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DIVISION: 05 00 00—METALS
SECTION: 05 05 23—METAL FASTENINGS
DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
SECTION: 06 05 23—WOOD, PLASTIC, AND COMPOSITE FASTENINGS

REPORT HOLDER:

ITW RAMSET

700 HIGH GROVE BOULEVARD
GLENDALE HEIGHTS, ILLINOIS 60139

EVALUATION SUBJECT:

RAMSET PLYWOOD FASTENERS FOR PLYWOOD PANEL SHEAR WALLS AND DIAPHRAGMS ATTACHED TO STEEL FRAMING

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Legacy report on the 1997 *Uniform Building Code*™

DIVISION: 05 00 00—METALS
Section: 05 05 23—Metal Fastenings

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 23—Wood, Plastic, and Composite Fastenings

RAMSET PLYWOOD FASTENERS FOR PLYWOOD PANEL SHEAR WALLS AND DIAPHRAGMS ATTACHED TO STEEL FRAMING

ITW RAMSET
700 HIGH GROVE BOULEVARD
GLENDALE HEIGHTS, ILLINOIS 60139

1.0 SUBJECT

Ramset Plywood Fasteners for Plywood Panel Shear Walls and Diaphragms Attached to Steel Framing.

2.0 DESCRIPTION

2.1 General:

Ramset Plywood fasteners are pneumatically or gas power driven fasteners used to attach plywood structural panels to light-gage steel framing for shear wall and horizontal diaphragm applications. Fasteners are limited to locations not exposed to the weather or damp environments.

2.2 Materials:

2.2.1 Ramset Plywood Fasteners: The fasteners are manufactured from AISI C 1030 steel, heat-treated to a Rockwell C hardness of 45 to 50, or AISI C 1060 steel, heat-treated to a Rockwell C hardness of 44 to 48. Minimum tensile strength is 210 ksi (1,447 MPa). The fasteners have a tapered helical point and annular threading on the shank. The fasteners have a shank diameter of 0.120 inch (3 mm) and are available with a length of either 1.5 or 1.75 inches (38.1 or 44.5 mm). The fastener head is either a 0.275-inch-diameter (6.9 mm) flat head or 0.312-inch-diameter (7.9 mm) bugle head. Fasteners with a flat head are zinc-plated with a chromate finish, and fasteners with a bugle head have a cathodic-epoxy electro-coating over a electro plated zinc coating.

2.2.2 Plywood Sheathing: Plywood panels must comply with UBC Standard 23-2, and be capable of supporting vertical loads in accordance with the panel span rating shown in the code. Plywood panels used for walls must have span ratings appropriate for the spacing of the wall framing.

2.2.3 Steel Framing: In this report, gage numbers for steel framing members refer to the following minimum base-metal thicknesses:

No. 14 gage : 0.0747 inch (1.9 mm)
No. 16 gage : 0.0598 inch (1.5 mm)
No. 18 gage : 0.0478 inch (1.2 mm)
No. 20 gage : 0.0359 inch (0.9 mm)
No. 22 gage : 0.0299 inch (0.8 mm)

Steel studs for shear walls must be C-shaped, with a minimum depth of $3^5/_8$ inches (92 mm) and a minimum flange width of $1^5/_8$ inches (41 mm), except No. 22 gage studs have a minimum flange width of $1^1/_4$ inches (32 mm). Steel studs must have a minimum yield strength of 33 ksi (228 kPa) and a minimum tensile strength of 52 ksi (359 kPa).

Steel joists for diaphragms must comply with the code and must be suitable for the direct support of floors and roof decks. The Ramset Plywood fasteners are limited for use with diaphragms framed with cold-formed framing members complying with Division VII, Chapter 22, of the 1997 *Uniform Building Code*™ (UBC). Recognition of the fasteners for use with heavier steel, common to open-web steel joists referenced in Section 3, Division IX, Chapter 22, of the UBC, is beyond the scope of this report.

2.3 Design:

2.3.1 General: Allowable pull-out and lateral loads for the Buildex fasteners attaching wood-based structural sheathing to light-gage steel framing members are specified in Table 1.

