

How to Read ICC-ES Evaluation Service® ESR-1539® 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-1539® providing information on Tables 10 and 11 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-1539® Revised Date 05/2018**.

http://www.icc-es.org/Reports/pdf_files/ESR-1539.pdf

Background:

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

Part I: Basic ESR Information covers the first four pages of ESR-1539® 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 10 of ESR-1539®) is the fastening schedule for wood framing connections. As was noted in Bulletin Part I, the document is in compliance with the 2018, 2015, 2012, 2009 IBC® and IRC®. The 2015 codes saw a number of changes made through additional connections and some harmonization between the IBC® and the IRC® with regards to the prescribed fasteners.

Figure A has been divided into the fastening requirements prescribed:

- 1 In the 2012 IBC® & IRC®, and the 2018 & 2015 IBC® & IRC®
- 2 By table number per each code
- 3 Wall, ceiling/roof and floor family of connections
- 4 Connection Number in the reference code

These connection numbers are sorted (with a few exceptions) by the 2018 / 2015 IRC® 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

In previous editions of ESR-1539, the single framing table that made up the fastening schedule for Wall, Ceiling/Roofing and Floors was divided into 3 separate table (10-12). The framing sketches previously include with the tables were move to separate figures (10-12) for resolution and sketch accuracy.

TABLE 10—FASTENING SCHEDULE – WALL FRAMING¹

CONNECTION DESCRIPTION	MINIMUM FASTENING REQUIREMENTS PRESCRIBED IN THE CODE								ALTERNATIVE FASTENING REQUIREMENTS Nails may be carbon steel or stainless, except where noted otherwise.							
	2012 IBC		2012 IRC		2018 & 2015 IBC		2018 & 2015 IRC									
	Table 2304.9.1		Table R602.3(1)		Table 2304.10.1		Table R602.3(1)									
#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	
Top plate to top plate @ end joint (lap splice) See Figure 10F	Connection 10b		Connection 14		Connection 13		Connection 13 13a for the 2015 IRC									
	Nails each side of joint								Nails each side of joint							
	8	16d com (3 1/2 x .162)	8	16d box (3 1/2 x .135)	8	16d com (3 1/2 x .162)	8	16d com (3 1/2 x .162)	8	16d com (3 1/2 x .162)	12	16d box (3 1/2 x .135)				
	12	3 x .131			12	3 x .131	12	16d box (3 1/2 x .135)	12	12d com (3 1/4 x .148)	12	3 1/4 x .131				
					12	10d box (3 x .128)	12	3 x .131	12	10d com (3 x .148)	12	3 x .131				
Top plate overlap at corners and intersections See Figure 10G	Connection 13		Connection 19		Connection 18		Connection 17									
	1	16d com (3 1/2 x .162)	2	10d box (3 x .128)	2	16d com (3 1/2 x .162)	2	16d com (3 1/2 x .162)	2	16d com (3 1/2 x .162)	3	3/4 x 0.131				
	1	3 x .131			3	3 x .131	3	3 x .131	3	12d com (3 1/4 x .148)	3	3 x 0.131				
					3	10d box (3 x .128)	3	10d box (3 x .128)	3	10d com (3 x .148)	4	3/4 x 0.120				
							3	16d box (3 1/2 x .135)	4	3 x 0.120						
