

SidePlate Modeling Basics

in RAM Structural System

09/29/2017



How to Model SidePlate Moment Connections in RAM

- 1. Identify your lateral frame members in RAM Modeler, and Validate your model. Page 4-12.
- 2. RAM Frame Assign Beams Frame Beam Connection Type: assign SidePlate to Both Ends, Left End, or Right End of SidePlate MF beams appropriately.

NOTE: if you pin a member to test its usefulness in your system, or to perform a rho check, but don't remove the SidePlate connections, it will remain partially fixed.

Assign Frame	e Beam Connec	tion Type						-
💿 Standard	ł							
Springs								
Left	Rotational Stiffr	ness		Right:	Rotationa	al Stiffness		
	Major Axis			2	Major Ax	iis		
	No Sprin	Ig			۲	No Spring		
	🔘 Use (kip	-in/rad):	0.00			Use (kip-in/rad):		0.00
	🔘 % of Bea	am Stiffness:	0.0			% of Beam Stiffr	ness:	0.0
Custom								
			– Stiffness Multi	pliers				
Left:	None	Distance (in)	Area	lx.	ly	Torsion J	Shear Ax	: Shear Ay
	Modify:	0.00	1.000	1.000	1.000	1.000	1.000	1.000
Right:	None							
	Modify:	0.00	1.000	1.000	1.000	1.000	1.000	1.000
Reduced	d Beam Section (RBS)						
🔘 Use F	Reduced Section	Properties in Anal	ysis 🛛 RE	3S Propertie	\$ >>			
🔘 Use F	Full Beam Section	n Properties in Ana	lysis					
Cide Dist.						Assign		
Sidemati							-	
Bot	h Ends					Single	Fence	All
C Let	t End							
O Rig	nt End						Cancel	Help

Once the beam ends have been assigned, RAM Frame will display a red rectangle symbolizing a SidePlate moment connection.



 RAM Frame – Criteria – General: Rigid End Zones can remain at Ignore Effects. For SidePlate, it does not matter what is checked here, as the SidePlate Feature will implement 100% rigid (or 0% Reduction) panel zone, as proven by testing.

 RAM Frame – Criteria – SidePlate: assign the correct SidePlate stiffness to the joints. R=8 for High Seismic connections (SMF, IMF or OMF applications), and R=3 for Low Seismic (R=3 Bolted applications).

NOTE: R=8 is the RAM default. If you are using an SMF, IMF or OMF connection (Field Bolted or Field Welded), you should use the *High Seismic (r=8)* stiffness for Both Seismic and Wind loading.



5. RAM FRAME – **Drift Control Points** – **View Results** View Results: See 30% reduction in drifts due to the SidePlate stiffness for R=8 SMF Bolted or Welded.

NOTE: For R=3 Bolted (low seismic), the drift reductions could be between 15%-20%

- Choose reduced beam and column sizes, optimized for SidePlate. For typical projects, choose a beam and column sizes that are 20% to 30% lighter than a conventional design, and start there. In really high seismic, choose beams that are 40% to 50% lighter.
- GEOMETRIC COMPATIBILITY (RAM 15.04 is programed to give you a warning if b_{bf} + 1.5" < b_{cf}, however this will be updated to the Bolted Geometric Compatibility limit below)
 - BOLTED GEOMETRIC COMPATIBILITY: bbf + 1" ≤ bcf
 - WELDED GEOMETRIC COMPATIBILITY: b_{bf} + 1.1*t_{bf} + 1/2" ≤ b_{cf}

NOTE: For more background information regarding SidePlate and Geometric Compatibility, refer to our *Engineering Design Guidelines* document.



Model Validation Tips for RAM (General for any Moment Frame Systems)

1. Under RAM Manager - **Criteria** – Self-Weight: check that you are self-calculating Beams, Columns, Walls, and Slabs/Decks as you have intended.

NOTE: Steel joists cannot be self-calculated and need to be added to the superimposed dead load and mass

Member Dead Loads	Story Masses
🔽 Beams	✓ Beams
🔽 Columns	Columns
	Include half mass of columns above and below
	Include full mass of columns below only
🔽 Walls	Valls 🗸
	Include half mass of walls above and below
	Include full mass of walls below only
📝 Slabs/Deck	✓ Slabs/Deck
ОК	Cancel Help

2. Model RAM Modeler – Integrity – Data Check ✓ – Integrated: confirm there are no identified modeling errors or warnings.

NOTE: This simple step can save hours of headaches to identify modeling errors before they can cause invalid results.

Data Check Options	×
 Gravity Only Frame Only Integrated 	OK Cancel Help

3. RAM Modeler – Layout – Loads Surface Loads AND Line Loads : check that Superimposed Loads and Line Loads have the correct Mass DL identified, and have been applied to every floor, as intended.

NOTE: partition loads are not included in the Mass, and need to be added, 10 psf Floor and 4 psf Roof, per code, when appropriate



