RAM[™] Connection Standalone CONNECT Edition

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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

Introduction

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.

	Metric
~	English
	SI
[U]	Units configuration
En	nglish 🔹 强 🔍 🚭 🛟

Chapter 1: General Overview

Units	?
Units system:	English •
Lengths:	ft 🔹
Section Dimensions:	in 💌
Axial and Shear loads	Kip 🔻
Moments:	Kip*ft ▼
Others:	Kip-ft 👻
Default units for system:	
English	SI Metric
	OK Cancel

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





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	
А	File button	Displays the backstage menu with basics commands such as Open a model, Save file, etc.
В	Quick access toolbar	Contains some commands required to be used with frequency, such as New, Open a model, Save file, Undo, etc.
С	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.
Н	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

\odot			
*	Open		
Sec.	(¹) Invest Pinish	Report Hodels	
Open			
3040	Carl Record Publics		
300.01	Contraction of the second seco		
ingen			
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64			

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.

A	Mit tanaha Madasarit 🖉 🔤 🗷
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	in part
1989	and a second sec
Care	
304	kannand
304040	
ingen	
lennings.	
Hele	
Oracle log model.	
H.	

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.

🛄 Impart Lenaus madel		N.			×
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Cav of A	Name	has modified	Ten A	See.	
	Address Depress 1000-00	AND DESCRIPTION	Nor Index Nor Index		
 C. Mai, Wei, ConvertionEnsignables. 	Earthry Bactinghampics Curtain Office Earthfree	CONCERNMENT OF	Alla haldar Alla haldar Alla haldar		
Lincapas Lincapas Lincapas	Downhadt Endorcidero	Upported to be and a second se	Electricity Electricity Decision		
 Methods - Handley Systems, Inc. 2019/212.ett., Alexador, Zandak 	My Depart Lines	Propriet and Phil	Kin Islan Kin Islan		
> Attachments > Cocuments	TEST, 403 Vipual Studie 2013	12/01/2018 3:54 PM	Kia koldar Kia koldar Kia koldar		
Microsoft Teams Chat Files Microsoft Teams Chat Files	Visual Studio 2015 Visual Studio 2017 RG (Sumplesters)	2502002004M 250204 1870AM 1970ADM AN PM	Elektron Kielotor Smoon-desument	410	
> RSA > Retwine Supports > Network Concerts	Fanyaflatalara	SALCONT PRESM	Second convert	10	
 This PC To Objects Evolution 					
Pitrame			-	Conservation (Long)	- Canod

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 New 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 Delete button, the selected joint will be deleted.
- When pressing the *X* ^{Delete all} 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 Copy button, the selected joint will be copied.

Load conditions group commands



• When pressing the Add/Edit button, the load conditions management window is displayed where it is possible to create and edit load conditions and combinations.

Num	ID	Desc	ription	Category	A 14
1	DL	Dead	Load	DL	
					<u>.</u>
					LC
		_			
					う
omb	inatior	15:			-
omb ormu Num	inatior la:	IS: DL	Туре		
omb ormu Num	ination la: ID	IS:	Туре		
omb ormu Num	inatior la: ID	IS: DL	Туре		
ormu Num	inatior la: ID	IS: DL	Туре		
omb ormu Num	inatior la:	IS: DL	Туре		
ormu ormu	inatior la:	IS: DL	Type		
o mb	inatior la:	B: DL DL 	Type		
ormu	inatior la:	IS: DL 	Type		
ormu Num	inatior la:	IS: DL 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Туре		
ormu	inatior la:	IS: DL DL 	Type		

Load conditions manager window

It is possible to add load conditions automatically with the $\boxed{12}$ button. This action displays a new dialog window to choose the load condition:

	ID	Description		Category		
7 3	11	Live Load		11		
	SL	Snow Load		SNOW		
	Ŵx	Wind in X		WIND		
	Wz	Wind in Z		WIND		
	EQx	Seismic in X		EQ		
I 🔁	EQz	Seismic in Z		EQ		
					Connect	
			Add		Cancel	
			Add		Cancel	
oad con	ditions		Add		Cancel	
oad con	ditions		Add		Cancel	
oad con	ditions	escription	Add		Cancel	
oad con ases: Num ID	ditions	escription	Add		Cancel	y
oad con ases: Num ID 1 DL 2 IJ	ditions	escription ead Load	Add		Cancel Categor DL	y
oad con ises: ium ID 1 DL 2 LL 3 We	ditions De Li	escription ead Load ve Load	Add		Cancel Categor DL LL WIND	y
oad con ises: um ID 1 DL 2 LL 3 Wx	ditions De Li W	escription ead Load ve Load /ind in X	Add		Cancel Categor DL LL WIND	y
pad con ises: lum ID 1 DL 2 LL 3 Wx	ditions De Li W	escription ead Load ve Load /ind in X	Add		Cancel Categor DL LL WIND	y

Chapter 1: General Overview

Manage categories		×
Categories list:		
Category ASH CRANE DL EQ HAIL LL LLR SNOW SNOW FLUID EARTH		
	ОК Саг	ncel

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

Delete load conditions	?	x
Select load conditions to be deleted:		
☑ DL = Dead Load		
Combinations All Current	None	
	None	
Delete	Ca	ncel

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.





The user cannot modify the generator files that are installed by the program, which are identified by the icon \boxed{a} , 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 \boxed{a} button that creates or adds a new generation file, after that, press the \boxed{b} button to copy the formulae and paste it with the \boxed{c} for the new generation file. Pressing the \boxed{a} button will save the changes for the new file and using the \boxed{b} button, the files created by the user may be deleted.

View group commands



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



Information

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

Databases group commands



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



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



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



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



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



• When pressing Anchors button, a window displayed where the anchors database can be updated

Assignment group commands

- When pressing the AISC-10 LRFD button, a dialog is displayed showing the "Design configuration" options. Before connections are designed the user should set this.
- When pressing the Assign •

button, a menu is displayed showing the following options for





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



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



• When pressing the template 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

II. Constant for

• 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.

General Internation		-	÷ 0	0	4	Bł 💿	-95 6	(?)	
A manual			and market	-	-		Um free		
tools	1000								•
+ Design provins									
heighten									
Encode effection									
Anapose method						0			
Fying adapt confident									
- Constitution Laborer									
Canadar hale defineration in	100								
Contract of the local division of the local									
						1			
Balt Group		-				68			
66 C		15							
Tala anangenesi									
ne feitudens				774		100			
on Roma of Baller.									
At Related unter to come									
an Venue open to camp									
Manual .							-		1000
the Network experiments					_		and the second second		
Annual and a state of the second									
and the second s								- X	10 m m
and the second se								- 26	1 2 2

• 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 Edit 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 Delete 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.

Delete		X
	Moment connection	
•	1 Shear connection	
	📫 & 🌖 Both connections	
	Cance	;

Reports group commands



• When pressing the button, the list of available general reports will be displayed

Joints list
Loads
Connection detail
Connections elements summary



• 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.

Shear connection Moment connection Gusset Shear and moment connection Truss connection

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

Save gra	phic	×
File name:		
C:V	B	rowse
Format		
🔘 Wind	lows Bitmap (BMP)	
O JPEG	à graphic (JPG)	
		1
Scale:	1	
Width:	1330	[pixels]
		- 1
Height:	619	[pixels]
🕑 Block a	aspect ratio	
	ОК	Cancel



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



• When pressing the box 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 Associate Disassociate 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

	CONNECTION	ProjectWise
the	Center	Projects

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

Help group commands



 \mathcal{O}

• When pressing the Advisor 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 New button and the next window will be displayed where all the data of the members and loads should be entered.

🚨 New joint			- 🗆 X	
Loads				
Property	Value	~	Help 🖉 Back 😓 Prin	ht.
Structural Type	Frame		Telp (- book @Thin	i.
Joint	CBB		Setback:	~
Description	1		A	
Is column end	No			
Actual members				
Column				
Section	W 21X68			
Material	A36			
Orientation (°)	0			
Right beam				
Section	W 12X79		Ŷ	
Material	A36		, ⊢sb	
sb: Setback to the support	0.5 in			
Upper right brace				
Section	W 12X87			
Material	A36			
Slope angle	45		H sb	
Rotation	0			
sbB: Setback	0.5 in	1		
		,	Nominal setback of the beam, physical distance between beam end and support face.	
			Note: In <i>beam-to-column web</i> Single Plate connections, if the beam ends outside shape, the setback is considered from the edge of the column flange (see graphic shown above), otherwise it is considered from the face of the column web.	
			Note Please note the distance considered for connections with vertical inclination angles.	
		~	sb	~
			OK Cancel	

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
СВ	Column to Base Plate
НСВВ	Horizontal Column Beam Braces
HBBB	Horizontal Girder Beam Braces
НХВ	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 *Edit* 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

Views	
Perspective	
C Active	
Perspective	
• The button activate	s a front YZ view.
• The button activate	s a front XZ view.
• The button activate	s a front XY view.
• The button activate	s a back YZ view.
• The button activate	s a back XZ view.
• The button activate	s a back XY view.
• The button activate	es an isometric -XZ view.
• The button activate	s an isometric XZ view.
• The Active button a shown with no perspective	ctivates the perspective. When the button is not pressed the view is ve.
• The Perspective to the view.	slider bar will indicate the percentage of perspective applied

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.
- Restauration Res

Available Connections

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

• B displays the basic connections.