2.3.2 Shear Walls:

2.3.2.1 Wind Resistance: Allowable shear for shear walls using Buildex fasteners to attach wood-based structural panels to light-gage studs is shown in Table 3 for wind forces. Maximum shear-wall height-to-width is $3^1/_2$:1 for panels fastened along all edges, and 2:1 where blocking is omitted at intermediate joints. The deflection of blocked panel shear walls uniformly fastened throughout is calculated by use of the following formula:

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_n + d_a$$

For **SI:**

$$\Delta = \frac{2000vh^3}{3EAb} + \frac{vh}{Gt} + 2.46he_n + d_a$$

where:

A = Area of boundary element cross section (vertical member at shear wall boundary), square inches (mm^2).

b = Wall width, feet (mm).

d_a = Deflection due to anchorage details (rotation and slip at tie-down bolts).

E = Elastic modulus of boundary element (vertical member at shear wall boundary), pounds per square inch (N/mm^2).

e_n = Fastener deformation, inches (mm). (See Table 2.)

G = Modulus of rigidity of plywood, pounds per square inch (N/mm^2). (See Table 23-2-J of UBC Standard 23-2.)

h = Wall height, feet (mm).

t = Effective thickness of plywood sheathing for shear, inches (mm). (See Tables 23-2-H and 23-2-I of UBC Standard 23-2.)

v = Maximum shear due to design loads at the top of the wall, pounds per lineal foot (N/mm).

Δ = The calculated deflection, inches (mm).

2.3.2.2 Seismic Resistance: Shear walls are constructed as follows:

1. Sheathing: Sheathing is Structural 1 plywood complying with UBC Standard 23-2, with the long dimension parallel to stud framing, and is nominally $^{15}/_{32}$ inch thick, or thicker. All panel edges must be fully blocked.
2. Framing: Studs must have minimum dimensions of $1^{5}/_{8}$ inches (41 mm) by $3^{1}/_{2}$ inches (89 mm), with a $^{3}/_{8}$-inch (9.5 mm) return lip. Track must have minimum dimensions of $1^{1}/_{4}$ inches (32 mm) by $3^{1}/_{2}$ inches (89 mm). Both studs and track must have a minimum uncoated base-metal thickness of 0.033 inch (0.084 mm), must not have a base-metal thickness greater than 0.0747 inch (1.90 mm), and must be ASTM A 653, SS, Grade 33. Stud spacing is a maximum of 24 inches (610 mm). Doubled studs are required at vertical edges of sheathing panels.
3. Fasteners: Framing screws must be No. 8 by $^{5}/_{8}$-inch (16 mm), wafer-head self-drilling screws. Sheathing fasteners are Buildex fasteners, spaced 2 inches (51 mm) on center around all plywood edges. Fasteners in the field of the panel must be installed at 12 inches (305 mm) on center. Edge distance is $^{3}/_{8}$ inch (9.5 mm) for plywood and framing.

Additional design and wall construction requirements are in Section 2219 of the UBC. In addition, supplemental requirements in Section 2220 of the UBC apply to shear walls located in Seismic Zone 3 or 4.

The nominal shear strength of the wall is 780 pounds per foot. Design shear values are determined in accordance with Section 2219.3 of the UBC. The maximum inelastic response displacement is $^{3}/_{4}$ inch (19.1 mm). The design level response displacement is determined in accordance with Section 2.3.2.1.

2.3.3 Diaphragms: Allowable shear for wind or seismic forces is shown in Table 4 for diaphragms using Ramset Plywood fasteners to attach plywood structural sheathing to steel framing members. The maximum span-to-width ratio of the diaphragm is 4:1. The deflection of blocked panel diaphragms uniformly fastened throughout is calculated by use of the following formula:

$$\Delta = \frac{5vL^3}{8EAb} + \frac{vL}{4Gt} + 0.188Le_n + \frac{\Sigma(\Delta_c X)}{2b}$$

For **SI:**

$$\Delta = \frac{52vL^3}{EAb} + \frac{vL}{4Gt} + 0.614Le_n + \frac{\Sigma(\Delta_c X)}{2b}$$

where:

A = Area of chord cross section, square inches (mm^2).

b = Diaphragm width, feet (mm).

E = Elastic modulus of chords, pounds per square inch (N/mm^2).

e_n = Fastener deformation, inches (mm). See Table 2.

G = Modulus of rigidity of sheathing, pounds per square inch (N/mm^2). (See Table 23-2-J of UBC Standard 23-2 for values of G.)

L = *Diaphragm length, feet (mm).*

t = Effective thickness of wood-based sheathing for shear, inches (mm). (See Tables 23-2-H and 23-2-I of UBC Standard 23-2 for values of t for plywood).

v = Maximum shear due to design loads in the direction under consideration, pounds per lineal foot (N/mm).