Bottom plate to joist, rim joist, band joist or blocking not at braced wall See Figure 10H	Connection 6a		Connection 15		Connection 14		Connection 14									
	@ 16" o.c.		@ 16" o.c.		@ 16" o.c.		@ 16" o.c.		@ 16" o.c.		@ 12" o.c. (cont)		@ 8" o.c.			
	1	16d box (3 1/2 x .135)	1	16d box (3 1/2 x .135)	1	16d com (3 1/2 x .162)	1	16d com (3 1/2 x .162)	1	16d com (3 1/2 x .162)	1	12d com (3 1/4 x .148)	1	3 1/4 x .120		
	@ 8" o.c.				@ 12" o.c.		@ 12" o.c.		@ 12" o.c.							
	1	3 x .131			1	3 x .131	1	3 x .131			1	16d box (3 1/2 x .135)				
Bottom plate to joist, rim joist, band joist or blocking at braced wall See Figure 10H	Connection 6b		Connection 16		Connection 15		Connection 15									
	@ 16" o.c.		@ 16" o.c.		@ 16" o.c.		@ 16" o.c.		@ 16" o.c.		@ 16" o.c. (cont.)		@ 12" o.c.			
	3	16d box (3 1/2 x .135)	3	16d box (3 1/2 x .135)	2	16d com (3 1/2 x .162)	2	16d com (3 1/2 x .162)	3	12d com (3 1/4 x .148)	4	3 x .131	2	16d com (3 1/2 x .162)		
	4	3 x .131			3	16d box (3 1/2 x .135)	3	16d box (3 1/2 x .135)	3	10d com (3 x .148)	4	3 1/4 x .120				
					4	3 x .131	4	3 x .131	3	16d box (3 1/2 x .135)	5	3 x .120				
Top or bottom plate to stud (face/end nail) See Figure 10J	Connections 7 and 8b		Connection 18		Connections 17 (2015) and 16b		Connection 16b									
	2	16d com (3 1/2 x .162)	2	16d box (3 1/2 x .135)	2	16d com (3 1/2 x .162)	2	16d com (3 1/2 x .162)	3	16d com (3 1/2 x .162)	4	3 1/4 x .131	4	3 1/4 x .120		
	3	3 x .131			3	3 x .131	3	16d box (3 1/2 x .135)	3	12d com (3 1/4 x .148)	4	3 x .131	4	3 x .120		
					3	10d box (3 x .128)	3	3 x .131	3	10d com (3 x .148)	4	8d com (2 1/2 x .131)				
							3	10d box (3 x .128)	3	16d box (3 1/2 x .135)						
Stud to top or bottom plate (toe nail) See figure 10K	Connection 8		Connection 17		Connection 16a		Connection 16a									
	4	8d com (2 1/2 x .131)	3	8d box (2 1/2 x .113)	4	8d com (2 1/2 x .131)	3	16d box (3 1/2 x .135)	3	16d com (3 1/2 x .162)	4	3 1/4 x .131	5	3 1/4 x .120		
	4	3 x .131	2	16d box (3 1/2 x .135)	4	3 x .131	4	8d com (2 1/2 x .131)	4	12d com (3 1/4 x .148)	4	3 x .131	5	3 x .120		
					4	10d box (3 x .128)	4	3 x .131	4	10d com (3 x .148)	4	8d com (2 1/2 x .131)	6	8d box (2 1/2 x .113)		
							4	10d box (3 x .128)	4	16d box (3 1/2 x .135)			6	2 3/8 x .113		
1" Diagonal brace to stud/plate (face-nail) See Figure 10L	Connection 20		Connection 20		Connection 18 (19 for 2015 IBC)		Connection 18		Nails Must be carbon steel, bright or galvanized							
	2	8d com (2 1/2 x .131)	2	8d box (2 1/2 x .113)	2	8d com (2 1/2 x .131)	2	8d com (2 1/2 x .131)	2	16d com (3/4 x .162)	3	3/4 x .131	3	3/4 x .120		
	2	3 x .131			2	3 x .131	3	8d box (2 1/2 x .113)	2	12d com (3/4 x .148)	3	3 x .131	3	3 x .120		
					2	10d box (3 x .128)	2	10d box (3 x .128)	2	10d com (3 x .148)	3	8d com (2 1/2 x .131)	3	8d box (2 1/2 x .113)		
							2	16d box (3 1/2 x .135)							3	2 3/8 x .113
														4	2 1/4 x .099	

Figure A Table 10 From ESR-1539
(Annotation and truncation in size of Table 10 is for clarity of example)