E	Basic SP
ii.	Basic TP (HSS)
	Basic EP Bolted
	Basic EP Welded
+	Basic EP CS Rectangular
	Basic EP CS Circular
D	Basic DA All bolted
Ð	Basic DA Weld support Weld beam
4	Basic BP Bolted
	Basic ST All bolted
	Basic ST Weld support Weld beam
1	Basic SSL Bolted
₽	Basic SSP Welded
2	Basic US Bolted
1	Basic US Welded
I	Basic FP Bolted
I	Basic FP Welded
T.	Basic MA Bolted
Т	Basic MEP Extended both ways (DG4)
I	Basic MEP Flush (DG16)
T	Basic MEP Extended upwards (DG16)
Т	Basic MEP Extended downwards (DG16)
1	Basic MEP Flush Beam Splice
1	Basic MEP Extended upwards Beam Splice
1	Basic MEP Extended downwards Beam Splice
D	Basic MEP Flush Beam Splice Apex
f ti	Basic MEP Extended Upwards Beam Splice Apex
P	Basic MEP Knee Vertical Extended upwards
F	Basic MEP Knee Horizontal Extended upwards
Ň	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

Chapter 1: General Overview

• S displays the smart connections.

E	Smart SP
	Smart EP Bolted
D	Smart EP Welded
-	Smart EP CS Rectangular
+	Smart EP CS Rounded
I)	Smart DA All bolted
₫	Smart DA All welded
₫	Smart DA Weld support Bolt beam
D	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
4	Smart SST Bolted
Ţ	Smart SST Welded
류	Smart SSL Bolted
루	Smart SSP Welded
1	Smart US Bolted
1	Smart US Welded
I	Smart FP Bolted
I	Smart FP Welded
	Smart FP Beam splice welded
I	Smart MA Bolted
I	Smart DW
I	Smart Fully DW
1	Smart Fully DW Beam Splice
	Smart Fully DW Beam Splice Apex
Ξ	Smart MEP Extended both ways (DG4/Seismic)
Ξ	Smart MEP HSS
Т	Smart MEP Ext One Way (DG16)
Ξ	Smart MEP Ext Both Ways (DG16)
Π	Smart MEP Flush (DG16)
1	Smart MEP Ext One Way Beam Splice
1	Smart MEP Ext Both Ways Beam Splice
1	Smart MEP Flush Beam Splice
<u>ا</u>	Smart MEP Flush Beam Splice Apex
n ∎	Smart MEP Extended Upwards Beam Splice Apex
P	Smart MEP Knee - Vertical
F	Smart MEP Knee - Horizontal
Ň	Smart MEP Knee - Perpendicular
	Smart SP Beam splice
	Smart DA Beam splice

• G displays the gusset connections							
	CBB_DA						
ľ	CBB_DA_cont						
	CBB_SP						
	CBB_DW						
200	CVR						
2	VXB						
	CBB_DW_CBF						
<u></u>	CVR_CBF						
際	HCBB_CA						
7	HBBB_CA						
×	НХВ						
•	displays the	base plate connections					
Ŧ	Smart Pinned Base F	Plate					
	Smart Fixed Uniaxial	Smart Fixed Uniaxial Major Axis Base Plate					
1	Smart Fixed Uniaxial	Smart Fixed Uniaxial Minor Axis Base Plate					
	Smart Fixed Uniaxial	Both Axis Base Plate					
	Smart Fixed Biaxial B	Smart Fixed Biaxial Base Plate					
L.	Smart Gusset Base Plate						

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

👑 СНВ

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.

Chapter 1: General Overview



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





0	Basic AC		Smart AC	1	C88_D6	Smart Pinned Base Plate
8	Basic Bpad	8	Smort Bpad	.	Cleat_DB	Smart Fixed Unionial Major Axis Base Plate
•	Basic FEP		Smart FEP			Smart Fixed Uniasial Minor Axis Base Plate
1	Basic SSeated Angle Bolted	4	Smart SeatedTee			Smart Fixed Uniasial Both Asis Base Plate
2	Basic SSeated Angle Welded	2	Smort USeated Angle			Smart Fixed Biaxial Base Plate
2	Basic SeatedTee	E	Smart WSP			
1	Basic USeated Angle Bolted	8	Smart BEP			
2	Basic USeated Angle Welded	N	Smart BEP Mitzed Knee			
	Basic WSP	11	Smart FP Bolted			
2	Basic BEP	12	Smart FP Welded			
N	Basic BEP Mitred Knee		Smart WBC			
1	Basic FP Bolted		Smart BCP 85 Flange			
Ξ	Basic FP Welded		Smart BCP 85 Web			
	Basic BCP BS Flange		Smart BEP BS			
	Basic BCP BS Web	10	Smart DW BS			
٠	Basic BEP BS	03	Smart BCP CS Flange			
63	Basic BCP CS Range	1.2	Smart BCP CS Web			
	Basic BCP CS Web	0	Smart DW CS			
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.

X	Senic 5P	ġ,	Smort SP	I K	C88_EP		Smark Pinned Base Plate
	Basic EP	ø	Smart EP	1	C88_Angles		Smart Fixed Unianial Major Axis Base Plate
0	Basic DA All bolted	•	Smart DA All bolted				Smart Fixed Uniasial Fixed Minor Base Plate
	Basic DA All welded		Smart DA All welded			13	Smart Flored Uniao Ial Both As is Base Plate
	Basic BEP		Smort DA Welded support Belted beam				Smark Fixed Bioxial Base Plate
ø	Basic BEP Mitted Knee	e.	Smart DA Bolted support Welded beam				
*	Basic DEP 05		Smart BLP				
2	Secic FP Solited	N	Smart BEP Mitred Knee				
2	Basic FP Welded	\$	Senant BEP BS				
123	Basic BCP B5 Flange	1	Smart FP Bolted				
63	Basic BCP CS Flange	1	Smart PP Welded				
12	Besic SST		Smort WBC				
2	Basic US Bolted	8	Smart BCP BS Range				
2	Basic US Welded	63	Smart BCP CS Flange				
10	Sasic WCP 85	4	Smort 357				
	Basic WCP CS	2	Smort US				
		38	Smart WCP 85				
		1.00	Smart W/2 / 5				

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.

	Det	ailing
	1	Shear connection
	5	Moment connection
		Truss connection
	Dat	a report
		Shear connection
		Moment connection
		Truss connection
	Res	ults report
		Shear connection
		Moment connection
		Truss connection
	Join	t
	E	Edit
\checkmark		Delete

2 BCF

Joint data display area

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

JOINT 2	JOINT 1
CBB	BCF
Column - Beams - Braces	Beam - Column flange
COLUMN	BEAM
Section : W 21X44	Section : W 12X30
Material : A36	Material : A36
RIGHT BEAM	COLUMN
Section : W 21X44	Section : W 21X44
Material : A36	Material : A36
LEFT BEAM	MOMENT CONNECTION
Section : W 18X65	Template : FP BCF Welded
Material : A36	Connection : Moment connection (Flange-plated)
DIAGONAL 1	Design code :
Section : W 16X40	SHEAR CONNECTION
Material : A36	Template : SP_BCF_1/4PL_2B3/4
Angle : 45.00	Connection : Shear connection (Single plate)
DIAGONAL 2 Section : W 14X53 Material : A36 <u>Angle : 45 00</u>	Design codē : AISC-10 LRFD V
Additional notes	Additional notes

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	
А	Toolbar	General commands for saving, printing and accessing to data and result reports, modifying tridimensional and DXF model view.
В	Edition area	In this area the user may enter or modify the required data for the connection.
С	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.





- Uransparent 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.



font 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:

- Back shows the last topic in the help area.
- Print 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.

Customize connection design	?
Design code	AISC-10 LRFD 🔻
Design parameters	
Maximum strength ratio limit:	1
National annexes	Configuration
Seismic design parameters	
Consider seismic provisions	
Seismic category	A 👻
Load conditions included in the design:	
☑ DL = Dead Load	
	5
	OK Cancel

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 Add/Edit 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.

- 🛅 Bent Plate BCF 🛛 🧧	~	BP_BCF_1/2PL_2B1	^
- 🛅 Bent Plate BCW			
- 🛅 Bent Plate BG		- BP_BCF_1/2PL_2B7/8	_
-🛅 Cap Plate CC		- BP_BCF_1/2PL_3B1	
-🛅 Clip Angle BCF			
-🛅 Clip Angle BCW		- BP_BCF_1/2PL_3B7/8	
-🛅 Clip Angle BG		- BP_BCF_1/2PL_4B1	
-🛅 Directly Welded BCF			
- Directly Welded BCW			
- Extended End Plate BCF	~	BP_BCF_1/2PL_5B1	~

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 [3], a basic connection [3], a gusset connection [3], base plate connection \mathbf{I} or tubular connections \mathbf{I} . Then, the connection type should be selected.

Pressing the standard buttons, the available connections displayed are:

• Basic connections.

	Basic SP
ii.	Basic TP (HSS)
	Basic EP Bolted
	Basic EP Welded
-	Basic EP CS Rectangular
	Basic EP CS Circular
D	Basic DA All bolted
₫	Basic DA Weld support Weld beam
4	Basic BP Bolted
0	Basic ST All bolted
D	Basic ST Weld support Weld beam
류	Basic SSL Bolted
4	Basic SSP Welded
3	Basic US Bolted
4	Basic US Welded
I	Basic FP Bolted
I	Basic FP Welded
물	Basic MA Bolted
Ξ	Basic MEP Extended both ways (DG4)
I	Basic MEP Flush (DG16)
T	Basic MEP Extended upwards (DG16)
Ξ	Basic MEP Extended downwards (DG16)
1	Basic MEP Flush Beam Splice
1	Basic MEP Extended upwards Beam Splice
1	Basic MEP Extended downwards Beam Splice
	Basic MEP Flush Beam Splice Apex
(t)	Basic MEP Extended Upwards Beam Splice Apex
ø	Basic MEP Knee Vertical Extended upwards
F	Basic MEP Knee Horizontal Extended upwards
Ň	Basic MEP Knee Perpendicular Extended upwards
-	Cap Plate
	Basic CS FP Bolted
n <mark>O</mark> n	Basic CS FP Welded
	Basic CS SP
	Basic CS FP SP Bolted
	Basic BS FP Bolted
	Basic BS FP Welded
	Basic BS SP
Ē	Basic BS FP SP Bolted

Chapter 2: Steel Connections

• Smart connections.

