Technical Bulletin

How to Read ICC-ES Evaluation Service® ESR-1539P©
Part V Framing Tables

Preface:

This is the fifth in a series of technical bulletins designed to provide a greater understanding of the ICC Evaluation Service® evaluation report ESR-1539P© providing information in Tables 11 - 14 dealing with framing connections referenced in the codes.

The driven fasteners (nails and staples) described in the evaluation report are used in engineered and non-engineered (prescriptive) structural connections and are primarily installed using power tools. This technical bulletin references **ESR-1539P© Revised Date 10/2024.**
http://www.icc-es.org/Reports/pdf_files/ESR-1539P.pdf

Background:

The first technical bulletin in this series, Terminology Used In ICC Evaluation Service Report ESR-1539P©, provides a brief description of several technical and administrative terms used.

Part I: Basic ESR Information covers the first four pages of ESR-1539P© and provides information on the document format, subject matter and product descriptions.

Part II: Fastener Basics and Table 1-3 covers the Table of Contents, fastener basics, applicable codes and information on the reference lateral design value of nails in some of the common species of wood used in building construction.

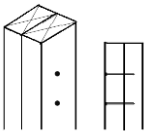
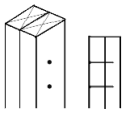
Part III: Fastener Withdrawal & Diaphragm Allowable Shear Tables addresses values for nail and staple withdrawal for a variety of wood specific gravities and details on the allowable shear tables for wood structural products.

Part IV: Shear Wall Allowable Shear Tables provides information on shear walls made of wood structural products (plywood and OSB) and fiberboard sheathing, gypsum lath, and other materials.

Figure A (first page Table 11 of ESR-1539P©) is the fastening schedule for wood framing connections. As was noted in Bulletin Part I, the document is in compliance with the 2024, 2021, 2018, 2015 IBC® and IRC®.

Figure A has been divided into the fastening requirements prescribed:

3 TABLE 12—FASTENING SCHEDULE – WALL FRAMING

CONNECTION DESCRIPTION 1	MINIMUM FASTENING REQUIREMENTS PRESCRIBED IN THE CODE				ALTERNATIVE FASTENING REQUIREMENTS	
	2015 & 2018 IBC Table 2304.10.1 IRC Table R602.3(1)		2021 & 2024 IBC Table 2304.10.2 IRC Table R602.3(1) 2		All nails are carbon steel. (1)	
	#	Nail Size [Type (inch)]	#	Nail Size [Type (inch)]	#	Nail Size [Type (inch)]
Stud-to-stud (double studs) **not** at **braced walls** 	**IBC Connection 8**				**@ 24" o.c.**	
	@ 24" o.c.				1	16d com ($3^1/_2$ x .162)
	1	16d com ($3^1/_2$ x .162)			**@ 16" o.c.**	
	@ 16" o.c.				1	12d com ($3^1/_4$ x .148)
6	1	3 x .131			1	10d com (3 x .148)
	1	10d box (3 x .128)			1	16d box ($3^1/_2$ x .135)
	IRC Connection 8 4				1	$3^1/_4$ x .131
	@ 24" o.c.				1	3 x .131
	1	16d com ($3^1/_2$ x .162)			**@ 8" o.c.**	
	@ 16" o.c.				1	8d com ($2^1/_2$ x .131)
	1	3 x .131			1	$3^1/_4$ x .120
					1	3 x .120
Stud-to-stud and abutting studs at intersecting wall corners at **braced walls** 	**IBC Connection 9** 4					
	@ 16" o.c.				**@ 16" o.c.**	
	1	16d com ($3^1/_2$ x .162)			1	16d com ($3^1/_2$ x .162)
	@ 12" o.c.				**@ 12" o.c.**	
	1	16d box ($3^1/_2$ x .135)			1	12d com ($3^1/_4$ x .148)
	1	3 x .131			1	10d com (3 x .148)
	IRC Connection 9				1	16d box ($3^1/_2$ x .135)
	@ 16" o.c.				1	$3^1/_4$ x .120
	1	16d com ($3^1/_2$ x .162)			1	3 x .131
	@ 12" o.c. 5				**@ 8" o.c.**	
	1	16d box ($3^1/_2$ x .135)			1	$3^1/_4$ x .120
	1	3 x .131			1	3 x .120

(Annotation and truncation in size of Table 12 is for clarity of example)

1 In the 2024, 2021, 2018 and 2015 IBC® & IRC ®

2 By table number per each code

3 Wall, ceiling/roof and floor family of connections

4 Connection Number in the referenced code

These connection numbers are separated by code year and connection number within each family of connections.

Within each code, fasteners are prescribed either by:

5 The on-center spacing required for the connection

6 The number of fasteners per connection

Unique to this table is a listing of alternatives to the code-prescribed fasteners for various framing connections. ISANTA members provide a number of different nail diameters and lengths to the market. When reviewing ESR-1539P© Tables 12-14, it is the responsibility of the user to determine if the listed number of nails can be driven into a particular connection. Consideration must be made with regards to size of the power nailer (will it fit into the confines of the area being nailed?), framing member sizes, potential for wood splitting, over crowding of nails, etc.