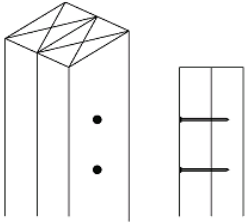
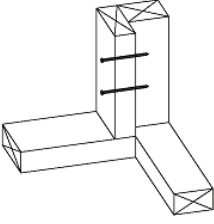
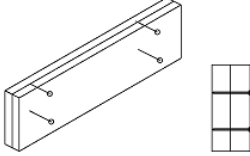
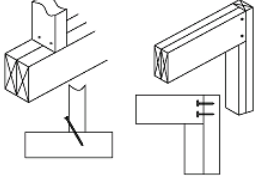
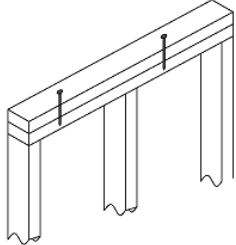
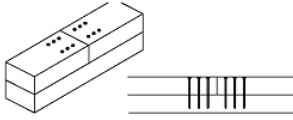
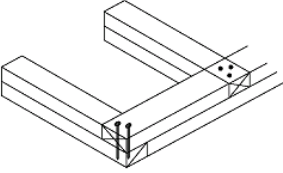
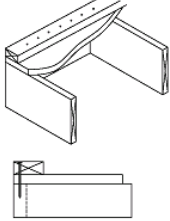
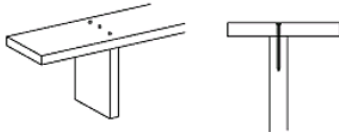
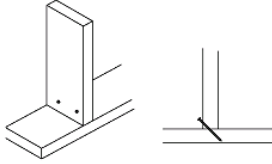
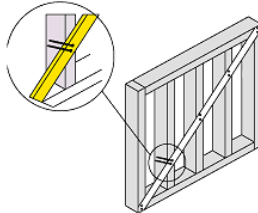
			
<p>Figure 10A – Stud to Stud (Double Stud)</p>	<p>Figure 10B Stud to Stud and Abutting Studs at Intersecting Wall Corners</p>	<p>Figure 10C- Built-up Header (2 by 2 by)</p>	<p>Figure 10D Continuous Header to Stud (toe-nail)</p>
			
<p>Figure 10E -Double Top Plate to Each Other</p>	<p>Figure 10F Top Plate to Top Plate at End Joint (lap splice)</p>	<p>Figure 10G Top Plate Overlap at Corners and Intersections</p>	<p>Figure 10H Bottom Plate to Joist, Rim Joist, Band Joist or Blocking</p>
			
<p>Figure 10J Top or Bottom Plate To Stud (end nail)</p>	<p>Figure 10K Stud to Top or Bottom Plate (toe-nail)</p>	<p>Figure 10L 1" Diagonal Bracing to Stud / Plate (face nail)</p>	

FIGURE 10 – PRESCRIPTIVE FASTENING DETAILS – WALL FRAMING

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-1539[®] Table 10, 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 10 of ESR-1539[®] on the next page) [Top of Sole (Bottom) Plate to Stud (end nail)], the lateral design value (Z) is calculated for each prescribed nail in each of the four codes.

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

2012 IBC[®]

Quantity	Nail Size	Z
2	3½ x 0.162	189
3	3 x 0.131	195

2012 IRC[®]

Quantity	Nail Size	Z
3	3½ x 0.135	207

2018 & 2015 IBC[®]

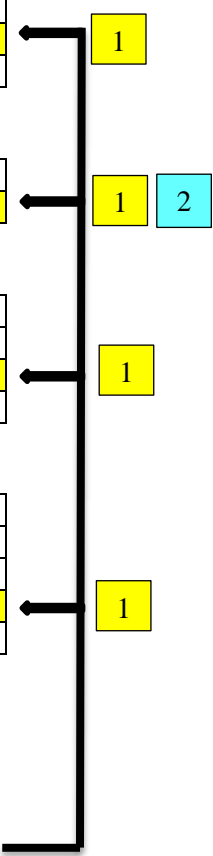
Quantity	Nail Size	Z
2	2 x 0.162	189
3	3 x 0.128	186
3	3 x 0.131	195

2018 & 2015 IRC[®]

Quantity	Nail Size	Z
2	3½ x 0.162	189
3	3 x 0.131	195
3	3 x 0.128	186
3	3½ x 0.135	207

Figure B

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



Of these four values, the **largest** value of Z is established as the target value of Z for the connection. In this example: [2] 16d box 3½ x 0.135 inch nails from the 2012 IRC[®].

2

Combinations for the multiple nail sizes listed in ESR-1539 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=207 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.