Surface Load Layout Mo	ode							
Label	DL	Constr DL	LL	Reduction	Partition	Constr LL	Mass DL	
Floor	30.0	5.0	100.0	Reducible	15.0	20.0	40.0	
Roof	115.0	5.0	100.0	Reducible	0.0	20.0	125.0	
Tree	968.0	5.0	0.0	Reducible	0.0	20.0	968.0	
Mech	180.0	5.0	40.0	Reducible	0.0	20.0	190.0	
Fountain	370.0	5.0	0.0	Reducible	0.0	20.0	370.0	
1ST Floor	10.0	0.0	100.0	Reducible	15.0	0.0	15.0	
Graphics Mode								
Whole Floor	Whole Dia	phragm	Property	Table >>				
Add								
Change	Change P	olygon						
Change Priority								Show Labels
Delete - Single	Delete -	Fence						Cancel
Show	Show S	ame						Help
Line Load Layout Mode								
Line Load Layout Mode	2							
Line Load Layout Mode	DL	Constr DL	LL	Reduction	Partition	Constr LL	Mass DL	
Line Load Layout Mode	DL 0.525	Constr DL 0.000	LL 0.000	Reduction	Partition 0.000	Constr LL 0 0.000	Mass DL 0.525	
Line Load Layout Mode Label Cladding Cladding at Roof	DL 0.525 0.330	Constr DL 0.000 0.000	LL 0.000 0.000	Reduction Reducible Reducible	Partition 0.000 0.000	Constr LL 0 0.000 0 0.000	Mass DL 0.525 0.330	
Line Load Layout Mode Label Cladding Cladding at Roof	DL 0.525 0.330	Constr DL 0.000 0.000	LL 0.000 0.000	Reduction Reducible Reducible	Partition 0.000 0.000	Constr LL 0 0.000 0 0.000	Mass DL 0.525 0.330	
Line Load Layout Mode Label Cladding Cladding at Roof	DL 0.525 0.330	Constr DL 0,000 0.000	LL 0.000 0.000	Reduction Reducible Reducible	Partition 0.000 0.000	Constr LL 0 0.000 0 0.000	Mass DL 0.525 0.330	
Line Load Layout Mode Label Cladding Cladding at Roof	DL 0.525 0.330	Constr DL 0.000 0.000	LL 0.000 0.000	Reduction Reducible Reducible	Partition 0.000 0.000	Constr LL 0 0.000 0 0.000	Mass DL 0.525 0.330	
Line Load Layout Mode Label Cladding Cladding at Roof Graphics Mode	DL 0.525 0.330	Constr DL 0.000 0.000	LL 0.000 0.000	Reduction Reducible Reducible	Partition 0.000 0.000	Constr LL 0 0.000 0 0.000	Mass DL 0.525 0.330	
Line Load Layout Mode Label Cladding Cladding at Roof Graphics Mode Whole Perimeter	DL 0.525 0.330	Constr DL 0.000 0.000	LL 0.000 0.000	Reduction Reducible Reducible	Partition 0.000 0.000	Constr LL 0 0.000 0 0.000	Mass DL 0.525 0.330	
Line Load Layout Mode Label Cladding Cladding at Roof Graphics Mode Whole Perimeter Add	DL 0.525 0.330 Whole Di Add Or	Constr DL 0.000 0.000 aphragm 1Beam	LL 0.000 0.000	Reduction Reducible Reducible	Partition 0.000 0.000	Constr LL 0.000 0.000	Mass DL 0.525 0.330	
Line Load Layout Mode Label Cladding Cladding at Roof Graphics Mode Whole Perimeter Add Change	DL 0.525 0.330 Whole Di Add Or	Constr DL 0.000 0.000 aphragm Beam	LL 0.000 0.000	Reduction Reducible Reducible	Partition 0.000 0.000	Constr LL 0.000 0.000	Mass DL 0.525 0.330	Show Labels
Line Load Layout Mode Label Cladding Cladding at Roof Graphics Mode Whole Perimeter Add Change Delete - Single	DL 0.525 0.330 Whole Di Add Or	Constr DL 0.000 0.000 aphragm I Beam	LL 0.000 0.000	Reduction Reducible Reducible	Partition 0.000 0.000	Constr LL 0 0.000 0.000	Mass DL 0.525 0.330	Show Labels
Line Load Layout Mode Label Cladding Cladding at Roof Graphics Mode Whole Perimeter Add Change Delete - Single Show	DL 0.525 0.330 Whole Dia Add On Delete	Constr DL 0.000 0.000 aphragm Beam Fence Same	LL 0.000 0.000	Reduction Reducible Reducible	Partition 0.000 0.000	Constr LL 0 0.000 0.000	Mass DL 0.525 0.330	Show Labels Cancel

4. RAM Modeler – Layout – Slab – **Deck Assign** check that deck properties and weights are as intended and applied to each level, especially when slab/deck is self-calculated. If you are using semi-rigid diaphragms, check that the Effec Thick, Poisson, and Elastic Mod are entered correctly.

Deck Assignment Mode	3												
Slab Action			Graphics	Mode									
 One-Way Two-Way 			V	Vhole Floo	r	W	hole Diap	ohragm					
Orientation				Add									
0				Change		C	hange Po	olygon					
• • •			Ch	ange Prior	ity								
© _ Angle	e: 0.00		De	elete - Sing	le		Delete - F	ence					
Parallel To	Pick			Show			Show Sa	ame					
Perpendicular To	Pick												
Framing System													
Omposite						Pro	operty Ta	able >>					
Noncomposite													
Concrete													
Label	Deck Type	Thick	Stud	Weight	fc	Fu	Diam	Deck Self-Wt	Shored	Effec Thick	Poisson	Elastic Mod	
W3 + 2.5 LW	VERCO W3 Formlok	2.50	4.5	115.00	3.00	60.0	0.750	3.00	N	0.0000	0.00	0.00	
Show Labels											Cancel	He	lp



5. RAM Modeler – Options – **Set Show Options** allows you to quickly scroll through the layout levels to check that the correct loads or decks are applied.



6. RAM Modeler – Layout – Slab Edge Slab Edge confirm that your slab edge is adequate to fit ½ your column depth or width plus SidePlate connection.

Slab Edge Layout Mode	Slab Edge Show
Left Slab Overhang (n): Right Graphics Mode Add Whole Perimeter Change - Single Move	Slab Edge Overhang (in) = 12.00 (54.0000, 65.0000) (83.0000, 65.0000)
Delete - Single Delete - Fence Show Cancel Hep	ОК

When information is not yet available for the exact slab edge, we recommend you use 12 inches. This will accommodate most SidePlate designs. SidePlate approximate minimum slab edge can be calculated below (we recommend you consider adding up to a ½ inch of tolerance to these minimum slab edge calculations):

- When column web is perpendicular to slab edge
 - SidePlate® Field Bolted or Welded 1/2* dc + tbf + 1/2"

If slab edge is critical, the column can be shifted inside the building, "off - grid"

- When column web is perpendicular to slab edge (Along Grid A in Fig 8)
 - SidePlate® Field Bolted or Welded 1/2* dc + bcf + 1/2"
- When column web is parallel to slab edge (Along Grid 1 in Fig 8)
 - SidePlate® Field Bolted, Standard ½* b_{cf} + t_{bf} + 4"
 - SidePlate® SMF Field Bolted, Standard ½* b_{cf} + 1.25* t_{bf} + 1/8" + 4"
 - SidePlate® SMF Field Welded 1/2* bcf + 2* tbf + 1/2"

NOTE: If slab edge is critical, we can use our narrow bolted configuration that moves the top set of angles from the outside face of the side plates to the inside face of the side plates to eliminate the 4" (or replace it with $1 \frac{1}{2}$ " for bolt nut).