E	Smart SP
	Smart EP Bolted
	Smart EP Welded
-	Smart EP CS Rectangular
++	Smart EP CS Rounded
D	Smart DA All bolted
1	Smart DA All welded
40	Smart DA Weld support Bolt beam
D	Smart DA Bolt support Weld beam
O	Smart ST All bolted
1	Smart ST Bolt support Weld beam
	Smart ST Weld support Bolt beam
	Smart ST Weld support Weld beam
昰	Smart SST Bolted
Ţ	Smart SST Welded
류	Smart SSL Bolted
4	Smart SSP Welded
1	Smart US Bolted
1	Smart US Welded
T	Smart FP Bolted
I	Smart FP Welded
	Smart FP Beam splice welded
븝	Smart MA Bolted
I	Smart DW
	Smart Fully DW
1	Smart Fully DW Beam Splice
	Smart Fully DW Beam Splice Apex
Ξ	Smart MEP Extended both ways (DG4/Seismic)
Т	Smart MEP HSS
π	Smart MEP Ext One Way (DG16)
Ξ	Smart MEP Ext Both Ways (DG16)
Ш	Smart MEP Flush (DG16)
1	Smart MEP Ext One Way Beam Splice
1	Smart MEP Ext Both Ways Beam Splice
1	Smart MEP Flush Beam Splice
<u>ا</u>	Smart MEP Flush Beam Splice Apex
	Smart MEP Extended Upwards Beam Splice Apex
P	Smart MEP Knee - Vertical
1	Smart MEP Knee - Horizontal
Ň	Smart MEP Knee - Perpendicular
	Smart SP Beam splice
	Smart DA Beam splice



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

👑 СНВ

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.

Chapter 2: Steel Connections







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

Chapter 2: Steel Connections



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 plateSA = Seating angles MA = Flange anglesBCP 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 plateAS 4100-1998 connections: AC = Angle cleatWSP = Web side plate EP = End plateSC = 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 plateNZS 3404-1997 connections: AC = Angle cleatWSP = Web side plate FEP = Flexible end plate 58

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*, all. 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:

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

AISC 360 connections:

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

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

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

The CA connection has a 15° 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	BCF	No	Yes	No	
Angles	BCW	No	Yes	No	
	BG	No	Yes	No	
Fin Plate	BCF	Yes	Yes	Yes	
	BCW	Yes	Yes	Yes	
	BG	Yes	Yes	Yes	
Flexible	BCF	Yes	Yes	Yes	
End Plate	BCW	Yes	Yes	Yes	
	BG	Yes	No	No	
Web Cover	BS	No	No	No	
Plate	CS	No	No	No	
Bolted End	BCF	No	Yes	No	
Directly	BCF	No	Yes	No	
Welded	BCW	No	Yes	No	
Directly	BCF	No	Yes	No	
Flanges and Web Welded	BCW	No	Yes	No	
Flange	BS	No	No	No	
Cover Plate	CS	No	No	No	

GB 50017 connections:

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

EN 1993-2005 connections:

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

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

Bolted splice	BS	No	No	No
web plates	CS	No	No	No
Flexible end	BCF	Yes	Yes	Yes
plate	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	BS	No	No	No
flange plates	CS	No	No	No
Base plate: Column	BP	No	No	No

For Design Standard AS 4100-1998:

Connection	Family	Inclination ang		
		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	BCF	Yes	Yes	Yes
plate	BCW	Yes	Yes	Yes
	BG	Yes	No	No
Bolted flange	BS	No	No	No
plate splices	CS	No	No	No
Bolted web	BS	No	No	No
plates splices	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	BCF	No	No	No
connections	BCW	No	No	No
Directly	BS	No	No	No
welded splices	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	BCF	Yes	Yes	Yes	
plate	BCW	Yes	Yes	Yes	
	BG	Yes	No	No	
Bolted flange	BS	No	No	No	
plate splices	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	СВ	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	
L L	BCW	Yes	Yes	Yes	
	BG	Yes	Yes	Yes	
End plate	BCF	Yes	Yes	Yes	
	BCW	Yes	Yes	Yes	
	BG	Yes	No	No	
Flange cover	BCF	No	No	No	
plate	BCW	No	No	No	
	BS	No	No	No	
	CS	No	No	No	
Web cover	BS	No	No	No	
plates splices	CS	No	No	No	
Bolted end	BCF	No	Yes	No	
plate	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	СВ	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
ТР	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	НСВВ	Bolted (CA, SP), /welded	welded
BPl	СВ	-	welded
GBP	СВ	-	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	СВ	-	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	СВ	-	welded

The following connections allow square or rectangular HSS supports:

EN 1993-2005 connections:

Connection	Family	Characteristics	
		to beam	to support
BPl	СВ	-	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	СВ	-	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	СВ	-	welded
WSP	BCF, BCW	bolted	welded
AC	BCW	bolted	bolted
EP	BCF, BCW	Bolted	bolted
Bpad	BCF, BCW	-	-
Column beam braces connections	СВВ	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	СВ	-	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
BP1	СВ	-	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	СВ	-	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	СВ	-	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	СВ	-	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:

CONNECTIO	FAMIL	MEMBE	BUILT UP	BUILT UP	MEMBER	SECTIONS
Ν	Y	R	SYMMETR	UNSYMMETR	FLANGE	ALLOWED
		TYPES	IC	IC	ROTATIO	
					Ν	
Base plate	CB	Prismatic	YES	YES	NO	I, I2C,
						HSS_RECT,
						HSS_CIRC
	СВ	Tapered	YES	YES	NO	Ι
Bent plate	BCF	Prismatic	YES	NO	NO	Ι
	BCW	Prismatic	YES	NO	NO	Ι
	BG	Prismatic	YES	NO	NO	Ι
Bracket	Bracket	Prismatic	YES	NO	NO	Ι
	plate					
	Tee	Prismatic	YES	NO	NO	Т
	bracket					
BS4Angles	BS	Prismatic	YES	YES	NO	Ι
Cap plate	СР	Prismatic	YES	NO	NO	Beam "I" -
						Column "I,
						HSS_RECT"
Clip angle	BCF	Prismatic	YES	YES	Column	Beam "I" -
					"YES"	Column "I,
						HSS_RECT"
	BCW	Prismatic	YES	YES	NO	Beam "I" -
						Column "I,
						HSS_RECT"
	BG	Prismatic	YES	YES	NO	Ι
Directly welded	BCF	Prismatic	YES	YES	Column	Beam "I" -
					"YES"	Column "I,
						HSS_RECT"
	BCW	Prismatic	YES	YES	NO	Beam "I" -
						Column "I,
						HSS_RECT"

Fully directly welded	BCF	Column, Beam "Prismati c"	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	Ι
	BS	Tapered member	YES	YES	NO	Ι
	BS	Haunched member	YES	YES	NO	I, T
End plate	BCF	Prismatic	YES	YES	Column "YES"	Ι
	BCW	Prismatic	YES	YES	NO	Ι
	BG	Prismatic	YES	YES	NO	Ι
Flange plate	CS	Prismatic	YES	YES	Top Column "YES"	Ι
	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	Ι
	BS	Prismatic	YES	YES	NO	Ι
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	BS	Prismatic	YES	YES	NO	Ι
plate	BS	Tapered	YES	YES	NO	Ι
	BS	Haunched	YES	YES	NO	I, T
	BCF	Column, Beam "Prismati c"	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 "Prismati c"	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"	Ι
PRConnector	PR	Prismatic	YES	NO	NO	Ι
Single plate	BS	Prismatic	YES	YES	NO	Ι
	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	Ι
	CS	Prismatic	YES	YES	Top Column "YES"	Ι
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	Ι
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	СНВ	Prismatic	NO	NO	NO	"HSS_RECT, HSS_CIRC"

BS 5950 connections:

CONNECTION	FAMIL	MEMBE	BUILT UP	BUILT UP	MEMBER FLANCE	SECTIONS
	I	TYPES	IC	IC	ROTATIO	ALLOW
					Ν	
Bolted end plate	BS	Prismatic	YES	NO	NO	Ι
	BS	Tapered	YES	NO	NO	Ι
	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	Ι
Fully welded	BCF	Prismatic	YES	NO	NO	Ι
	BCW	Prismatic	YES	NO	NO	Ι
Flanges welded	BCF	Prismatic	YES	NO	NO	Ι
	BCW	Prismatic	YES	NO	NO	Ι
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	Ι
Flange cover plate	BS	Prismatic	YES	NO	NO	Ι
	CS	Prismatic	YES	NO	NO	Ι
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	Ι
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	Ι
	CS	Prismatic	YES	NO	NO	Ι

GB 500017 connections:

CONNECTI ON	FAMIL Y	MEMBER TYPES	BUILT UP SYMMETR IC	BUILT UP UNSYMMETR IC	MEMBER FLANGE ROTATIO N	SECTIONS ALLOW
Base plate	СВ	Prismatic	YES	NO	NO	Column "I, I2C, HSS_RECT, HSS_CIRC"
		Tapered	YES	NO	NO	Ι
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	Ι
	BCW	Prismatic	YES	NO	NO	Ι
	BG	Prismatic	YES	NO	NO	Ι
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	Ι
	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	Ι

EN 1993-2005 connections:

CONNECTI ON	FAMIL Y	MEMBE R TYPES	BUILT UP SYMMETR IC	BUILT UP UNSYMMETR IC	MEMBER FLANGE ROTATIO N	SECTIONS ALLOW
Base plate	СВ	Prismatic	YES	YES	NO	Column "I, I2C, HSS_RECT, HSS_CIRC"
Bolted end	BS	Prismatic	YES	YES	NO	Ι
plate	BS	Haunched	YES	YES	NO	I, T
	BCF	Column, Beam "Prismati c"	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		Ι
Cleat angle	CS	Prismatic	YES	YES	Top Column "YES"	I
Fully welded BCF	BCF	Prismatic	YES	YES	Column "YES"	Ι
Fully welded BCW	BCW	Prismatic	YES	YES		Ι
Flanges welded BCF	BCF	Prismatic	YES	YES	Column "YES"	Ι
Flanges welded BCW	BCW	Prismatic	YES	YES		Ι
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		Ι
	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		Ι
Flange cover	BS	Prismatic	YES	YES		Ι
plate	CS	Prismatic	YES	YES	Top Column "YES"	I
Gusset column beam brace	СВВ	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	BS	Prismatic	YES	YES		Ι
plate	CS	Prismatic	YES	YES	Top Column "YES"	Ι

IS 800-2007 connections:

CONNECTI ON	FAMIL Y	MEMBE R TYPES	BUILT UP SYMMETR IC	BUILT UP ASYMMETR IC	MEMBER FLANGE ROTATIO	SECTIONS ALLOWED
					Ν	
Base plate	СВ	Prismatic	YES	YES	NO	I, I2C, HSS_RECT, HSS_CIRC (Column)
Moment end	BS	Prismatic	YES	YES	NO	Ι
plate	BS	Haunched	YES	YES	NO	I, T

	BCF	Prismatic (Column, Beam)	YES	YES	YES (Column)	Ι
	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	Ι
Flange angles	BCF	Prismatic	YES	YES	YES (Column)	Ι
Seating angles	BCF	Prismatic	YES	YES	YES (Column)	Ι
	BCW	Prismatic	YES	YES	NO	Ι
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	Ι
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	Ι
Flange cover	BS	Prismatic	YES	YES	NO	Ι
plates	CS	Prismatic	YES	YES	YES (Top Column)	Ι

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

AS 4100-1998 connections:

CONNECTI ON	FAMIL Y	MEMBE R TYPES	BUILT UP SYMMETR	BUILT UP ASYMMETR	MEMBER FLANGE	SECTIONS ALLOWED
			IC	IC	ROTATIO N	
Base plate	СВ	Prismatic	YES	YES	NO	I, I2C, HSS_RECT, HSS_CIRC (Column)
Bolted end	BS	Prismatic	YES	YES	NO	Ι
piate	BS	Haunched	YES	YES	NO	I, T
	BCF	Prismatic (Column, Beam)	YES	YES	YES (Column)	Ι
	BCF	Haunched (Beam)	YES	YES	YES (Column)	I, T (Haunch)
Mitred Knee	BCF	Prismatic	Yes	Yes	YES (Column)	Ι
Angle cleat	BCF	Prismatic	YES	YES	YES (Column)	Ι
	BCW	Prismatic	YES	YES	NO	Ι
	BG	Prismatic	YES	YES	NO	Ι
Flange plate	BCF	Prismatic	YES	YES	YES (Column)	Ι
	BCW	Prismatic	YES	YES	NO	Ι
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)	Ι

	BCW	Prismatic	YES	YES	NO	Ι
	BG	Prismatic	YES	YES	NO	Ι
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	Ι
Bolted flange	BS	Prismatic	YES	YES	NO	Ι
plates	CS	Prismatic	YES	YES	YES (Top Column)	Ι
Bolted web	BS	Prismatic	YES	YES	NO	Ι
plates	CS	Prismatic	YES	YES	YES (Top Column)	Ι
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	BS	Prismatic	YES	YES	NO	Ι
welded splices	CS	Prismatic	YES	YES	YES (Top Column)	Ι
Welded beam to column	BCF	Prismatic	Yes	Yes	YES (Column)	Ι
Column beam braces	CBB	Prismatic	YES	Column "YES" - Beams	Column "YES"	Column "I, HSS_RECT"

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

NZS 3404-1997 connections:

CONNECTI ON	FAMIL Y	MEMBE R TYPES	BUILT UP SYMMETR IC	BUILT UP ASYMMETR IC	MEMBER FLANGE ROTATIO N	SECTIONS ALLOWED
Base plate	СВ	Prismatic	YES	YES	NO	I, I2C, HSS_RECT, HSS_CIRC (Column)
Bolted end	BS	Prismatic	YES	YES	NO	Ι
plate	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)	Ι
Angle cleat	BCF	Prismatic	YES	YES	YES (Column)	I
	BCW	Prismatic	YES	YES	NO	Ι
	BG	Prismatic	YES	YES	NO	Ι
Flange plate	BCF	Prismatic	YES	YES	YES (Column)	Ι
	BCW	Prismatic	YES	YES	NO	Ι
End plate	BCF	Prismatic	YES	YES	YES (Column)	Ι
	BCW	Prismatic	YES	YES	NO	I
	BG	Prismatic	YES	YES	NO	Ι

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

CSA S16-14 connections:

CONNECTI ON	FAMIL Y	MEMBE R TYPES	BUILT UP SYMMETR IC	BUILT UP ASYMMETR IC	MEMBER FLANGE ROTATIO N	SECTIONS ALLOWED
Base plate	СВ	Prismatic	YES	YES	NO	I, I2C, HSS_RECT, HSS_CIRC (Column)
Bolted end	BS	Prismatic	YES	YES	NO	Ι
plate	BS	Haunched	YES	YES	NO	I, T
	BCF	Prismatic (Column, Beam)	YES	YES	YES (Column)	Ι
	BCF	Haunched (Beam)	YES	YES	YES (Column)	I, T (Haunch)
Mitred Knee	BCF	Prismatic	Yes	Yes	YES (Column)	Ι

Angle cleat	BCF	Prismatic	YES	YES	YES (Column)	Ι
	BCW	Prismatic	YES	YES	NO	Ι
	BG	Prismatic	YES	YES	NO	Ι
Flange plate	BCF	Prismatic	YES	YES	YES (Column)	Ι
	BCW	Prismatic	YES	YES	NO	Ι
End plate	BCF	Prismatic	YES	YES	YES (Column)	Ι
	BCW	Prismatic	YES	YES	NO	Ι
	BG	Prismatic	YES	YES	NO	Ι
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	Ι
Flange plate	BS	Prismatic	YES	YES	NO	Ι
spices	CS	Prismatic	YES	YES	YES (Top Column)	Ι
Web cover	BS	Prismatic	YES	YES	NO	Ι
plates splices	CS	Prismatic	YES	YES	YES (Top Column)	Ι
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 15°. If a joint has more than 15° 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 ^{Connections} 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:

Typeofconnections(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

AISC 360 connections:

	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-I	Brace	Gusset-to-	Beam or Co	lumn
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

Typeofconnections(Folder name)	Family and Description	Optimization of the following parameters
Tubular connections	СНВ	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	Family and Description	Optimization of the following parameters
(Folder name)		
СА	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	Family and Description	Optimization of the following parameters
(Folder name)		
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:	Column base plate connections	Thickness, length and width
Pinned,		of the base plate, the length and diameter of the anchors
Fixed uniaxial,		and the support's weld size
Fixed biaxial		
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	Bolt number if it is
geometry	bolted connection

For the Design standard IS 800-2007:

Family and Description	Optimization of the following parameters
BCF, Moment End Plate connections	Bolt number, weld sizes, plate thickness, and flush extension distance.
BS, Moment End Plate connections	Bolt number, weld sizes, plate thickness, and flush extension distance.
BS, CS, bolted flange splice plates connections	Bolt number, plate thickness.
BS, CS, bolted web splice plates connections	Bolt number, plate thickness.
BCF, BCW, BG Cleats angles connections	Angle section, bolt number to beam and support.
BCF, BCW, BG Web side plate connections	Bolt number, weld sizes, plate thickness.
BCF, BCW, BG, Flexible end plate connections	Bolt number, weld sizes, plate thickness.
BCF, BCW, seating angle connections	Angle section, bolt number, and weld sizes.
BCF, flange moment angles	Angle section, bolt number.
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.
	Family and Description BCF, Moment End Plate connections BS, CS, bolted flange splice plates connections BS, CS, bolted web splice plates connections BCF, BCW, BG Cleats angles connections BCF, BCW, BG, Flexible end plate connections BCF, BCW, seating angle connections BCF, flange moment angles Column base plate connections

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:	Column base plate connections	Thickness, length and width
Pinned,		of the base plate, the length and diameter of the anchors
Fixed uniaxial,		and the support's weld size.
Fixed biaxial		
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	Bolt number if it is
geometry	bolted connection

For the Design standard NZS 3404-1997:

Type of connections	Family and Description	Optimization of the following parameters
(Folder name)		er e
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	Family and Description	Optimization of the
connections		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.

