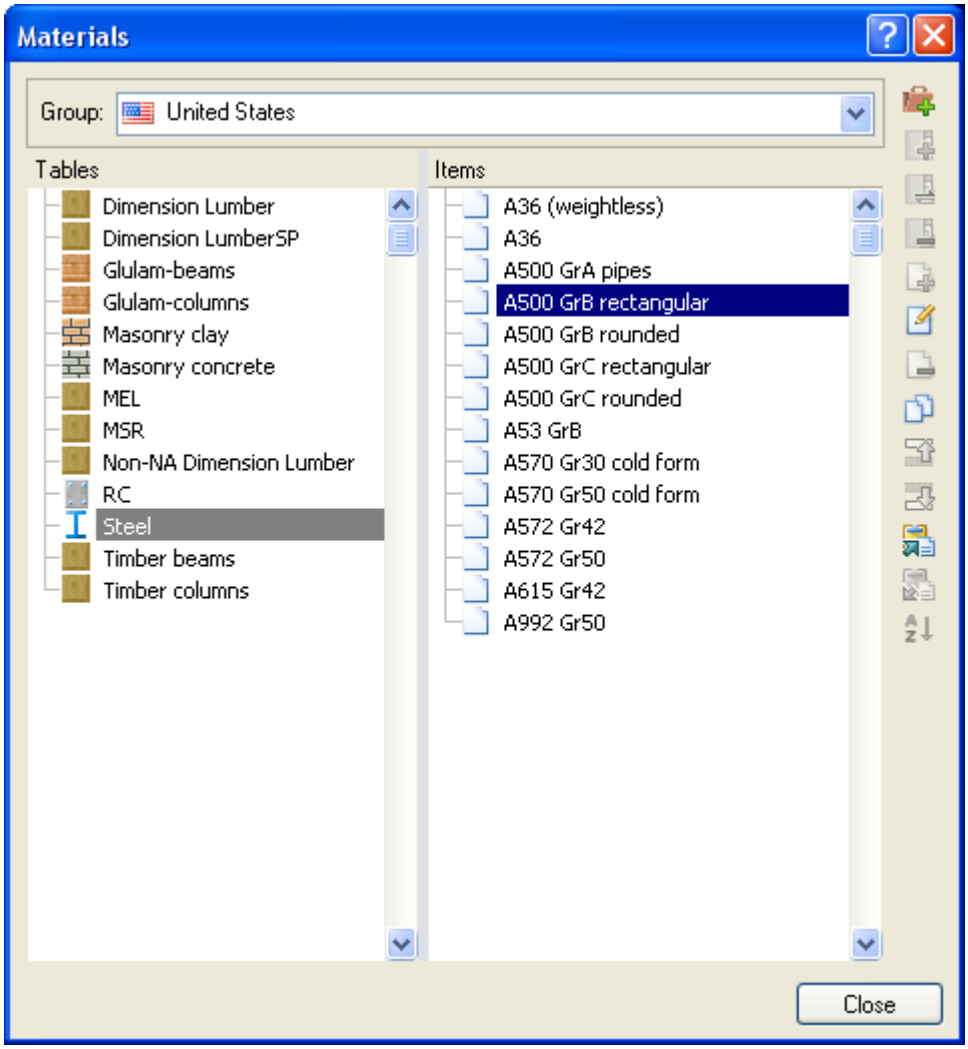
Databases for sections, materials, bolts, welds and anchors

The program already comes with the most common types of bolts, welds, anchors, materials and sections. If materials and sections that do not exist in the database are required, this can be defined in the same way the new connection templates are.



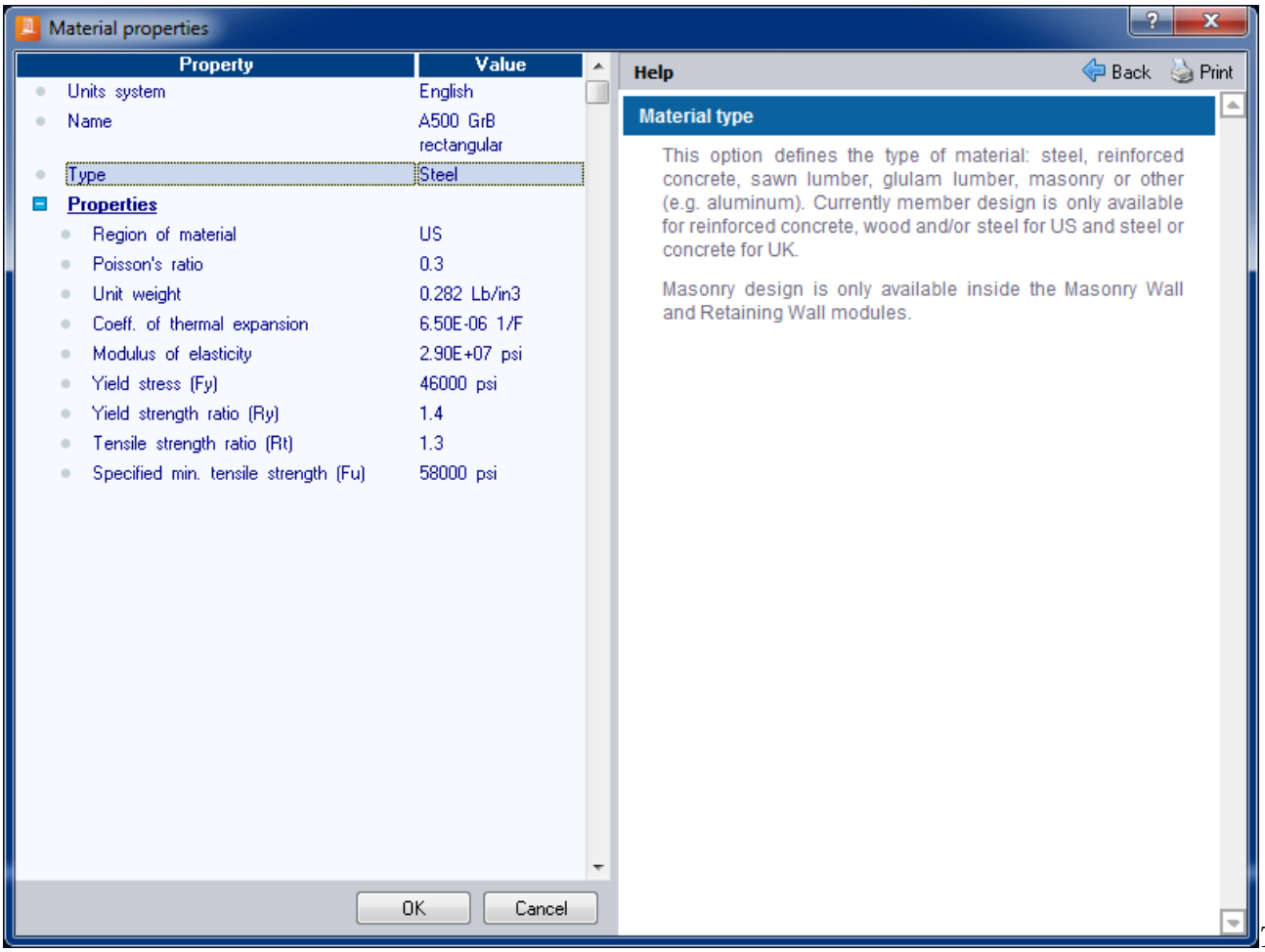
Go to the required item and click in the right button of the combo to access to the available database.

For example, to edit a material existing in the database, press the *Materials* button in the *Databases group*, *Home tab*.



A dialog window will appear with the list of available items and the tool buttons to create, edit and manage the database.

Then, press the  button.



To edit or create an item, a new dialog will show up with all the required data

To create a new material, Press the button to add a New group to the database. After that, a name for the new group is required in the displayed window.

Then, add a new Table by pressing the button. A new dialog will be displayed to enter the name for the new table. It is also required to select the type of table.

Press the button to create a new item (material) for the current table.

There are similar tools to the connection template dialog to manage data in other databases dialogs. For more information, see the sensitive context help.

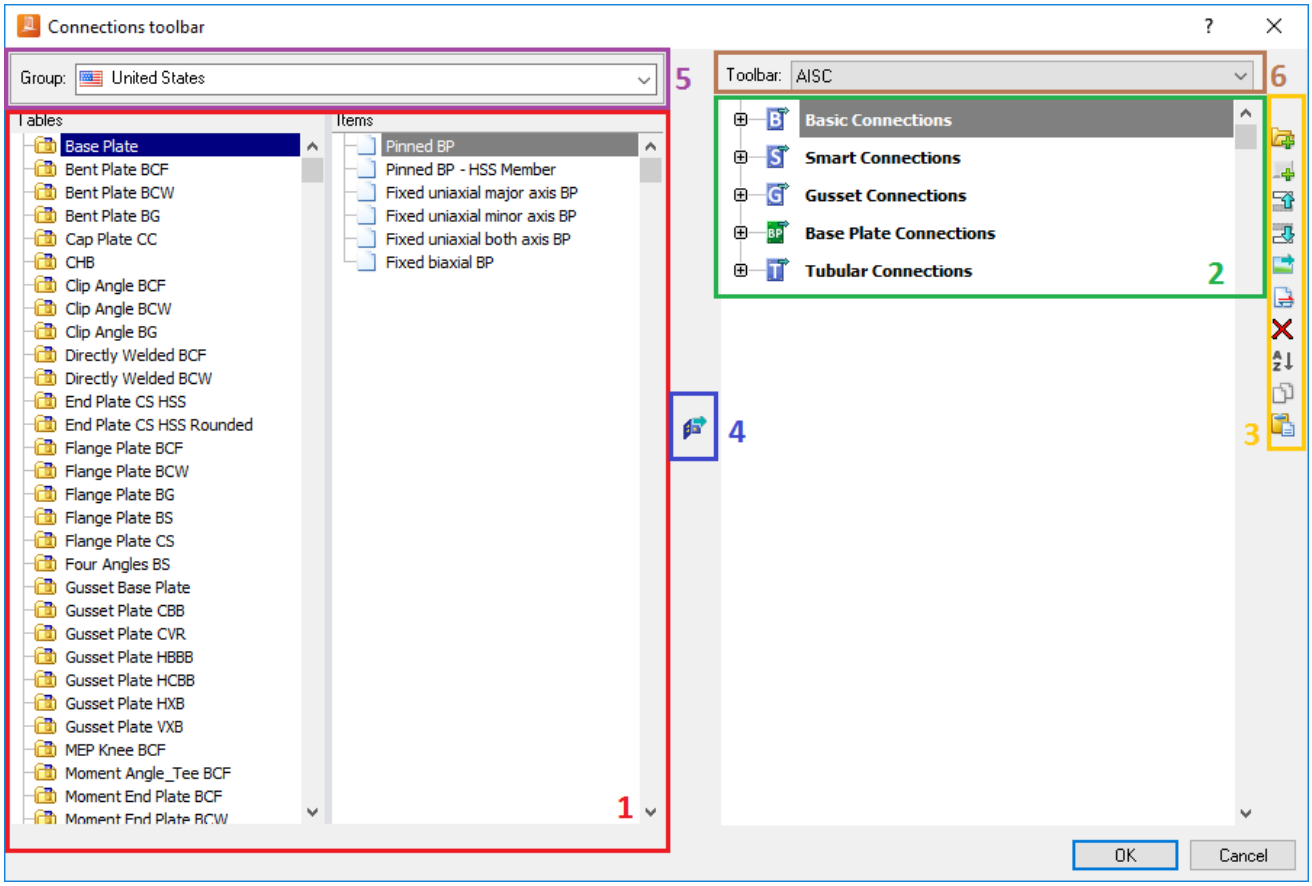
Assignment group and its commands

The connection A*ssignment group* and its buttons were described in the previous chapter. For the *Assign* button a menu is displayed for three assignment options, Basic, Smart and Gusset connections. The last option of that menu may be used to customize the list of templates grouped in the basic, smart and gusset connections.

Customizing the connection assignment buttons

It is important that the connection assignment buttons are configured according to user's preferences. This determines the list of connections that will be associated with the assignment options in the

Assignment menu, and the order in which these connections will be attempted. To configure this buttons, go to the *Design tab*, *Assignment group* and press the *Assign button*, and select the *Customize the toolbar*...option. The configuration window will appear with the current template arrangement.



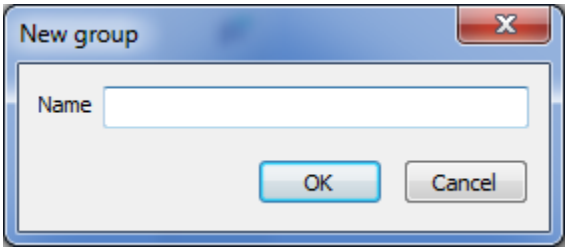
Connection toolbar configuration window.

In the area (1), the available database templates is shown, in the area (2), the assignment buttons that are defined for the menu can be found, in the area (3) there are tools to configure the list, in the area (4) there is a command to add a template to the selected button, in area (5) there is the group of the database and in area (6) the user may choose the toolbar to configure.

The user should notice that it is not possible to modify the toolbar defined by the program (the tools does not enable), but the user can configure an own assignment toolbar, based on groups, tables and templates of the program or those previously created. For this purpose, the “USER” toolbar may be selected from the combo box located at the upper-right corner of this window.

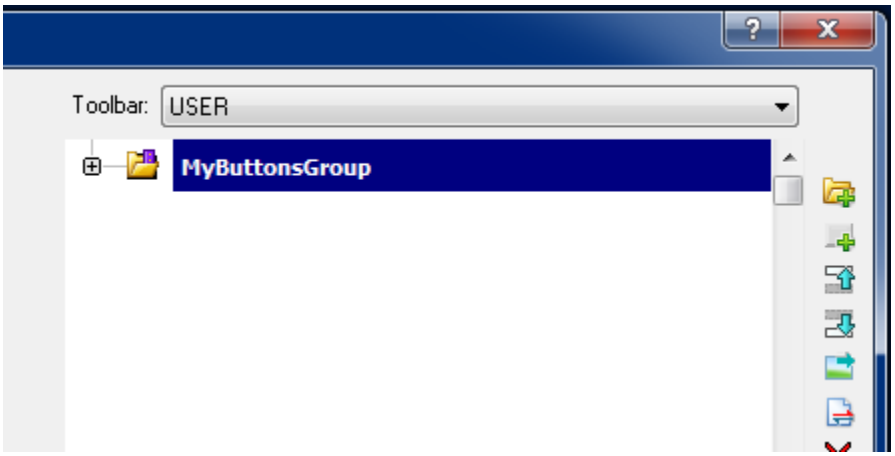
The assignment buttons created in the *Root* folder will always be visible along with the main group buttons. Therefore, it is recommended to include in this folder only the assignment buttons that are frequently used.

It is possible to create a new group button with the  button. The name of the new group will be asked.



Dialog window asking the name of the new group.

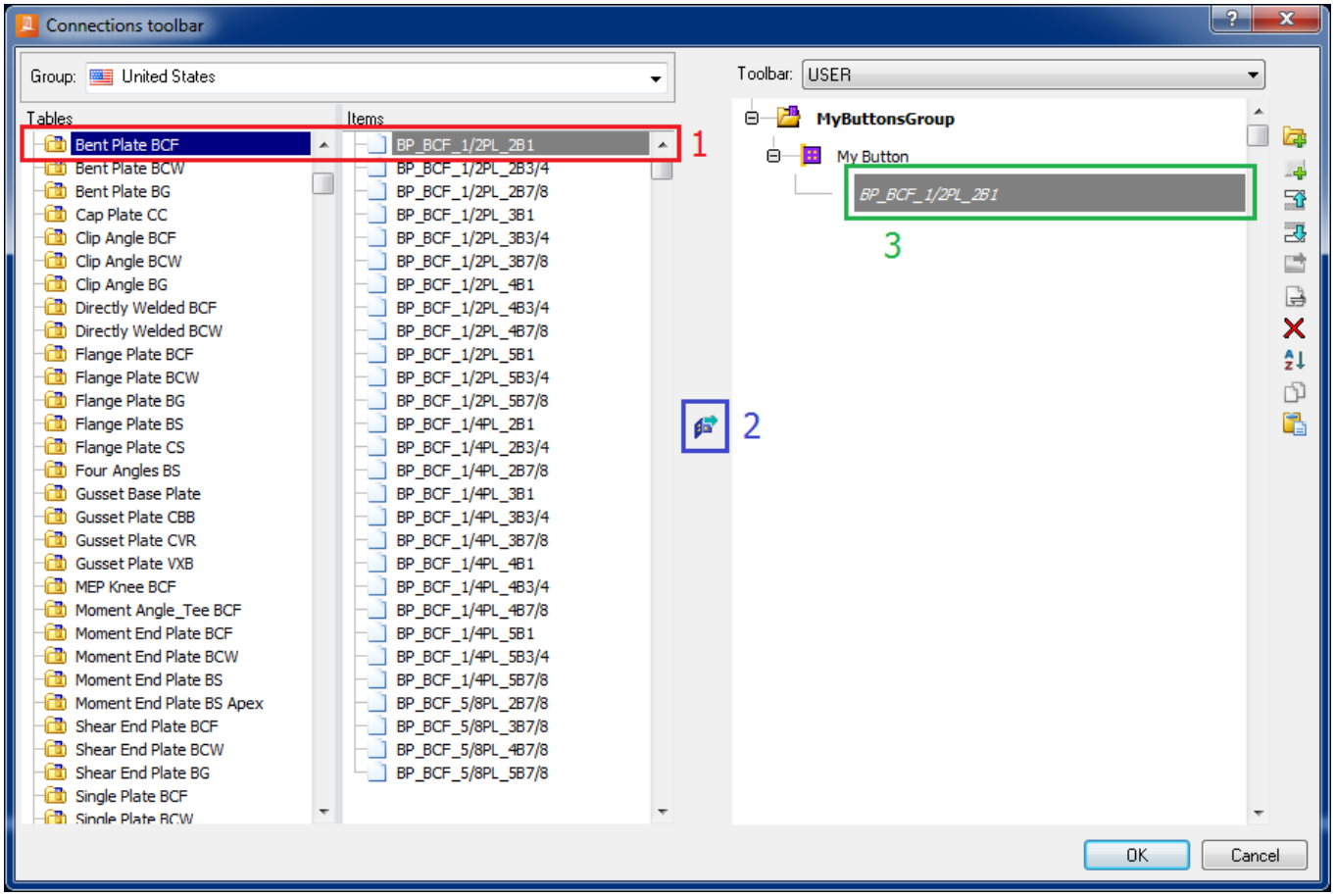
To create a new assignment button, place the cursor at the desired place.



For example locate a new assignment button in the recently created group.

Then press the  button and enter the name of the button.

Then go to the list of available connections of the database and choose the templates for the button (1). Press the  button to include the current template in the button list (2). Note that if a folder of the database is selected, all the connection templates of the folder will be assigned to the button keeping the same order as in the database (3).

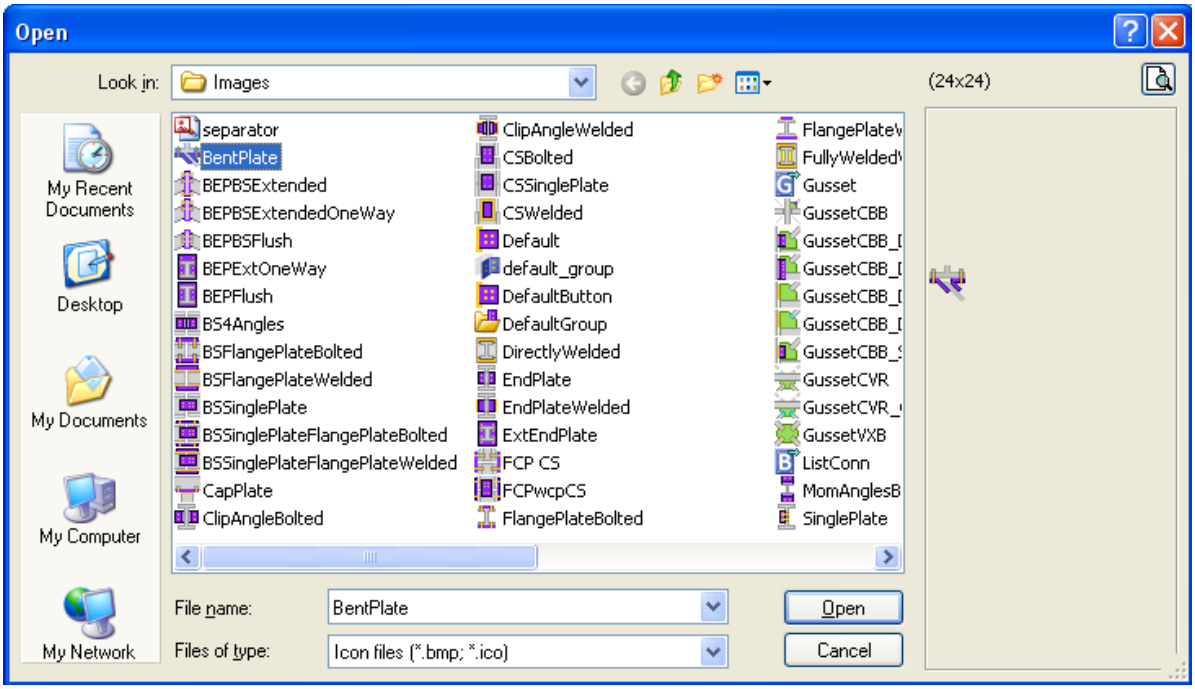


Select the connection templates desired to be associated with the button "My Button" in the group "My Buttons Group".

It is very important to specify the order of the templates within a list because this order will be used during the assignment. To sort the templates use the buttons and to move the selected template up or down.

To delete a button use the command.

Notice that all buttons that are created have by default the same bitmap. The user can define the bitmap to be associated for each button with the button tool.