How are the quantities of nails in the Alternative Fastening Requirements column determined?

In the example shown in Figure C (Table 12 of ESR-1539P© on the next page) [Stud to top or bottom plate, toe nail), the lateral design value (Z) is calculated for each prescribed nail in each of the codes.

The caluclated values of Z for each nail are listed below in Figure B.

2018 & 2015 IBC®

Quanity	Nail Size	Z
4	2½ x .131	388
4	3 x .131	388
4	3 x .128	371

2024, 2021 IBC® 2024, 2021, 2018 & 2015 IRC©

Quanity	Nail Size	Z
3	3½ x .135	309
4	2½ x .131	388
4	3 x .131	388
4	3 x .128	371
4	2½ x .113	289

Figure B

1

2

The prescribed nail combination that provides the **lowest** value of (Z') is identified for each of the eight codes.

Of these values, the **largest** value of Z is established as the target value of Z for the connection. In this example: [4] 3 x 0.128 inch nails from the 2018 & 2015 IBC®.

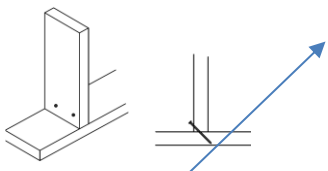
Combinations for the multiple nail sizes listed in ESR-1539P were evaluated and compared to this target. The Z value of these other nail combinations MUST be equal to or greater than the target, Z=371 in this example.

This can result in a nail that is prescribed in one code with a lower quantity of nails to be listed with a higher quantity of nails in the alternative fastening columns.

Example:
Target Z = 371
[3] 3½ x 0.135 Z= 309 less than target Z
but
[4] 3½ x 0.135 Z= 413 exceeds target Z

Items listed in the Alternative Fastening Requirements column meet or exceed the minimum requirements of all the codes 2015, 2018, 2021 and 2024 IBC® and IRC®.

TABLE 12—FASTENING SCHEDULE – WALL FRAMING (cont.)

CONNECTION DESCRIPTION	MINIMUM FASTENING REQUIREMENTS PRESCRIBED IN THE CODE				ALTERNATIVE FASTENING REQUIREMENTS	
	2015 & 2018 IBC Table 2304.10.1 IRC Table R602.3(1)		2021 & 2024 IBC Table 2304.10.2 IRC Table R602.3(1)		All nails are carbon steel. (1)	
	#	Nail Size [Type (inch)]	#	Nail Size [Type (inch)]	#	Nail Size [Type (inch)]
Stud to top or bottom plate (toe nail) 	IBC Connection 16a		IBC Connection 16a		3	16d com (3½ x .162)
	4	8d com (2½ x .131)	3	16d box (3½ x .135)	4	12d com (3¼ x .148)
	4	3 x .131	4	8d com (2½ x .131)	4	10d com (3 x .148)
	4	10d box (3 x .128)	4	3 x .131	4	16d box (3½ x .135)
			4	10d box (3 x .128)	4	3¼ x .131
			4	8d box (2½ x .113)	4	3 x .131
	IRC Connection 16a		IRC Connection 17a		4	8d com (2½ x .131)
	3	16d box (3½ x .135)			5	3¼ x .120
	4	8d com (2½ x .131)			5	3 x .120
	4	3 x .131			6	8d box (2½ x .113)
	4	10d box (3 x .128)			6	2⅜ x .113
	4	8d box (2½ x .113)			6	6d com (2 x .113)

Annotation and truncated size for clarity of example

1

2

TABLE 15—SUMMARY OF ALTERNATIVE FASTENING DESIGNS DESCRIBED IN TABLES 12 THROUGH 14[1,2,3,4]