3

Target Z = 207
 [2] 3½ x 0.162 Z= 189 **less than target Z**
 [3] 3½ x 0.162 Z= 283 **exceeds target Z**

Items listed in the Alternative Fastening Requirements column meet or exceed the minimum requirements of all the codes, 2009, 2012 2015 and 2018 IBC[®] and IRC[®].

TABLE 10—FASTENING SCHEDULE – WALL FRAMING¹ (cont.)

CONNECTION DESCRIPTION	MINIMUM FASTENING REQUIREMENTS PRESCRIBED IN THE CODE								ALTERNATIVE FASTENING REQUIREMENTS					
	2012 IBC Table 2304.9.1		2012 IRC Table R602.3(1)		2018 & 2015 IBC Table 2304.10.1		2018 & 2015 IRC Table R602.3(1)							
	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)
Top or bottom plate to stud (end nail) See Figure 10J	Connections 7 and 8b		Connection 18		Connections 17 (2015) and 16b		Connection 16b							
	2	16d com (3 1/2 x .162)	2	16d box (3 1/2 x .135)	2	16d com (3 1/2 x .162)	2	16d com (3 1/2 x .162)	3	16d com (3 1/2 x .162)	4	3 1/4 x .131	4	3 1/4 x .120
	3	3 x .131			3	3 x .131	3	16d box (3 1/2 x .135)	3	12d com (3 1/4 x .148)	4	3 x .131	4	3 x .120
					3	10d box (3 x .128)	3	3 x .131	3	10d com (3 x .148)	4	8d com (2 1/2 x .131)		
Stud to top or bottom plate (toe nail) See figure 10K	Connection 8		Connection 17		Connection 16a		Connection 16a							
	4	8d com (2 1/2 x .131)	3	8d box (2 1/2 x .113)	4	8d com (2 1/2 x .131)	3	16d box (3 1/2 x .135)	3	16d com (3 1/2 x .162)	4	3 1/4 x .131	5	3 1/4 x .120
	4	3 x .131	2	16d box (3 1/2 x .135)	4	3 x .131	4	8d com (2 1/2 x .131)	4	12d com (3 1/4 x .148)	4	3 x .131	5	3 x .120
					4	10d box (3 x .128)	4	3 x .131	4	10d com (3 x .148)	4	8d com (2 1/2 x .131)	6	8d box (2 1/2 x .113)
							4	10d box (3 x .128)	4	16d box (3 1/2 x .135)			6	2 7/8 x .113
						4	8d box (2 1/2 x .113)					6	6d com (2 x .113)	
1" Diagonal brace to stud/plate (face-nail) See Figure 10L	Connection 20		Connection 20		Connection 18 (19 for 2015 IBC)		Connection 18							
	2	8d com (2 1/2 x .131)	2	8d box (2 1/2 x .113)	2	8d com (2 1/2 x .131)	2	8d com (2 1/2 x .131)	2	16d com (3 1/2 x .162)	3	3 1/4 x .131	3	3 1/4 x .120
	2	3 x .131			2	3 x .131	3	8d box (2 1/2 x .113)	2	12d com (3 1/4 x .148)	3	3 x .131	3	3 x .120
					2	10d box (3 x .128)	2	10d box (3 x .128)	2	10d com (3 x .148)	3	8d com (2 1/2 x .131)	3	8d box (2 1/2 x .113)
									2	16d box (3 1/2 x .135)			3	2 7/8 x .113
												4	2 1/4 x .099	

Figure C - Table 10 From ESR-1539
Annotation and truncated size of Table 10 is for clarity of example

What determines which value to use when there are multiple options for the same nail?

When a user of ESR-1539[®] is trying to determine how many nails of a certain size can be used there are two options.

- a. consult the code that the structure is being built to (e.g., 2012 IBC[®]) and choose a nail combination prescribed under that code
- b. consult the alternative fastening column and choose a nail combination

Example 1

Example 1: The structure is being built to the **2012 IBC[®]** and the preference would be to use 3 x 0.131 inch nails for a top plate to stud connection. After choosing the proper connection in ESR-1539[®] Table 10, the quantity is determined to be [3] nails for the

IBC connection and [4] nails in the alternative column. The choice would be [3] 3 x 0.131 inch nails in the 2012 IBC[®] column in this case. (See Figure D on next page)

Example 2

Example 2: A similar structure is being built to the **2015 IRC[®]** and the builder wishes to use 3¼ x 0.120 inch nails. This size nail is not prescribed in the 2015 IRC[®], thus the choice comes from the Alternative Fastener listing. In this case [4] 3¼ x 0.120 inch nails would be used in the connection.

