

CONNECTION STIFFNESS IMPLEMENTATION PROCEDURE FOR RAM USERS (V14.04 & NEWER)

Comprehensive analysis and design of moment frames using SidePlate® connection technology are now available in the RAM Structural System. This document describes the use of this feature.

Modeling:

Create the model as customary for any project using steel moment frames. When selecting preliminary lateral beam and columns sizes in RAM Modeler, it is important to keep in mind the following two rules:

GEOMETRIC COMPATIBILITY: $b_{f-bm} + 2.0t_{f-bm} \leq b_{f-col}$

Background: The SidePlate connection typically consists of cover plates at the beam ends to bridge the difference between the beam flange width and the wider column flange width. The cover plates are fillet welded to the beam flange edges of which the top cover plate is detailed to be approximately the same width as the column flange width.

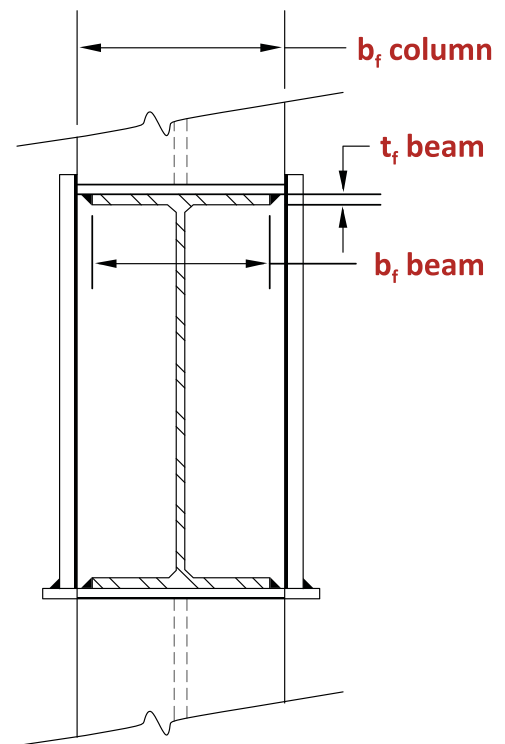
Note that RAM Frame will check geometric compatibility each time Analysis is run when moment connections have been assigned as SidePlate.

STRONG COLUMN WEAK BEAM COMPLIANCE FOR R=8 SMF DESIGNS ONLY:

$$\sum (Z_{x,col}) > 1.7 * \sum (Z_{x,bm}) \quad \text{for 1-12 stories (rule of thumb)}$$

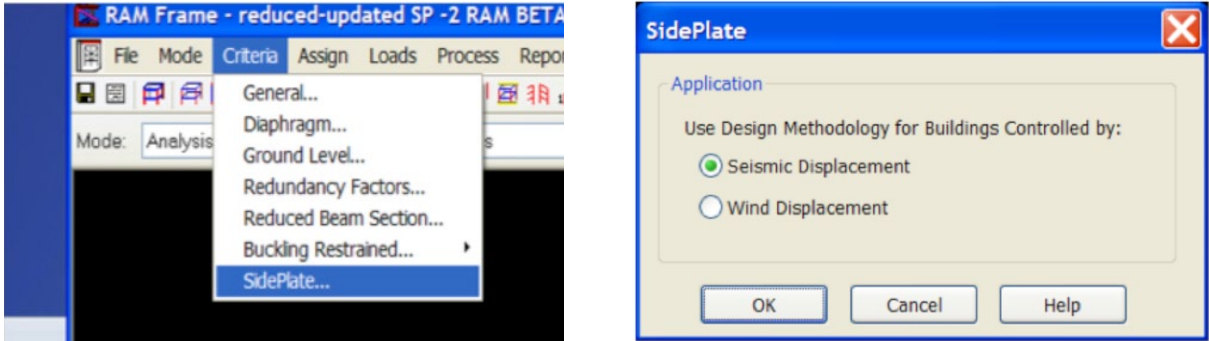
Background: The above equation takes into account the latest Seismic Provisions equation for SCWB compliance of SMF connections, including an approximate allowance for reduction in column capacity due to axial loads as well as the pushing out of the plastic hinge into the beam.

Note that RAM Frame Steel - Seismic Provisions includes the actual SCWB checks for SidePlate moment connections.