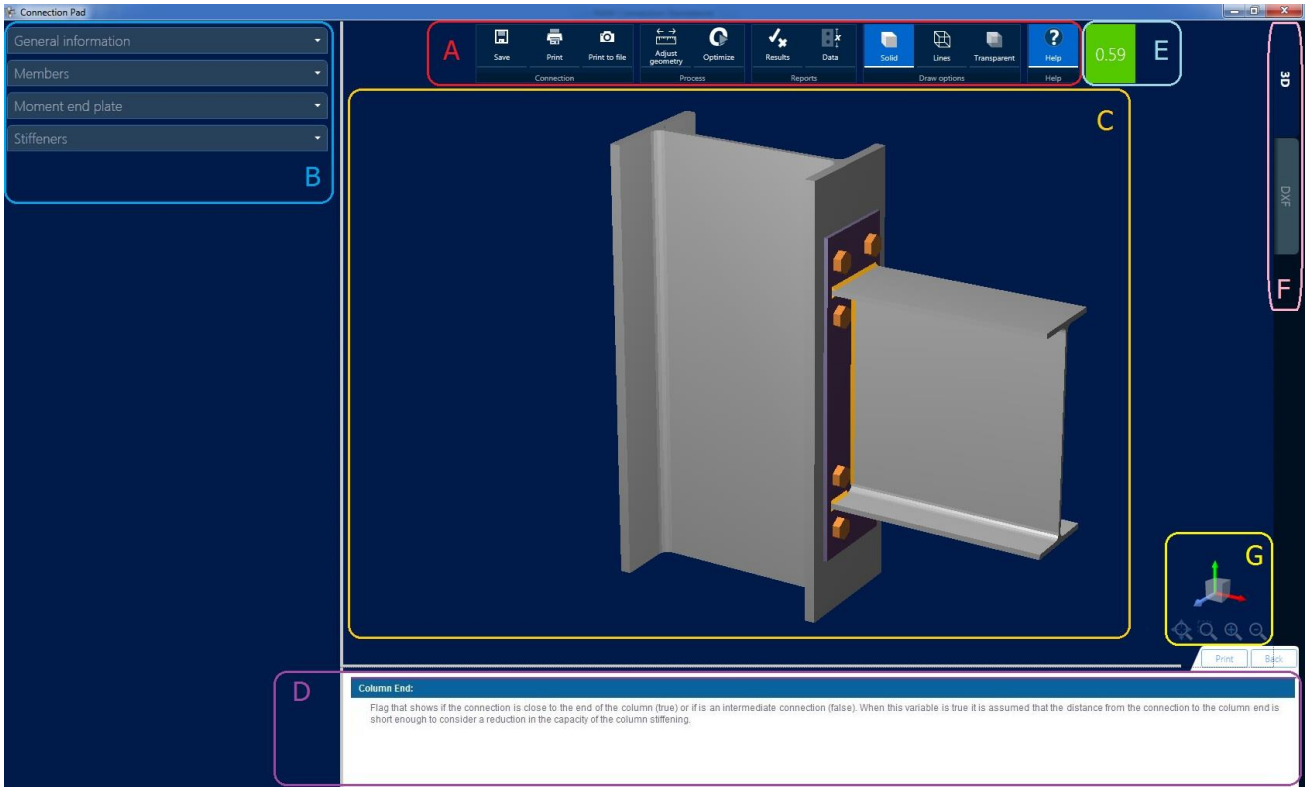
The bitmap has to be a bmp file of 22x22 pixels. There are ready-to-use choices in the ConnectionToolBars\Images folder.

The user can draw an own bitmap with any drawing application like Microsoft Paint.

Connection pad

The connection pad or connection dialog is required for the creation of templates for the database and also to review/edit a model connection, or many model connections with the connections detailer. It is accessed when any template of the database is edited, when the user double clicks a model connection, or when several identical model connections are selected and the detailing command is invoked from the *Design tab*, *Connections group* and *Edit button*.

The connection pad has the following areas:



Connection pad.

Area		Function
ID	**Name**	
A	Toolbar	General commands for saving, printing and accessing to data and result reports, modifying tridimensional and DXF model view.
B	Edition area	In this area the user may enter or modify the required data for the connection.
C	Graphic area	Shows the 3D and DXF view of the connection.
D	Sensitive help area	Displays helpful information about the data for the connection.
E	Traffic light	Shows the design status of the connection.
F	Tab	Choose the 3D and DXF view of the connection.
G	Navigation control	Tool that rotates, translate the model and also contain tools to change to default view models.

Edition area

In this section the user enters all the necessary data to define the connection template (or reviews/modifies the properties of the selected model connections). The following connection data

should be provided: Units system, Code, Loads, Tag, and all the specific data required in Shear, Moment, Combined or Gusset connections.

The available units systems are Metric, English and SI. The available codes are AISC 360-05 ASD, AISC 360-05 LRFD, AISC 360-10 ASD, AISC 360-10 LRFD, AISC 360-16 ASD, AISC 360-16 LRFD, BS5950-00, GB 50017-03, EN 1993-2005, IS 800-2007, AS 4100-1998, NZS 3404-1997 and CSA S16-14. The loads can be entered in a spreadsheet that enables only certain loads according to the selected connection (i.e., in a bracket plate connection only shear load is allowed). Note that when editing model connections, the joint loads are transferred to the connection automatically.

Notes: All data with the  icon (when editing model connections) is transferred to the connection pad directly from RCSA. When editing a model connection, any change in this data will not be permanent.

Choose the unit system as is appropriate to enter and display the connection data.

Notice that the current units of each property are shown beside their value. When entering a value without units, the currently units will be considered for the value. It is also possible to enter a value with its own units, which could be different from the current unit system; in this case the program will transform the entered value to the current units system.

The following length units are displayed according to the unit system selected. Metric: cm, m. English: in, ft. SI: mm, m.

Note: All the connection properties with units (as edge distances, plate length, etc.) will show their value and will be edited according to the current unit system. When entering a property value with small units, a dimension in centimeters for example, the default units when editing the property will be cm, inches or mm, according to the current unit system. On the other hand, if big units would have been used (as meters or feet), the default units would be meters or feet. Consider that this modification is applied only to the template or connection being modified.

For example (If the current units system is English):

Entering “1.5 in” Setback means 1.5 inches

Entering “0.1 ft” in Setback means 0.1 feet (the default unit becomes “ft”).

Notice that the program allows to enter, for example, “1.5 kip” for a length. Although this is accepted, the resulting value may not be the expected. Also, this will not change the units of the property (in this case a length measure will not be changed to a force measure).

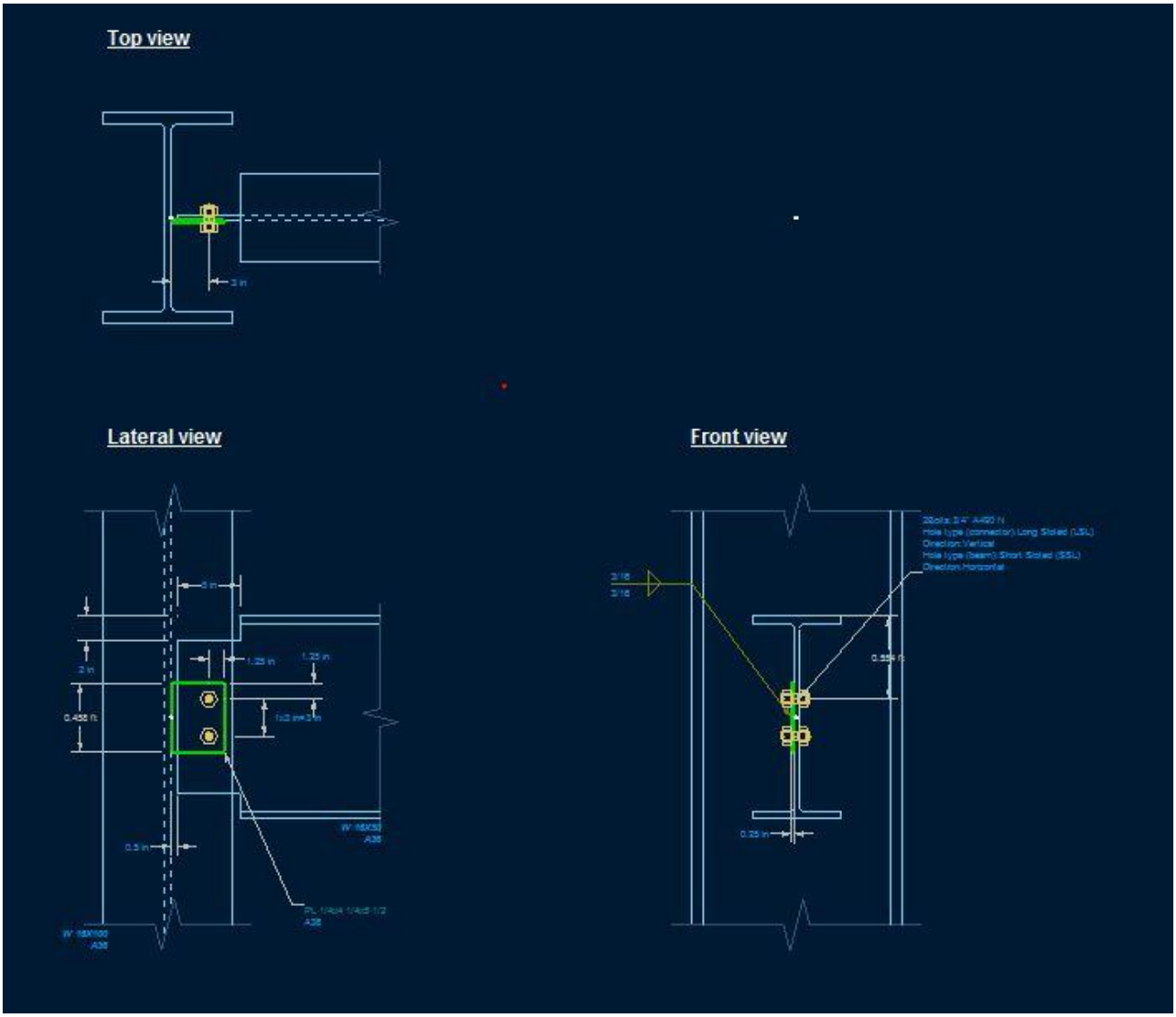
When creating a connection template in the database through the connection pad, the first time the connection pad is displayed it is filled with the default connection properties values. To see it drawn with some specific member sections (and materials) or to get preliminary (test) reports, assign the required sections and materials.

Graphic area

In this part of the Connection Pad a true 3D or 2D visual representation of the selected connection is shown.

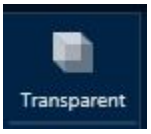
Change to the *Extruded View tab* to view the tridimensional model of the joint. Switch to the *DXF View tab* to view the bidimensional drawing of the joint. Notice that only one view may be set at a time.

Tridimensional representation of a single plate BCW.



2D Drawing with different views and the option to export as a DXF file.

The following command buttons are used to modify the view of the connection:

- 

button allows seeing the 3D image as transparency.
- 

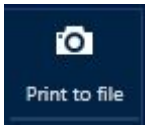
button allows seeing the 3d image only with lines (This view is different to the DXF).
- 

displays the DXF drawing layers.

- 

increases font size for the graphic in the screen.
- 

decreases font size for the graphic in the screen.
- 

opens a dialog window to print the graphic.
- 

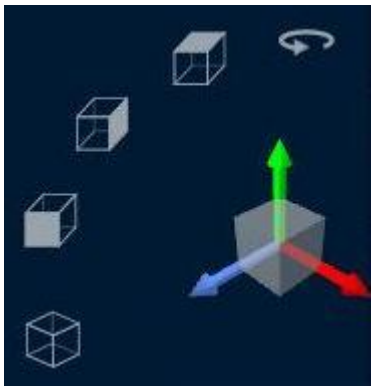
opens a dialog window to print to a file the graphic.
- Press 

, name the file and save it. The graphic will be saved in a DXF format available to open with any CAD program.

TIP To rotate the 3D view of the connection, right-click and drag freely over the graphic area. With a mouse wheel it is possible to zoom in or out.

Navigation control

The graphical area is referred to the area in the main screen where the 3D joint view is shown. In this area the joint view can be rotated, can be increased or reduced. Pressing navigation control displays a popup buttons with view options.



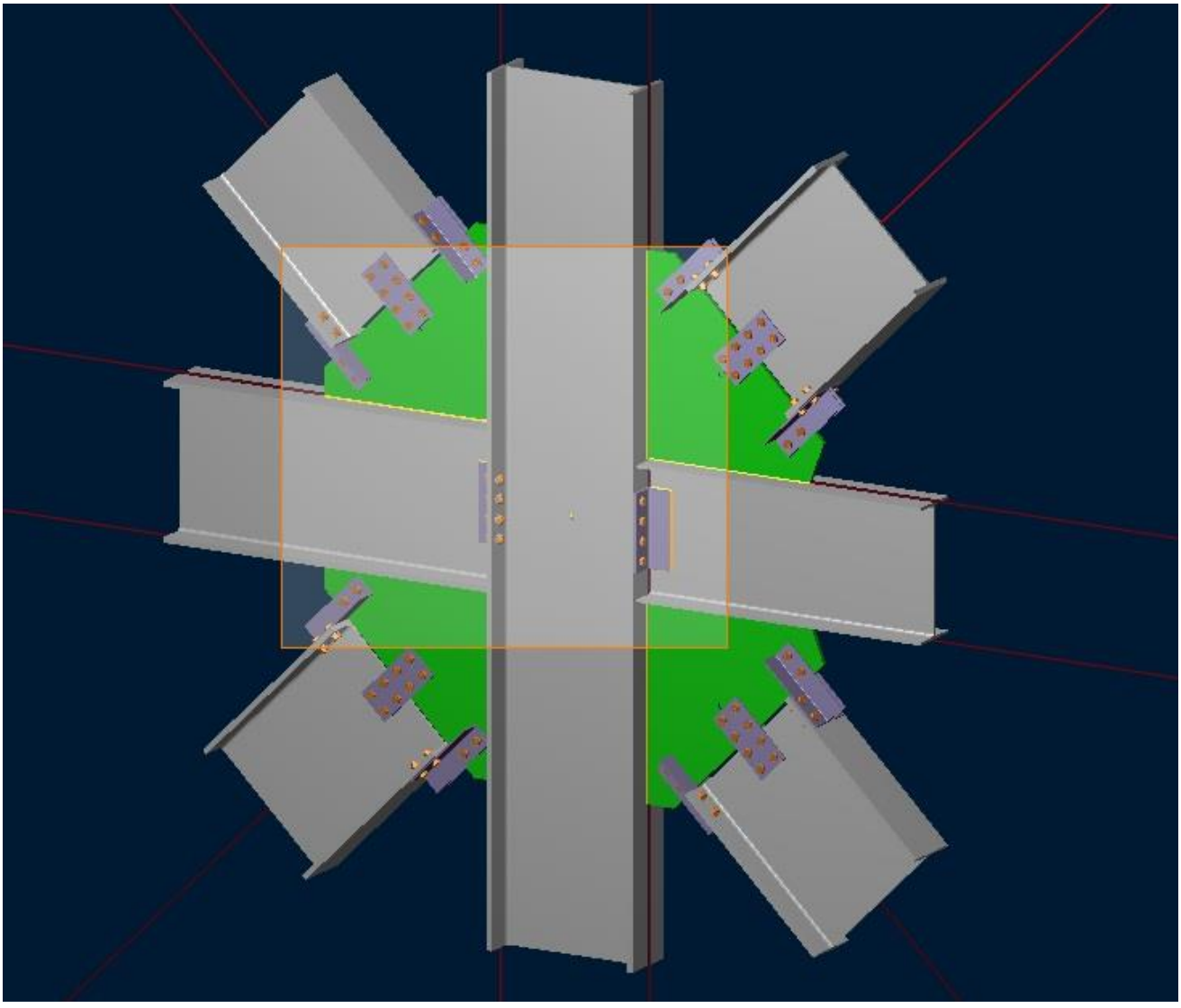
-  button activates top view.
-  button activates lateral view.
-  button activates front view.

-  button activates an isometric view.
-  button inverts the views described.

Other commands that affect the view in the graphic area are in toolbar besides navigation control.

A brief description of these commands is presented as follows:

- The  button sets the original joint view.
- Press the  button and drag a rectangle to select the area of the graphic to amplify the view.

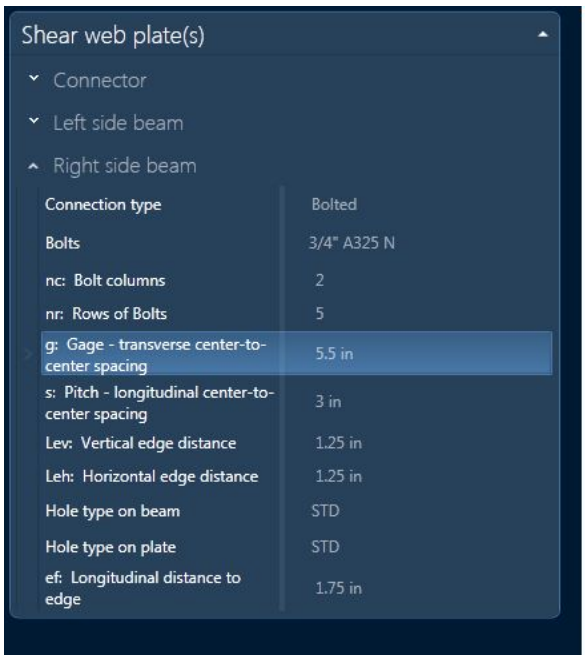


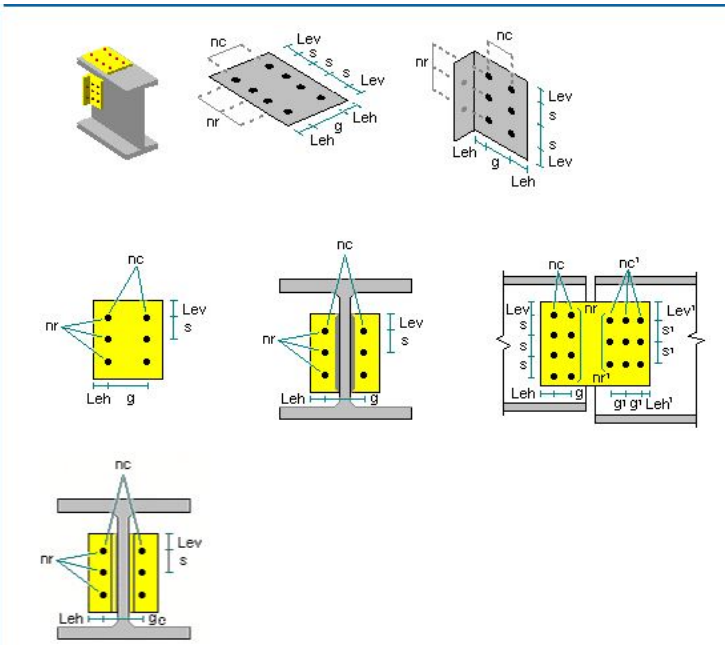
Example of area zoom

-  Zoom in button.
-  Zoom out button.

Help area

In this section of the Connection Pad the help information related to the selected data in the Edition area is displayed:





Click the Back button to return to the previous explanation of the help window.

Click the Print button to print the current explanation of the help window.

The Connection Pad has also a status box in the top right part of the window 

that shows the design status and ratio of the model. If the red light is on, it shows that the status and strength ratio of the connection are not good. When the yellow light is on 

, the strength ratio is OK

but there is a design requirement not fulfilled and finally, if the green light is on 

, the connection design status is OK.

Press the 

button to save the changes made over the connection.

The 

button displays the data report of the connection.

The 

button displays the results report of the connection.

Connections Reports

It is possible to obtain connection reports from the *Connection Pad* or from the program ribbon commands.

To obtain data or results reports from the *Connection Pad*, while reviewing/editing a connection or creating/editing a connection template, press one of the following buttons, 

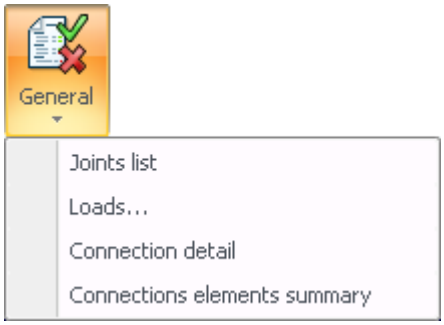
or 

.

The data report provides the full description of the connection(s) considering the geometry and characteristics of the members and connection elements.

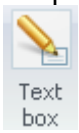
The results report provides all the connection capacity values for the critic load condition. At the beginning of the report there is a list of the load conditions considered. The second section of the report checks that the critical dimensions are within allowable code prescribed ranges or geometrical requirements. If a dimension is out of range, the status of the connection will reflect it (semaphore light turns into yellow. There is also a geometric verification to see the compatibility of the connection with the members (for example, this check will indicate if a plate exceeds the support width) in which case warning messages will also be reported. The third section shows the different capacity checks that are performed comparing the calculated capacity of the connection with the connection demand. If any capacity is not sufficient, the status of the connection will change to N.G. (not good). Finally, at the bottom of the report, the most critical strength ratio of the connection is reported.

RCSA offers the possibility to have detailed or summary reports for several connections.

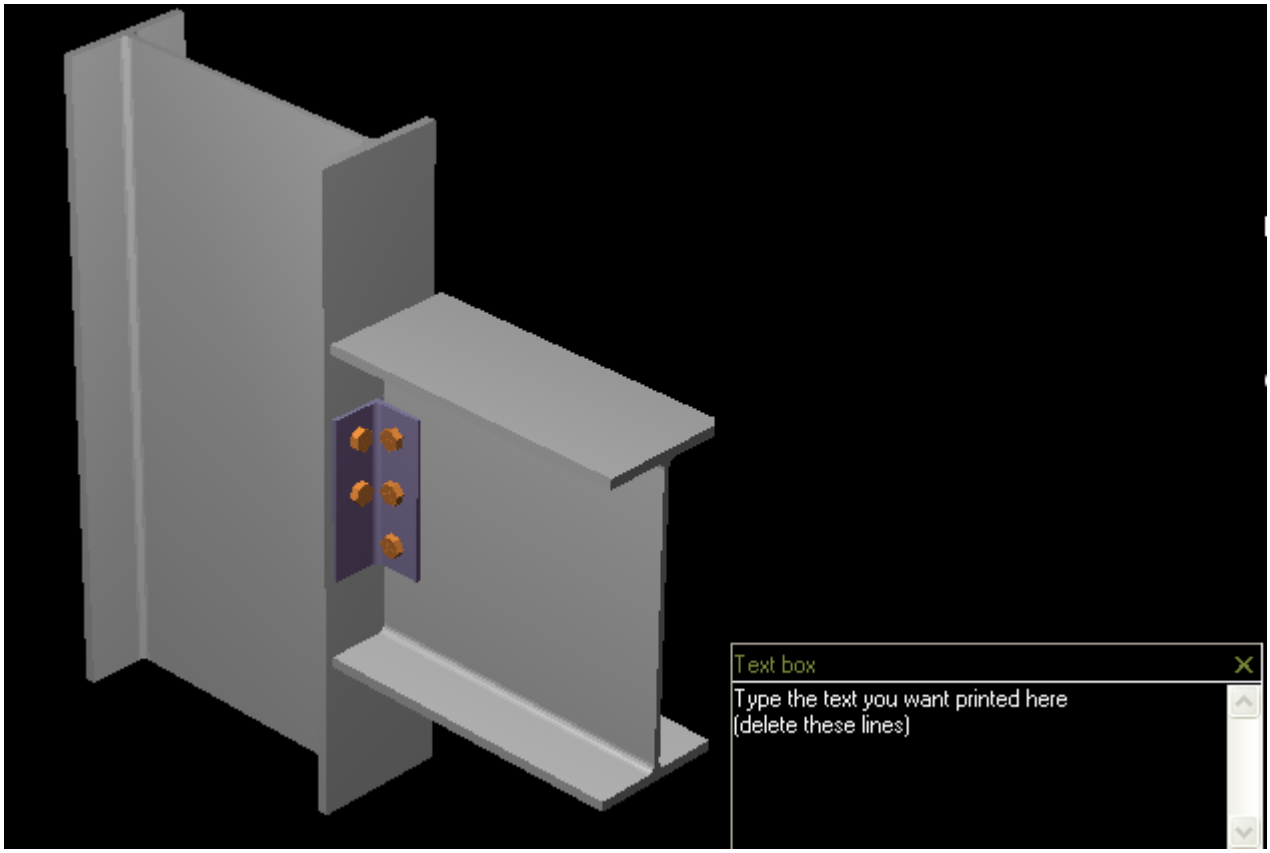


Option in the menu to choose the type for the connection report

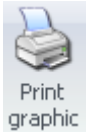
The user can choose between the report of joint list that describe the connection members with the strength ratio and the status, the load reports that considers the loads with the strength ratio and the status and the connections summary.