8. RAM Modeler – **Story...**: check story heights and column splice locations are as intended.



NOTE: For conventional moment frames, the latest research shows that a centerline analysis is not always conservative, and counting partial rigidity of the joint further overestimates its stiffness in many buildings.

- Check that P-Delta is applied using Mass or Gravity Loads.
- Check that T_b is Off for Drift.

Rigid End Zones	P-Delta	AISC 360
Ignore Effects	© No	Use Reduced Stiffness for Steel Members
Include Effects	Yes	🔘 ՄՆ = 1.0
Reduction %: 0	Use Mass Loads Scale Factor: 1	🔿 Use 🏷 1
Member Force Output	O Use Gravity Loads	Wall Element
At Face of Joint	Load Scale Factors:	Include out-of-plane stiffness (bending)
At Centerline of Joint	Dead: 1 Roof: 1	Release rotational fixity at wall foundation nodes
Response Spectra Analysis	Live: 1 Snow: 1	Store wall stresses
🗹 Consider Sign for Analysis Results	Solver Type	Include Rigid Link at Fixed Beam-to-Wall
Include nodal mass in Z-direction	Direct Solver	Locations
(applicable for semirigid diaphragms only)	O In-Core	Buckling Restrained Braces
Eigenvalue Analysis	Uut-or-Core	the Gravity Load Case Analysis
eigen Vectors	Direct Sparse Solver	Analytical Model
Ritz Vectors	In-Core Rut of Court	Merge Node Tolerance (in): 0.0100
	Uut-or-core	Mesh Controls
	Uptions O Use Single CPU Core	Max. Distance Between
	Use All Available CPU Cores	Nodes on Mesh Line (ft): 4.0000
		Geometry Tolerance (in) : 0.00500



12. RAM Frame – Criteria – Diaphragm: check that intended diaphragms are Rigid or Semi-Rigid.

NOTE: If you are using Semi-Rigid diaphragms, check that the Mesh Controls are not larger than your smallest (lateral frame beam span)/4 to ensure accurate results. The current RAM default is 4 ft.

Story	Diaph.#	Dianhragm	Analytical Model		
roof	1	Rigid	Meson Node Television Gel	0.0	100
2nd	1	Rigid	Made Castala		
			Messi Conucis		
			Max. Distance between Nod Line (R):	es on Mesh 4.0	0
			Geometry Tolerance (in) :	0.0	0500
			Hard Node Density Factor:	1	
			Diaphragm Boundary	Diaphragm Mass	
			Use Slab Edges for Exterior Boundary	Our Calculated	
All Rigid	All Semirigid	lisconnect	Use Beams for Exterior Boundary	 Uniformly Distribution Mass Over Diapit 	ute Tota hragm
All Pseudo-Flexible	All Flexible		Note: Semirigid diaphragms are also meshed if they contain any	always meshed. Rigid diaphra two-way decks.	agms are
ut-of-Plane Stillness (Bendi	nal			_	
Include Out-of-Plane Stift	ness for One-way Decks				OK
				Ca	ancel
tote: Ulut-or-plane soffness r	or two-way decks is awa			H	lelp
Gravity Members Supportin	ig Two-way Decks			c	
(ii) Include Gravity Me	mhers			Comm	gines
Include Gravity Me	mbers as Vertical Springs				
Columns					
- Av/alle					
w dis					

If you are using Pseudo-Flexible diaphragms verify the correct distribution of loads are applied at **Loads** – **Pseudo Flexible Diaphragm Properties**: every frame must be manually assigned the correct proportion of Wind, Seismic, Notional, and Dynamic loads, as applies. Every frame must be carefully numbered at **Assign** – **Frame Numbers**.

NOTE: When you add a frame member it is automatically assigned to 0, and must be re-numbered. Also, Pseudo Flexible Diaphragms can cause short buildings to have inaccurate periods.

		Stor	y:					Stor	y:
		Roo	of	-				Roo	of
d Seismic Not	tional/User Dynamic				Wind Se	ismic Not	ional/User Dynamic		
Diaphragm	Frame	Effective %: X-dir.	Effective %: Y-dir.		Diap	hragm	Frame	Effective %: X-dir.	Effective %: Y-dir.
	1	0.00	22.22		1		1	0.00	22.22
	2	0.00	27.78				2	0.00	27.78
	3	0.00	22.22				3	0.00	22.22
	4	0.00	22.22				4	0.00	22.22
	5	0.00	5.56		<u> </u>		5	0.00	5.56
	6	50.00	0.00				6	45.0	0.00
	7	50.00	0.00				7	55.0	0.00
	-	Sum = 100.00	Sum = 100.00					Sum = 100.00	Sum = 100.00
		1	1						
		-							
									· · · · · · · · · · · · · · · · · · ·
			JJ						JJ
					Analy 7	h 0	officer to Others Lond	T	
Apply These Perci	entages to Other Load	Types			Abbia	nese Perce	entages to Other Load	rypes	
stributo Applied L	ande Amone				Distribute	e Applied L	oads Among		
suibute Applieu b	udus Among								
Frame Member	rs Equally				I Fran	ne member	sequally		
Frame Member	rs Based on Their Relati	ive Stiffness			France	me Member	rs Based on Their Relat	ve Stiffness	



13. RAM Frame – **Criteria** – **Ground Level**: confirm that the lateral analysis is starting at the base, or the correct level, when modeling a basement or steel grade beams.

Ground Level	×
 At Base At Story Level 	OK Cancel
2nd 👻	Help

14. RAM Frame – **Loads** – **Exposure**: confirm that the appropriate parapet(s) have been assigned.

Building Extents Use Calculated Val	ues 🔘 Use S	pecified Value	15				
			Building	Extents			
Story	Diaph. #	Min X	Max X	Min Y	Max Y	Parapet	Exposure
roof	1	-1.00	184.50	23.00	144.00	2.50	Full
2nd	1	-1.00	187.50	-1.00	168.00	0.00	Full

15. RAM Frame – **Loads** – **Diaphragm Masses**: confirm that there are no masses in the list without a number under "Diaph.#," and if any are listed as "none," determine the appropriate floor and assign that diaphragm under "Combine To."