What if the structure being built is under the requirements of an earlier code?

The user can either use a copy of the earlier code to look up the fastening requirements or can choose a combination listed in the Alternative Fastening Requirements Column. (See Figure D on next page)

Table 11-Summary of Alternative Fastening Designs Recognized in Table 10 through 12

Figure E (Table 13 in ESR-1539[®]) on page 7, provides a summary of the alternative fasteners listed in Table 10 of ESR-1539[®]. These values are acceptable for use in any of the I-Codes published between 2009-2018.

As with Tables 10-12, this table is separated into:

- 1 Wall, floor, roof/ceiling framing categories
- 2 Connection description
- 3 Nail size (diameter x length)
- 4 On-center spacing
- 5 Quantity per connection

TABLE 10—FASTENING SCHEDULE – WALL FRAMING¹ (cont.)

CONNECTION DESCRIPTION	MINIMUM FASTENING REQUIREMENTS PRESCRIBED IN THE CODE								ALTERNATIVE FASTENING REQUIREMENTS					
	2012 IBC Table 2304.9.1		2012 IRC Table R602.3(1)		2018 & 2015 IBC Table 2304.10.1		2018 & 2015 IRC Table R602.3(1)		#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)
	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)						
	Example 1				Example 2									
Top or bottom plate to stud (end nail) See Figure 10J	Connections 7 and 8b		Connection 18		Connections 17 (2015) and 16b		Connection 16b							
	2	16d com (3 ¹ / ₂ x .162)	2	16d box (3 ¹ / ₂ x .135)	2	16d com (3 ¹ / ₂ x .162)	2	16d com (3 ¹ / ₂ x .162)	3	16d com (3 ¹ / ₂ x .162)	4	3 ¹ / ₄ x .131	4	3 ¹ / ₄ x .120
	3	3 x .131			3	3 x .131	3	16d box (3 ¹ / ₂ x .135)	3	12d com (3 ¹ / ₄ x .148)	4	3 x .131	4	3 x .120
					3	10d box (3 x .128)	3	3 x .131	3	10d com (3 x .148)	4	8d com (2 ¹ / ₂ x .131)		
Stud to top or bottom plate (toe nail) See figure 10K	Connection 8		Connection 17		Connection 16a		Connection 16a							
	4	8d com (2 ¹ / ₂ x .131)	3	8d box (2 ¹ / ₂ x .113)	4	8d com (2 ¹ / ₂ x .131)	3	16d box (3 ¹ / ₂ x .135)	3	16d com (3 ¹ / ₂ x .162)	4	3 ¹ / ₄ x .131	5	3 ¹ / ₄ x .120
	4	3 x .131	2	16d box (3 ¹ / ₂ x .135)	4	3 x .131	4	8d com (2 ¹ / ₂ x .131)	4	12d com (3 ¹ / ₄ x .148)	4	3 x .131	5	3 x .120
					4	10d box (3 x .128)	4	3 x .131	4	10d com (3 x .148)	4	8d com (2 ¹ / ₂ x .131)	6	8d box (2 ¹ / ₂ x .113)
1" Diagonal brace to stud/plate (face-nail) See Figure 10L	Connection 20		Connection 20		Connection 18 (19 for 2015 IBC)		Connection 18							
	2	8d com (2 ¹ / ₂ x .131)	2	8d box (2 ¹ / ₂ x .113)	2	8d com (2 ¹ / ₂ x .131)	2	8d com (2 ¹ / ₂ x .131)	2	16d com (3 ¹ / ₂ x .162)	3	3 ¹ / ₄ x .131	3	3 ¹ / ₄ x .120
	2	3 x .131			2	3 x .131	3	8d box (2 ¹ / ₂ x .113)	2	12d com (3 ¹ / ₄ x .148)	3	3 x .131	3	3 x .120
					2	10d box (3 x .128)	2	10d box (3 x .128)	2	10d com (3 x .148)	3	8d com (2 ¹ / ₂ x .131)	3	8d box (2 ¹ / ₂ x .113)
								2	16d box (3 ¹ / ₂ x .135)			3	2 ³ / ₈ x .113	
												4	2 ¹ / ₄ x .099	