Δ = Calculated deflection, inches (mm).

$\Sigma(\Delta_c X)$ = Sum of individual chord-splice slip values on both sides of the diaphragm, each multiplied by its distance from the nearest support.

2.4 Installation:

Fasteners are installed using pneumatic or gas powered tools recommended by ITW Ramset. Installation must be in accordance with this report and the published manufacturer's installation instructions. The fasteners are installed in such a manner that they pierce the wood-based panels being fastened and the knurl of the fastener protrudes through the steel framing members a minimum of $^{1}/_{4}$ inch (6.4 mm). The fasteners must be installed with the heads flush to the panel surface. If overdriving occurs, no more than 20 percent of the fasteners are permitted to be overdriven more than $^{1}/_{16}$ inch (1.6 mm).

2.5 Identification:

The Ramset Plywood fasteners are identified on the carton by the manufacturer's name and product name, and identified on the head of each fastener by one of the following logos:

Bugle Head

Ramset

3.0 EVIDENCE SUBMITTED

Reports of shear wall tests, cyclic tests, and individual fastener pull-out and pull-through tests; and descriptive literature.

4.0 FINDINGS

That the Ramset Plywood fasteners described in this report, comply with the 1997 *Uniform Building Code*™, subject to the following conditions:

4.1 Fasteners are manufactured, identified and installed in accordance with this report.

4.2 Individual fastener allowable values for attachment of wood-based panels to light-gage steel are limited to the values noted in Table 1.

4.3 Allowable shear values for shear walls intended to resist wind loads and horizontal diaphragms are limited to the values noted in Tables 3 and 4.

4.4 Shear walls intended to resist seismic forces comply with Section 2.3.2.2.

4.5 Limitations based on deflections of shear walls and horizontal diaphragms must be considered in design.

This report is subject to re-examination in one year.

TABLE 1—ALLOWABLE WITHDRAWAL AND LATERAL LOADS FOR A RAMSET PLYWOOD FASTENER USED TO ATTACH STRUCTURAL PLYWOOD PANELS TO STEEL FRAMING MEMBERS[1,2,3]

MINIMUM STEEL THICKNESS (gage)[4]	MINIMUM THICKNESS OF STRUCTURAL PANELS				MINIMUM THICKNESS OF STRUCTURAL PANELS			
	$^{3}/_{8}$ inch	$^{15}/_{32}$ inch	$^{19}/_{32}$ inch	$^{23}/_{32}$ inch	$^{3}/_{8}$ inch	$^{15}/_{32}$ inch	$^{19}/_{32}$ inch	$^{23}/_{32}$ inch
	Withdrawal Loads (pounds)				Lateral Loads (pounds)			
14	90	90	95	120	135	160	190	215
16	90	90	90	110	135	160	165	185
18	90	90	90	90	135	160	160	160
20	70	70	70	70	110	130	130	130
22	50	50	50	50	110	110	110	110

For **SI:** 1 inch = 25.4 mm, 1 pound = 4.448 N.

[1]Tabulated values are for loads due to wind or earthquake, and must be reduced by 25 percent for other applications.
[2]Tabulated values allow for no more than 20 percent of the fasteners to be overdriven more than $^{1}/_{16}$ inch.
[3]Minimum edge distance and spacing are $^{3}/_{8}$ inch and 3 inches, respectively.
[4]Section 2.2.3 describes minimum base-metal thicknesses associated with gages.

TABLE 2—e_n VALUES[1,2,3]

GAGE OF STRUCTURAL STEEL MEMBER	MAXIMUM LOAD (lb./fastener)	e_n
14	235	0.031
16	180	0.021
18	125	0.016
20	80	0.031
22	135	0.031

For **SI:** 1 pound = 4.448 N.

[1]These load values include a one-third increase for short-term loading and must not be exceeded. The maximum load per fastener must not be exceeded. Lower values may be used with the en values noted in the table.
[2]The load per fastener is determined by dividing the shear per foot by the number of fasteners per foot.
[3]Section 2.2.3 describes minimum base-metal thicknesses associated with gages.