NOTE: This is usually caused by flying beams or columns that are outside the modeled diaphragm. The same can be repeated for gravity loads.

Di	aphragm Masses									X
									-% E	Eccentricity
	Use Calculated Values	🔘 Use	Specified	Values					5	Recalculate
	Story	Diaph. #	Weight	Mass	Inertia	Xm	Ym	Eccen X	Eccen Y	Combine To
	31019	Diapin.#	kips	k-s2/ft	ft-k-s2	ft	ft	ft	ft	
	roof	1	4697.25	145.877	631787	91.85	82.54	9.27	6.05	None
	2nd	1	3538.99	109.906	624779	92.18	82.89	9.42	8.45	None
	2nd	None	19.69	0.611	72	91.75	167.00			1 – 2nd 👻
1										
		пк	L L	Can	cel		Help	1	Communitie	
		UIX					Пор	1	Commente	9



- 16. RAM Frame Loads **Show Member Options: I** to turn floors and gravity members off to see the frames better.
- 17. RAM Frame Loads **Show Member Options** iview **Fixity** "All" and "Major Axis" in 3D and by floor, to determine that all Moment Frame Beams and Columns have appropriate Fixity applied.

NOTE: When changing gravity beams to lateral, they will be Pinned unless manually fixed. Columns are automatically Fixed, so watch pinned base situations.

- 18. RAM Frame Reports Takeoff, skip to bottom, TOTAL STRUCTURE FRAME TAKEOFF:
 Record the Total Floor Area, to be used to validate the building mass.
- 19. RAM Frame **Process Analyze**: run ALL load cases Select All with Tb Off.
- 20. RAM Frame Reports Loads and Applied Forces:
 - Verify that all the seismic and wind factors are inputted accurately.
 - Record the Total Building Weight (kips) from the seismic load case. Calculate Total Building Weight / Total Building Area (from Takeoff report) to get Average Mass. Verify that the average mass is reasonable:
 - Office Buildings are Typically 80 psf 110 psf.
 - Hospitals are Typically 90 psf 120 psf.
- 21. RAM Frame **Process Results Mode Shape**

 : even for a wind governed project, run an Eigen load case to verify the model is behaving as expected, and the Periods & Modes Report is showing 90% mass participation.
- 22. RAM Frame **Process –Analyze**: run only EQ Drift load cases (for this example) with T_b Off.
- 23. RAM FRAME **Drift Control Points** : verify drift points are set up at reasonable corners of the building.

NOTE: We have seen errors in RAM, when drift points are not chosen Exactly ON frame members. We have

the best success using the magnifying glass in RAM Modeler to get the coordinate of appropriate columns or beam ends to use as our drift points.

When using semi-rigid diaphragms, gravity members are allowed to "stretch", when points are not chosen on a perimeter Lateral member, and checked only in the direction of the frame. As such, if you are getting unexpected results, you can try adding "pinned lateral"

Drif	Drift at Control Points								
		X (ft)	Y (ft)						
	1	0.000	23.000	Cancel					
	2	183.500	143.000						
	3	92.000	83.000	Неір					
	4			View Results					
	5								
	6								
	7			1					
	8								
	9								
	10								

members at the perimeter of the building, and chord locations, to use as drift points until expected results are achieved.



24. RAM FRAME – **Drift Control Points** – **View Results** : verify lateral drifts are within allowable. Seismic and Wind cases can be run separately to make this easier to view.

NOTE: Many engineers we work with feel more comfortable with modeling the RBS connection with a standard joint, and using the code commentary recommendation of 5% to 10% decrease in stiffness based on testing. Since most engineers use the mid-range of the cutout, they decrease their allowable drift by 7% for RBS.

For this example, allowable drift is 2%*I/Cd*93% - 0.0036*0.93 = 0.0034 for the RBS design.

RESULTS:

Location (ft): (0.000, 23.000)

Story	LdC	Displacement		Story Drift		Drift Ratio	
		Х	Y	Х	Y	Х	Y
		in	in	in	in		
roof	E5	1.1041	0.0544	0.5901	0.0263	0.0029	0.0001
	E6	1.1754	-0.0552	0.6285	-0.0322	0.0031	0.0002
	E7	0.0535	1.0572	0.0292	0.5873	0.0001	0.0029
	E8	-0.0518	1.2193	-0.0284	0.6752	0.0001	0.0033
2nd	E5	0.5140	0.0282	0.5140	0.0282	0.0024	0.0001
	E6	0.5469	-0.0231	0.5469	-0.0231	0.0025	0.0001
	E7	0.0242	0.4699	0.0242	0.4699	0.0001	0.0022
	E8	-0.0234	0.5440	-0.0234	0.5440	0.0001	0.0025

Location (ft): (183.500, 143.000)

Story	LdC	Dis	Displacement		Story Drift	Drift Ratio	
-		Х	Y	Х	Y	Х	Y
		in	in	in	in		
roof	E5	1.1753	-0.0544	0.6245	-0.0263	0.0031	0.0001
	E6	1.1031	0.0552	0.5864	0.0322	0.0029	0.0002
	E7	-0.0542	1.2219	-0.0291	0.6765	0.0001	0.0033
	E8	0.0525	1.0598	0.0283	0.5886	0.0001	0.0029
2nd	E5	0.5509	-0.0282	0.5509	-0.0282	0.0026	0.0001
	E6	0.5167	0.0231	0.5167	0.0231	0.0024	0.0001
	E7	-0.0251	0.5454	-0.0251	0.5454	0.0001	0.0025
	E8	0.0242	0.4712	0.0242	0.4712	0.0001	0.0022





Convert Lateral Connections to SidePlate (page 1-2)

See 30% reduction in drifts due to the SidePlate stiffness for R=8 SMF Bolted or Welded.

NOTE: For R=3 Bolted (low seismic), the drift reductions could be between 15%-20%.