Image: Solution of the sector of the sect	For New Open Bree Save as Setings Help Structural Dashboard Create bug report Ext
Configuration Graphic Print User folders Language NOTE: Please save your model before modifying any item on this p Models: C:\ProgramData\Bentley\Engineering\RAM Connection\11.2.0\Data\ Databases: C:\ProgramData\Bentley\Engineering\RAM Connection\11.2.0\Database	? × page!
Toolbar: C:\ProgramData\Bentley\Engineering\RAM Connection\11.2.0\ConnectionToolbars	<u>sl</u>
Default values	Cancel

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:

🖷 United States	*
🔚 United Kingdom 🖼 United States	
	United States United Kingdom United States

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

New gro	oup
Name:	ShearConnections 1
	OK Cancel

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:

<u>n</u>	- 🗆 X
New connection	Print Back
Frame	Single plate
Design code : AISC Connector type : Shear connection	A single plate connection is always welded to the column and bolted to the supported beam.
Joint type :	₩₩
Beam - Column flange	
Connector name : Single plate	
T 11	Single Plate (Description)
ShearConnections1	\sim
	OK Cancel

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.

<u></u>		_		×
New connection		Print	В	ack
Frame	Single plate			^
Design code : 2 AISC	A single plate connection is always column and bolted to the supported bea	welded m.	to the	
Connector type : 3 Shear connection				
Joint type : 4 Beam - Column flange				
Connector name : 5 Single plate				
Table name: 6 ShearConnections1	Single Plate (Description)			\sim
	OK	(Can	cel

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.

connection roo		
Name Template_2		
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onsider sheared edges		
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am sethack	→ 0.5 in	
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al angle (deg)		
ontal eccentricity		
Top cope depth		
Top cope length		
: Bottom cope depth		
Bottom cope length		
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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:

- Greates a new template.
- D 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.
- ²¹ 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 ExcelTM 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.

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

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5 SP BCE 1/4PL 4B3/4	FALSE	FALSE	0	W 21x50	A36	3/4" A325	0	1	0	1	E70XX	3			
6 SP BCE 1/4PL 5B3/4	FALSE	FALSE	0	W 21x50	A36	1" A325 N	0	1	0	1	F70XX	3			
7 SP BCF 1/4PL 2B7/8	FALSE	FALSE	0	W 21x50	A36	7/8" A325	0	1	0	1	E70XX	3			_
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4) Then select all the information and copy the data to the clipboard (Ctrl+C)
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5) In RAM Connection paste the connection templates to the desired folder in the database by pressing the "Paste items from clipboard" button.

Connections		×
Connections Group: MyShearConnections Tables MySinglePlateBCF	Items SP_BCF_1/4PL_2B3/4 - Copy(1) SP_BCF_1/4PL_3B3/4 - Copy(1) SP_BCF_1/4PL_4B3/4 - Copy(1) SP_BCF_1/4PL_5B3/4 - Copy(1) SP_BCF_1/4PL_2B7/8 - Copy(1)	
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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.

Single plate				
 Connector 				
tp: Plate thickness	0.25 in			
Material	A36			
Plate position on beam	Center			
Bolts	3/4" A325 N			
nr: Rows of Bolts	ОК	Cancel	Bolts	
s: Pitch - longitudinal center-to- center spacing			Group: United States 🔻	
Lev: Vertical edge distance	AISC	3/4" A325 M	N	
Leh: Horizontal edge distance		7/8" A325 N	N	
a: Distance between weld and		1 1/8" A325	5 N	
bolts		1 1/4" A325	5 N	
Hole type on plate		1 3/8" A325	5 N	
Hole type on beam		1/2" A325 X	(
Walding electrode to support		5/8" A325 >	(
weiding electrode to support		3/4" A325 >		
D: Weld size to support (1/16 in)		1" A325 X	ς	
		1 1/8" A325	šΧ	
		1 1 // * ٨ 2 2 4	: V	

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.

Materials		? 🛛
Materials Group: United States Tables Dimension Lumber Dimension LumberSP Glulam-beams Glulam-columns Masonry clay Masonry concrete MEL MSR Non-NA Dimension Lumber RC Timber beams Timber columns	Items A36 (weightless) A36 A36 A36 A500 GrA pipes A500 GrB rounded A500 GrC rectangular A500 GrC rounded A570 Gr30 cold form A572 Gr50 A615 Gr42 A992 Gr50	
		~
		Close

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 $\boxed{\ }$ button.

<u> </u>	Material properties		? <mark>*</mark>	
	Property	Value 🔺	Help 🗇 Back 嬦 Pr	int
:	Units system Name	English A500 GrB rectangular	Material type This option defines the type of material: steel, reinforced	
	Type Properties Poisson's ratio Unit weight Coeff. of thermal expansion Modulus of elasticity Yield strength ratio (Ry) Tensile strength ratio (Rt) Specified min. tensile strength (Fu)	Steel US 0.3 0.282 Lb/in3 6.50E-06 1/F 2.90E+07 psi 46000 psi 1.4 1.3 58000 psi	concrete, sawn lumber, glulam lumber, masony or other (e.g. aluminum). Currently member design is only available for reinforced concrete, wood and/or steel for US and steel or concrete for UK. Masonry design is only available inside the Masonry Wall and Retaining Wall modules.	
				-

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

To create a new material, Press the is 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 ⁴ 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 Assignment 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 ^{Lee} button. The name of the new group will be asked.

New gro	up		×
Name			
	C	ОК	Cancel

Dialog window asking the name of the new group.

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

	? ×
Toolbar: USER	•
MyButtonsGroup	🕞
	4
	1

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 \swarrow 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).

Connections toolbar				? ×
Group: 🚾 United States		•	Toolbar: USER	•
Group: United States Tables Tables Bent Plate BCF Bent Plate BG Bent Plate BG Bent Plate BG Cap Plate CC Bent Plate BG Cap Plate CC Bent Plate BG Bent Plate BCF Bent Plate BCF Bent Plate BG Bent Plate BG Bent Plate BS Bent Plate CS Bent Plate CBB Bent Plate BCF Bent Plate CBB BentPlate CBB Bent Plate CBB Bent	BP BF Image: Pice Pice Pice Pice Pice Pice Pice Pice	 ↓ 1 	Toolbar: USER MyButtonsGroup MyButton BP_BCF_1/2PL_2B1 3	
Moment End Plate BCW Moment End Plate BS Moment End Plate BS Bear End Plate BCF Shear End Plate BCW Shear End Plate BG Single Plate BCF Single Plate BCF Single Plate BCW	 BP_BCF_1/4PL_5B3/4 BP_BCF_1/4PL_5B7/8 BP_BCF_5/8PL_2B7/8 BP_BCF_5/8PL_3B7/8 BP_BCF_5/8PL_4B7/8 BP_BCF_5/8PL_5B7/8 	÷		•
				OK Cancel

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 32 and 32 to move the selected template up or down.

To delete a button use the command \times .

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

Open							? 🛛
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My Recent Documents Desktop My Documents	BEPBSFlush BEPPSFlush BEPFlush BEPFlush BEPFlush BEFFlush BSFlangePlateB BSFlangePlateB BSFlangePlateFl BSSinglePlateFl BSSinglePlateFl CapPlate	i JoneWay , olted velded angePlateBolted angePlateWelded	 ClipAngleWelded CSBolted CSSinglePlate CSWelded Default default_group DefaultButton DefaultGroup DirectlyWelded EndPlate EndPlate EndPlate ExtEndPlate FCP CS FCPwcpCS FlangePlateBolted 		FlangePlateV FullyWelded Gusset GussetCBB GussetCBB GussetCBB GussetCBB GussetCBB GussetCBB GussetCBB GussetCVR	K.€	
ing compator	<	Ш			>		
S	File <u>n</u> ame:	BentPlate		~	<u>Open</u>		
My Network	Files of type:	Icon files (*.bmp;	*.ico)	*	Cancel		

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.
В	Edition area	In this area the user may enter or modify the required data for the connection.
С	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.



V 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.

- \bigcirc
 - 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



Help area

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

S	hear web plate(s)	*	nc Lev	nc
-	Connector		Lev nr	• • Tiev
✓ Left side beam			nr Leh	s
-	 Right side beam 		Let	g Lev
	Connection type	Bolted		Edit
	Bolts	3/4" A325 N	nc nc	
	nc: Bolt columns			
	nr: Rows of Bolts			
	g: Gage - transverse center-to- center spacing	5.5 in		
	s: Pitch - longitudinal center-to- center spacing	3 in		
	Lev: Vertical edge distance	1.25 in	22-5	
	Leh: Horizontal edge distance	1.25 in	nc A	
	Hole type on beam	STD		
	Hole type on plate	STD		
	ef: Longitudinal distance to edge	1.75 in		
Cl	ick the Back by	utton to return to the pr	evious explanation of the help windo	w.
	ist the Print by	the second the second	t avalanction of the halp window	

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

3.52

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 connection design status is OK.



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,

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 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.

Chapter 2: Steel Connections

Gen	eral	
	Join	ts list
	Loads	
	Connection detail	
	Connections elements summary	

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 box 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 graphic *graphic group*, then select the printer options and accept printing.

button from Output tab, Model

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.
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- DeWolf, J.T. and Ricker, D.T. (1990), Column Base Plates, Steel Design Guide 1, American Institute of Steel Construction, Chicago, IL.
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- 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.
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- IS 800 (2007) Indian Standard General Construction in Steel Code of Practice.
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- International Federation for Structural Concrete (2011). Design of Anchorages in Concrete. CEP-FIP. Lousanne, Switzerland.