TABLE 3—ALLOWABLE SHEAR FOR WIND FORCES FOR STRUCTURAL PLYWOOD SHEAR WALLS ATTACHED TO LIGHT GAGE STEEL STUDS WITH RAMSET PLYWOOD FASTENERS[1,2,3] (pounds per foot)

PANEL TYPE	MINIMUM PANEL THICKNESS (inch)	FRAMING		FASTENER SPACING[4,5] (inches on center)			
		Minimum Gage[6]	Spacing (inches on center)	6	4	3	2
Structural I or Rated Sheathing and Siding	$^{3}/_{8}$	22	16	180	270	360	459
	$^{3}/_{8}$		24	144	216	288	367
	$^{15}/_{32}$		16 or 24	170	255	340	433
	$^{3}/_{8}$	20	16	180	270	360	459
	$^{3}/_{8}$		24	144	216	288	367
	$^{15}/_{32}$		16 or 24	208	313	417	531
	$^{3}/_{8}$	18	16	214	321	428	546
	$^{3}/_{8}$		24	171	257	342	437
	$^{15}/_{32}$		16 or 24	253	380	506	645
	$^{19}/_{32}$		16 or 24	259	389	518	661
	$^{23}/_{32}$		16 or 24	259	389	518	661
	$^{19}/_{32}$	16	16 or 24	266	399	532	679
	$^{23}/_{32}$		16 or 24	296	445	593	756
	$^{19}/_{32}$	14	16 or 24	304	456	608	776
	$^{23}/_{32}$		16 or 24	345	517	690	879

For **SI:** 1 inch = 25.4 mm, 1 pound/linear foot = 0.0146 N/mm.

TABLE 3—ALLOWABLE SHEAR FOR WIND FORCES FOR STRUCTURAL PLYWOOD SHEAR WALLS ATTACHED TO LIGHT GAGE STEEL STUDS WITH RAMSET PLYWOOD FASTENERS[1,2,3] (pounds per foot) (Continued)

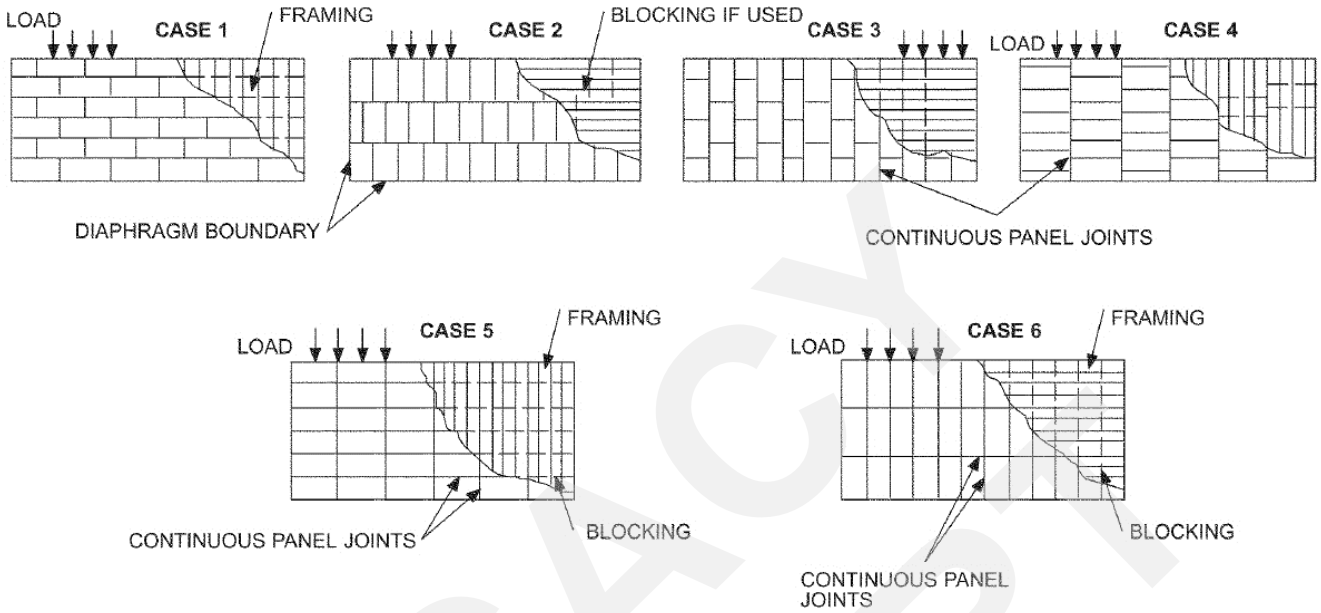
[1]These values are for short-term loads due to wind and must be reduced 25 percent for normal loading. See Table 1.
[2]The pin must be long enough to penetrate through the metal framing a minimum of $^{1}/_{4}$ inch.
[3]Tabulated values allow for a maximum of 20 percent of the fasteners to be overdriven more than $^{1}/_{16}$ inch.
[4]All panel edges must be blocked with minimum nominal 2-inch framing. Panels are permitted to be installed either horizontally or vertically. Fasteners must be spaced a maximum of 6 inches on center along intermediate framing members for $^{3}/_{8}$-inch-thick panels installed on framing spaced 24 inches on center, and 12 inches on center for framing 16 inches on center or thicker panels.
[5]Tabulated values are for structural plywood panels applied to one side of a wall. Values cannot be increased for panels attached to both sides of a wall.
[6]Section 2.2.3 describes minimum base-metal thicknesses associated with gages.