There is also the possibility to print the 3D graph with a descriptive text box. To do this set the view and press the 

button from the *Output tab, Model graphic group*.



Enter the desired text that will be included in the graphics printing.

To print the actual view, execute the action pressing the 

button from *Output tab, Model graphic group*, then select the printer options and accept printing.

References

The references used for connections are:

For AISC 360 design code:

- ANSI/AISC 360-05 Specification for Structural Steel Buildings.
- ANSI/AISC 341-05 Seismic Provisions for Structural Steel Buildings.
- ANSI/AISC 358-05 Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications.
- ANSI/AISC 360-10 Specification for Structural Steel Buildings.
- ANSI/AISC 341-10 Seismic Provisions for Structural Steel Buildings.
- ANSI/AISC 358-10 Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications.
- ANSI/AISC 360-16 Specification for Structural Steel Buildings.
- ANSI/AISC 341-16 Seismic Provisions for Structural Steel Buildings.
- ANSI/AISC 358-16 Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications.
- Steel Tube Institute - HSS Design Manual, Volume 4: Truss & Bracing Connections.
- Federal Emergency Management Agency – Recommended Seismic Design Criteria for New Steel Moment-Frame Buildings, FEMA-350/June 2000.
- Murray Thomas M., Extended End-Plate Moment Connections, Steel Design Guide Series 4, AISC, 2003.
- Ellifritt Duane S. and Sputo Thomas, Design Criteria for Stiffened Seated Connections to Column Webs, Proceedings of NSCC Sponsored by AISC, New Orleans, April, 1-3, 1998
- J. H. Garret, JR. and R. L. Brockenbrough, Design Loads for Seated-beam in LRFD, Engineering Journal, AISC, 1986.
- Akbar R. Tamboli, Handbook of Structural Steel Connection Design and Details, McGraw Hill, 1999
- Sherman, Donald R., Ales, Joseph M., The Design of Shear Tabs with Tubular Columns, Master of Engineering Project, University of Wisconsin at Milwaukee, 1990.
- Thornton, William A., Loescher Michael, AISC - Hollow Structural Sections Connections Manual, American Institute of Steel Construction, 1997.
- Bull Moose Tube HSS Connections Manual, Bull Moose Tube Company, 1999.
- J.A. Packer, J.E. Henderson, Hollow Structural Section - Connections and Trusses - A Design Guide, Canadian Institute of Steel Construction, 1997.
- Sherman, D. R. and J. M Ales, 1991, The Design of Shear Tabs with Tubular Connections, Proceedings of the 1991 National Steel Construction Conference, pp.1.1-1.22, AISC, Chicago, IL.

- Dowswell Bo, Connection Design for Steel Structures (Lecture Notes), Structural Design Solutions, LLC, 2003.
- Blodgett, O. W. (1966), Design of Welded Structures, The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio.
- DeWolf, J.T. and Ricker, D.T. (1990), Column Base Plates, Steel Design Guide 1, American Institute of Steel Construction, Chicago, IL.
- Drake, R.M. and Elkin, S.J. (1999), "Beam-Column Base Plate Design—LRFD Method," Engineering Journal, American Institute of Steel Construction, Vol. 36, No. 1, First Quarter.
- Fisher, J.M. and Kloiber, L.A. (2006), Base Plate and Anchor Rod Design, Steel Design Guide 1, American Institute of Steel Construction, Chicago, IL.
- ACI (2008), Building Code Requirements for Structural Concrete and Commentary, ACI318-08/ACI 318R-08, American Concrete Institute, Farmington Hills, MI.
- PCA (2005), Notes on ACI 318-05 Building Code Requirements for Structural Concrete with Design Applications, Portland Cement Association, Skokie, Illinois.

For BS 5950-00 design code:

- BS 5950-1:2000. Structural use of steelwork in building.
- Joints in Steel Construction - Simple Connections, Steel Construction Institute and the British Constructional Steelwork Association, United Kingdom, 2002.
- Joints in Steel Construction - Moment Connections, Steel Construction Institute and the British Constructional Steelwork Association, United Kingdom, 1997.
- Trahair N.S., Bradford M. A., Nethercot D.A., The Behaviour and Design of Steel Structures to BS5950, Third Edition - British, Spon Press, Great Britain, 2001.
- Joannides Frixos, Weller Alan, Structural Steel Design to BS 5950: part 1, Thomas Telford Publishing, Great Britain, 2002.

For GB 50017-03 design code:

- GB50017 - 2003. Code for design of steel structures.
- 钢结构连接节点设计手册（第二版）
- GB 50010 – 2010. Code for design of concrete structures
- GB 50011 - 2001. Code for seismic design of buildings

For EN 1993-2005 design code:

- EN 1993-1-1 (2005) Eurocode 3. Code for design of steel structures: General rules and rules for buildings.
- EN 1993-1-8 (2005) Eurocode 3. Code for design of steel structures: Design of joints.
- BS EN 1993-1-8 (2005). Incorporating Corrigenda December 2005, September 2006, July 2009 and August 2010. Eurocode 3: Design of steel structures – Part 1-8: Design of joints.
- NA to BS EN 1993-1-8:2005. UK National Annex to Eurocode 3: Design of steel structures. Part 1-8: Design of joints.

- prEN 1992-4 (2013) Eurocode 2: Design of concrete structures – Part 4: Design of fastenings for use in concrete.
- Joints in Steel Construction: Simple Joints to Eurocode 3, Steel Construction Institute and the British Constructional Steelwork Association, United Kingdom, 2014.
- Joints in Steel Construction: Moment-Resisting Joints to Eurocode 3, Steel Construction Institute and the British Constructional Steelwork Association, United Kingdom, 2013.

For IS 800-2007 design code:

- IS 800 (2007) Indian Standard – General Construction in Steel – Code of Practice.
- Bhavikatti, S.S. Design of Steel Structures by Limit State Method as Per IS: 800-2007. New Delhi: I.K. International Publishing House Pvt. Ltd., (2014).
- Subramanian, N. Steel Structures, Design and Practice. Oxford University Press, (2010).
- International Federation for Structural Concrete (2011). Design of Anchorages in Concrete. CEP-FIP. Lousanne, Switzerland.

For AS 4100-1998 design code:

- AS 4100 Supp. 1-1999 Steel structures – Commentary (Supplement to AS 4100-1998). Australian Steel Institute.
- Design guide 1. Bolting in structural steel connections. Australian Steel Institute. T.J. Hogan.
- Design guide 2. Welding in structural steel connections. Australian Steel Institute. T.J. Hogan.
- Design guide 3. Web side plate. Australian Steel Institute. T.J. Hogan.
- Design guide 4. Flexible end plate connections. Australian Steel Institute. T.J. Hogan.
- Design guide 5. Angle cleat connections. Australian Steel Institute. T.J. Hogan.
- Design guide 6. Seated connections. Australian Steel Institute. T.J. Hogan.
- Design guide 7. Pinned base plate connections for columns. Australian Steel Institute. T.J. Hogan.
- Design guide 10. Bolted moment end plate beam splice connections. Australian Steel Institute. T.J. Hogan.
- Design guide 11. Welded beam to column. Australian Steel Institute. T.J. Hogan.
- Design guide 12. Bolted end plate to column moment connections. Australian Steel Institute. T.J. Hogan.
- Design guide 13. Splice connections. Australian Steel Institute. T.J. Hogan.
- Handbook 1. Design of structural steel connections. Australian Steel Institute. T.J. Hogan.
- Tubular design guide 21: Bolted bracing connections. Australian Steel Institute. P.W. Key and A.A. Syam.
- Tubular design guide 22: Bolted bracing cleats. Australian Steel Institute. P.W. Key and A.A. Syam.

For NZS 3404-1997 design code:

- NZS 3404: Part 1:1997 – Incorporating Amendment No. 1 and Amendment No. 2 – Steel Structures Standard – Commentary (Supplement to AS 4100-1998). Australian Steel Institute.
- Steel Connect – Structural Steelwork Connections Guide: Design Procedures – SCNZ 14-1:2007. SCNZ Steel Construction New Zealand.

For CSA S16-14 design code:

- S16-14 – Design of steel structures – CSA Group. Canadian Institute of Steel Construction, Standards Association.
- Moment connections for Seismic Applications, second edition. CISC-ICCA Canadian Institute of Steel Construction.

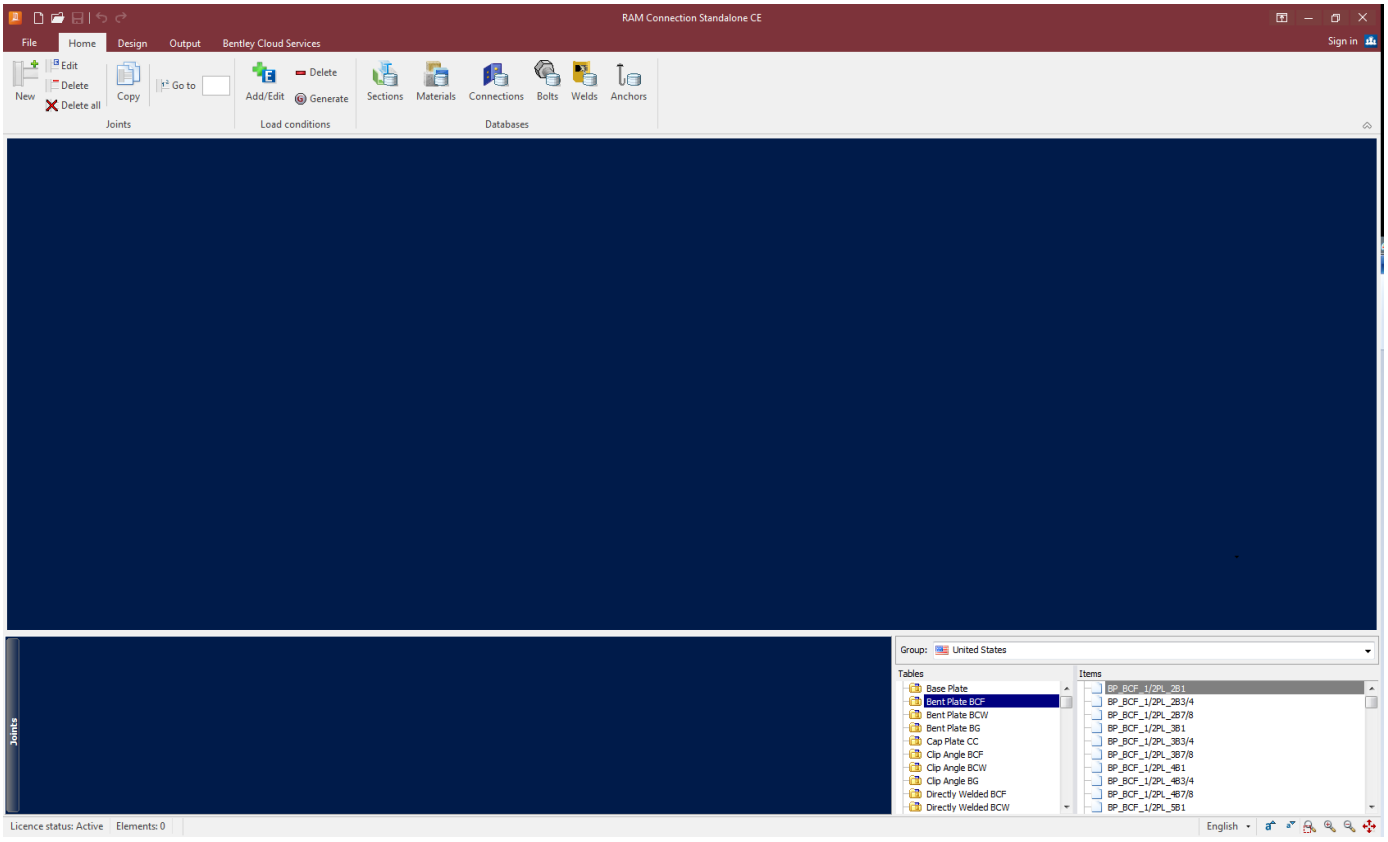
Chapter 3: Connections example for RC-Standalone

This chapter will explain the user step by step through the creation, design and optimization of steel connections in RAM Connection Standalone.

1) Run RAM Connection Standalone and define general design options

Once all the information needed for the connection design is available, execute RAM Connection standalone.

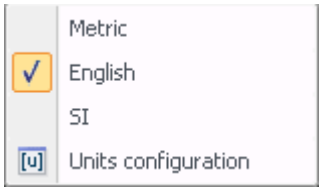
Press the Shortcut to run RAM Connection, or run the program from the start menu.



The RAM Connection window will appear.

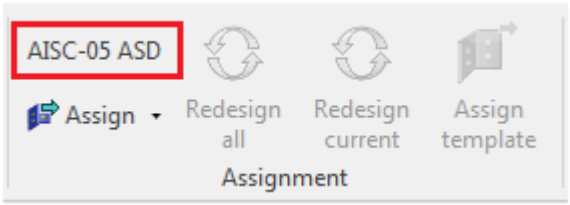
Select the unit system to work with.

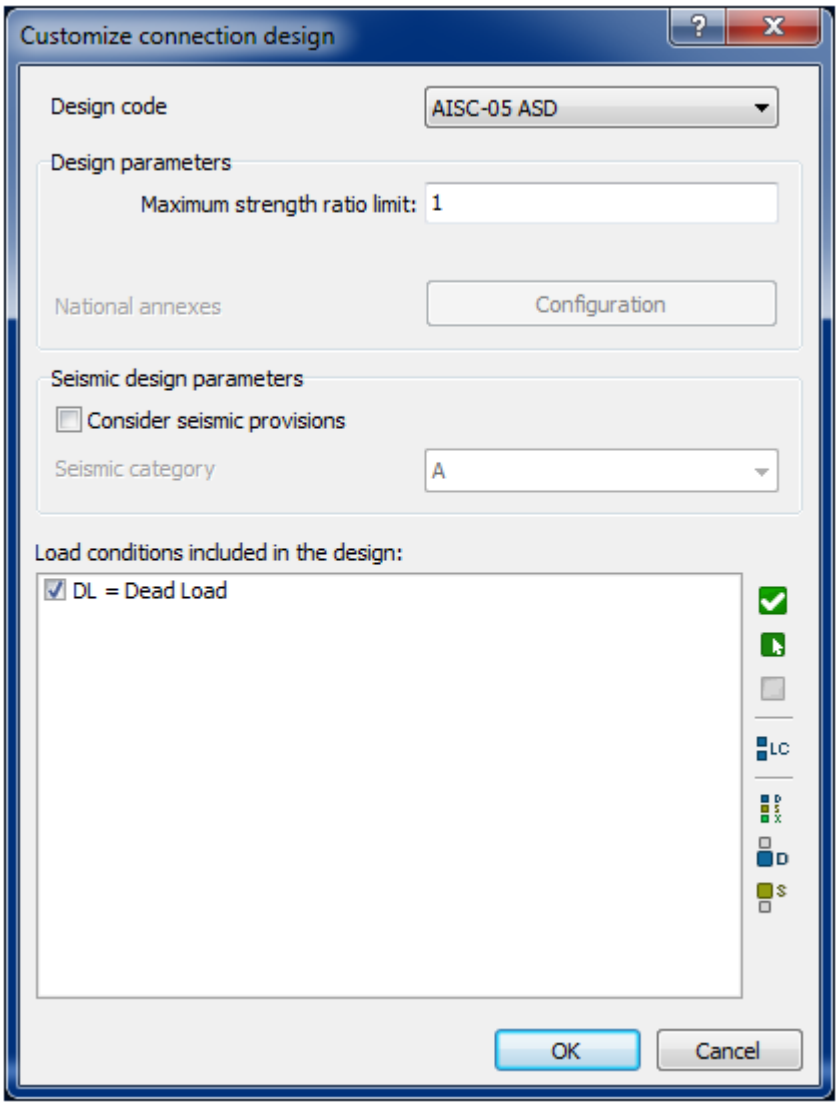
Press the units button located in the status bar.



For the example select the English Units System.

Select the maximum allowable design ratio and the design code. To do this, in the *Assignment group* press the dialog box launcher and select the Design Standard and Design Method in the dialog that is displayed. For this example, select AISC 360-05 as standard and ASD as design method. Also, set the maximum strength ratio to the unity (1.0). The procedures that are described below can also be used to design connections according to the BS 5950-00, GB 50017-03, EN 1993-2005, IS 800-2007, AS 4100-1998, NZS 3404-1997 or CSA S16-14.



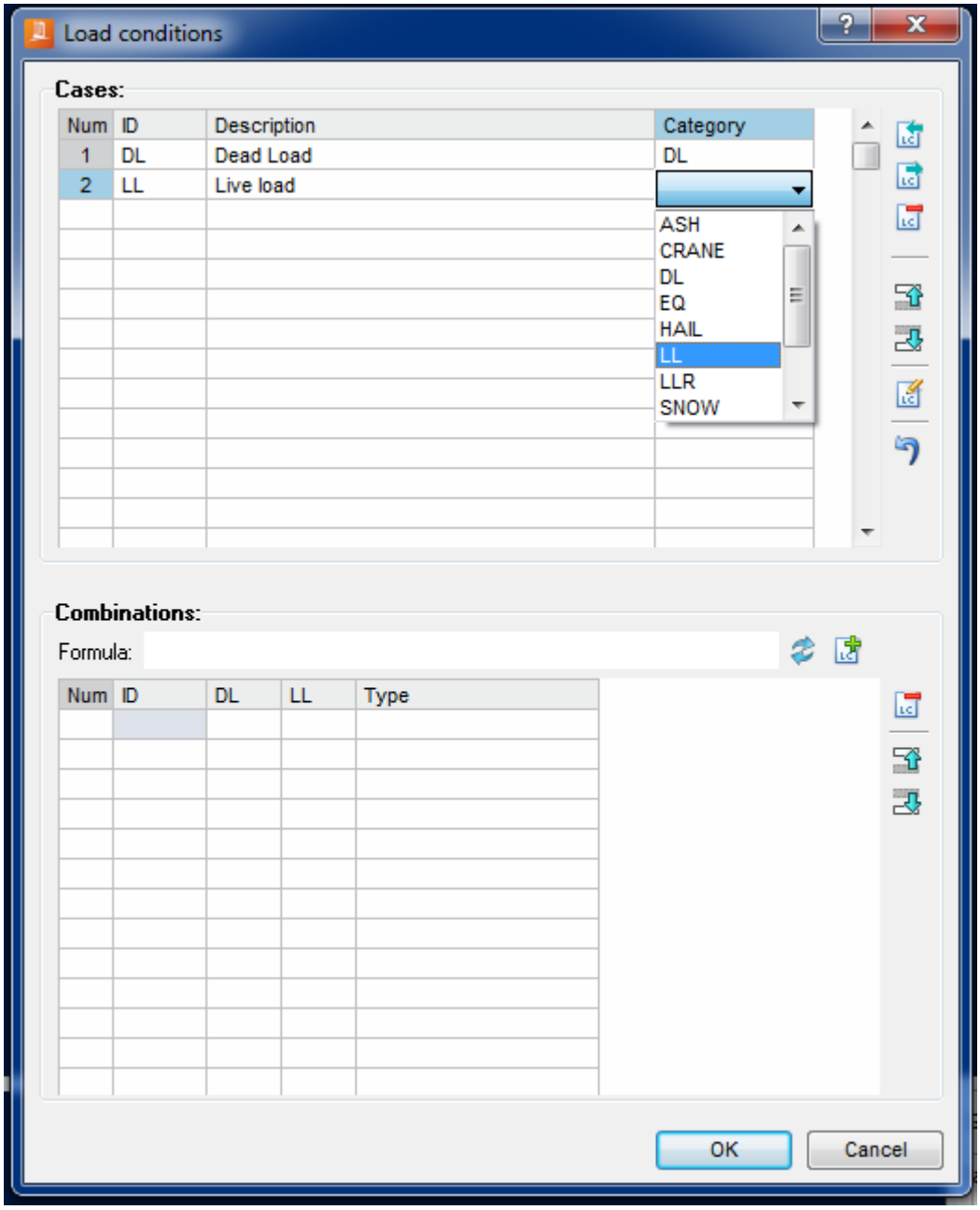


For the example take a maximum strength ratio equal to one (the default and most common value) and the AISC 360-05 ASD code.

Determine the load conditions that will be considered in the design. For the example we will consider two load cases: Dead load and Live load.