Figure D - Table 10 From ESR-1539
Annotation and truncated size of Table 10 is for clarity of example

TABLE 11—FASTENING SCHEDULE – CEILING AND ROOF FRAMING¹

CONNECTION DESCRIPTION	MINIMUM FASTENING REQUIREMENTS PRESCRIBED IN THE CODE								ALTERNATIVE FASTENING REQUIREMENTS Nails may be carbon steel or stainless, except where noted otherwise.					
	2012 IBC		2012 IRC		2018 & 2015 IBC		2018 & 2015 IRC							
	Table 2304.9.1		Table R602.3(1)		Table 2304.10.1		Table R602.3(1)							
	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)	#	Nail Size (Type, inch)
Blocking between joists or rafters or top palte (toe-nail) See Figure 11A	Connection 11		Connection 1		Connection 1		Connection 1		Nails at each end					
	Nail (Total)		Nail (Total)		Nail (at each end)		Nail (Total)							
	3	8d com (2 1/2 x .131)	3	8d box (2 1/2 x .113)	3	8d com (2 1/2 x .131)	3	8d com (2 1/2 x .131)	3	16d com (3 1/2 x .162)	3	3 1/4 x .131	4	3 1/4 x .120
	3	3 x .131			3	3 x .131	3	3 x .131	3	12d com (3 1/4 x .148)	3	3 x .131	4	3 x .120
					3	10d box (3 x .128)	3	10d box (3 x .128)	3	10d com (3 x .148)	3	8d com (2 1/2 x .131)	5	8d box (2 1/2 x .113)
							4	8d box (2 1/2 x .113)	3	16d box (3 1/2 x .135)				
Ceiling Joist to plate (toe-nail) nail thru each side See Figure 11B	Connection 15		Connection 2		Connection 2		Connection 2		Nails must be carbon steel, bright or galvanized					
	3	8d com (2 1/2 x .131)	3	8d box (2 1/2 x .113)	3	8d com (2 1/2 x .131)	3	8d com (2 1/2 x .131)	3	16d com (3 1/2 x .162)	3	3 1/4 x .131	5	8d box (2 1/2 x .113)
	5	3 x .131			3	10d box (3 x .128)	3	10d box (3 x .128)	3	12d com (3 1/4 x .148)	3	3 x .131	5	2 3/8 x .113
					3	3 x .131	3	3 x .131	3	10d com (3 x .148)	4	3 1/4 x .120	5	6d com (2 x .113)
								3	3 x .131	3	16d box (3 1/2 x .135)	4	3 x .120	
Ceiling Joist (not connected t parallel rafter-no thrust) laps over partition See Figure 11C	Connection 17		Connection 3		Connection 3		Connection 3							
	3	16d com (3 1/2 x .162)	3	10d box (3 x .128)	3	16d com (3 1/2 x .162)	3	16d com (3 1/2 x .162)	3	16d com (3 1/2 x .162)	4	3 1/4 x .131	5	3 1/4 x .120
	4	3 x .131			4	3 x .131	4	3 x .131	4	12d com (3 1/4 x .148)	4	3 x .131	5	3 x .120
					4	10d box (3 x .128)	4	10d box (3 x .128)	4	10d com (3 x .148)				
								4	16d box (3 1/2 x .135)					

Figure E - Table 11 From ESR-1539
Annotation and truncated size of Table 11 is for clarity of example

In the 2015 IRC, changes were made to three framing connections

- Ceiling Joists to Top Plate, toe nail [Connection 2]
- Rafter or Roof Truss to Plate, toe nail [Connection 6]
- 1" Brace to Each Stud and Plate, face nail [Connection 19]

The basis of the number of nails per each of these 3 connections was based on both Reference Lateral Strength and Reference Withdrawal Strength.