Criteria:

In RAM Frame, the Criteria for these moment connections can be specified using the **Criteria – SidePlate** command.

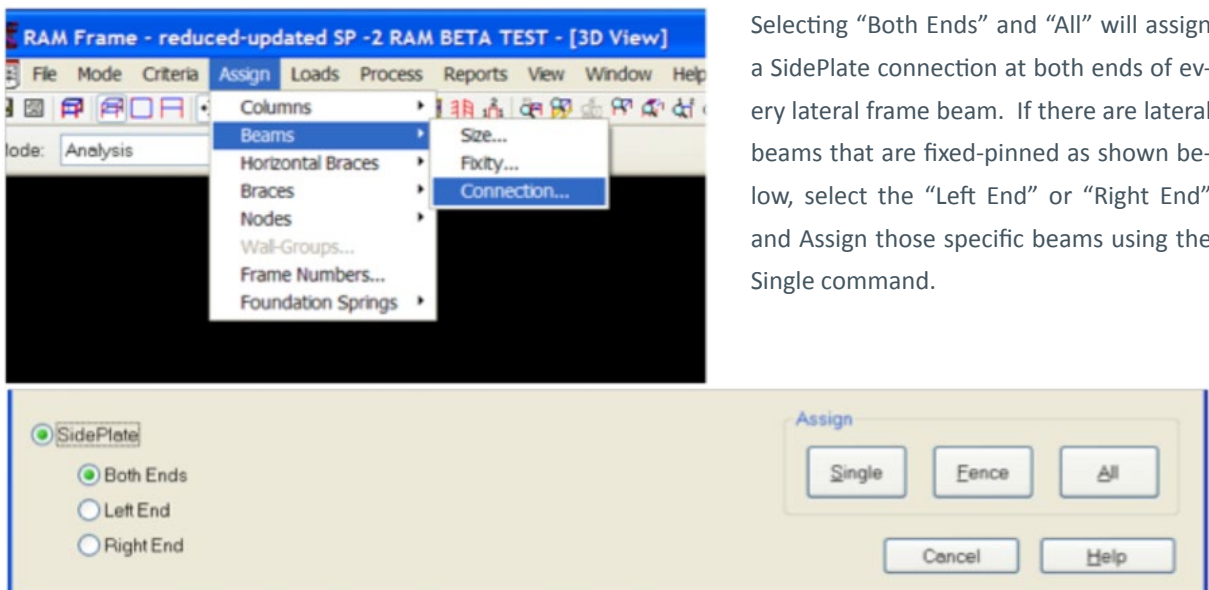


The connection properties are different for high seismic (inelastic) applications versus wind (elastic) and low seismic applications. Select the criteria that will most likely govern the sizing of the moment frames. For R=8 designs, seismic displacement will typically govern. For R=3 designs, wind displacement will typically govern.

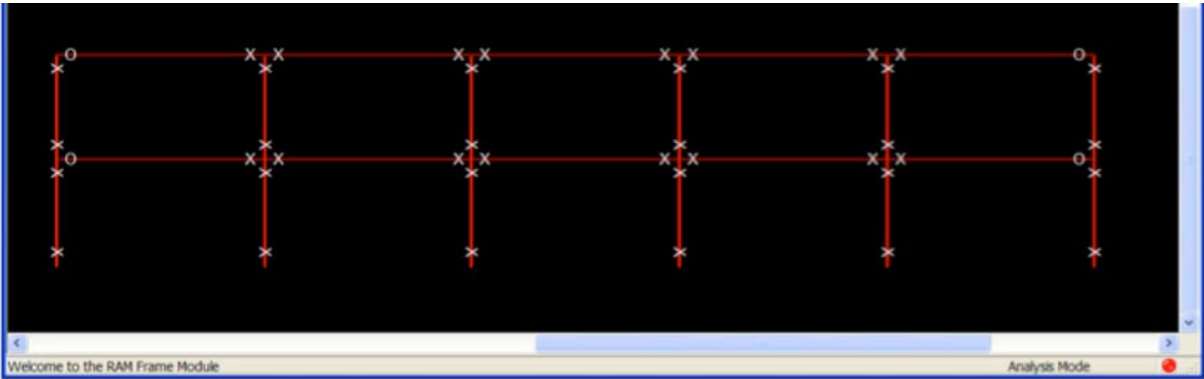
Note that SidePlate 100% rigid end zone (e.g. panel zone) properties are now built-in automatically and accounted for when SidePlate is assigned as a moment connection and will be considered as such regardless of the specific selection in **General Criteria – Rigid End Zones**.