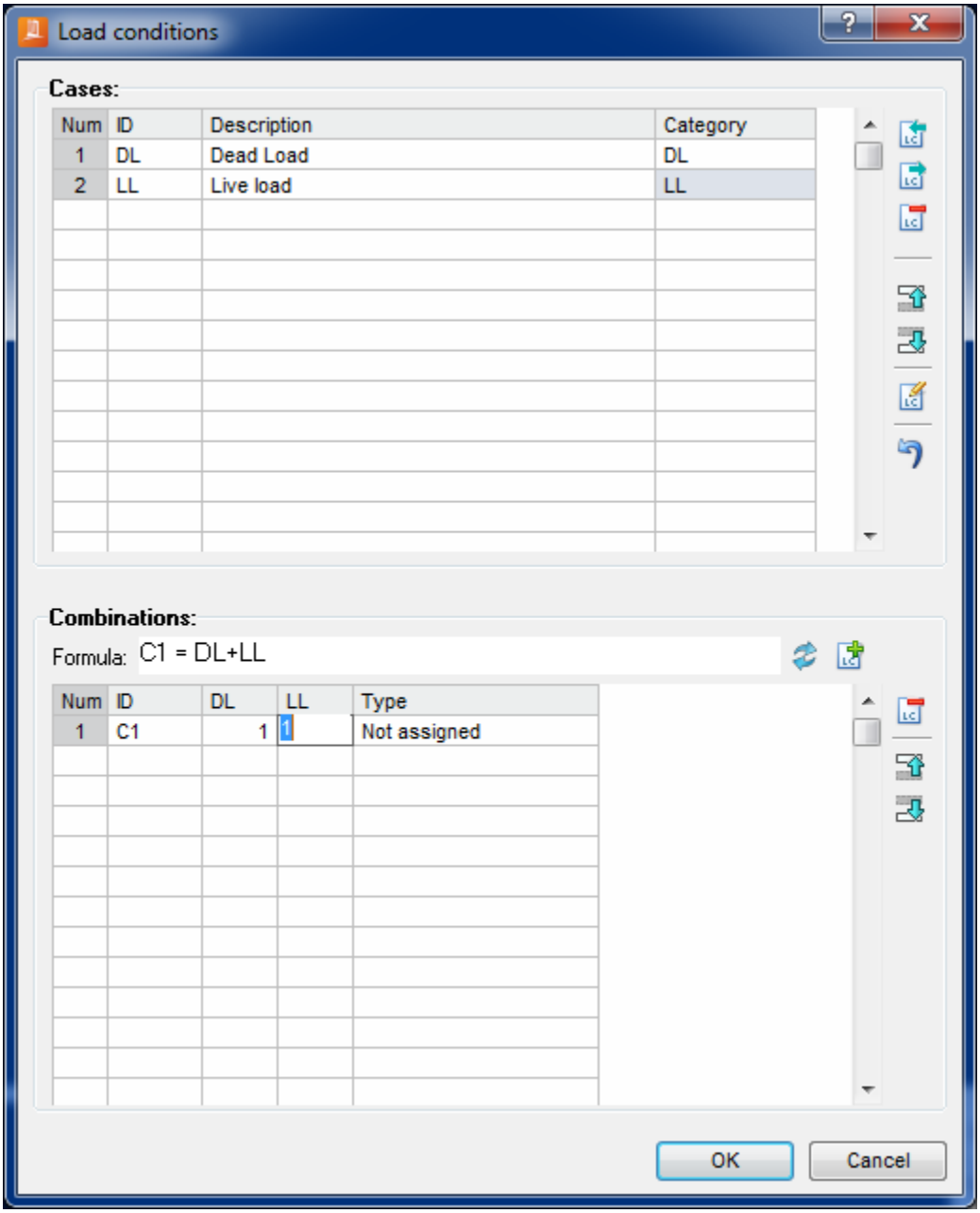
Dead Load comes as the default load case. Create the Live load case, press the 

button and the dialog will appear:



Enter the required data to define the new load case.

The user can generate the desired load combinations:

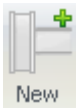


Define the load combination C1 as DL + LL (for the ASD Specification).

Now it is time to assign the first connection.

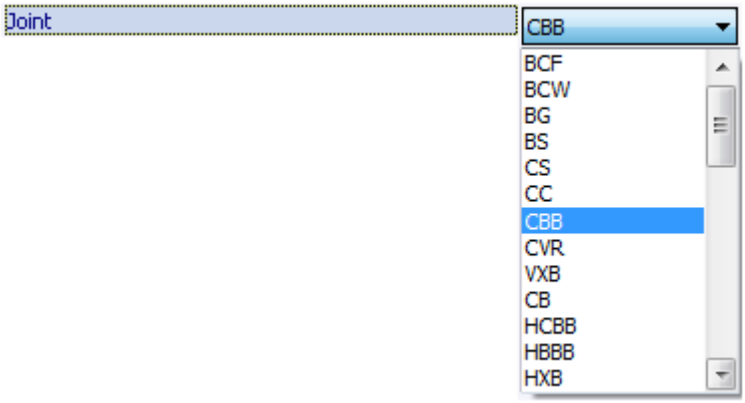
2) Assign basic connections

RAM Connection includes ready-to-use connections templates called basic connections. In the following sections it will be explained how to customize them to own work practice. For the moment the standard settings are taking for illustration.

First, press 

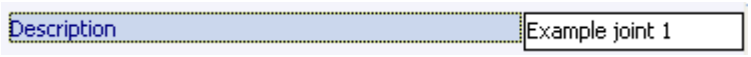
to create a joint.

In the joint creation dialog that appears, select the type of joint desired to create.



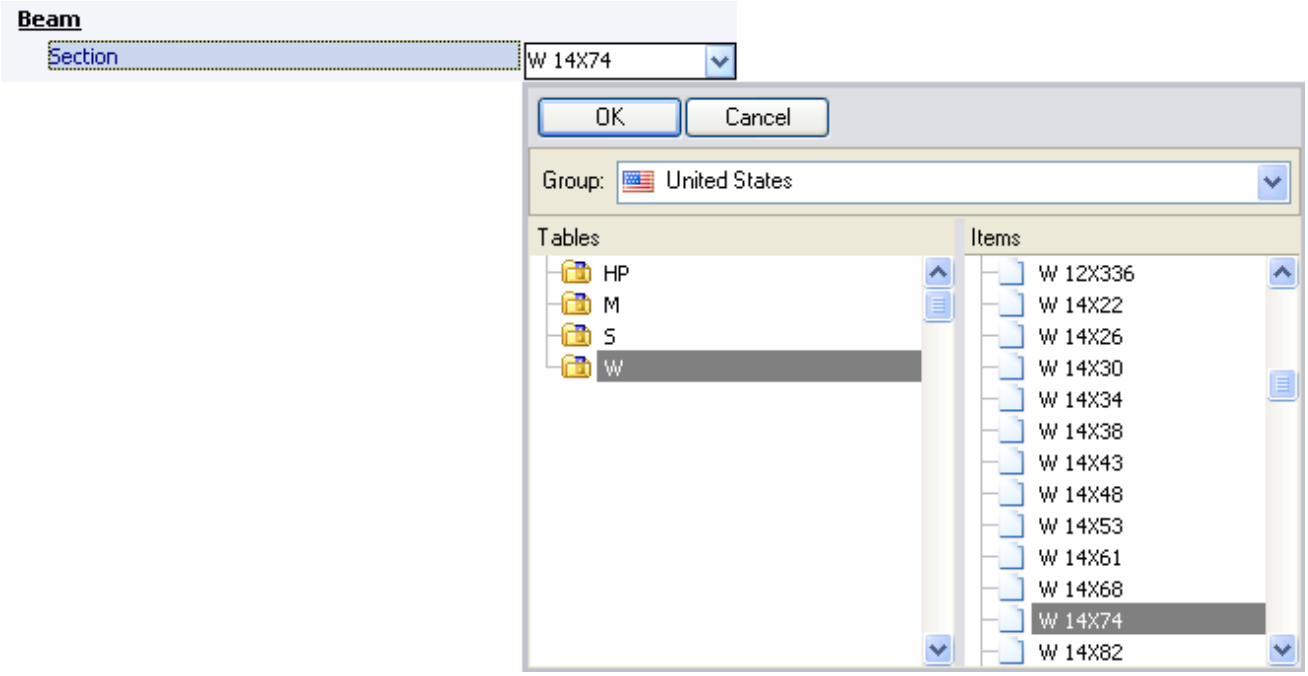
Joint type adopted for the first example

Now enter a joint description. Note that the description is used to identify the joint.

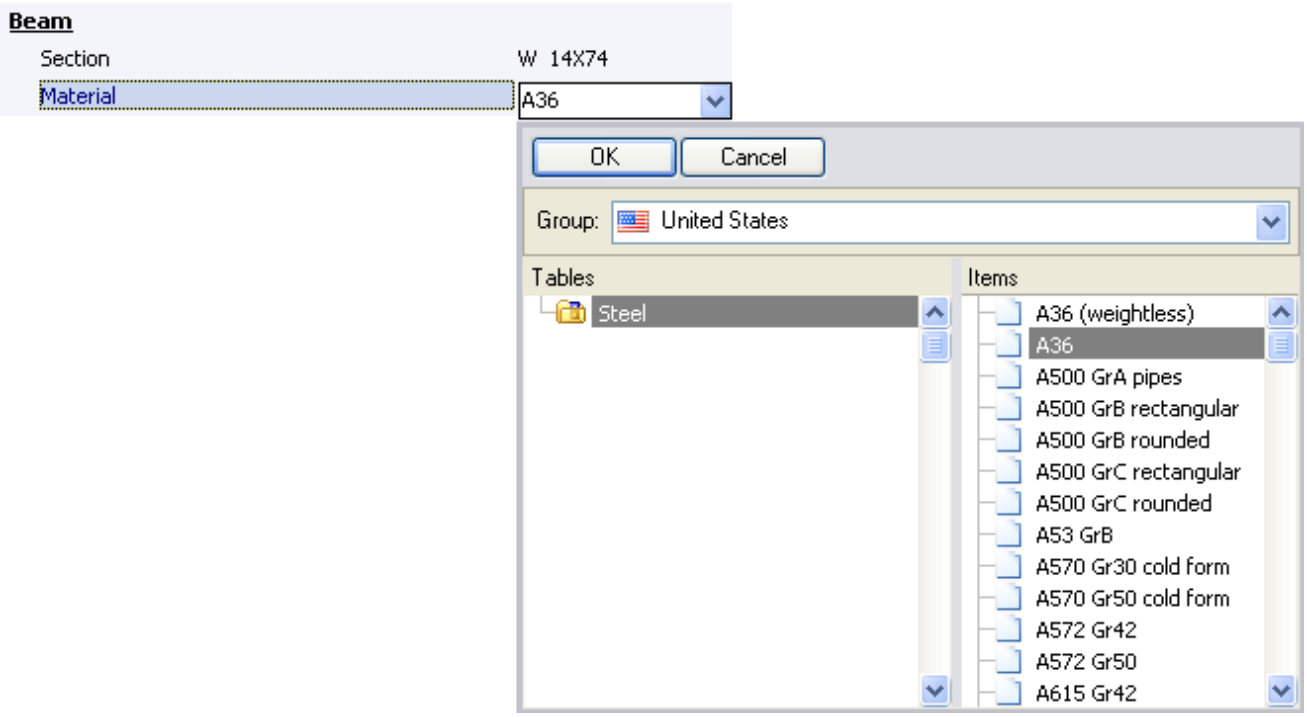


Adopted description for the example

Enter the members sections:



Select the section and material for the beam, for the example W14x74 for section and A36 for material are entered.

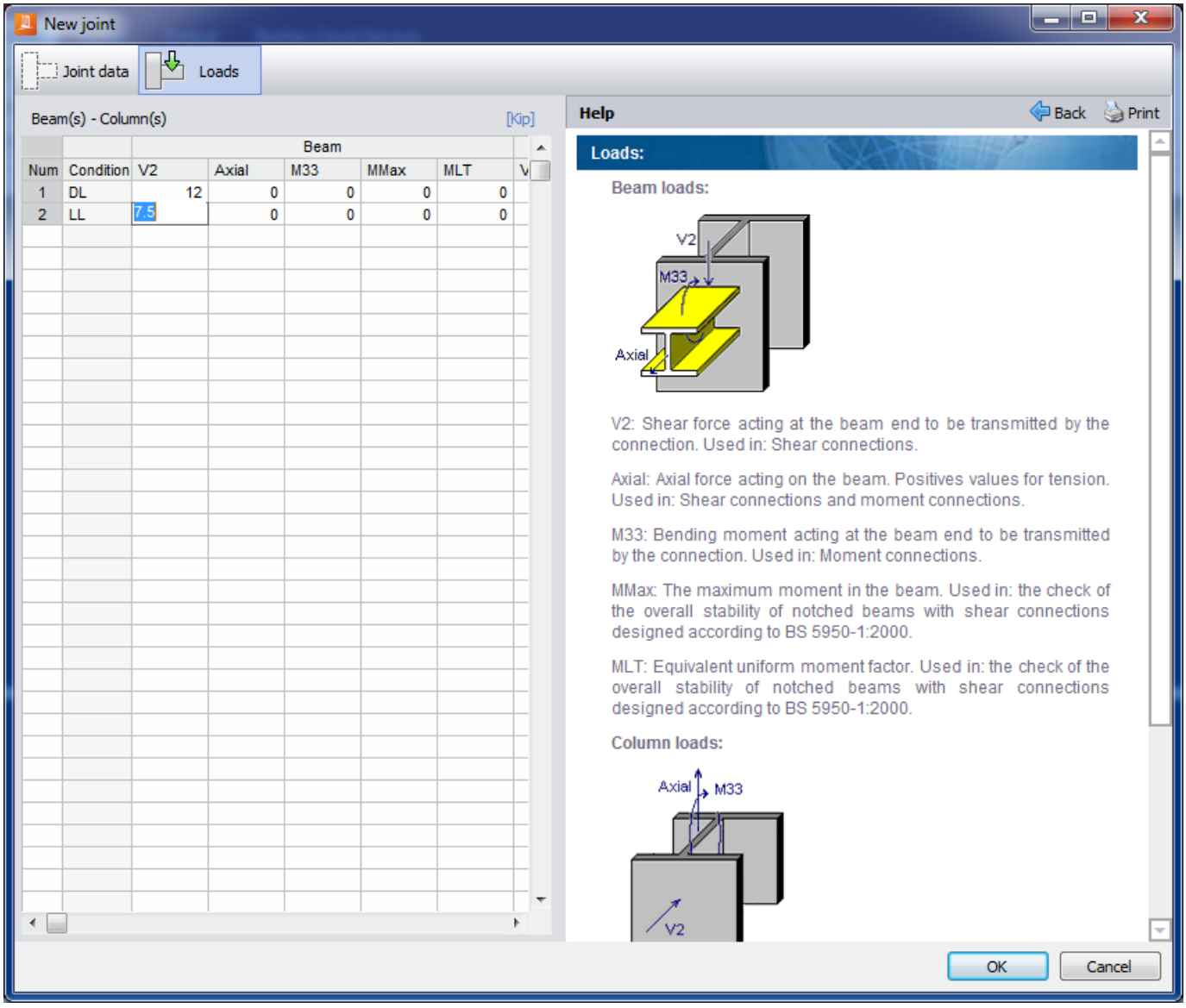


Repeat the last operation for the column; in the example the section W 16x89 and the A36 material will be used.

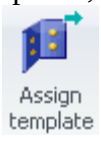
Enter the rest of the required data.

Enter the loads, press the 

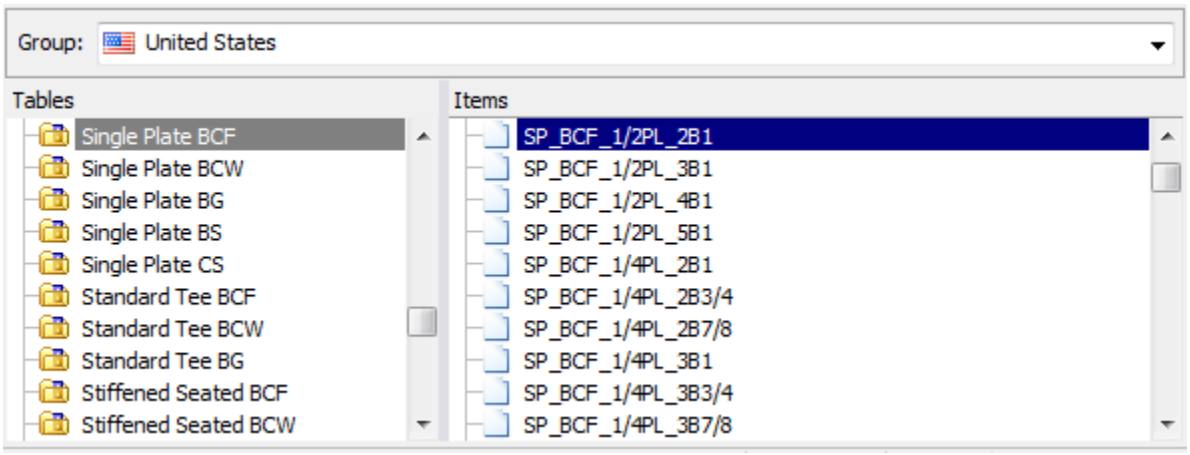
tab, note that a spreadsheet will be shown in which are listed all the load conditions of the model. The load combination are not shown as they will be determined automatically from the load conditions data.



Enter 12 kips as shear force for dead load (DL) and 7.5 kips as shear force for live load (LL).

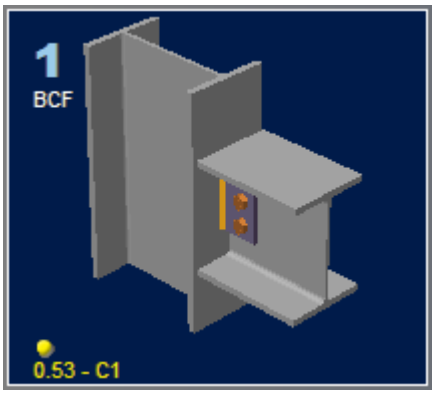
Define the type of connection to be used. In the list of available templates, open the folder of the desired template and assign it to the joint by pressing the button 

from the *Design tab*, *Assignment group*.



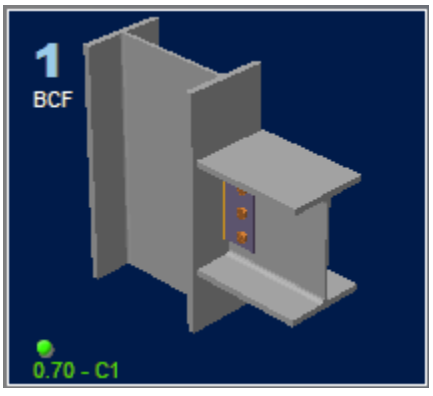
For the example select the SP_BCF_1/2PL_2B1 as the template for the connection.

The connection will be assigned.



Notice that the ratio of the connection is less than 1, but the status shown yellow flag, meaning geometric warnings in the model.

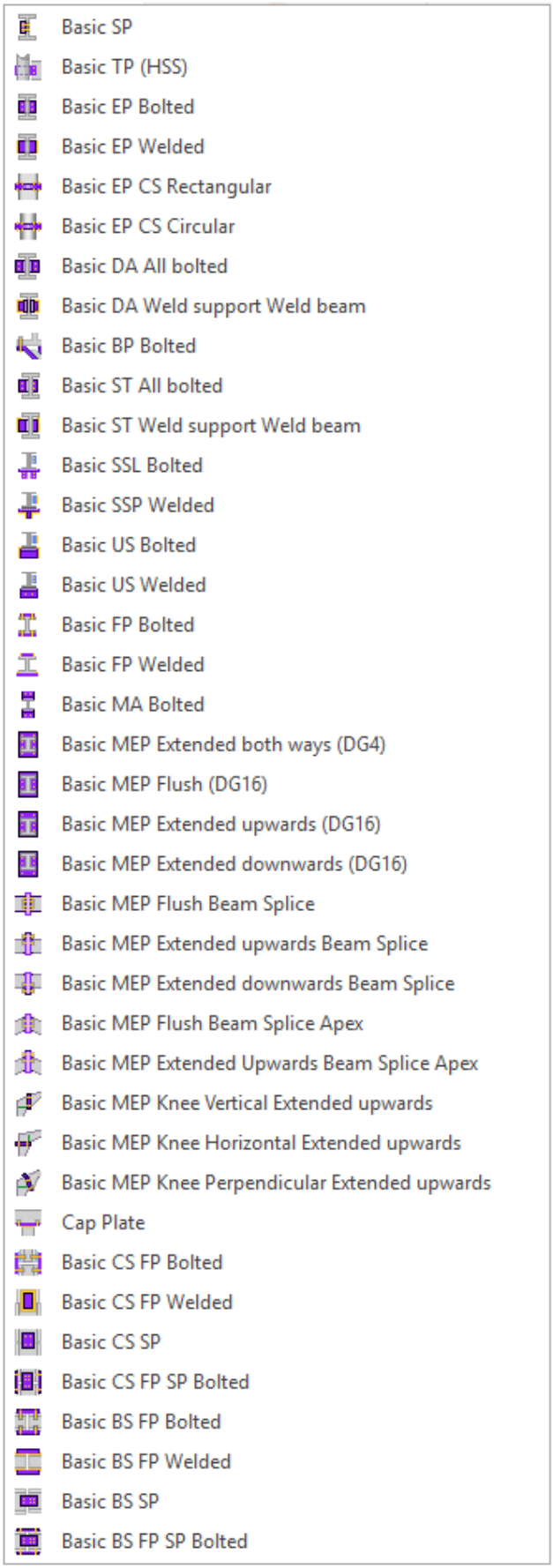
Try with the SP_BCF_1/4PL_3B3/4 template.



The ratio and status for the new connection are OK now.

Alternatively there is another way to assign connections using the 

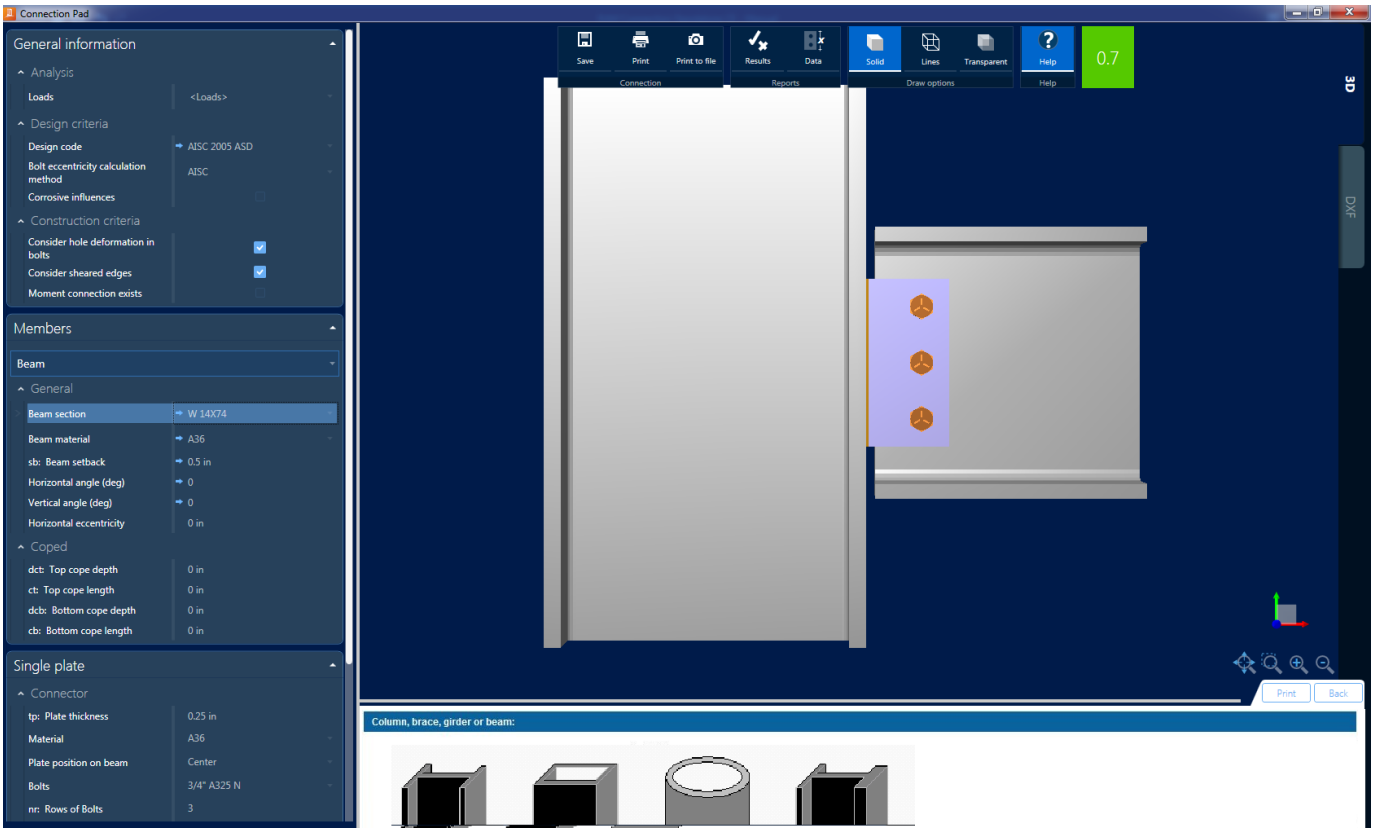
button to obtain the same result without iterations. Selecting the button the next option list will be displayed (for AISC design code).