RESULTS:

Location (ft): (0.000, 23.000)

Story	LdC	Displacement		5	story Drift	Drift Ratio		
		Х	Y	Х	Y	Х	Y	
		in	in	in	in			
roof	E5	0.9414	0.0446	0.4642	0.0193	0.0023	0.0001	
	E6	1.0012	-0.0455	0.4936	-0.0246	0.0024	0.0001	
	E7	0.0542	0.8688	0.0271	0.4424	0.0001	0.0022	
	E8	-0.0353	1.0036	-0.0178	0.5094	0.0001	0.0025	
2nd	E5	0.4773	0.0253	0.4773	0.0253	0.0022	0.0001	
	E6	0.5076	-0.0209	0.5076	-0.0209	0.0024	0.0001	
	E7	0.0271	0.4264	0.0271	0.4264	0.0001	0.0020	
	E8	-0.0175	0.4942	-0.0175	0.4942	0.0001	0.0023	

Location (ft): (183.500, 143.000)

Story	LdC	Displacement		5	Story Drift	Drift Ratio		
•		X	Y	Х	Y	Х	Y	
		in	in	in	in			
roof	E5	1.0009	-0.0464	0.4898	-0.0200	0.0024	0.0001	
	E6	0.9404	0.0474	0.4607	0.0256	0.0023	0.0001	
	E7	-0.0548	1.0354	-0.0268	0.5248	0.0001	0.0026	
	E8	0.0357	0.8952	0.0176	0.4552	0.0001	0.0022	
2nd	E5	0.5111	-0.0264	0.5111	-0.0264	0.0024	0.0001	
	E6	0.4797	0.0218	0.4797	0.0218	0.0022	0.0001	
	E7	-0.0280	0.5106	-0.0280	0.5106	0.0001	0.0024	
	E8	0.0181	0.4399	0.0181	0.4399	0.0001	0.0020	

One side of the model is softer than we expect because the cantilever beam is not yet modeled correctly. The drift should be even on both sides since the building is symmetrical. Choose reduced beam and column sizes, optimized for SidePlate, and fix cantilevers (see trouble shooting section below). For typical projects, choose a beam and column sizes that are 20% to 30% lighter, and start there. In really high seismic, choose beams that are 40% to 50% lighter.





SidePlate troubleshooting for RAM

1. Cantilevers and SidePlate:



The SidePlate feature will not activate if a MF beam extends through the column with cantilever in the plane of the MF beam.



These type of cantilevers need to be converted to a "Gravity Stubs" in Modeler.

- Layout Beams Show or View Measure Distance to get the exact length of the cantilever.
- Layout Beams 🔛 Delete Cantilevers 🔀 to remove the extension.
- Layout Beams Assign Cantilever 🕶 to Add a Gravity Stub.





NOTE: Any cantilevers that run perpendicular to the MF beam should be left as "extension cantilevers," as shown above, or RAM will assume they have no back span, and will falsely introduce weak axis bending in the MF column. This is not a problem for the in-plane cantilever because the MF beam is fixed to the column to resist the back span moment.



2. Short Story for grade beams or screen walls

- In high seismic, for high demand projects, some of our clients prefer to use steel grade beams to "Fix" the base of the moment frames instead of concrete. This allows for simple and less expensive detailing of the concrete "surround," used only for soil bearing and cover with only temperature steel required.
- When modeling steel grade beams, it is standard practice to create a "Grade Beam" level with the columns Pinned at the base.



When modeling any short story like this, or dummy levels for screen walls (so the parapet can be assigned to a defined area smaller than a whole level), the minimum height of the short level is ½ the SidePlate beam depth + 3 inches. If the story is too short (causing a clash in the model), you will get an error, and the model will not run.





Checking a SidePlate Model for Accuracy & Code Compliance

- 1. RAM Frame **Reports Takeoff**, skip to bottom 𝔍 , under TOTAL STRUCTURE FRAME TAKEOFF:
 - Verify that the correct number of SidePlate Joints have been applied.

NOTE: RAM gives an estimated SidePlate connection weight (this is the weight of the side plates only and is only accurate for our SMF Field Welded connection at this time.) This will be updated in future versions.

- For Field Bolted R=3 (low seismic) use reported value *0.9
- For SMF Field Bolted R=8 (high seismic) use reported value *1.2
- For SMF Field Welded R=8 (high seismic) use reported value
 - Verify that the beam and column sizes, and quantities, look correct.

NOTE: Sometimes a beam or column cannot be modified correctly in RAM Frame, or can be missed when changing sizes by fence. We have had success erasing and re-drawing the member in RAM Modeler to remove the error.

- 2. RAM Frame Process Analyze: run only EQ Drift load cases with Tb Off.
- 3. RAM Frame Criteria SidePlate: Set SidePlate to R=8 or R=3, see #4 on Page 3:



4. RAM FRAME – Drift Control Points → View Results View Results : Drift: Since there is no stiffness reduction for SidePlate because of the 100% rigidity of the panel zones, the allowable seismic drift at 2%h is 0.02*I/Cd = 0.0036 for this example.

RESULTS:

Location	(ft):	(0.000,	23.000)
----------	-------	---------	---------

Story	LdC	Displacement		Story Drift		Drift Ratio	
		Х	Y	Х	Y	Х	Y
		in	in	in	in		
roof	E5	1.2915	0.0541	0.6726	0.0237	0.0033	0.0001
	E6	1.3637	-0.0562	0.7079	-0.0299	0.0035	0.0001
	E7	0.0610	1.0982	0.0292	0.5438	0.0001	0.0027
	E8	-0.0549	1.2752	-0.0284	0.6314	0.0001	0.0031
2nd	E5	0.6189	0.0304	0.6189	0.0304	0.0029	0.0001
	E6	0.6558	-0.0263	0.6558	-0.0263	0.0030	0.0001
	E7	0.0318	0.5544	0.0318	0.5544	0.0001	0.0026
	E8	-0.0264	0.6438	-0.0264	0.6438	0.0001	0.0030

Location (ft): (183.500, 143.000)

Story	LdC	Displacement		5	story Drift	Drift Ratio		
		X	Y	Х	Y	Х	Y	
		in	in	in	in			
roof	E5	1.3627	-0.0547	0.7036	-0.0237	0.0034	0.0001	
	E6	1.2899	0.0567	0.6687	0.0300	0.0033	0.0001	
	E7	-0.0615	1.2856	-0.0289	0.6326	0.0001	0.0031	
	E8	0.0552	1.1069	0.0281	0.5449	0.0001	0.0027	
2nd	E5	0.6591	-0.0310	0.6591	-0.0310	0.0031	0.0001	
	E6	0.6212	0.0267	0.6212	0.0267	0.0029	0.0001	
	E7	-0.0327	0.6529	-0.0327	0.6529	0.0002	0.0030	
	E8	0.0271	0.5620	0.0271	0.5620	0.0001	0.0026	



NOTE: Even when you don't think wind will govern, you should do a quick check. As you can see wind is not even close to h/400 or 0.0025 in this example, but this is a 2 story, square building in high seismic. Many taller buildings will have wind govern even in high seismic, especially when doing a dynamic analysis.