Assign:

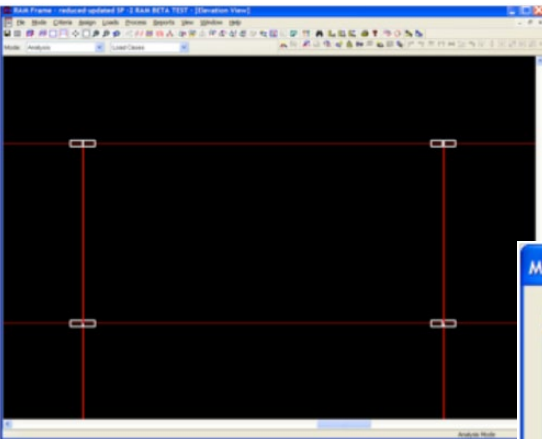
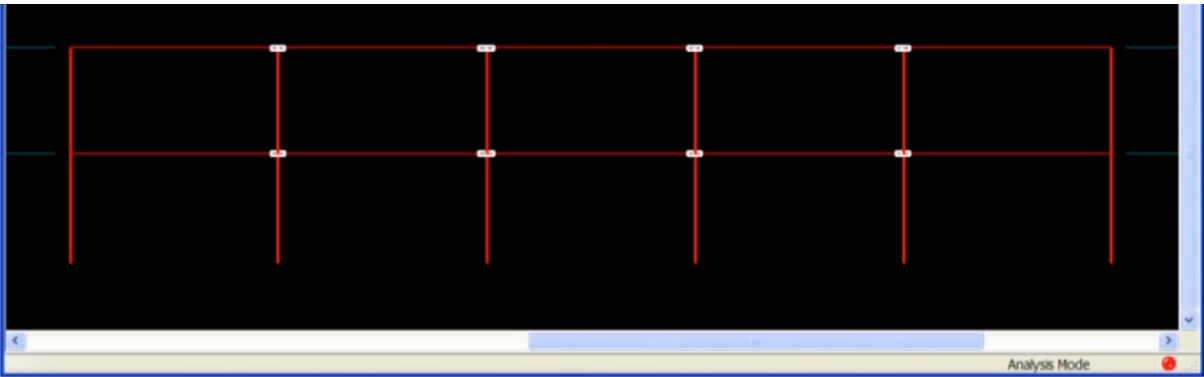
In RAM Frame, Assign the moment connection type using the **Assign – Beams - Connection** command.



Selecting “Both Ends” and “All” will assign a SidePlate connection at both ends of every lateral frame beam. If there are lateral beams that are fixed-pinned as shown below, select the “Left End” or “Right End” and Assign those specific beams using the Single command.

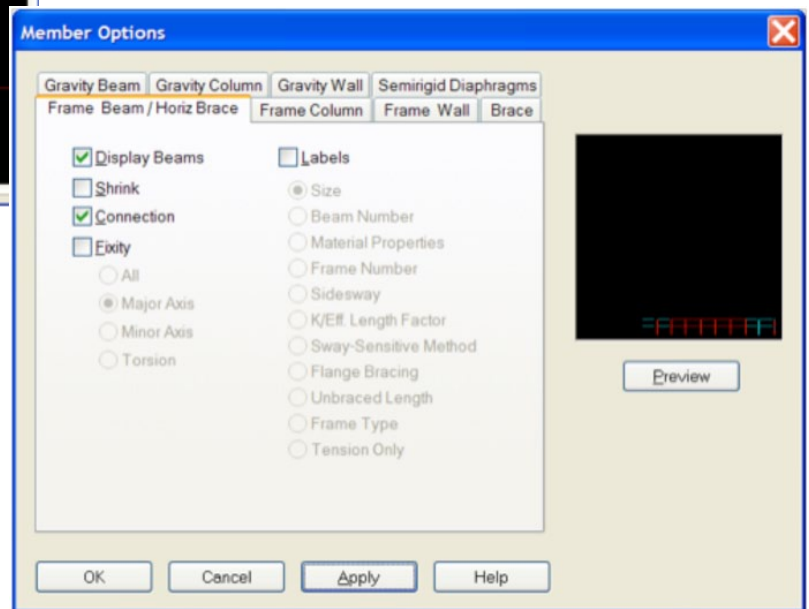


Once the beam ends have been assigned, RAM Frame will display a white rectangle symbolizing a SidePlate moment connection as shown below:



Close up of moment frame to the left.