Basic SP
Basic TP (HSS)
Basic EP Bolted
Basic EP Welded
Basic EP CS Rectangular
Basic EP CS Circular
Basic DA All bolted
Basic DA Weld support Weld beam
Basic BP Bolted
Basic ST All bolted
Basic ST Weld support Weld beam
Basic SSL Bolted
Basic SSP Welded
Basic US Bolted
Basic US Welded
Basic FP Bolted
Basic FP Welded
Basic MA Bolted
Basic MEP Extended both ways (DG4)
Basic MEP Flush (DG16)
Basic MEP Extended upwards (DG16)
Basic MEP Extended downwards (DG16)
Basic MEP Flush Beam Splice
Basic MEP Extended upwards Beam Splice
Basic MEP Extended downwards Beam Splice
Basic MEP Flush Beam Splice Apex
Basic MEP Extended Upwards Beam Splice Apex
Basic MEP Knee Vertical Extended upwards
Basic MEP Knee Horizontal Extended upwards
Basic MEP Knee Perpendicular Extended upwards
Cap Plate
Basic CS FP Bolted
Basic CS FP Welded
Basic CS SP
Basic CS FP SP Bolted
Basic BS FP Bolted
Basic BS FP Welded
Basic BS SP
Basic BS FP SP Bolted

From this list select Basic SP (single plate); this action will assign the most adequate connection to the recently created joint.

To review all the data and the connection design, select the image in the Joint selection area and press the Edit... button for the connection to be edited. As explained before, other ways to access to the connection pad (dialog) are: 1) double-clicking over the connection image in the graphic area (3D view), or 2) by pressing the 

button from the *Design tab*, *Connections group*, and selecting the correct type of connection.



Review all the data for the selected connections in the connection Pad. It is important to verify if the status and critic strength ratio are OK.

To print the data report or the results report, press 

or 

respectively.

It is possible to edit any parameter of the connections. This is very useful when the design was not successful in order to achieve an adequate design connection. Note that any manual changes will be lost if the connections are redesigned or reassigned.

Now it is time to save the model file with all the connections. Press  in the quick access toolbar, or in the RCSA button menu.

Following a similar procedure as outlined for Example 1, design the following connections:

Example2	BG	SP_BG_1/4PL_3B3/4
Example3	BCW	SP_BCW_1/4PL_2B3/4
Example4	BCF	FP_BCF_5/8PL_1B3/4

Use the following data for Member 1 (Beam):

Example2	BG	W 12x30	A36
Example3	BCW	W 12x30	A36
Example4	BCF	W 18x50	A36

And the following data for Member 2 (Column):

Example2	BG	W 18x71	A36
Example3	BCW	W 21x44	A36
Example4	BCF	W 14x99	A36

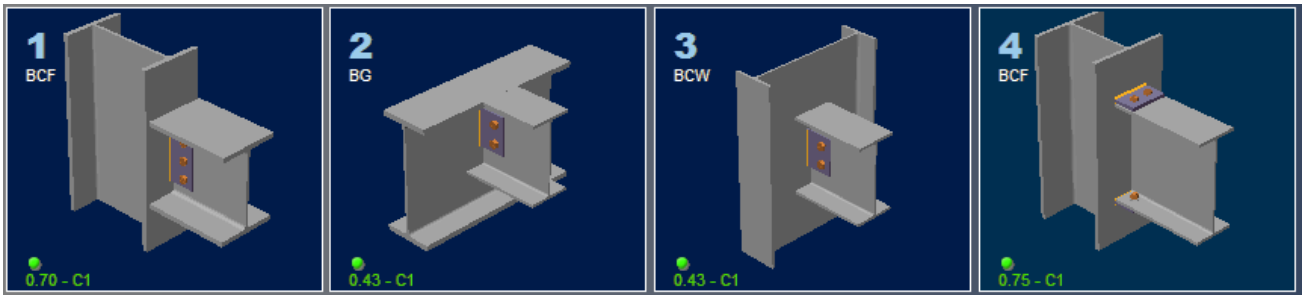
With the following loads: (Kip-ft)

Example	**Joint family**	**Dead load**		**Live load**	
		V2 [kip]	**M33 [kip-ft]**	**V2 [kip]**	**M33 [kip-ft]**
Example2	BG	5	0	5	0
Example3	BCW	5	0	5	0
Example4	BCF	0	12	0	12

The results to be obtained are:

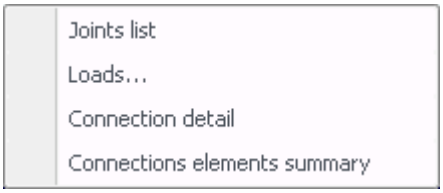
Example	**Joint family**	**Connection**	**Ratio**	**Status**
Example 1	BCF	SP_BCF_1/4PL_3B3/4	0.47	OK *
Example 2	BG	SP_BG_1/4PL_2B3/4	0.24	OK *
Example 3	BCW	SP_BCW_1/4PL_2B3/4	0.43	OK *
Example 4	BCF	FP_BCF_5/8PL_1B3/4	0.75	OK *

*When the design was satisfactory, the design status is represented by the small sphere in the joints windows and it turns green.



Final results

As described in previous chapters, it is possible to obtain a report of all the created connections.

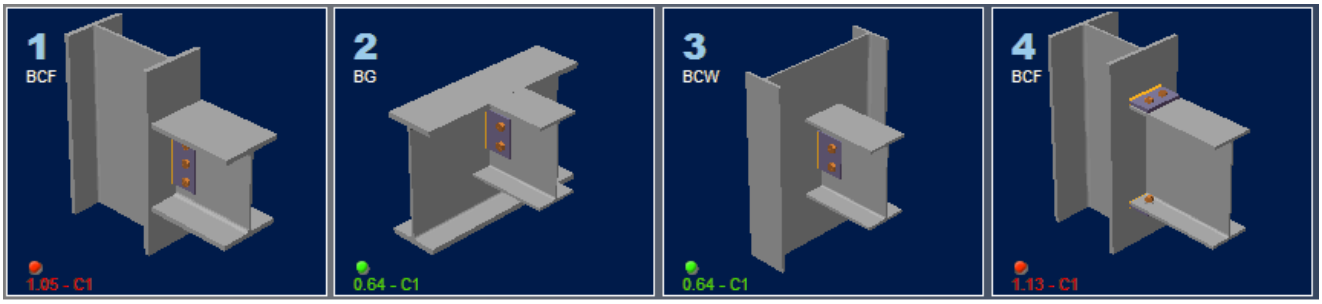


Choose the type of report desired and then print it.

What if the loads, geometry or any design condition change?

No problem. The user can redesign all or part of the connections in a very fast way.

For example, modify the loads by multiplying by 1.5, the ratio and status of the connections have changed and two connections are not good (status in red and critic strength ratio bigger than one).

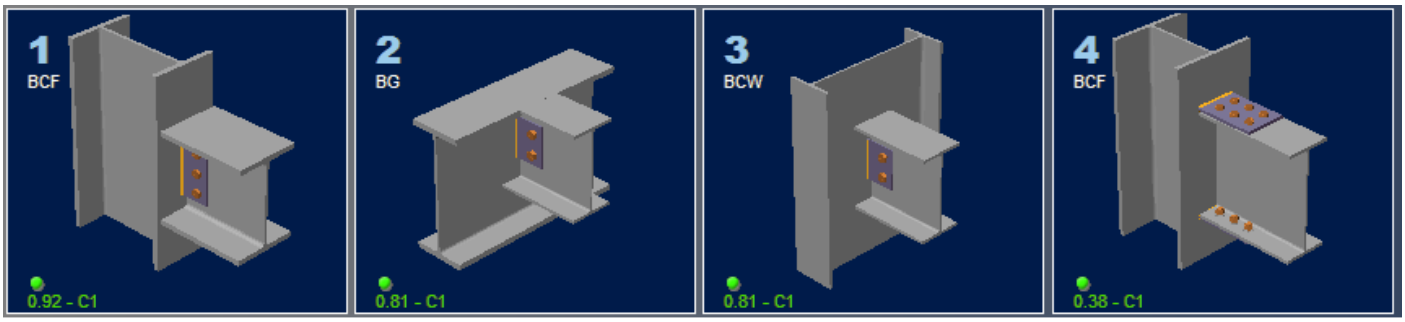


Ratio and status of connections with the loads increased.

For the first 3 examples press the 

button and for the fourth example press 

from the menu displayed pressing the  button. The new connections have been assigned with a good design (green status).



Note: If designing the connections with the buttons from the *Assign button* menu, use the 

button to redesign all of the connections independently of the assignment buttons used or the 

button to redesign the connections of the current joint, the results obtained are the same.

3) Assigning gussets connections

RAM Connection Standalone has templates to assign gussets-to-braces connections, groups of connections that design and optimize themselves automatically at the moment of changing any parameter of data in the connection dialog.

Thus, as previously done, add a CBB joint with the description “Example joint 5” in the joint dialog.

Property	Value
Joint	CBB
Description	Example joint 5
Is column end	No
Actual members	
Right beam	Yes
Left beam	Yes
Upper right brace	Yes
Upper left brace	Yes
Lower left brace	Yes
Lower right brace	Yes
Column	
Section	W 18X106
Material	A36
Orientation (°)	0
Right beam	
Section	W 14X68
Material	A36
sb: Setback to the column	0.5 in
Left Beam	
Section	W 14X68
Material	A36
sb: Setback to the column	0.5 in
L: Length	10 ft
Upper right brace	
Section	W 12X87
Material	A36
Slope angle	40
Rotation	0
sbB: Setback	0.5 in
Upper left brace	
Section	W 12X87
Material	A36
Slope angle	40
Rotation	0
sbB: Setback	0.5 in
Lower left brace	
Section	W 12X87
Material	A36
Slope angle	40
Rotation	0
sbB: Setback	0.5 in
Lower right brace	
Section	W 12X87
Material	A36
Slope angle	40
Rotation	0
sbB: Setback	0.5 in

Joint type adopted for example 5

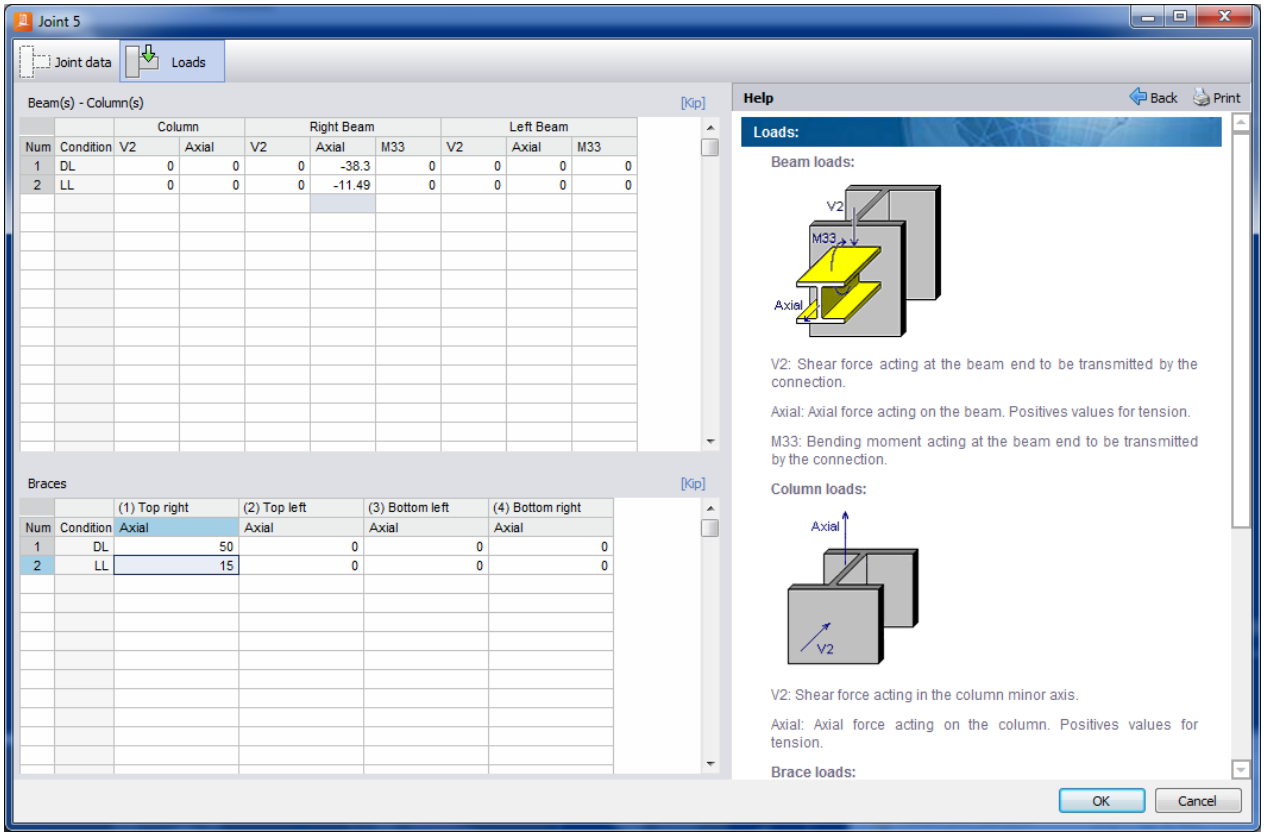
Introduce the properties for the members and braces, for this example the following was used:

Member	**Section**	**Material**
Column	W 18X106	A36
Left Beam	W 14X68	A36
Right Beam	W 14X68	A36

Brace	**Section**	**Material**
Brace 1	W 12X87	A36
Brace 2	W 12X87	A36
Brace 3	W 12X87	A36
Brace 4	W 12X87	A36

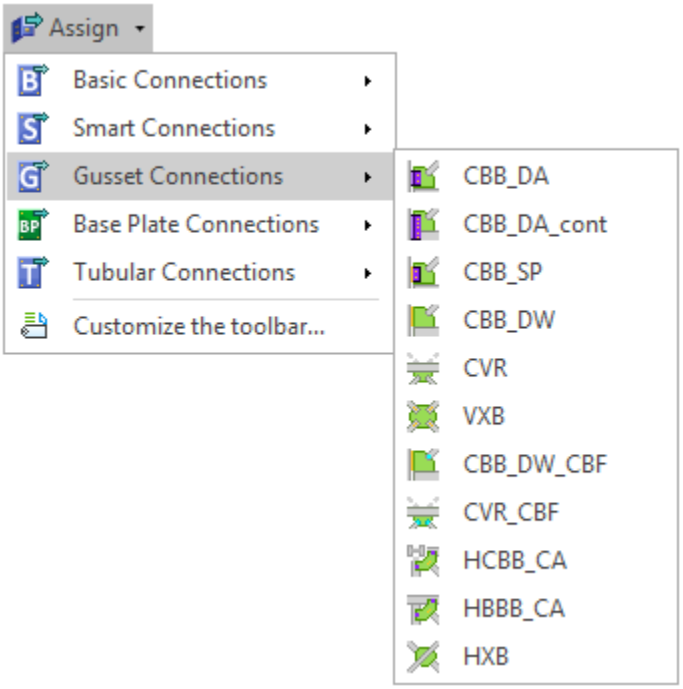
Note. It's very important to introduce the slope angle of the brace so the template may assign the connection correctly. For the example, the slope angle is 40º.

Introduce the loads:



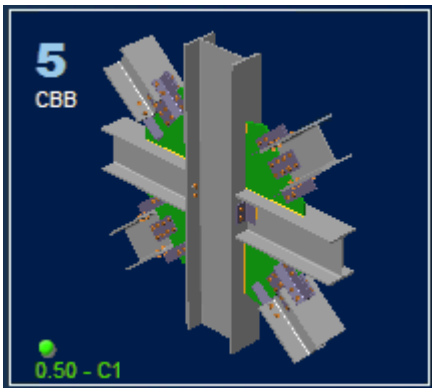
Set a load of 50 Kips as dead load and for the live load 15 Kips as axial load in the brace 1. In order to have the system in equilibrium, introduce axial loads to the beams to balance those introduced for the brace, set - 38.3 Kips as dead load and – 11.49 Kips as live load for the right beam.

As the next step, pick one of the available templates by pressing the button for gussets connections and choose the one shown in the figure.



Choose CBB-DW as the template for the connection.

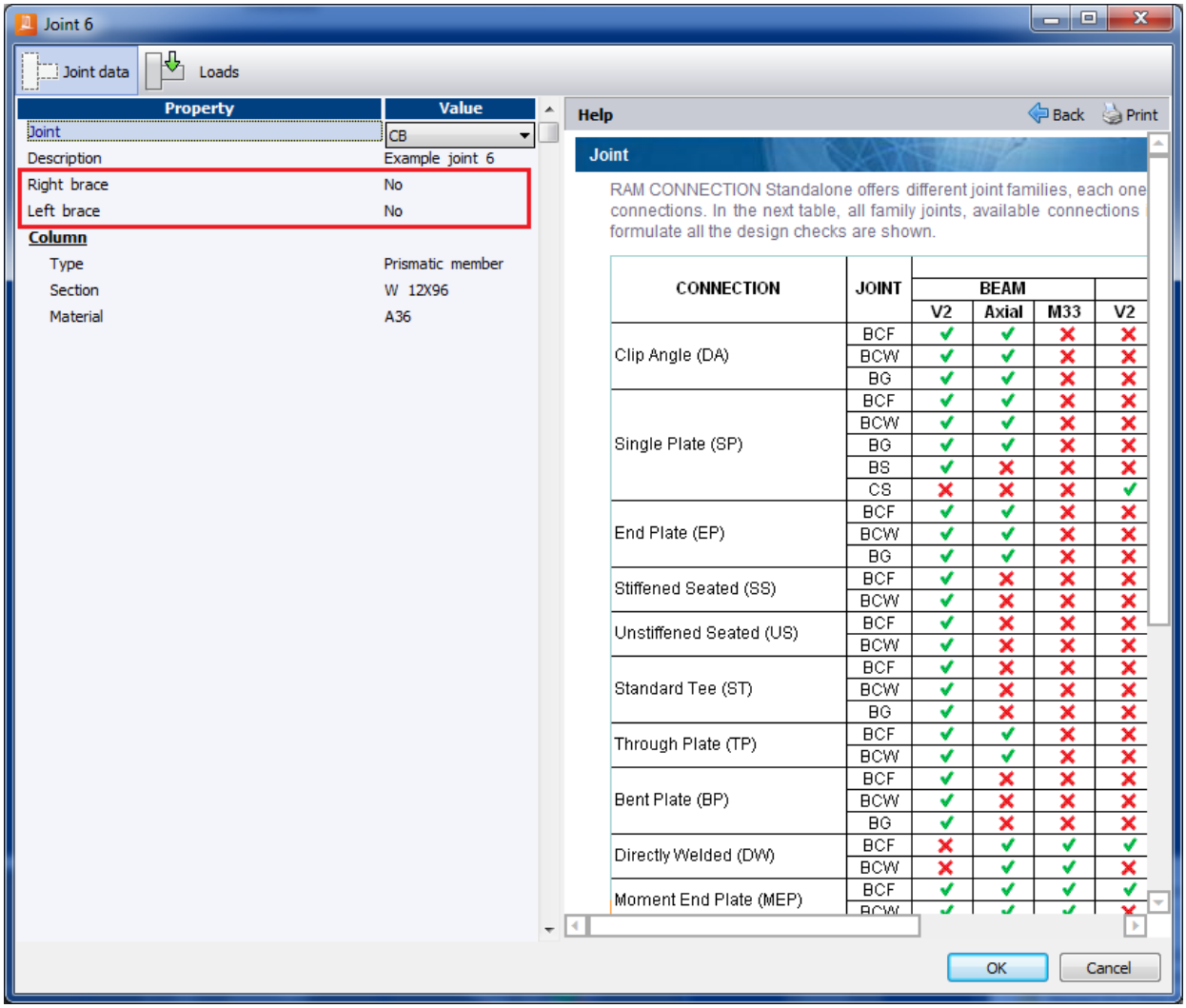
The connection will be assigned to the joint and the user will be able to watch it immediately with its ratio and design status.



4) Assigning base plate connections (column - base plate)

RAM Connection Standalone allows the creation of column – base plate connections using predefined templates. The base plate templates are defines as 'Smart', as they allow the program to determine the main design parameters as the base plate dimensions, weld sizes, anchor embedment length and diameter based on the acting forces.

To assign a base plate connection, add a CB type joint with the description “Example 6” in the joint dialog. Check no braces are assigned.