Location	(ft):	(0.000,	, 23.000)
----------	-------	---------	-----------

Story	LdC		Displacement		Story Drift		Drift Ratio	
		Х	Y	Х	Y	Х	Y	
		in	in	in	in			
roof	W13	0.1343	0.0008	0.0589	-0.0000	0.0003	0.0000	
	W14	0.0007	0.1540	0.0001	0.0636	0.0000	0.0003	
	W15	0.0914	0.0148	0.0406	0.0054	0.0002	0.0000	
	W16	0.1101	-0.0137	0.0477	-0.0054	0.0002	0.0000	
	W17	0.0176	0.0893	0.0072	0.0369	0.0000	0.0002	
	W18	-0.0166	0.1417	-0.0071	0.0585	0.0000	0.0003	
2nd	W13	0.0754	0.0008	0.0754	0.0008	0.0003	0.0000	
	W14	0.0006	0.0904	0.0006	0.0904	0.0000	0.0004	
	W15	0.0508	0.0095	0.0508	0.0095	0.0002	0.0000	
	W16	0.0623	-0.0082	0.0623	-0.0082	0.0003	0.0000	
	W17	0.0105	0.0524	0.0105	0.0524	0.0000	0.0002	
	W18	-0.0095	0.0832	-0.0095	0.0832	0.0000	0.0004	

- 5. Scaling Dynamic Stress in RAM (If you are using Equivalent Lateral Force, skip to step 6)
 - RAM Frame Process Analyze: run EQ Stress load cases with Tb OFF.
 - RAM Frame Reports Building Story Shear: to obtain the Largest appropriate Equivalent Lateral Force (ELF).

NOTE: Since we can only obtain the Dynamic base shear from the Building Story Shear report, we need to get the Static Force base shear from the same report so that they both include P-delta and eccentricity affects. It will be larger than the base shear reported in Loads and Applied Forces.

- RAM Frame **Process Analyze**: run Dynamic Stress load cases with T_b ON.
 - RAM Frame Criteria: turn T_b ON

General Criteria		×
Rigid End Zones Ignore Effects Conclude Effects Reduction %: 0	P-Delta ○ No ④ Yes ③ Use Mass Loads Scale Factor: 1	AISC 360 ✓ Use Reduced Stiffness for Steel Members ● ℃b = 1.0 ● Use ℃b 1

• RAM Frame – **Reports** – **Building Story Shear**: skip to bottom 🕅 , and ensure that the Smallest Dyn base shear in each direction is 85% of ELF.

NOTE: If your analytical base is not the "base" of your model, you will have to get your story shear from your analytical base level instead of the bottom. Since you will check stress with Tb ON, and you cannot set the period for a dynamic load case, you should have Tb ON when you run the Dynamic load cause for scaling. This ensures proper scaling.



6. RAM Frame – Criteria: turn Tb ON to check stress

General Criteria		x
Rigid End Zones	P-Delta	AISC 360
Ignore Effects	© No	Use Reduced Stiffness for Steel Members
Include Effects	Yes	• Tb = 1.0
Reduction %: 0	 Use Mass Loads Scale Factor: 1 	🔘 Use Tb : 1

- 7. RAM Frame Process Analyze: run all appropriate load cases with T_b ON.
 - Switch Analysis to Steel.



- Verify appropriate Steel Design Code.
- Verify f1, Live Load Factor, Sds, RhoX, and RhoY are entered correctly.
 ASC360 10 LRFD Load Combination Generation

Code for Combinations: IBC 2012 / ASCE 7-10 LRFD -				CE 7-10 LRFD 🔹		Redunda	Redundancy Factor	
nalyzed Loa	d Cases t	o incluc	le in Loa	d Combinations		Live Load factor f1 (0.5 or 1.0) 0.500 Sds (for Ev) 1.000	 Use L. Use 	alculated
Labe	1	Sym	Use	Туре	A		RhoX	1.000
DeadLo	ad	D	7	RAMUSER	-		Hhor	1.000
PosLiveL	oad	Lp	V	RAMUSER				
EQ Stre	55	E1	V	EQ_ASCE710_X_+E_F	1			
EQ Stre	ss	E2	V	EQ_ASCE710_XE_F	1			
EQ Stre	SS	E3	V	EQ_ASCE710_Y_+E_F	1			
EQ Stre	55	E4	V	EQ_ASCE710_YE_F				
EQ Drit	ft	E5	V	EQ_ASCE710_X_+E_Drft				
EQ Drift E6 V EQ_ASCE710_X_E_Drft Notional Loads EQ Drift E7 V EQ_ASCE710_Y_+E_Drft V Consider with Combinations				Notional Loads				
					Consider with Combinations containing only gravity loads			
EQ Drit	ft	E/		EQ_ASCE/10_Y_+E_Drft		Consider with Combinations containing only gravity loads		
EQ Drit	ations	E/			Ge	Consider with Combinations containing only gravity loads		
EQ Drit	ations	E/			Ge	Consider with Combinations containing only gravity loads netate I Combinations		
EQ Drit	ations	E/	0 D + 1.4	EQ_ASCE/10_Y_+E_Drit	Ge	Consider with Contributions containing only gravity loads metals		
EQ Drif	ations	E/ 1.40 1.40	0 D + 1.4 0 D + 1.4	EQ_ASCE/10_Y_+E_D/m	Ge	Consider with Contributions containing only gravity loads nervice		
EQ Drit	ations Use V	E/ 1.40 1.40 1.40	0 D + 1.4 0 D + 1.4 0 D - 1.4	EQ_ASCE/10_Y_+E_D/m	Gr	Consider with Contributions containing only gravity loads netrate	-	
EQ Drift	ations Use V	E7 1.40 1.40 1.40 1.40	0 D + 1.4 0 D + 1.4 0 D - 1.4 0 D - 1.4	EQ_ASCE/10_Y_+E_DFR	Ge	Consider with Containations containing only gravity loads netrate		OK.
EQ Drift and Combine 1 2 3 4 5	ations Use V V V V V V V V V V V V V V V V V V V	E7 1.40 1.40 1.40 1.40 1.20	0 D + 1.4 0 D + 1.4 0 D - 1.4 0 D - 1.4 0 D - 1.4	EQ_ASCE/10_Y_+E_DFR	Ge Loan	Consider with Contributions containing only gravity loads metrolo		OK
EQ Drit	ations Use V V V V V V V V V V V V V V V V V V V	E7 1.40 1.40 1.40 1.20 1.20	0 D + 1.4 0 D + 1.4 0 D - 1.4 0 D - 1.2 0 D + 1.2 0 D + 1.2	EQ_ASCE/10_YE_0Fit 100 ND1 100 ND2 100 ND2 100 ND1 100 ND2 100 ND1 + 1600 Lp + 1600 NL 100 ND2 + 1600 Lp + 1600 NL	Contraction of the second seco	Consider with Containations containing only gravity loads net ale		0K Cancel
EQ Drit	tt abions Use V V V V V	E7 1.40 1.40 1.40 1.20 1.20 1.20	0 D + 1.4 0 D + 1.4 0 D - 1.4 0 D - 1.4 0 D + 1.2 0 D + 1.2 0 D + 1.2 0 D + 1.2	EQ_ASCE/10_YE_DFR 00 ND1 00 ND2 00 ND2 00 ND2 100 ND2 + 1600 Lp + 1600 NL 00 ND2 + 1600 Lp + 1600 NL 00 ND2 + 1600 Lp - 1600 NL	Coa	Consider with Contributions containing only gravity loads metals Combinations		OK Cancel Help