To maintain the SidePlate moment connection symbol visible, simply check the Connection Box under **Member Options – Frame Beam / Horiz Brace**




Analysis:

When the Analysis is performed, the appropriate SidePlate connection criteria properties are applied accordingly. A frame beam-to-column geometric compatibility is performed each time an Analysis is performed to confirm compliance: $b_{f-bm} + 2.0t_{f-bm} \leq b_{f-col}$

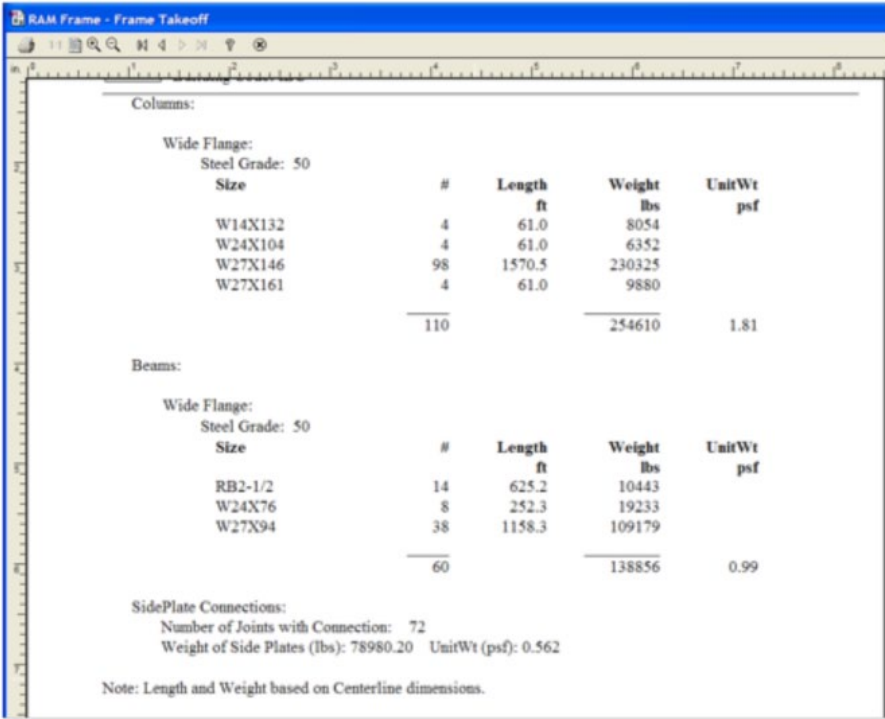
(Note: the above formula can be overly conservative especially with larger sections, if it indicates that a particular combination is not compatible, but is close, please call SidePlate Systems as a quick project specific connection design may be needed)

If any particular combination is not satisfied, the following WARNING will be displayed:

 The beam and column sizes are not compatible for SidePlate connection at Node 44. The beam is too wide. Select a beam with a narrower flange or a column with a wider flange or contact SidePlate Systems, Inc. for a project specific connection design.
The beam and column sizes are not compatible for SidePlate connection at Node 48. The beam is too wide. Select a beam with a narrower flange or a column with a wider flange or contact SidePlate Systems, Inc. for a project specific connection design.

The Member Forces report has been enhanced to include pertinent SidePlate information such as beams being identified as having SidePlate connections with forces reported at key points along the beam. Such added locations are used for stress checks in the beam as well as information for connection designs used by SidePlate. Column rigid end zones reflect the geometry of SidePlate connections, including appropriate depths of side plates.

A new section has been added to the Frame Takeoff report to include the plate weight of the SidePlate connection.