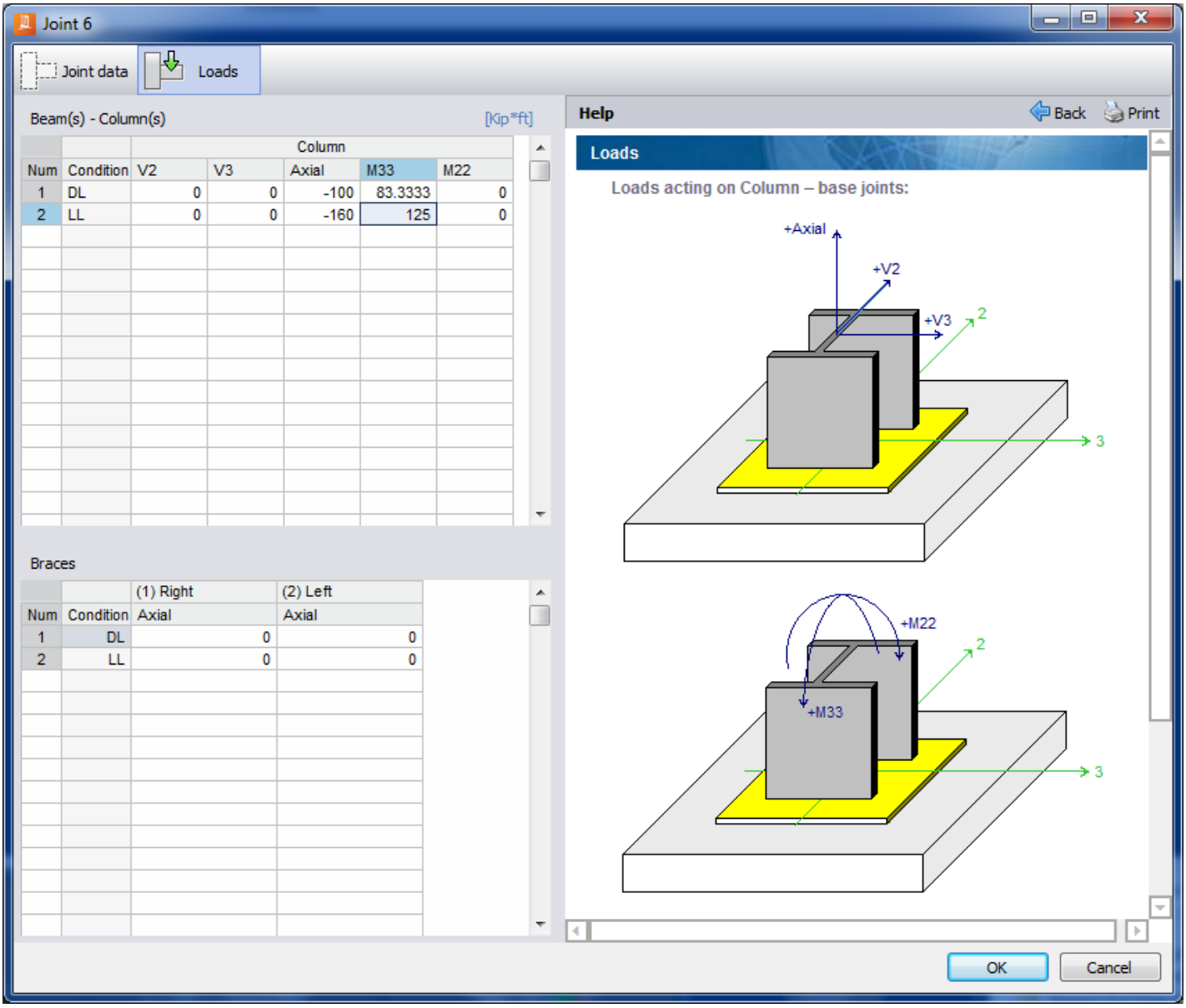


Joint type adopted for example 6

Enter the column properties, for this example the following data was used:

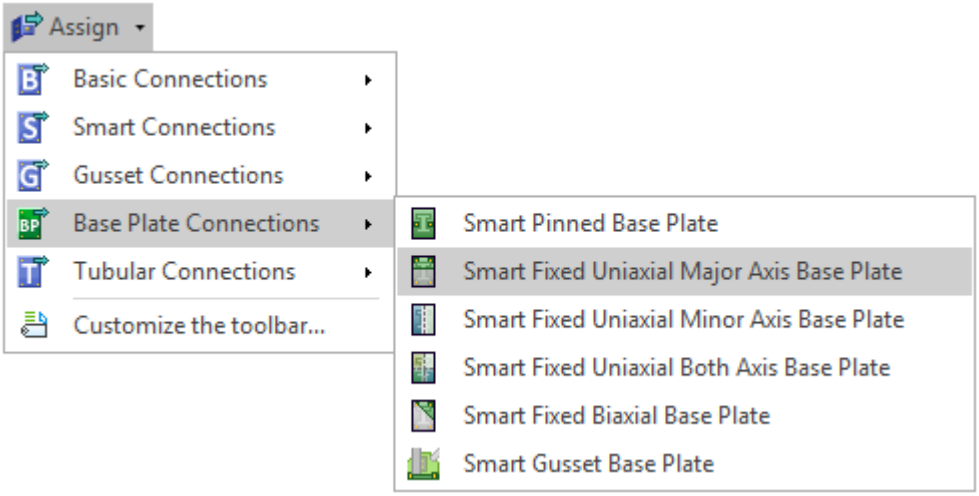
Member	**Section**	**Material**
Column	W 12X96	A36

Enter the loads:



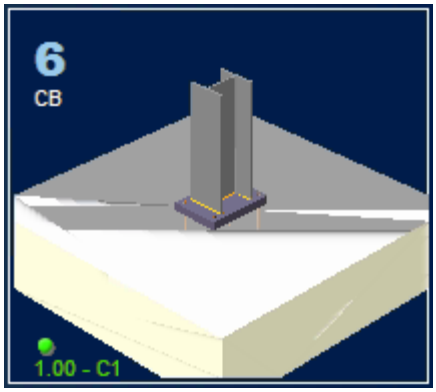
Enter axial loads of 100 Kips and 160 Kips for dead load and live load. Besides enter moments of 1000 Kips-in and 1500 Kips-in for the dead load and live load respectively.

Then in order to assign a connection to the joint, in the Assign button, select the Base Plate connection option and pick the required connection.

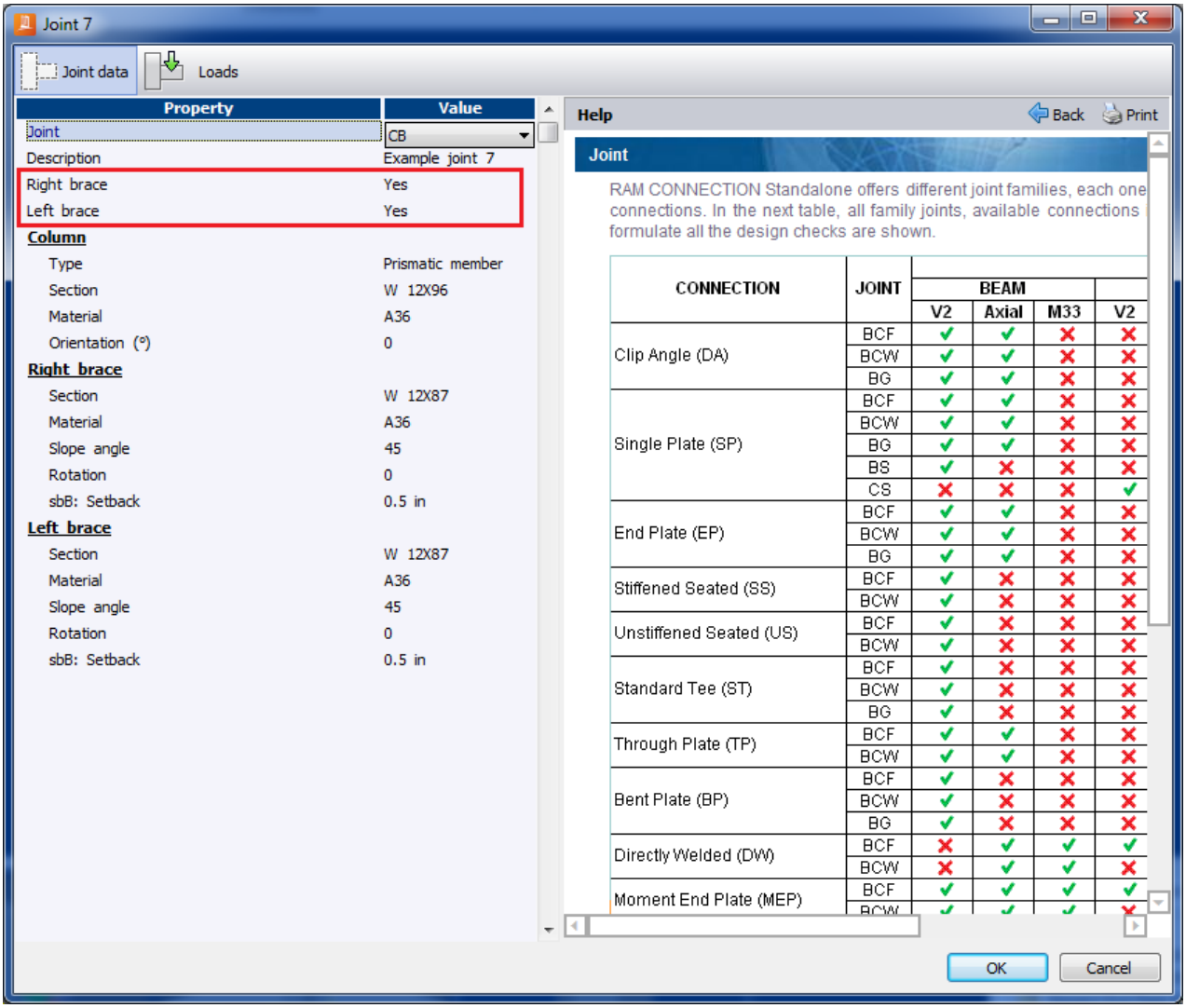


Choose Smart Fixed Uniaxial Base Plate as the template for the connection.

The connection will be assigned to the joint, and the user will be able to watch it immediately with its ratio and design status.



In the same way, it is possible create a base plate connection with braces. In order to do that it is necessary to add them in the joint dialog as it is shown as follows:



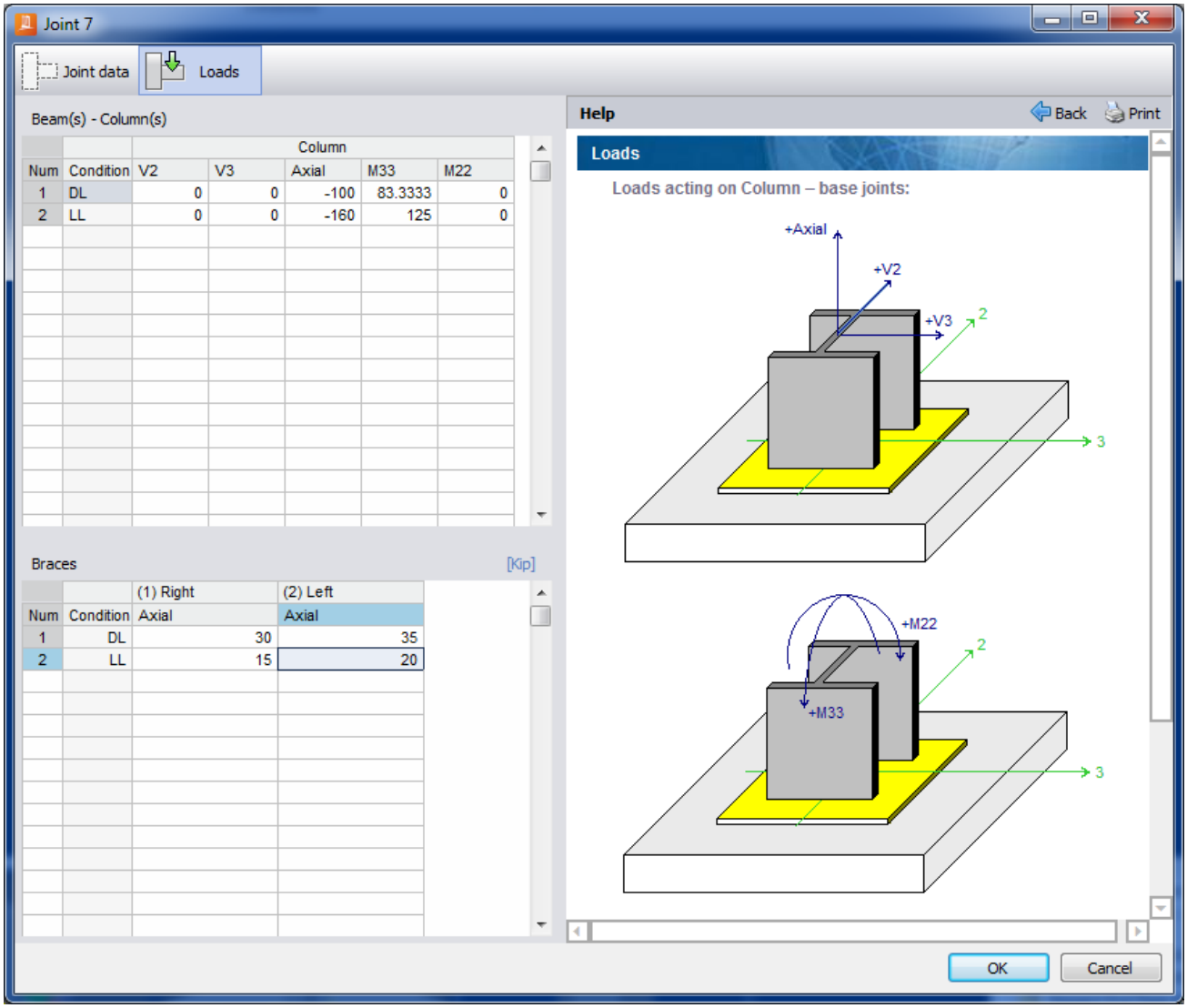
Enter column and braces properties, for this example the following was used:

Member	Section	Material
Column	W 12X96	A36

Brace	Section	Material
Left Brace	W 12X87	A36
Right Brace	W 12X87	A36

Note. It's very important to enter the brace slope angle so the template may be assigned correctly. For the example, the slope angle is 45º.

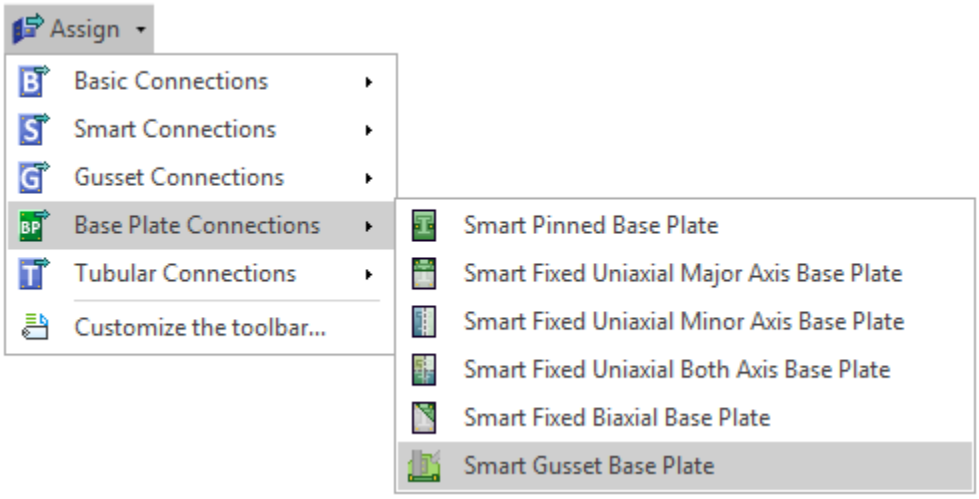
Enter the loads:



Enter axial loads of 100 Kips and 160 Kips for dead load and live load. Besides enter moments of 1000 Kips-in and 1500 Kips-in for the dead load and live load respectively.

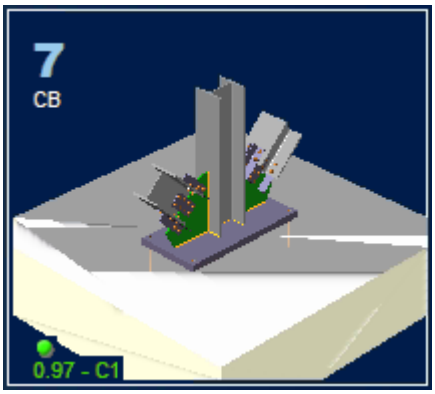
The left brace will be under axial loads of 30 Kips and 15 Kips for the dead and live loads and the right brace will be under and axial loads of 35 Kips and 20 Kips for dead and live loads respectively.

Then in order to assign a connection to the joint, in the Assign button, select the Base Plate connection option and pick the required connection.

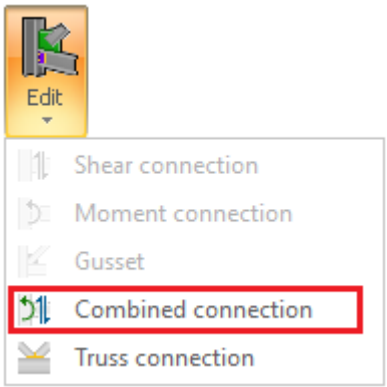


Choose Smart Gusset Base Plate as the template for the connection.

At the same way to the base plate without braces, the connection will be assigned to the joint and the user will be able to watch it immediately with its ratio and design status.



Once the connection is assigned, select the *Edit/Combined connection* option from the *Assignment* group in the *Design* tab to review the design of the connection.



For a detailed connection report, select the *Extruded view* tab and choose the *Results* 

option. The report shows all the verifications performed for the connection.

5) Create a connection template

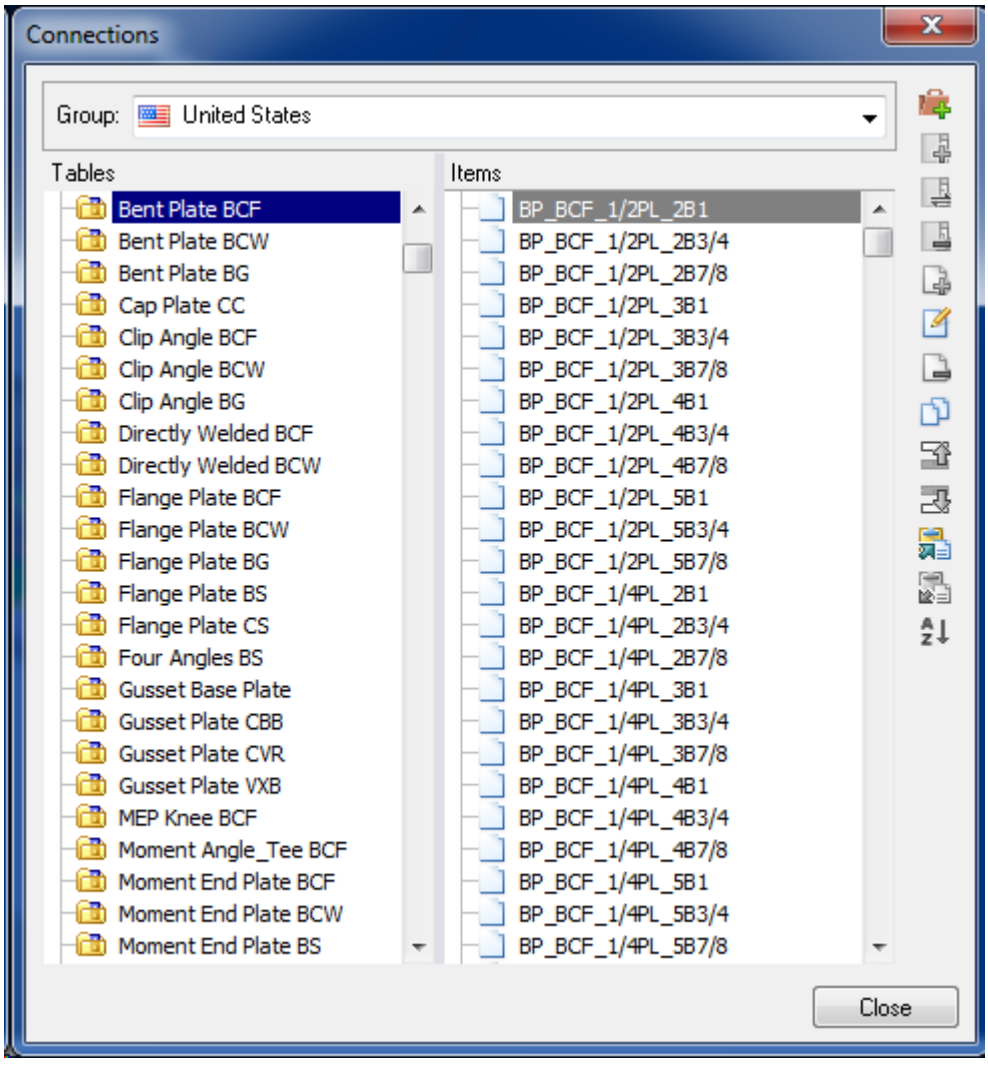
Although RAM Connection Standalone has several templates in the database, the user may want to define new templates with all the specific characteristics required by user's own practice.

Hint: It is always suggested to create a backup of the connections database (file Connections.ini in the DB folder of main directory) before generating or changing the templates.

Press 

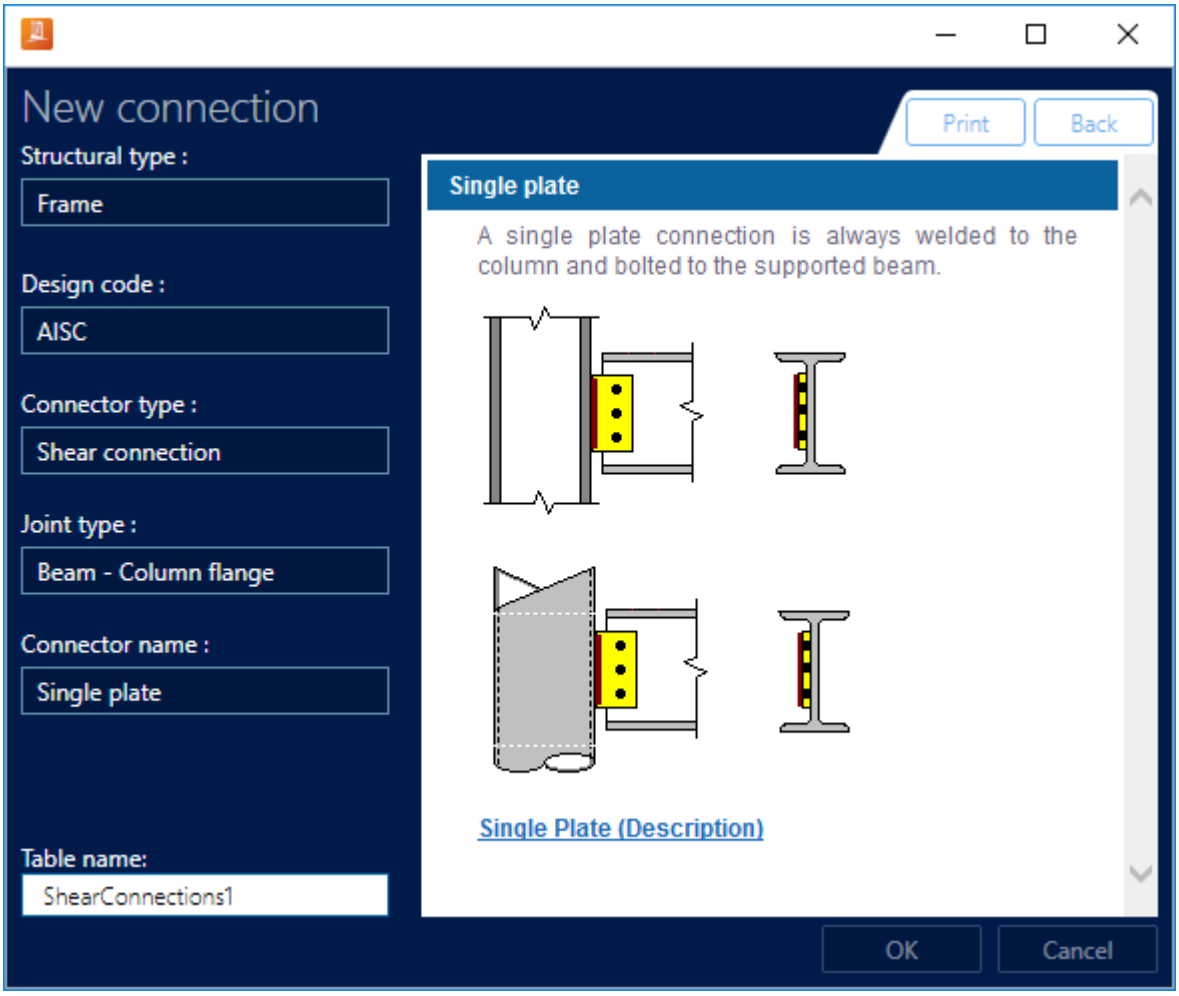
to access the connections database.