- 8. RAM Frame Criteria B1 and B2 factors: (must be in steel, not analyze to get this menu)
 - Verify that Apply B1 Factors are Checked, to account for small displacements.
 - Verify that Apply B2 Factors are NOT Checked, so that P-Delta is not double counted.

B1 and B2 Facto	rs 💌 💌
Apply B1	Factors
Rmx:	1.00 -
Rmy:	1.00 👻
ОК	Cancel Help



9. RAM Frame – Assign – Beam - Lateral Bracing: assign lateral bracing as will be required by code to ensure that stress will be checked with the appropriate unbraced length.

Assign Beam Unbraced Length	×
Unbraced Length - Axial Major Axis - Lx	Unbraced Length - Flexure Minor Axis - Lby © Global Criteria
O Use (ft):	Our State (Stress of the state of the sta
Minor Axis - Ly © Global Criteria	
Ouse (ft): 8.8	
Global Criteria Global Criteria set in Criteria - Flange B Bottom Flange NOT Continuously Brac Top Flange NOT Continuously Braced	racing ced
Assign Single Fence	All
	Cancel Help

NOTE: SidePlate testing and approvals show that lateral bracing is never required at the hinge location and can be counted from the Ends (except OSHPD) of the side plates. Even though a SidePlate design has lighter beam sizes, the required lateral bracing is often less than a conventional design.

Also, sometimes a small tweak in gravity framing can save in lateral braces. In the example below of a typical 30' bay with gravity purlins spaced at 10' o.c., the spacing can be changed to at 11'-9'-11' at the lateral frames. This allows bracing for typical lateral beams like W24x76, W27x94, W30x108, etc. to only be braced at the 2 purlin locations, and eliminates the need for 3 extra lateral braces that would be required in a conventional design.

***For R=3 projects, lateral bracing is NOT required by code.





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- 10. RAM Frame **Process** Member Code Check everify members are within allowable stress.
 - RAM Frame Process Member View Update: look at details of any members in question.
 - RAM Frame Assign Beam Size: change member size

NOTE: For Ram version 15.03 and older, if you change beam or column sizes in Frame and run your analysis you may get inaccurate results, like increased stress in just those members, or some members showing a stress of 0, or inaccurate drifts. To ensure accurate final results, you need to re-run the Beam and Column design. We have alerted RAM of this issue, and they are working on a solution.



11. Switch Standard Provisions to – Seismic Provisions (as applicable for R=8)



• Verify appropriate Seismic Provision Codes:

NOTE: You can un-check the Cpr factor when you have SidePlate assigned, as the appropriate calculated Cpr will be applied regardless of what is checked here.

• Verify f₁, Live Load Factor, Sds, and Omega are entered correctly.

Understands UBC 2012 / ASCE 710 LFPC UL Analyzed Load Cases to include in Load Combinations St Labet Sym Use Type Image: Stress to include in Load Combinations D V BAUUSER Image: Stress to include in Load Combinations D V BAUUSER Image: Stress to include in Load Combinations D V BAUUSER Image: Stress to include in Load Combinations D V BAUUSER Image: Stress to include in Load Combinations D V BAUUSER Image: Stress to include in Load Combinations D V BAUUSER Image: Stress to include in Load Combinations D V BAUUSER Image: Stress to include in Load Combinations D	L0) 0.500 1.000 3.000
Label Sym Use Type 0 Destc.ad 0 V RANUSER 0 Peat.ord 0 V RANUSER 0 Destc.ad 0 V RANUSER 0 Post.red 0 V RANUSER 0 Domotiond 10 V RANUSER 0 E0 Smess 11 V C0.ASCF10_V_LEF 0 E0 Smess 23 V E0.ASCF10_V_LEF 0 E0 Smess 13 V E0.ASCF10_V_LEF 0 E0 Smess 64 V E0.ASCF10_V_LEF 0 E0 Dimes 64 V E0.ASCF10_V_LEF 0	1.000 1.000 3.000
Label Sym Use Type A Desd.cad D // RAUUSER III D // IIII D // IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	1.000 3.000
Label Sym Use Type * 0 2 Desticad 0 '/ RAMISER I 1 </td <td>3.000</td>	3.000
DeskLoad D Ø PAMUSER PosLiveLoad L Ø PAMUSER EG Stress E1 Ø EQ_ASCE710_X_t£_F EG Stress E1 Ø EQ_ASCE710_X_t£_F EG Stress E3 Ø EQ_ASCE710_X_t£_F EG Stress E3 Ø EQ_ASCE710_Y_t£_F E0 Stress E4 Ø EQ_ASCE710_Y_t£_F E0 Drites E4 Ø EQ_ASCE710_Y_t£_F	*
Post-vet.oad Lp V RAMUSER EQ Stress E1 V EQ ASCE710, X, e.F. EQ Stress E2 V EQ ASCE710, X, e.F. EQ Stress E3 V EQ ASCE710, Y, e.F. EQ Stress E3 V EQ ASCE710, Y, e.F. EQ Stress E4 V EQ ASCE710, Y, e.F. EQ Stress E4 V EQ ASCE710, Y, e.F.	
EQ Stress E1 y EQ_ASCE710_X_+C_F EQ Stress E2 v EQ_ASCE710_X_+C_F EQ Stress E3 v EQ_ASCE710_Y_+C_F EQ Stress E4 v EQ_ASCE710_Y_+C_F EQ Stress E4 v EQ_ASCE710_Y_+C_F	
EQ Stress E2 V EQ_ASCE710_X_E_F EQ Stress E3 V EQ_ASCE710_Y_e_F EQ Stress E4 V EQ_ASCE710_Y_e_F_F EQ Drift E5 V EQ_ASCE710_Y_e_F_F	
EQ Stress E3 V EQ_ASCE710_Y_+E_F EQ Stress E4 V EQ_ASCE710_YE_F EQ Drift E5 V EQ ASCE710_X +E Drft	
EQ Stress E4 V EQ_ASCE710_YE_F EQ Drift E5 V EQ_ASCE710_X_+E_Drft	
EQ Drift E5 Z EQ ASCE710 X +E Drft	
EQ Drift E6 V EQ_ASCE710_XE_Drft No	
EQ Drift E7 V EQ_ASCE710_Y_+E_Drft +	