Columns:

Wide Flange: Steel Grade: 50 Size	#	Length ft	Weight lbs	UnitWt psf
W14X132	4	61.0	8054	
W24X104	4	61.0	6352	
W27X146	98	1570.5	230325	
W27X161	4	61.0	9880	
	110		254610	1.81

Beams:

Wide Flange: Steel Grade: 50 Size	#	Length ft	Weight lbs	UnitWt psf
RB2-1/2	14	625.2	10443	
W24X76	8	252.3	19233	
W27X94	38	1158.3	109179	
	60		138856	0.99

SidePlate Connections:
Number of Joints with Connection: 72
Weight of Side Plates (lbs): 78980.20 UnitWt (psf): 0.562

Note: Length and Weight based on Centerline dimensions.

Steel – Standard Provisions:

The Design moment and shear for the beams is taken at the face (end) of the SidePlate connection. The unbraced length of the beam is measured from end of the SidePlate to end of SidePlate. No design is performed for the beam within the connection, nor for the connection itself. Connection designs are provided by SidePlate Systems, Inc. (www.sideplate.com).

The Design moment and shear for the columns is taken at the face (top and bottom edges) of the SidePlate. The unbraced length (both x and y) is taken as the clear height between SidePlates.

The Member Code Check report for the beams indicates that the beam has SidePlate connection(s):

RAM Frame - Member Code Check

Right Connection - SidePlate Connection

INPUT DESIGN PARAMETERS:

	X-Axis	Y-Axis
Lu for Axial (ft)	24.26	4.63
Lu for Bending (ft)	24.26	4.63
K	1.00	1.00
Top Flange Continuously Braced	No	
Bottom Flange Continuously Braced	No	

CONTROLLING BEAM SEGMENT FORCES - SHEAR
Load Combination: 1.366 D + 0.500 Lp + 1.000 E1

Segment distance (ft) i - end	22.50
j - end	27.13

SHEAR CHECK:

Vux (kip) = -61.64	1.00Vnx (kip) = 395.43	Vux/1.00Vnx = 0.156
Vuy (kip) = -0.00	0.90Vny (kip) = 402.30	Vuy/0.90Vny = 0.000

CONTROLLING BEAM SEGMENT FORCES - FLEXURE
Load Combination: 1.366 D + 0.500 Lp + 1.000 E1

Segment distance (ft) i - end	22.50
j - end	27.13

CALCULATED PARAMETERS:

Pu (kip) = 0.00	0.90Pn (kip) = 1084.83
Mux (kip-ft) = -481.40	0.90Mnx (kip-ft) = 1042.50
Muy (kip-ft) = -0.00	0.90Mny (kip-ft) = 145.50
Cbx = 1.31	

INTERACTION EQUATION:

Pu/φPn = 0.000
 Eq H1-1b: 0.000 + 0.462 + 0.000 = 0.462

Verify SidePlate Connections with SidePlate prior to finalizing structural design.

Steel – Seismic Provisions:

In the Steel – Seismic Provisions mode the seismic provision requirements for AISC 341-05 ASD and LRFD have been implemented for SidePlate connections. Select one of the codes in the **Criteria – Codes** command.

It is necessary to assign a frame type to each member, used by the program to determine which seismic provisions are pertinent. This is done using the **Assign – Frame Type** command. Select either *Special Moment Resisting Frame*, *Intermediate Moment Resisting Frame* or *Ordinary Moment Resisting Frame* as appropriate.

The Frame Type assignment on each member can be displayed using the View – Members command by selecting the Frame Type labels option on the Frame Beam and Frame Column tabs.

The text should show either SMRF, IMRF or OMRF.

Select the **Process – Member Code Check** to have the code check performed on all of the members and select the **Process – Member View/Update** command to select and view the results for an individual member.

Select the **Process – Joint Code Check** to have the code check performed on all of the joints and select the **Process – Joint View/Update** command to select and view the results for an individual member.

The Seismic Provisions Member Code Check and Joint Code Check reports shows the results of all the checks, including compliance that structural framing does not exist within the beam’s protected zone as defined for SidePlate connections.

Upon completion of preliminary and/or final lateral designs using SidePlate connection technology, users should send their RAM model (e.g. “xxx.rss” file), including any customized beam, column or deck tables, to SidePlate Systems, Inc. (1-949-305-7889) at [www. solutions@sideplate.com](mailto:solutions@sideplate.com) for verification and validation of computer model. Upon completion of model review, SidePlate Systems will provide structural drawings (notes and details), including stamped/signed calculations for each SidePlate moment connection for the specific project.