A dialog window showing the available connections grouped in folders will appear:



Create a new group with the  button. Enter a name for the new group of connections. For the example you can adopt the "MyShearConnections" group.

Then, add a new table with the  button.

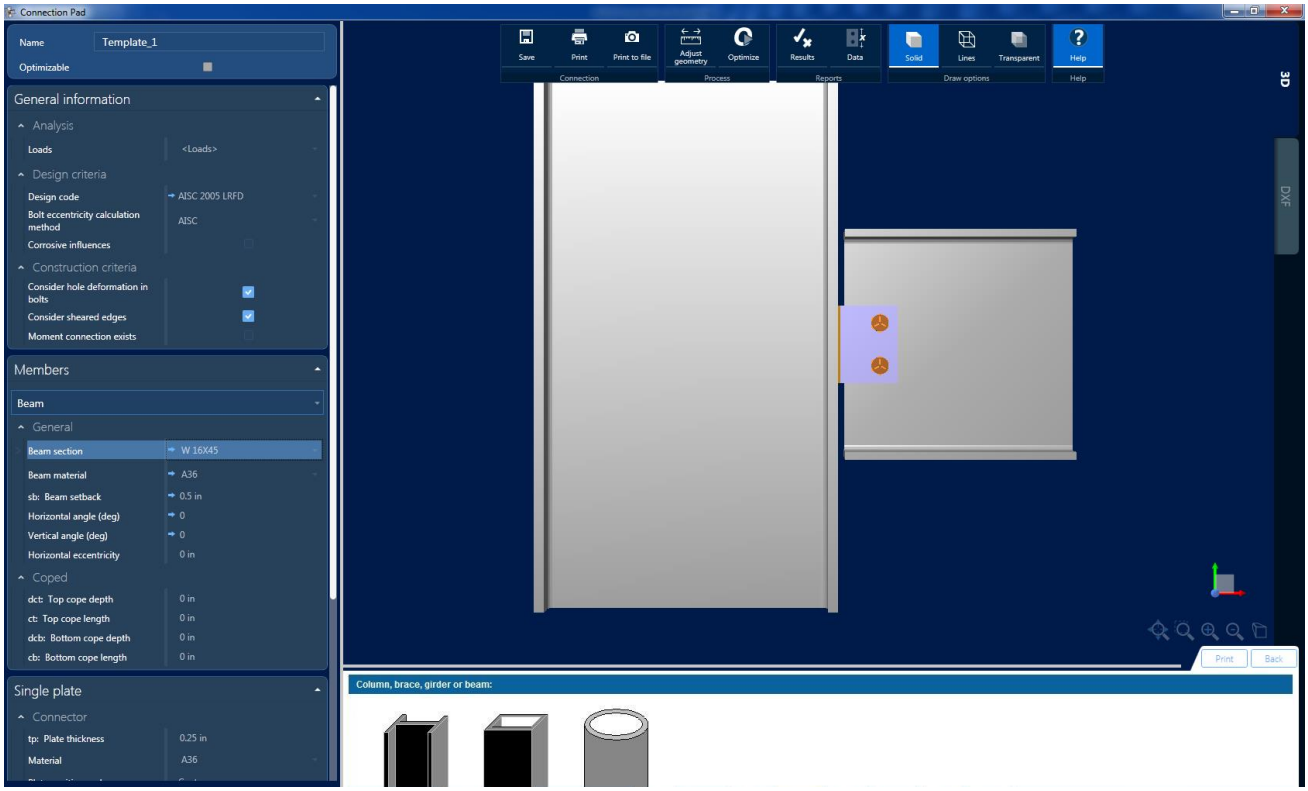


Enter the name, family, type, design code and press OK. In this case enter the options shown in the figure.

With the former table selected, press the  button to create a new connection.

Notice that the name of the template is used to identify the connection and has to be unique in the whole database (including all folders). Thus, assign a name that describes the geometry and main characteristics of the connection

The following window will be displayed:



The following data are required: Design Code, Loads, General information and the specific data required in Shear and/or Moment connections.

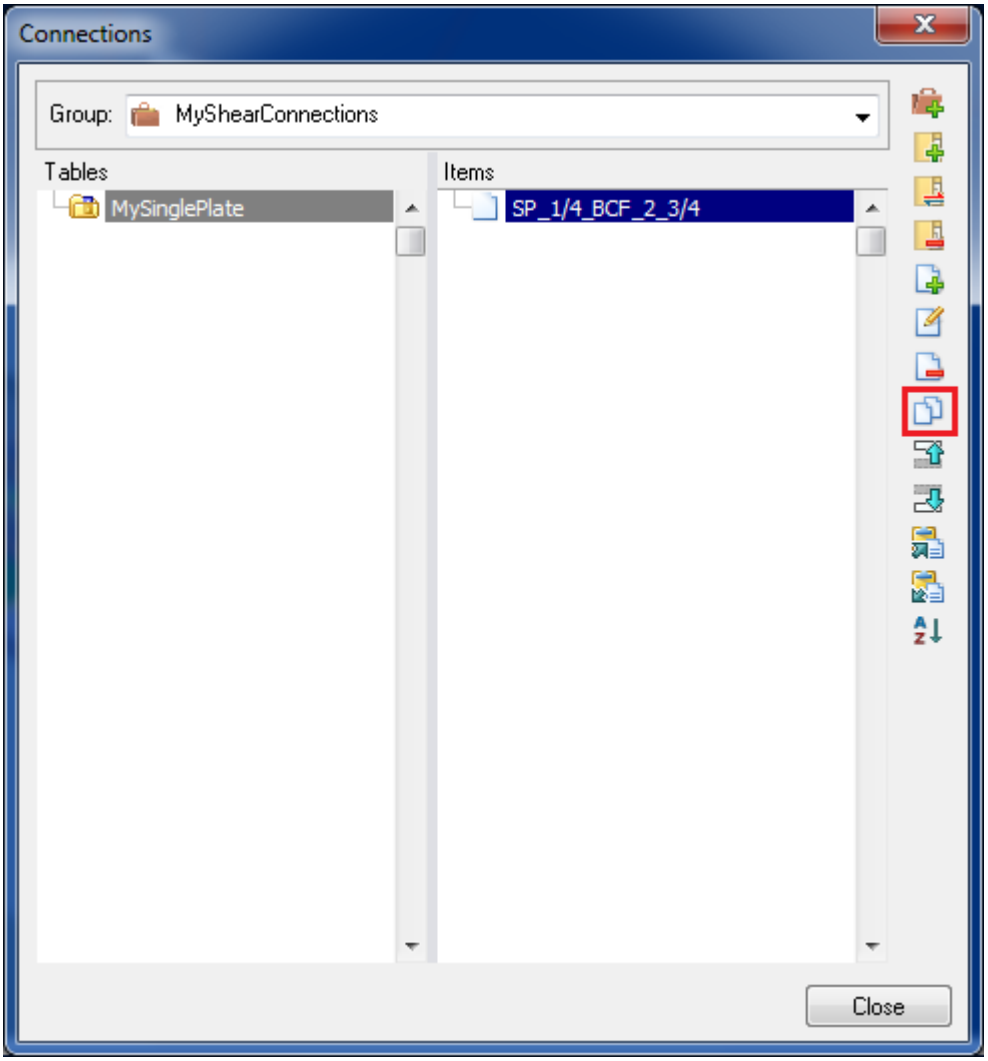
To enter the specific parameters for the connection, note that the beam and support sections and materials are also transferred from the main program and there is no need to define them. The default values shown are used only for the 3D drawing.

The user has to enter only the parameters that are different from the desired values and are constant for all connections to be generated with the template. The variable parameters are calculated automatically by the program. They may be required for design or optimization and will be treated at the end of the example.

For this case accept all the default values, pressing the OK button. Any change performed will be reflected in the Graphic Area.

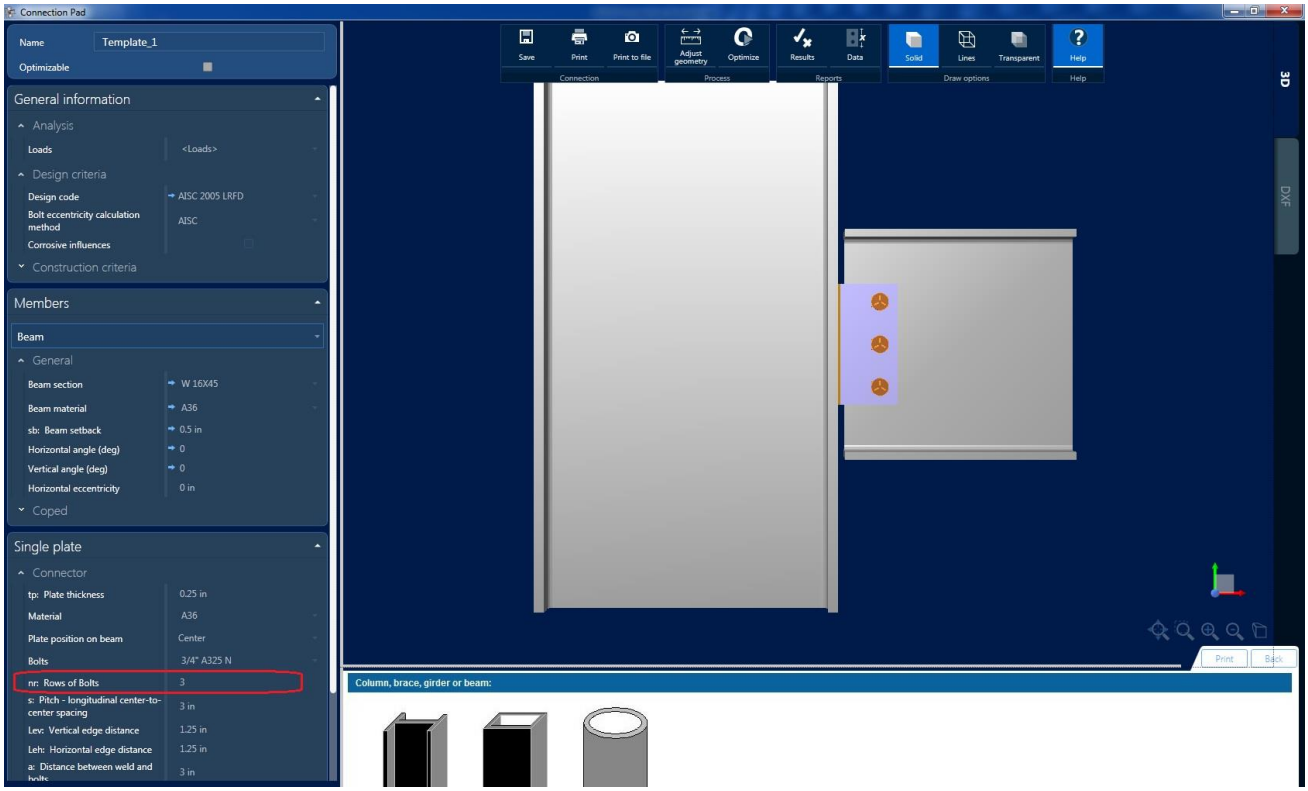
6) Edit the templates to be used

To enter a connection similar to the existing ones, the Copy button can be used. For example, place the cursor at the connection SP_1/4_BCF_2_3/4 and press the  button as shown below:



The new item will be copied with the name "SP_1/4_BCF_2_3/4 – Copy(1)". Introduce the new name of the connection accessing the connection pad with the button. For this example use SP_**1/4**_BCF_**3**_3/4.

Edit the new connection by pressing the button. In this example change the number of bolts from 2 to 3 and press the OK button. Note that the connection is displayed with 3 bolts and that the length has automatically changed to fit the bolts.



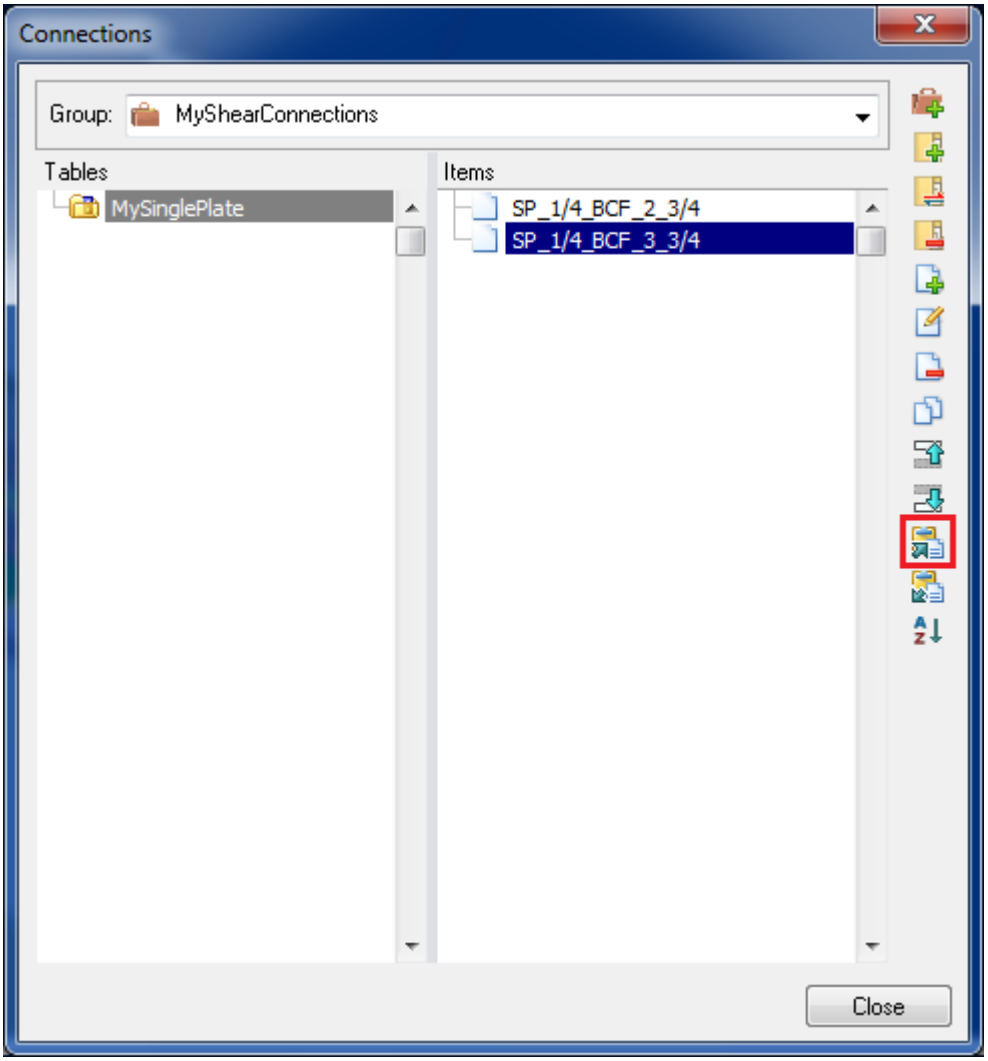
Change the number of bolts from to 2 to 3 for the new template.

7) Create a connection database

To create several connections, the procedure outlined in steps 4 and 5 may be very lengthy and time consuming. A very fast procedure can be used in order to change/create a set of connections.

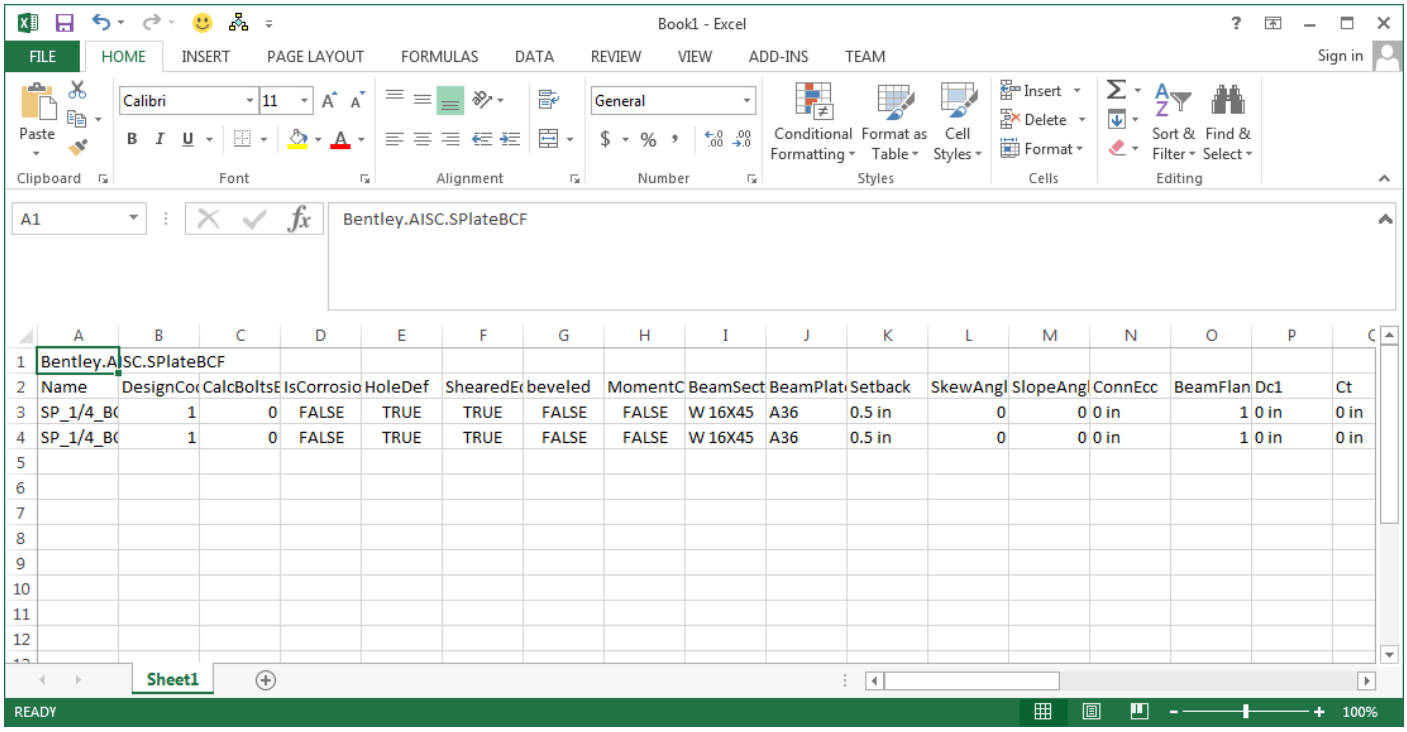
First, create a connection prototype as performed in the last steps.

Now generate a whole set of Single Plate connections of the database.