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- 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.

English 🔻

Press the units button located in the status bar.

	Metric
\checkmark	English
	SI
[U]	Units configuration

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.



Customize connection design	? ×
Design code	AISC-05 ASD
Design parameters	
Maximum strength ratio limit:	1
National annexes	Configuration
Seismic design parameters	
Consider seismic provisions	
Seismic category	A •
Load conditions included in the design:	
DL = Dead Load	
	-
	∎ x □
	D S
	Ŭ.
	OK Cancel

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.

*****e

Dead Load comes as the default load case. Create the Live load case, press the Add/Edit button and the dialog will appear:

Maria	s.	Deco								
Num	D	Dead	Load			Ci	ategory		Â	Ŀ
2	LL	Live	oad				-	_		
-		2.00					201			D
						CF	RANE	Â		
						DL				
						EC	1	=		1
						H/	AIL	_		2
					 	LL	R			
					 	SI	IOW	Ŧ		10
					 					5
Comb	inatior	IS:							Ť	
Comb Formu Num	inatior la: ID	IS: DL	LL	Туре				\$		
Comb Formu Num	inatior la: ID	DL	LL	Туре				\$:	
Comb Formu Num	inatior la: ID	IS: DL	LL	Туре				\$:	
Comb Formu Num	inatior la: D	DL		Туре				Ş		
Comb Formu Num	inatior la: ID	DL		Тура				æ		
Comb Formu Num	inatior la: D	IS: DL		Туре				¢		2
Comb Formu Num	inatior la: ID	IS: DL		Тура				æ	:	
Comb Formu Num	inatior la:	IS: DL						æ		
Comb Formu Num	inatior la:	IS: DL		Type				2		
Comb	inatior la:	IS: DL 		Type				¢	:	
Comb	ination la:	IS: DL 		Type				Ð		
Comb Formu Num	inatior la:	IS: DL DL DL DL		Type 				2		

Enter the required data to define the new load case.

The user can generate the desired load combinations:

		lions				
~q268	s:					
Num	ID	Descr	iption		Category	·
1	DL	Dead	Load		DL	
2	LL	Live lo	bad		LL	<u> </u>
						ົ າ
						_
Comb	ination	ns:				
Comb Formu Num	ination _{Ia:} C1	ns: = DL+LL DL	LL	Туре		¢ 🕏
Comb Formu Num 1	ination _{la:} C1 ID C1	ns: = DL+LL DL	LL 1	Type Not assigned		¢ 🗟
Comb Formu Num 1	ination _{la:} C1 ID C1	ns: = DL+LL DL	LL 1	Type Not assigned		\$ 1
Comb Formu Num 1	ination _{la:} C1 ID C1	ns: = DL+LL DL 1	LL 1	Type Not assigned		2 2 2 2 3 3 3 3 3 3 3
Comb Formu Num 1	ination _{la:} C1 D C1	ns: = DL+LL DL 1		Type Not assigned		 Image: Constraint of the second second
Comb Formu Num 1	inatior _{la:} C1 D C1	ns: = DL+LL DL 1		Type Not assigned		 2 2 2 3 3 3 3 3 3 4 4<
Comb Formu Num 1	ination la: C1 C1	ns: = DL+LL DL 1		Type Not assigned		 2 2 3 3 3 3 3
Comb Formu Num 1	ination _{la:} C1 C1	ns: = DL+LL DL 1		Type Not assigned		 2 2 3 3 3 3 3 3 3 4 4<
Formu Num 1	inatior la: C1 C1	ns: = DL+LL DL 1		Type Not assigned		
Comb Formu Num 1	ination _{la:} C1 C1	15: = DL+LL DL 1		Type Not assigned		 2 2 3 3 3 3 3 3
Comb Formu Num 1	ination la: C1 C1	ns: = DL+LL DL 1		Type Not assigned		 2 2 3 3 3 3 3 3 3 3 4 4<
Comb Formu Num 1	ination la: C1 C1	ns: = DL+LL DL 1		Type Not assigned		 Image: Second second
Comb Formu Num 1	inatior la: C1 C1	ns: = DL+LL DL 1		Type Not assigned		 2 2 3 3 3 4 5 4 5 5<

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.

Π	-	+
	-	-

First, press New 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.

Description	Europe In Asia b 1
pescription	Example juint 1

Adopted description for the example

Enter the members sections:

Section	W 14X74 V OK Cance Group: Mited State	el 25 🗸
	Tables - C HP - C M - C S - C W	Items W 12X336 W 14X22 W 14X26 W 14X30 W 14X34 W 14X38 W 14X43 W 14X43 W 14X43 W 14X53 W 14X53 W 14X61 W 14X61 W 14X68 W 14X68 W 14X74 W 14X82

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.

<u>Column</u>	
Section	W 16×89
Material	A36

Enter the rest of the required data.

Enter the loads, press the **barrent state** 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.

💷 Ne	ew joint								
[]]	Joint data		Loads						
Bear	n(s) - Colur	mn(s)		Beem			[Kip]	
Num	Condition	V2	Axial	M33	MMax	ML	.т	ŵ	Loads:
1	DL	12	2 (D)	0	0		Beam loads:
2		7.5					0		Axial
									V2: Shear force acting at the beam end to be transmitted by the connection. Used in: Shear connections.
									Axial: Axial force acting on the beam. Positives values for tension. Used in: Shear connections and moment connections.
								_	M33: Bending moment acting at the beam end to be transmitted by the connection. Used in: Moment connections.
									MMax: The maximum moment in the beam. Used in: the check of the overall stability of notched beams with shear connections designed according to BS 5950-1:2000.
									MLT: Equivalent uniform moment factor. Used in: the check of the overall stability of notched beams with shear connections designed according to BS 5950-1:2000.
									Column loads:
								-	Axial 🔓 M33
•									/v2
									OK Cancel

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 Assignment group.

Group: United States	•
Tables	Items
-🛅 Single Plate BCF	SP_BCF_1/2PL_2B1
-🛅 Single Plate BCW	SP_BCF_1/2PL_3B1
-🛅 Single Plate BG	SP_BCF_1/2PL_4B1
-🛅 Single Plate BS	— SP_BCF_1/2PL_5B1
-🛅 Single Plate CS	SP_BCF_1/4PL_2B1
-🛅 Standard Tee BCF	
-🛅 Standard Tee BCW	SP_BCF_1/4PL_2B7/8
-🛅 Standard Tee BG	SP_BCF_1/4PL_3B1
- 🛅 Stiffened Seated BCF	SP_BCF_1/4PL_3B3/4
- 🛅 Stiffened Seated BCW	F - SP_BCF_1/4PL_387/8

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).

B	Basic SP
H.	Basic TP (HSS)
	Basic EP Bolted
	Basic EP Welded
-	Basic EP CS Rectangular
+++	Basic EP CS Circular
D	Basic DA All bolted
Ð	Basic DA Weld support Weld beam
4	Basic BP Bolted
	Basic ST All bolted
	Basic ST Weld support Weld beam
井	Basic SSL Bolted
4	Basic SSP Welded
3	Basic US Bolted
4	Basic US Welded
I	Basic FP Bolted
I	Basic FP Welded
I	Basic MA Bolted
Т	Basic MEP Extended both ways (DG4)
I	Basic MEP Flush (DG16)
	Basic MEP Extended upwards (DG16)
Ξ	Basic MEP Extended downwards (DG16)
¢	Basic MEP Flush Beam Splice
1	Basic MEP Extended upwards Beam Splice
1	Basic MEP Extended downwards Beam Splice
	Basic MEP Flush Beam Splice Apex
n 🗈	Basic MEP Extended Upwards Beam Splice Apex
ø	Basic MEP Knee Vertical Extended upwards
F	Basic MEP Knee Horizontal Extended upwards
Ň	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

Edit

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.



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	Dead load		Live load	
	family	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.

	Joints list
	Loads
	Connection detail
	Connections elements summary
_	

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 Basic SP button and for the fourth example press Basic FP Bolted 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



edesi

button to redesign all of the connections independently of the assignment buttons used or the current 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	СВВ 🗸
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 40°.

Introduce the loads:

jol 🛄	int 5													
	Joint data Loads													
Bean	Beam(s) - Column(s) [Kip] Help 🗇 Back 🍐 Print													
		Col	umn		Right Bear	n		Left E	Beam				Loads:	-
Num	Condition	V2	Axial	V2	Axial	M33	V2	Axia		M33			Ream loads:	
1	DL	0	0	0	-38.3		י ר	0	0		0		Beam loads.	
													V2: Shear force acting at the beam end to be transmitted by the connection.	
												-	M33: Bending moment acting at the beam end to be transmitted	
													by the connection.	
Brac	es											[Kip]	Column loads:	
		(1) Top rig	ht	(2) Top left		(3) Bottom	left	(4) Botto	om rigt	ht				
Num	Condition	Axial	50	Axial	0	Axial	0	Axial		0			Axiai	1
			15				0			0		Ŧ	V2: Shear force acting in the column minor axis. Axial: Axial force acting on the column. Positives values for tension. Brace loads:	
													OK Cancel	