With the reduction in the withdrawal strength of stainless steel nails in the 2018 NDS (see How to Read ESR-1539 Part III), these three connections are now only referencing the use of carbon steel nails.

TABLE 13—SUMMARY OF ALTERNATIVE FASTENING DESIGNS RECOGNIZED IN TABLE 10 THROUGH 12^{1,2,3}

CONNECTION	NAIL SIZE (DIAMETER X LENGTH) (inches)													
	3 1/2 x 0.162	3 1/4 x 0.148	3 x 0.148	3 1/2 x 0.135	3 1/4 x 0.131	3 x 0.131	2 1/2 x 0.131	3 1/4 x 0.120	3 x 0.120	2 1/2 x 0.113	2 3/8 x 0.113	2 x 0.113	2 1/4 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.	4	4	4	4	1
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.	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.	8" o.c.					
Built up header 2" to 2" w/ 1/2" 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.	8" o.c.					
Continuous header to stud (toe nail)	3	4	4	4	4	4	4	5	5	6	6	6	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											
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.	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.	4 @ 16" o.c.	5 @ 16" o.c.					
Top or sole plate to stud (end nail)	3	3	3	3	4	4	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)	3	3	3	3	3	3	3	4	4	5				
Ceiling joist to plate	3	3	3	3	3	3	3	4	4	5	5	5		
Ceiling joists laps over partitions (no thrust)	3	4	4	4	4	4		5	5					
Ceiling joist to parallel rafter	See Table 11													
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)	3	4	4	4	4	4		5	5					
Roof rafter to 2-by ridge beam (toe-nail rafter to beam)	3	4	4	4	5	5	5	6	6	6	6	6		
Jack rafter to hip (toe-nail)	3	4	4	4	5	5	5							
Jack rafter to hip (end nail)	3	4	4	4										
Floor Framing														
Joist to sill or girder (toe-nail)	3	3	3	3	3	3	3	4	4	5	5	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.	4" o.c.	3" o.c.	3" o.c.
Joist to band Joist (face nail)	3	4	4	4	4	4		6	6					
Built-up girders & beams Face-nail @ top and bottom PLUS # at ends or splice	24" o.c.	24" o.c.	24" o.c.	24" o.c.	24" o.c.	24" o.c.		16" o.c.	16" o.c.					
Ledger Strip	3	4	4	4	5	5	6	6	6					
Bridging to Joist (toe-nail)	2	2	2	2	2	2	2	3	3	3	3	3	3	4

For SI: 1 inch = 25.4 mm

¹Alternative fastening requirements shown in this table have been evaluated as alternatives to the 2018, 2015 and 2012 IBC and 2018, 2015 and 2012 IRC. They can be used under earlier editions of the IBC and IRC where the prescriptive fastening requirements are no worse than those shown in the Tables 10 through 12.

²This fastening schedule applies to framing members having an actual thickness of 1 1/2" (nominal "2-by" lumber).

³Fastening schedule only applies to buildings of conventional wood frame construction where wind or seismic analysis is not required by the applicable code. In areas where wind or seismic analysis is required, required fastening must be determined by structural analysis.

⁴Nails may be carbon steel (bright or galvanized) or stainless steel, unless otherwise noted

⁵Nails must be carbon steel (bright or galvanized).

Figure F Table 13 From ESR-1539 Annotation of Table 13 is for clarity of example

Referenced Documents:

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

ANSI/AWC SDPWS – 2015 Special Design Provisions for Wind and Seismic © American Wood Council 2014

ASTM F1667-17 Standard Specifications for Driven Fasteners: Nails, Spikes and Staples
© ASTM International April 2017

2018, 2015, 2012, 2009, 2006 International Building Code (IBC) © International Code Council Inc. ®

2018, 2015, 2012, 2009, 2006 International Residential Code (IRC) © International Code Council Inc. ®

AC116 ICC-ES Acceptance Criteria for Nails
© ICC Evaluation Service (ICC-ES) ® March 2018

AC201 ICC-ES Acceptance Criteria for Staples
© ICC Evaluation Service (ICC-ES) ® March 2018

ICC-ES Evaluation Report ESR-1539
© ICC Evaluation Service (ICC-ES) ® May 2018

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