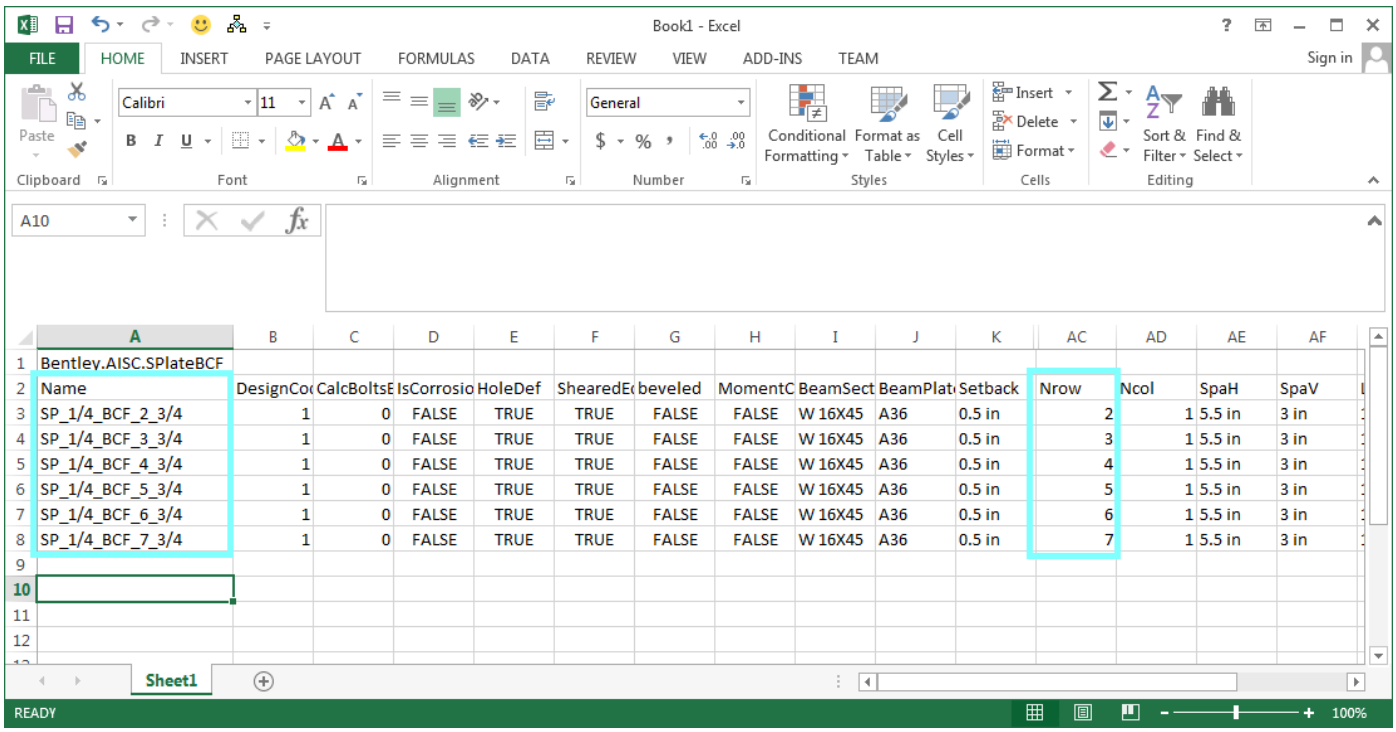
Select the former generated folder. Press the button  *"Copy items to clipboard". Open Excel and paste it in a worksheet*

The spreadsheet will look similar to the following figure:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Bentley.A	SC.SPlateBCF															
2	Name	DesignCo	CalcBoltsE	IsCorrosio	HoleDef	ShearedE	beveled	MomentC	BeamSect	BeamPlat	Setback	SkewAngl	SlopeAng	ConnEcc	BeamFlan	Dc1	Ct
3	SP_1/4_B	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	0	0	0 in	1	0 in	0 in
4	SP_1/4_B	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	0	0	0 in	1	0 in	0 in
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	

Note that each column of the spreadsheet contains the different values of a specific parameter of the connection. The different tools are available on Excel to copy or change the values. In this example copy the data line (row 4) 4 times. The following columns will be edited in the following way:



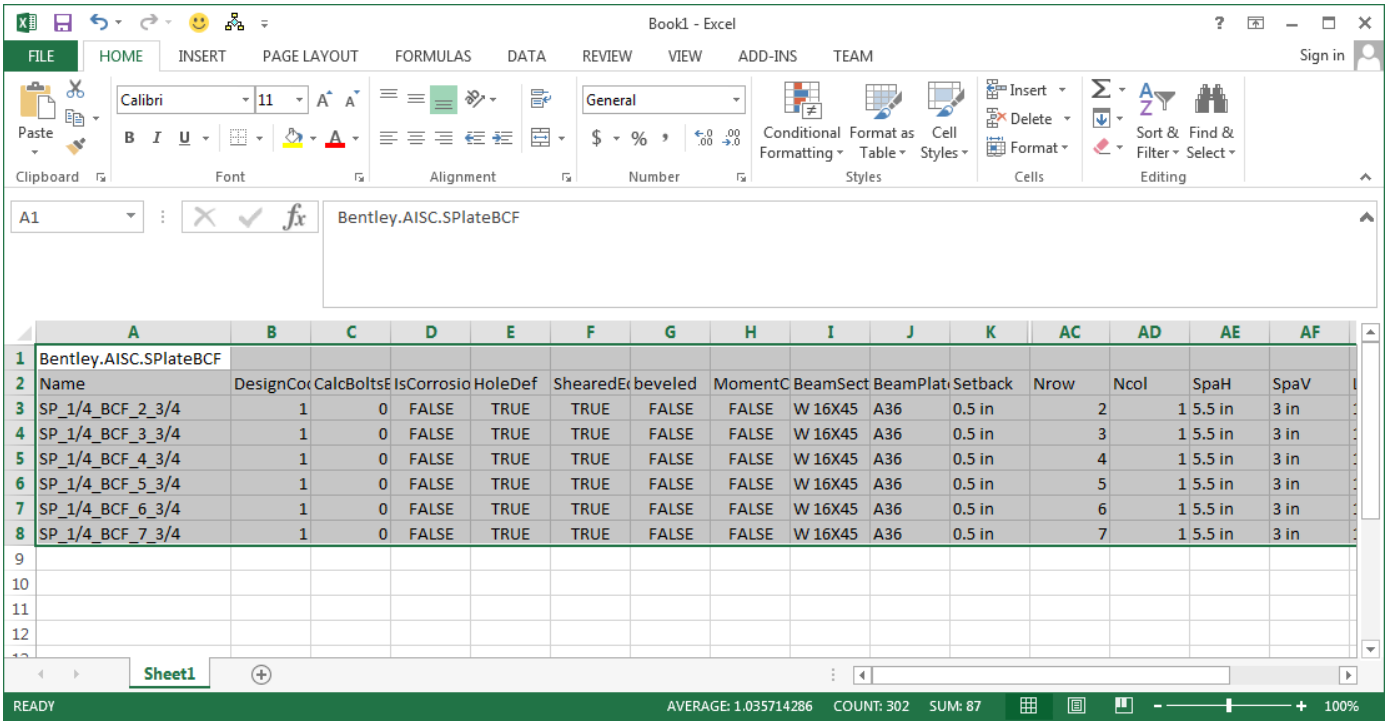
	A	B	C	D	E	F	G	H	I	J	K	AC	AD	AE	AF
1	Bentley.AISC.SPlateBCF														
2	Name	DesignCo	CalcBoltsE	IsCorrosio	HoleDef	ShearedE	beveled	MomentC	BeamSect	BeamPlat	Setback	Nrow	Ncol	SpaH	SpaV
3	SP_1/4_BCF_2_3/4	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	2	1	5.5 in	3 in
4	SP_1/4_BCF_3_3/4	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	3	1	5.5 in	3 in
5	SP_1/4_BCF_4_3/4	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	4	1	5.5 in	3 in
6	SP_1/4_BCF_5_3/4	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	5	1	5.5 in	3 in
7	SP_1/4_BCF_6_3/4	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	6	1	5.5 in	3 in
8	SP_1/4_BCF_7_3/4	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	7	1	5.5 in	3 in
9															
10															
11															
12															

The name and the number of bolt rows (Nrow) are changed.

The user can keep or even erase the rest of the columns. In the latter case the connection will take the default values.

Once the data is defined, the user may proceed with the generation.

Then select all the information and copy the data to the clipboard (Ctrl+C)

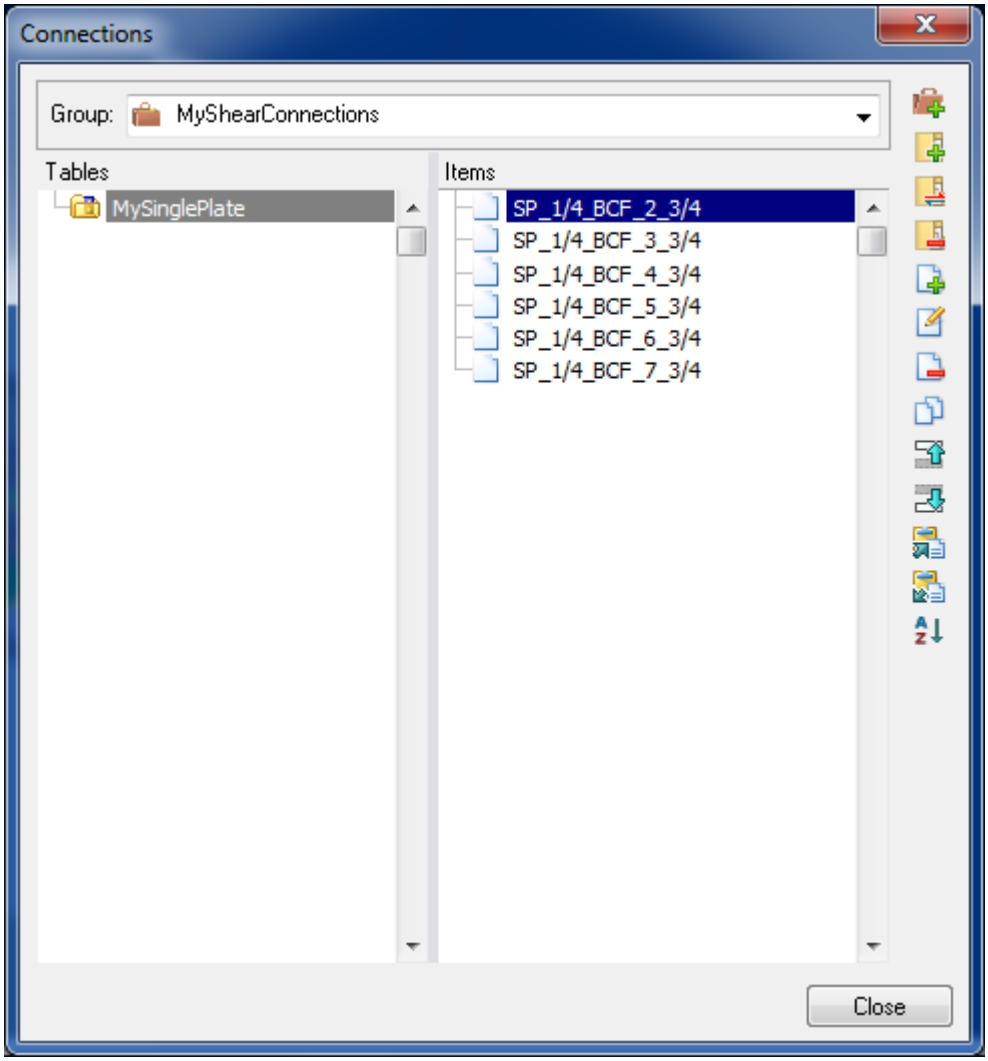


	A	B	C	D	E	F	G	H	I	J	K	AC	AD	AE	AF
1	Bentley.AISC.SPlateBCF														
2	Name	DesignCo	CalcBoltsE	IsCorrosio	HoleDef	ShearedE	beveled	MomentC	BeamSect	BeamPlat	Setback	Nrow	Ncol	SpaH	SpaV
3	SP_1/4_BCF_2_3/4	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	2	1	5.5 in	3 in
4	SP_1/4_BCF_3_3/4	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	3	1	5.5 in	3 in
5	SP_1/4_BCF_4_3/4	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	4	1	5.5 in	3 in
6	SP_1/4_BCF_5_3/4	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	5	1	5.5 in	3 in
7	SP_1/4_BCF_6_3/4	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	6	1	5.5 in	3 in
8	SP_1/4_BCF_7_3/4	1	0	FALSE	TRUE	TRUE	FALSE	FALSE	W 16X45	A36	0.5 in	7	1	5.5 in	3 in
9															
10															
11															
12															

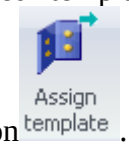
Press the  button to paste the connections into the database.

The program will ask if the existing connections are going to be replaced. Answer yes and then a message with the number of generated connections (6) will be displayed.

The following connections will be generated:



As can be seen, this way of generating the connections is fast and allows creating the complete set of templates that a design office may need with the required custom values.

Notice that it is necessary to configure the connection assignment menu in order to use the recently created templates in an assigning button. However, it is possible to assign them with the button 

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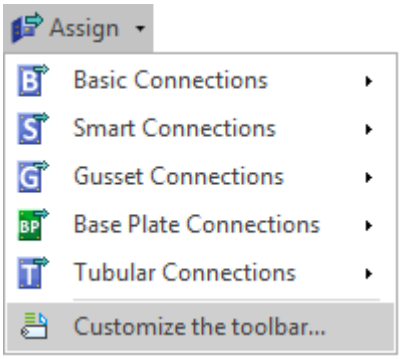
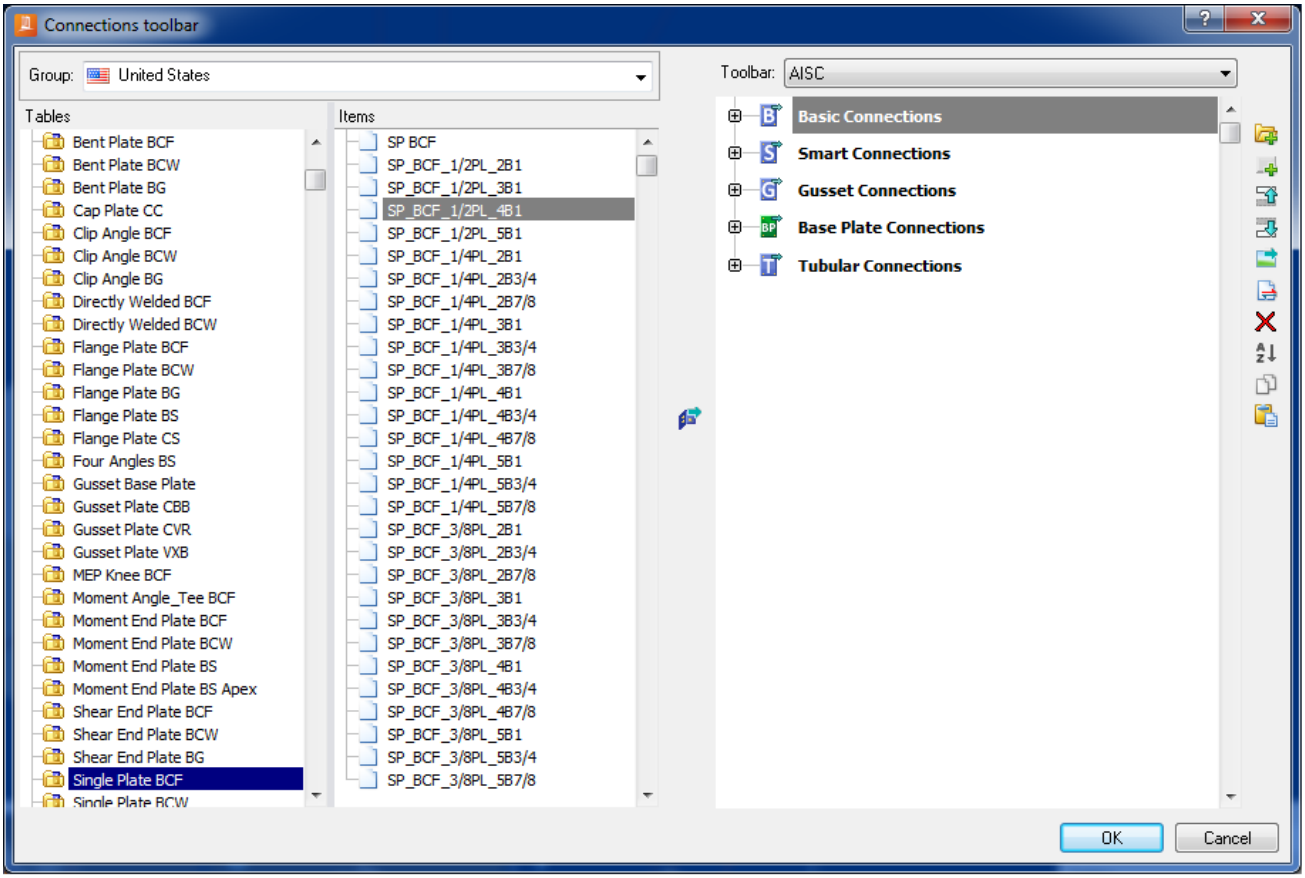
8) Configure the toolbar

Normally, a reduced list of connections of the same type may be required for a specific project. This list may be defined in an assignment button in the following way:



Go to Design tab, Assignment group, press the Assign button and a menu will be displayed. Then execute the option Customize the Toolbar.

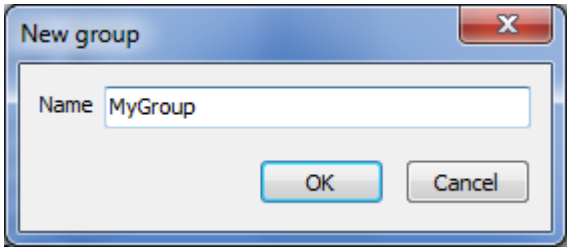
The following window will appear:



Toolbar configuration window.

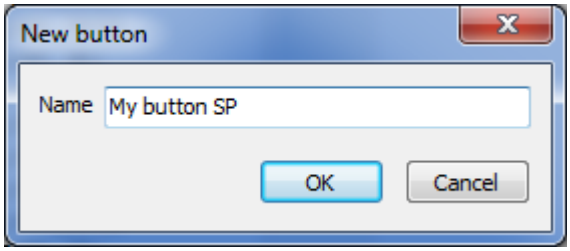
There are groups of connections that are predefined by the program and cannot be edited but it is possible to define a new user's group. For this purpose, select the "USER" group in the "Toolbar" combo box.

Press  to define a new group. Enter the name of the group (My group).

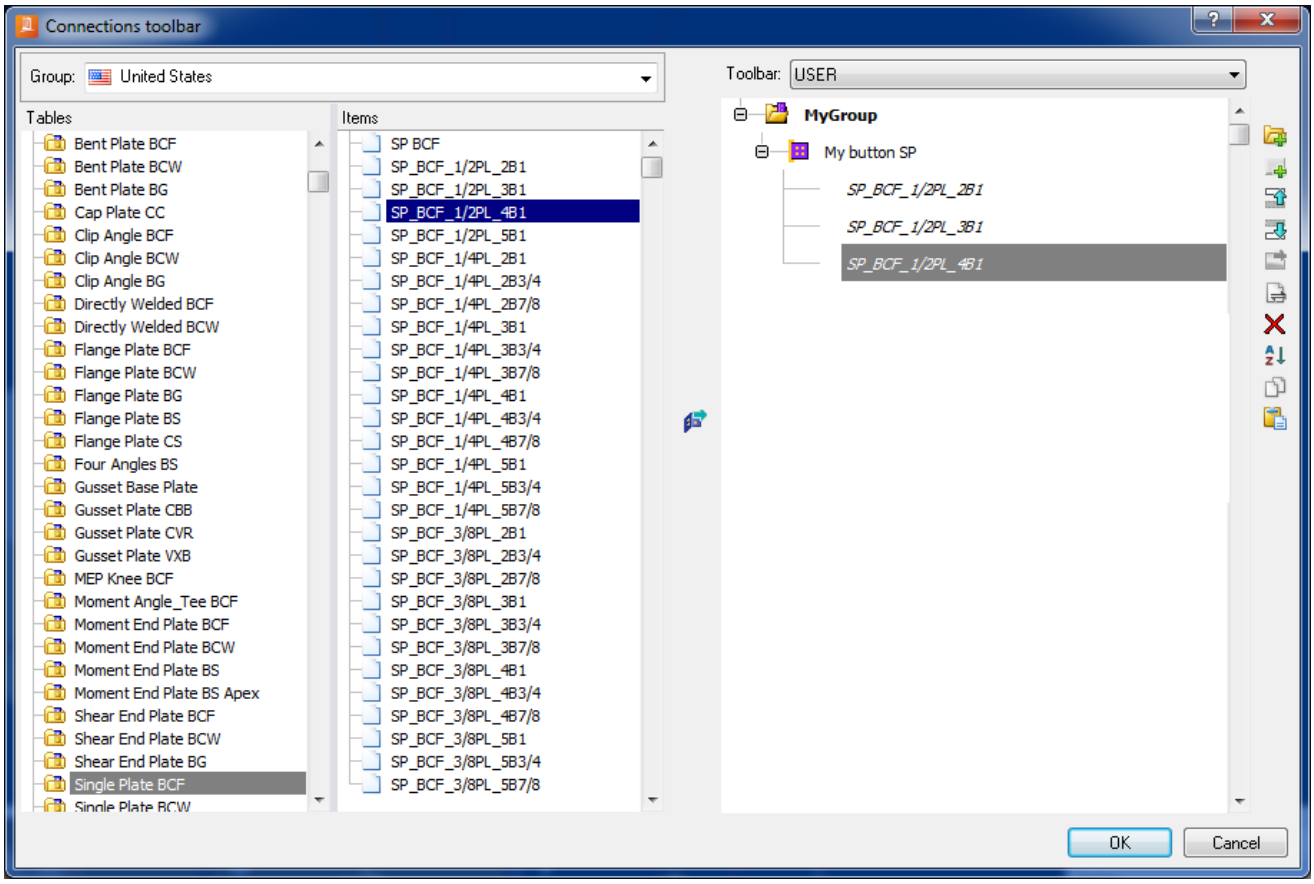


Dialog window to define a new group of buttons in the toolbar.

Press  to define a new assigning button.



Dialog window to define the name of the new button.



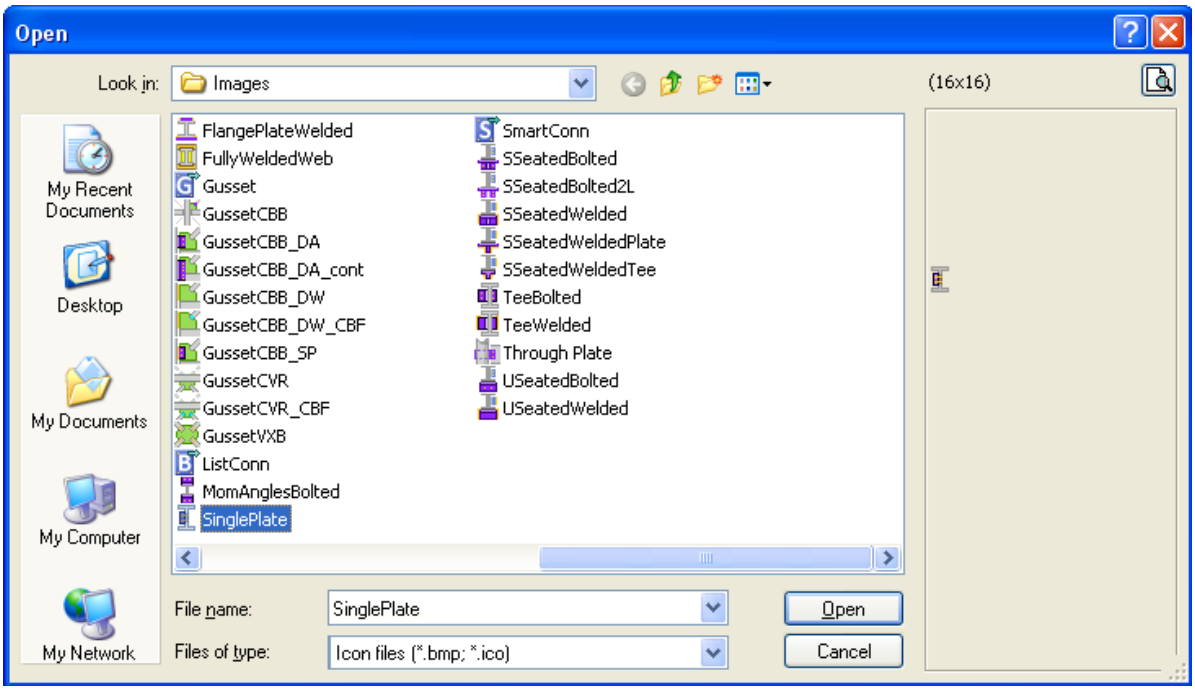
Steps to assign the group of SP templates to the new button.

Select the desired template or group of templates and press the  button. Repeat the process until all the desired connections of the list are assigned to the button. Note that the order in the list is very

important because it will define the priority in the selection of the template. To change the order in the list use the  or  buttons.

To assign an adequate bitmap to the new button press  and select the bitmap for the single plates.

Remark: It is possible to create bitmaps with any drawing tool like Paint™.



Dialog window for selecting the bitmap for the new assigning button.

Now there is a new button ready to be used in the connections design with a customized single plate connections list. As an exercise the user may try to repeat all the steps explained so far to create new buttons with a similar procedure as the one performed with the basic connections.

9) Assign smart connections

The program comes with another group of templates besides the basic connections. They are the 'Smart' connections, with them the program determines all the main design parameters as the connector size, number of bolts, size of welds, etc. based on the connection forces. This allows having one smart connection template per family and connection type. These self-optimizing templates are included in the Smart Connections button group  .

The user can evaluate the connection with the strength ratio and status that are displayed in the worksheet.