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 6									X
Loads									
Property	Value	4	Help				<	쿠 Back	🍓 Print
point	iCB ▼		loir	nt		100 Y -1	1440	-	A 199
Description	Example joint 6		501		$M \cap \mathcal{H}$	Contract of			
Right brace	No		F	RAM CONNECTION Standalor	e offers o	lifferent	joint fam	ilies, ea	ch one
Left brace	No		C f/	connections. In the next table,	all family	/ joints,	available	e conne	ctions
Column				ormulate all the design check.	s are sho	VVII.			
Туре	Prismatic member								
Section	W 12X96			CONNECTION	JOINT		BEAM		
Material	A36		-		0.05	V2	Axial	M33	V2
				Clin Angla (DA)	BCF	×		×	×
			ľ	Crip Angle (DA)	BCW	<u> </u>	- *		
			-		BOE		- <u>-</u>	- 0	-
					BCW	- ž	1 V	- x	x
			5	Single Plate (SP)	BG	v	V.	×	X
					BS	-	×	×	X
					CS	×	×	×	 Image: A set of the set of the
					BCF	×	 Image: A second s	×	×
			E	End Plate (EP)	BCW	 Image: A second s	 Image: A start of the start of	×	×
			-		BG	 Image: A start of the start of	 Image: A state of the state of	×	X
			5	Stiffened Seated (SS)	BCF	_	X	×	X
			-		BCW	×	×	×	×
			l	Unstiffened Seated (US)	BCF	- ×			
			-		BCF		- x	- 2	÷÷
			5	Standard Tee (ST)	BCW	`	x	x	x
					BG	-	×	×	×
			-	Through Plate (TP)	BCF	 Image: A second s	 Image: A second s	×	×
				mough Flate (TF)	BCW	 Image: A second s	 Image: A second s	×	×
					BCF	-	×	×	×
			E	Bent Plate (BP)	BCW	 Image: A second s	X	×	×
			-		BG	•	X	×	×
			[Directly Welded (DW)	BCW	×	- *	- *	
			-		BCF	- 2	1.		<u>-</u>
			1	Moment End Plate (MEP)	BCIAL		1.5	5	<u> </u>
		▼ [4	(►
							ОК		ancel
							_		

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:

ol 🛄	int 6								
[Joint data	R∯ L	oads						
1									A Same
Bear	n(s) - Colur	nn(s)				[Kip'	ft]	Help 🖓 E	Sack 🎯 Print
Num	Condition	1/2	1/2	Column	M33	1122	<u> </u>	Loads	
1	DL	0	0	-100	83.3333	M22 0		Loads acting on Column – base joints:	
2	LL	0	0	-160	125	0			
								+Axial	
								+V2	
								+V3 72	
									1
									J I
									→3
							Ψ.	(/ /	
Brac									
Diac	C 3	(1) Pight		(2) Left					
Num	Condition	Axial		Axial			Ē.		
1	DL		0		0				
2	LL		0		0			* * *	
								'+M33	1 4
									→3
							-	4	
1									
								ОК	Cancel

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.

12 A	kssign 👻			
B	Basic Connections	٠		
S	Smart Connections	•		
G	Gusset Connections	•		
BP	Base Plate Connections	•	Ŧ	Smart Pinned Base Plate
T	Tubular Connections	•		Smart Fixed Uniaxial Major Axis Base Plate
1	Customize the toolbar			Smart Fixed Uniaxial Minor Axis Base Plate
			5	Smart Fixed Uniaxial Both Axis Base Plate
			N	Smart Fixed Biaxial Base Plate
			Ŀ,	Smart Gusset Base Plate

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:

Joint 7								x
Loads								
Property	Value		teln			(Back	A Print
Joint	СВ		icip				- Duck	- Second
Description	Example joint 7	_	Joint			11-1		-
Right brace	Yes		RAM CONNECTION Standalor	ne offers d	lifferent	ioint fam	nilies ea	ch one
Left brace	Yes		connections. In the next table,	, all family	/ joints,	availabl	e conne	ctions
Column			formulate all the design check	s are sho	wn.			
Type	Prismatic member							
Section	W 12X96		CONNECTION	JOINT		BEAM		
Material	A36				V2	Axial	M33	V2
Orientation (°)	0			BCF		 Image: A second s	×	×
Pight brace	ů l		Clip Angle (DA)	BCW	>	 Image: A set of the set of the	×	×
Section	W 12V97			BG	v	×.	X	×
Securi	VV 12X07			BCF	_	_	X	X
Material	Abb		Single Plate (SP)	BCW		×	÷	- č
Slope angle	45		Olligie Flate (OF)	BS		×	- -	
Rotation	0			CS	×	x x	x	
sbB: Setback	0.5 in			BCF	v	v	×	×
Left brace			End Plate (EP)	BCW	>	 Image: A second s	×	X
Section	W 12X87			BG	>	 Image: A set of the set of the	×	×
Material	A36		Stiffened Seated (SS)	BCF	 Image: A set of the set of the	×	×	×
Slope angle	45			BCW	_	X	×	X
Rotation	0		Unstiffened Seated (US)	BCH	×	×	×	
sbB: Setback	0.5 in			BCF				÷÷
			Standard Tee (ST)	BCW	- V	x X	x	x
				BG		×	X	X
			Through Plate (TP)	BCF		 Image: A second s	×	×
				BCW		 Image: A set of the set of the	×	×
				BCF	 Image: A set of the set of the	×	X	×
			Bent Plate (BP)	BCW	_	×	X	X
				BCE	- *	×	X	×
			Directly Welded (DW)	BCW	- •	- Š	.	× ·
				BCF		1 V	,	- `` -
			Moment End Plate (MEP)	BCW/	j	1	J	t 🙀 🗅
		T	I		_			
						ОК		Cancel
						_		

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 45°.

Enter the loads:

Chapter 3: Example for RC-Standalone



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.

≸ ⊉ A	Assign 👻			
B	Basic Connections	۲		
S	Smart Connections	۲		
G	Gusset Connections	۲		
BP	Base Plate Connections	×	Ŧ	Smart Pinned Base Plate
T	Tubular Connections	۲		Smart Fixed Uniaxial Major Axis Base Plate
1	Customize the toolbar			Smart Fixed Uniaxial Minor Axis Base Plate
			5	Smart Fixed Uniaxial Both Axis Base Plate
				Smart Fixed Biaxial Base Plate
			<u>لة</u>	Smart Gusset Base Plate

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.



Results

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 ^{Connections} to access the connections database.

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

Connections		×
Group: 🔤 United States	linese	-
Bent Plate BCW Bent Plate BCW Bent Plate BG Cap Plate CC Cip Angle BCF Clip Angle BCW Clip Angle BG Clip Angle BG Directly Welded BCF Directly Welded BCF Directly Welded BCW Flange Plate BCF	BP_BCF_1/2PL_2B1 BP_BCF_1/2PL_2B3/4 BP_BCF_1/2PL_2B7/8 BP_BCF_1/2PL_3B1 BP_BCF_1/2PL_3B3/4 BP_BCF_1/2PL_3B7/8 BP_BCF_1/2PL_4B1 BP_BCF_1/2PL_4B3/4 BP_BCF_1/2PL_4B7/8 BP_BCF_1/2PL_5B1	
Image Plate BCW Image Plate BG Image Plate BG Image Plate BS Image Plate BS Image Plate CS Image Plate BS Image	BP_BCF_1/2PL_5B3/4 BP_BCF_1/2PL_5B7/8 BP_BCF_1/4PL_2B1 BP_BCF_1/4PL_2B3/4 BP_BCF_1/4PL_2B7/8 BP_BCF_1/4PL_3B1 BP_BCF_1/4PL_3B3/4 BP_BCF_1/4PL_3B7/8 BP_BCF_1/4PL_3B7/8 BP_BCF_1/4PL_4B1	2. J
MEP Knee BCF MEP Knee BCF Moment Angle_Tee BCF Moment End Plate BCF Moment End Plate BCW Moment End Plate BS	■, BP_BCF_1/4PL_4B3/4 BP_BCF_1/4PL_4B3/4 BP_BCF_1/4PL_4B7/8 BP_BCF_1/4PL_5B1 BP_BCF_1/4PL_5B3/4 BP_BCF_1/4PL_5B7/8	~
		Close

Create a new group with the ^k 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 **L** button.

<u>n</u>	- 🗆 X
New connection	Print Back
Frame	Single plate
Design code : AISC Connector type : Shear connection	A single plate connection is always welded to the column and bolted to the supported beam.
Joint type :	╨╌╲╌╨
Beam - Column flange Connector name : Single plate	
T 11	Single Plate (Description)
ShearConnections1	\sim
	OK Cancel

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 \square 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:

nection Pad																
ne Template_1. imizable						Save	Print Pri	i O nt to file	← → rmpm Adjust cometry C	C Optimize	√ ≱ Results	Data	Solid	Eines	Transparent	? Help
			1			Co	onnection	_	Process		Repor	te				
al information		-														
łs		- 25														
n code		18														
eccentricity calculation		14														
a ive influences													_	_	_	=
ler hole deformation in																
der sheared edges	-															
it connection exists																
		-											•			
		-														
tion	→ W 16X45															
rial	→ 436													_		
setback	→ 0.5 in															
al angle (deg)																
gle (deg)																
al eccentricity																
pe depth																
pe length																
om cope depth																
im cope length																
te		-	Column,	brace, girder o	or beam:											
					_	-										
			4				S	\rightarrow								
thickness																
hickness																

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:

Connections	— X —
Connections Group: MyShearConnections Tables Items SP_1/4_BCF_2_3	/4 /4
	™ ₩ ™ <p< td=""></p<>
-	-
	Close

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 \square button. For this example use SP_1/4_BCF_3_3/4.

Edit the new connection by pressing the *states* 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.