TABLE 4—ALLOWABLE SHEAR FOR WIND OR SEISMIC FORCES FOR STRUCTURAL PLYWOOD HORIZONTAL DIAPHRAGMS SUPPORTED BY LIGHT-GAGE STEEL FRAMING ATTACHED WITH RAMSET PLYWOOD FASTENERS[1] (pounds per foot)

SHEATHING PANEL	MINIMUM PANEL THICKNESS (inch)	SUPPORTING STEEL MEMBER FLANGE DIMENSIONS		BLOCKED DIAPHRAGMS				UNBLOCKED DIAPHRAGMS	
		Width (inches)	Minimum Gage[6]	Fastener Spacing at Diaphragm Boundaries (all cases), at Continuous Panel Edges Parallel to Load (Cases 3 and 4) and at All Panel Edges (Cases 5 and 6)[2,3,4,5]				Nails Spaced 6 Inches Maximum at Supported Edges	
				6	4	$2^{1}/_{2}$	2	Case 1 (no unblocked edges or continuous joints to load)	All Other Cases (Cases 2 through 6)
				Fastener Spacing at Other Panel Edges					
				6	6	4	3		
Structural I or Rated sheathing	$^{3}/_{8}$	1.5	22	202	270	405	459	180	135
	$^{3}/_{8}$	2.5		227	303	455	515	202	152
	$^{15}/_{32}$	1.5		191	255	382	433	170	127
	$^{15}/_{32}$	2.5		215	286	430	487	191	143
	$^{3}/_{8}$	1.5	20	202	270	405	459	180	135
	$^{3}/_{8}$	2.5		227	303	455	515	202	152
	$^{15}/_{32}$	1.5		234	313	469	531	208	156
	$^{15}/_{32}$	2.5		263	351	527	597	234	176
	$^{3}/_{8}$	1.5	18	241	321	481	546	214	160
	$^{3}/_{8}$	2.5		270	361	541	613	240	180
	$^{15}/_{32}$	1.5		285	380	569	645	253	190
	$^{15}/_{32}$	2.5		320	426	640	725	284	213
	$^{19}/_{32}$	1.5		292	389	583	661	259	194
	$^{19}/_{32}$	2.5		328	437	655	743	291	218
	$^{23}/_{32}$	1.5		292	389	583	661	259	194
	$^{23}/_{32}$	2.5		328	437	655	743	291	218
Structural I or Rated sheathing	$^{19}/_{32}$	1.5	16	300	399	599	679	266	200
	$^{19}/_{32}$	2.5		337	449	673	763	299	224
	$^{23}/_{32}$	1.5		333	445	667	756	296	222
	$^{19}/_{32}$	2.5		375	500	749	849	333	250
	$^{19}/_{32}$	1.5	14	342	456	685	776	304	228
	$^{19}/_{32}$	2.5		385	513	769	872	342	256
	$^{23}/_{32}$	1.5		388	517	776	879	345	259
	$^{19}/_{32}$	2.5		436	581	872	988	388	291

For **SI:** 1 inch = 25.4 mm, 1 pound/linear foot = 0.0146 N/mm.

[1]These values are for short-term loads due to wind or earthquake, and must be reduced 25 percent for normal loading.
[2]The pin must be long enough to penetrate through the metal framing a minimum of $^{1}/_{4}$ inch.
[3]Fasteners are spaced a maximum of 12 inches on center along intermediate framing members.
[4]Tabulated values allow for a maximum of 20 percent of the fasteners to be overdriven more than $^{1}/_{16}$ inch.
[5]Framing is permitted to be oriented in either direction for diaphragms, provided sheathing is designed for vertical loads.
[6]Section 2.2.3 describes minimum base-metal thicknesses associated with gages.



NOTE: Framing may be oriented in either direction for diaphragms provided sheathing is properly designed for vertical loading.