 RAM Frame - Assign – Frame Type: assign all lateral beams and columns as part of the SMF lateral load resisting system.

ssign Frame Type
Assign
Frame Type: Special Moment Resisting Frame
Single Fence All
Cancel Help

- RAM Frame Process Member Code Check Process Member View Update
- RAM Frame Process Joint Code Check E: verify members meeting SCWB.

Increase size of "green or red dots" in the red members and go un-noticed.

NOTE: There can be false green dots, especially with a dynamic analysis, where the member actually fails SCWB. So, each joint should be checked with View Joint/Update. The details will show accurate results.

71	Se	ismic Provisi	ons Mei	mber Code	Check	
RAM Fr DataBase Building	ame v14.05.0 e: 20120518_ Code: IBC	3.00 FLS Office 2 revis	07/03/13 11:07: Steel Code: AISC341-05 - LRF			
Beam Parameters Story: 1st Floor Fy (ksi): 50.00 Frame Type: Sp Left Connection Right Connect	oecial Momen 1 - SidePlate (ion - SidePlate	Frame No: 7 Size: W24X76 Resisting Frame Connection e Connection	Me	mber No: 2		
9.2 Beam-to-Colun SidePlate bear interstory drift Required flexu All SidePlate b ICC-ES ESR-1	nn Joints and n-to-column o ratio. OK ral strength o eam-to-colum 275. OK	Connections connection must b of connection (kip nn joints to demo	be capable -ft) = 666 instrate con	of sustaining d .67 at story dr nformance wit	a 0.04 radian ift angle in (1) h 9.2a as indicated in 9.2b per	
9.4 Beam and Cole Flange b/tf = Web h/tw =	mn Limitati 6.61 48.95	ons OK Limit = Limit =	7.22	OK OK		
9.8 Lateral Bracin Max Lu (in) = Lateral Bracing Required stir Lateral Bracing Not Required Cd = 1.0 Lb = dist.	g of Beams - 64.67 Requirements ength of lateral fness of bracin Requirements <i>l per ICC-ES</i> assumed for ance between	OK Lu Limit = along Beam brace along beam g (A-6-8) = 6316 at Plastic Hinge <i>ESR</i> -1275 eqns (A-6-7/8) braces (in)	95.73 a = 9.47 k 39 kip / Lt	OK.		
Hinge-to-Hinge / Hinge-to-Hinge Minimum L' / D L' / Depth = 12	Beam Depth Length L' (ft) epth = 4.5 .99 OK	Ratio = 25.87				
Protected Zone Protected Zone Protected Zone No members fr	i (ft): 2.44 to j (ft): 27.98 t ame into Prote	o 4.10 to 29.64 ected Zone OK				

Verify SidePlate Connections with SidePlate prior to finalizing structural design.



SidePlate vs. RBS

Descripti	on: 2-Sto	ory Store or Rest	taurant		Area:	49,998	s.f. (model)	
Material Tak	ke-Off:							
Structura	l Steel System	RBS	R	BS	SP1	SidePlate	Welded [®]	
Foundati	on Type		Fib	(ed		Fix	Fixed	
			(psf)	(tons)		(psf)	(tons)	
Gravity B	eams		7.47	187		7.63	191	
Gravity C	olumns		0.83	21		0.93	23	
Latoral Co	Lateral Columns		W24x		SP Joints	W	W24x	
Lateral Co			2.88	72	24	1.77	44	
		Bm Ends	W	W30x		W	W30x	
Lateral Be	Lateral Beams		1.97	49	32	1.23	31	
Connection Weight of		SidePlates	0.00	0		0.55	14	
Misc Steel (% of total steel)		el) 15%	1.97	49		1.97	49	
TOTAL STEEL WEIGHT			15.12	378		14.08	352	
Model/MS Revi		MS Reviewed By	EK	Steel Savi	ngs (psf/tons)	1.04	26	
Export Fee APPROVED b		e APPROVED by	HG					



Questions?

SidePlate is here to help you

Please send us your SidePlate model for review, even in the preliminary design phase. We are happy to run your model through our connection design software to catch any flags or special checks to ensure that you have the best performing and most optimal lateral design for your client.

If your client is requesting pricing, we are happy to provide you with a pricing package containing detailed connection information, and an Excel file with all take-off information, to facilitate an accurate price from fabricators.

Please feel free to contact SidePlate at **solutions@sideplate.com** anytime with questions or concerns. We are happy to set up a WebEx meeting to walk you through SidePlate and or RAM. If you are not getting the results you would expect, we are happy to look at your model to trouble shoot any possible problems.