Connection Pad			
Name	Template_1	-	
opumizable		-	
neral inform	ation		A .
Loads			- 22
Design code			
Bolt eccentricity of	alculation		-
ethod prrosive influen	P5		
Construction			
a chorn			
mbers			*
im			-
			l
eam section		- W 16X45	
Seam material		- A36	14
ib: Beam setback		➡ 0.5 in	100
orizontal angle	deg)		
tical angle (de	g)		
orizontal eccent	ricity		
le plate			•
Plate thicknes			
laterial			1. 1 . 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.
ite position on	beam		100
olts		3/4" A325 N	
Rows of Bolts			
Pitch - longitus nter spacing	linal center-to-		
v: Vertical edg	distance		
: Horizontal e	dge distance		
a: Distance betw holtr	en weld and		

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.

Connections	x
Connections Group: MyShearConnections Tables Items SP_1/4_BCF_2_3/4 SP_1/4_BCF_3_3/4	
T Close	21

Select the former generated folder. Press the button ² "Copy items to clipboard". Open Excel and paste it in a worksheet

The spreadsheet will look similar to the following figure:

🗴 🖯 🖉	c - 🙂	- 5 %a ≑					Boo	ok1 - Excel						?			×
FILE HON	INSER	т ра	GE LAYOUT	FORM	IULAS [DATA	REVIEW	VIEW A	DD-INS	TEAM						Sign in	0
Paste	Calibri B I <u>U</u> -	• 11	• A A • <u>A</u> •	= =			General \$ - % >		Conditic Formatti	onal Formata ng • Table •	s Cell Styles ≠	Insert Insert	∑ - A ↓ Z ↓ So Fi	ort & Find & Iter - Select -			•
Cippoard 19	r	roni	6		Alignment	121	NUMD	er ia		Styles		Cells	E	aiting			_
A1	• : X	~	∫x Ber	ntley.AIS	C.SPlateBC	F											^
A	В	С	D	Е	F	G	Н	Ι	J	К	L	М	N	0	Ρ		
1 Bentley.AlS	C.SPlateBCF	:															
2 Name D	esignCocCa	IcBoltsE	IsCorrosio I	HoleDef	ShearedE	beveled	Moment	BeamSec	t BeamPl	at Setback	SkewAn	gl SlopeAng	ConnEcc	BeamFlan	Dc1	Ct	
3 SP_1/4_BC	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_BC	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																	-
	Sheet1	+]
READY													8 🗉	+		+ 1009	%

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:

🕅 🔒 🕤 · 👌 ·	🙂 🖧	Ŧ					Book1 - E	xcel						?	* -	n x
FILE HOME	INSERT	PAGE LA	YOUT	FORMULAS	DATA	REVIEV	V VIEW	ADD-IN	NS TEAN	Л					Sig	n in 🔍
Paste	• U • !!!	11 ·			% - ₽	Gener	al % • 5	▼ 0 .00 Con Form	nditional Fo matting ▼ T	rmat as C Table - Styl	∎ ell les ▼ E	elete v [∑ • A Z • Sort & Filter •	Find & Select •		
Cipboard is	Font			Alight	nent	121	Number	121	Sty	162		ens	Eaiting)		
A10 • :	XV	f _x														~
A		в		D	F	F	6	н	T	1	ĸ	AC	AD	٨E	AE	
1 Bentley AISC SPlat	eBCE	D	<u> </u>	U		F	0		1	,	ĸ	AC	AD	AL	Ar	— F
2 Name	De	signCod	CalcBoltsE	IsCorrosio	HoleDef	ShearedE	beveled	Moment	BeamSec	t BeamPla	etback	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	1
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	1
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	1
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	1
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	1
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	1
9																
10																
11																
12																
Shee	t1 (+						1	: : : •							
READY													•		+	100%

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.

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FILE HOME INSERT PAG	LAYOUT	FORMULAS	DATA	REVIEW	VIEW	ADD-IN	S TEAN	Λ					Sig	jn in 🔼
Paste V (linboard D Calibri 11 B I U V I V Sector				Genera	 %	→ Con → Form	iditional Fo natting ▼ T	rmat as Ce able ▼ Styl		sert ▼ ∑ elete ▼ ↓ prmat ▼	Sort & Filter	Find & Select •		
		Alighting			adilibei	1311	Styl	163		CIIS	Luting			
A1 • : X ✓ J	r Bentle	y.AISC.SPlat	teBCF											^
A B	С	D	E	F	G	н	I	J	К	AC	AD	AE	A	F 🔺
1 Bentley.AISC.SPlateBCF														
2 Name DesignO	o CalcBoltsE	IsCorrosio I	loleDef	ShearedE	beveled	MomentC	BeamSect	t BeamPlat	Setback	Nrow	Ncol	SpaH	SpaV	l
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	1
9														
10														
11														
12														
Sheet1 (+)							: 4	1	1					
READY					AVERA	GE: 1.035714	286 COUI	NT: 302 SU	M: 87		.	- 1	+	100%

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

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



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:

Connections toolbar				? <mark>×</mark>
Group: 🔤 United States		•	Toolbar: AISC	•
Tables Image: Bent Plate BCF Image: Bent Plate BCW Image: Bent Plate BG Image: Bent Plate BCF Image: Cip Angle BCF Image: Directly Welded BCF Image: Plate BCW	Items SP BCF SP BCF_1/2PL_2B1 SP_BCF_1/2PL_3B1 SP_BCF_1/2PL_4B1 SP_BCF_1/2PL_4B1 SP_BCF_1/4PL_2B1 SP_BCF_1/4PL_2B7/8 SP_BCF_1/4PL_2B7/8 SP_BCF_1/4PL_3B1 SP_BCF_1/4PL_3B1 SP_BCF_1/4PL_3B1 SP_BCF_1/4PL_3B7/8		Basic Connections Basic Connections Smart Connections G Gusset Connections Base Plate Connections Tubular Connections	
Flange Plate BG Flange Plate BS Flange Plate BS Flange Plate CS Four Angles BS Gusset Plate CBB Gusset Plate CBB Gusset Plate CVR Gusset Plate CVR Moment End Plate BCF Moment End Plate BCF Moment End Plate BCF Moment End Plate BS Moment End Plate BS Moment End Plate BS Moment End Plate BS Moment End Plate BCF Shear End Plate BCF Shear End Plate BG Shear End Plate BG Single Plate BCF Single Plate BCW	 SP_BCF_1/4PL_4B1 SP_BCF_1/4PL_4B3/4 SP_BCF_1/4PL_4B7/8 SP_BCF_1/4PL_5B1 SP_BCF_1/4PL_5B3/4 SP_BCF_3/8PL_2B1 SP_BCF_3/8PL_2B3/4 SP_BCF_3/8PL_2B3/4 SP_BCF_3/8PL_3B1 SP_BCF_3/8PL_3B3/4 SP_BCF_3/8PL_3B3/4 SP_BCF_3/8PL_3B3/4 SP_BCF_3/8PL_3B3/4 SP_BCF_3/8PL_4B1 SP_BCF_3/8PL_4B1/4 SP_BCF_3/8PL_4B1/4 SP_BCF_3/8PL_4B1/4 SP_BCF_3/8PL_4B3/4 SP_BCF_3/8PL_4B3/4 SP_BCF_3/8PL_5B1 SP_BCF_3/8PL_5B1 SP_BCF_3/8PL_5B1/8 SP_BCF_3/8PL_5B1/8 	ß		₽ ₩
				OK Cancel

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

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New gro	oup		×
Name	MyGroup		
		ОК	Cancel

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

Press **I** to define a new assigning button.

New bu	tton		×
Name	My button SP		
		ОК	Cancel

Dialog window to define the name of the new button.

Connections toolbar				?
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Tables Image: Sent Plate BCF Image: Bent Plate BCW Image: Sent Plate BG Image: Sent Plate BCF Image: Sent BCF Image: Se	Items SP BCF SP_BCF_1/2PL_2B1 SP_BCF_1/2PL_3B1 SP_BCF_1/2PL_4B1 SP_BCF_1/4PL_2B1 SP_BCF_1/4PL_2B1 SP_BCF_1/4PL_2B3/4 SP_BCF_1/4PL_2B3/4 SP_BCF_1/4PL_381 SP_BCF_1/4PL_4B1 SP_BCF_1/4PL_4B1 SP_BCF_1/4PL_4B1 SP_BCF_1/4PL_4B1 SP_BCF_1/4PL_4B1 SP_BCF_1/4PL_4B1 SP_BCF_1/4PL_4B1 SP_BCF_1/4PL_4B1 SP_BCF_1/4PL_4B7/8 SP_BCF_3/8PL_2B1 SP_BCF_3/8PL_2B1 SP_BCF_3/8PL_2B3/4 SP_BCF_3/8PL_2B3/4 SP_BCF_3/8PL_2B3/4 SP_BCF_3/8PL_2B3/4 SP_BCF_3/8PL_3B3/4 SP_BCF_3/8PL_4B1 SP_BCF_3/8PL_4B1 SP_BCF_3/8PL_4B1 SP_BCF_3/8PL_4B3/4 SP_BCF_3/8PL_5B1 SP_BCF_3/8PL_5B1 SP_BCF_3/8PL_5B1 SP_BCF_3/8PL_5B1 SP_BCF_3/8PL_5B3/4 SP_BCF_3/8PL_5B3/4 SP_BCF_3/8PL_5B3/4 SP_BCF_3/8PL_5B3/4 SP_B		Image: State of the state	
				OK Cancel

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 \square or \square buttons.

To assign an adequate bitmap to the new button press \square and select the bitmap for the single plates. **Remark:** It is possible to create bitmaps with any drawing tool like PaintTM.

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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 **S**.

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