CONNECTION		NAIL SIZE (DIAMETER X LENGTH) (inches)												
		3½ x 0.162	3¼ x 0.148	3 x 0.148	3½ x 0.135	3¼ x 0.131	3 x 0.131	2½ x 0.131	3¼ x 0.120	3 x 0.120	2½ x 0.113	2⅜ x 0.113	2 x 0.113	2¼ x 0.099
Wall Framing														
Double studs (face nail)	Typical	24" o.c.	16" o.c.	16" o.c.	16" o.c.	16" o.c.	16" o.c.	8" o.c.	8" o.c.	8" o.c.				
	At braced walls	16" o.c.	12" o.c.	12" o.c.	12" o.c.	12" o.c.	12" o.c.		8" o.c.	8" o.c.				
Abutting studs at corners and intersections	Typical	12" o.c.	12" o.c.	12" o.c.	12" o.c.	8" o.c.	8" o.c.	8" o.c.	8" o.c.	8" o.c.				
	At braced walls	12" o.c.	12" o.c.	12" o.c.	12" o.c.	12" o.c.	12" o.c.		8" o.c.	8" o.c.				
Built up header 2" to 2" w/ ½" spacer		12" o.c.	8" o.c.	8" o.c.	12" o.c.	8" o.c.	8" o.c.		8" o.c.	8" o.c.				
Continuous header to stud (toe nail)		3	4	4	4	4	4	4	5	5	6	6		
Adjacent full-height stud to end of header (end-nail)		3	4	4	4	4	4		5	5				
Double top plates to each other (face nail)		16" o.c.	12" o.c.	12" o.c.	12" o.c.	12" o.c.	12" o.c.	8" o.c.	8" o.c.	8" o.c.				
Top plate to top plate at end joint (lap splice) (each side of joint)		8	12	12	12	12	12							
For 2015 IRC Connection 13b		10	12	12	12									
Top plate overlap at corners and intersections (face nail)		2	3	3	3	3	3		4	4				
Sole plate to joist or blocking **not** at braced wall panels		16" o.c.	12" o.c.	12" o.c.	12" o.c.	12" o.c.	12" o.c.		8" o.c.	8" o.c.				
Sole Plate to joist or blocking **at braced wall panel**		2 @ 16" o.c.	3 @ 16" o.c.	3 @ 16" o.c.	3 @ 16" o.c.	4 @ 16" o.c.	4 @ 16" o.c.		4 @ 16" o.c.	5 @ 16" o.c.				
Top or sole plate to stud (end nail)		2	3	3	3	3	3	4	4	4				
Stud to top or sole plate (toe-nail)		3	4	4	4	4	4	4	5	5	6	6	6	
Diagonal bracing to stud/plate		2	2	2	2	2	2	2	3	3	3	3		4
Ceiling and Roof Framing														
Blocking between joists or Rafter to Top Plate (toe-nail) (each end)		2	3	3	3	3	3	3	4	4	4			
Blocking between rafters or truss, not at wall top plate (toe-nail)		2	2	2	2	2	2	2						
Blocking between rafter or truss, not at wall top plate (end nail)		2	3	3	3	3	3		4	4				
Flat blocking to truss and web filler – face nail		1 @ 6" o.c.	1 @ 6" o.c.	1 @ 6" o.c.	1 @ 6" o.c.	1 @ 6" o.c.	1 @ 6" o.c.							
Ceiling joist to plate[5]		2	3	3	3	3	3	3	4	4	4	4	5	
Ceiling joists laps over partitions (no thrust)		3	4	4	4	4	4		5	5				
Collar tie to rafter		3	3	3	4	4	4	5	5	5	6			
Roof rafter to plate (toe-nail) (+ connectors per IBC)		3	3	3	3	4	4	4	4	4				
Roof rafter to 2-by ridge beam (end-nail rafter to beam)		2	3	3	3	3	3		4	4				
Roof rafter to 2-by ridge beam (toe-nail rafter to beam)		3	3	3	4	4	4	4	5	5	5	5	5	
Jack rafter to hip (toe-nail)		3	3	3	4	4	4	4						
Jack rafter to hip (end nail)		2	3	3	3									
Floor Framing														
Joist to sill or girder (toe-nail)		2	3	3	3	3	3	3	4	4	4	4	5	
Rim joist to top plate(Toe-nail)		6" o.c.	6" o.c.	6" o.c.	6" o.c.	6" o.c.	6" o.c.	6" o.c.	4" o.c.	4" o.c.	4" o.c.	4" o.c.	3" o.c.	3" o.c.
Joist to band Joist (face nail)		3	4	4	4	4	4		5	5				
Built-up girders & beams Face-nail @ top and bottom		24" o.c.	24" o.c.	24" o.c.	24" o.c.	24" o.c.	24" o.c.		16" o.c.	16" o.c.				
PLUS # at ends or splice		3	3	3	3	3	3		3	4				
Ledger Strip		3	4	4	4	4	4	5	5	5				
Bridging to Joist (toe-nail)		2	2	2	2	2	2	2	3	3	3	3	3	4

Figure E Table 15 Annotation of Table 14 is for clarity of example

Referenced Documents:

ANSI/AWC NDS-2018 National Design Specification for Wood © American Wood Council 2017

ANSI/AWC SDPWS – 2021 Special Design Provisions for Wind and Seismic© American Wood Council 2020

ASTM F1667/F1667M-21a Standard Specifications for Driven Fasteners: Nails, Spikes and Staples
© ASTM International February 2021

2021, 2018, 2015, 2012 International Building Code (IBC) ®© International Code Council Inc. ®

2021, 2018, 2015, 2012 International Residential Code (IRC) ®© International Code Council Inc. ®

AC116 ICC-ES Acceptance Criteria for Nails
© ICC Evaluation Service (ICC-ES) ® March 2021

AC201 ICC-ES Acceptance Criteria for Staples
© ICC Evaluation Service (ICC-ES) ® December 2020

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