Technical Bulletin

Terminology Used In ICC Evaluation Service® Report ESR-1539©

Preface:

This is the beginning in a series of technical bulletins designed to provide a greater understanding of the ICC Evaluation Service evaluation report ESR-1539©. 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© Reissue Date 07/2022.**
http://www.icc-es.org/Reports/pdf_files/ESR-1539.pdf

When reviewing ESR-1539© and other technical bulletins available from ISANTA, a number of references are made that may be unfamiliar to the reader. This technical bulletin provides a brief description for many of those references. Some of the engineering terminolgy, although broad in scope, has been focused to apply specifically to ESR-1539©. Throughout this document, references to fasteners will apply to both nails and staples unless otherwise noted.

ISANTA®- International Staple, Nail & Tool Association is an organization of power fastening companies involved in the design, manufacturing and sale of power tools and the fasteners used in these power tools.

***ICC* – International Code Council®[a]**

The International Code Council is a member-focused association, dedicated to developing model codes and standards used in the design, build and compliance process to construct safe, sustainable, affordable and resilient structures.

IBC - International Building Code® establishes minimum regulations for building systems using prescriptive and performance-related provisions.

IRC – International Residential Code® establishes miniumum regulations for one- and two-family dwellings and townhouses using prescriptive provisions.

Code / Codes / I-Codes®*: refer to the IBC® and IRC®*

***ICC-ES* – ICC Evaluation Service®**

A nonprofit LLC that develops and issues technical evaluations of building products, components, methods and materials. ICC-ES is a subsidiary of ICC, but it is a separate company with its own management, staff, rules, and procedures. *Acceptance Criteria (AC) and Evaluation Reports (ESR)* are the two main document types of interest to ISANTA that are developed and administered by ICC-ES.

Acceptance Criteria: Documents that provide interested parties with guidelines for demonstrating compliance with minimum performance requirements defined within the codes. Acceptance Criteria will detail: use, testing, reporting, package labeling, quality control, and evaluation report recognition of the products. The two acceptance criteria used in the development of ESR-1539© are Acceptance Criteria for Nails *AC116*© and Acceptance Criteria for Staples *AC120*©.

Evaluation Report: An evaluation report presents the findings of ICC-ES discussing code requirements and compliance of the report subject, e.g., a particular building product, component or material.

***ASTM*[b]**

A globally recognized leader in the development and delivery of international voluntary consensus standards used to improve product quality, enhance safety, facilitate market access and trade, and build consumer confidence.

ASTM F1667/F1667M© - Standard Specification for Driven Fasteners: Nails, Spikes and Staples: terminology; classifications; material requirements; physical properties; dimensions, and tolerances; workmanship; protective coatings; and packaging requirements for fasteners. Codes reference ASTM F1667 and specific fasteners in various construction connections.

***AWC* – American Wood Council[c]**

AWC represents North American traditional and engineered wood products manufacturing through the development of engineering data, technology, and standards for use by design professionals and building officials, assuring the safe and efficient design and use of wood structural products. AWC publishes a number of technical manuals and documents, including the *NDS* and *SDPWS* that are extensively referenced in the development of ESR-1539© and the *IBC*® and *IRC*®.

NDS National Design Specification® for Wood Construction 2018 Edition: NDS® provides a national standard of practice for structures based on testing, technology and state-of-the-art engineering. The NDS® is intended to be used in conjuction with competent engineering design, accurate fabrication and adequate supervision of construction.

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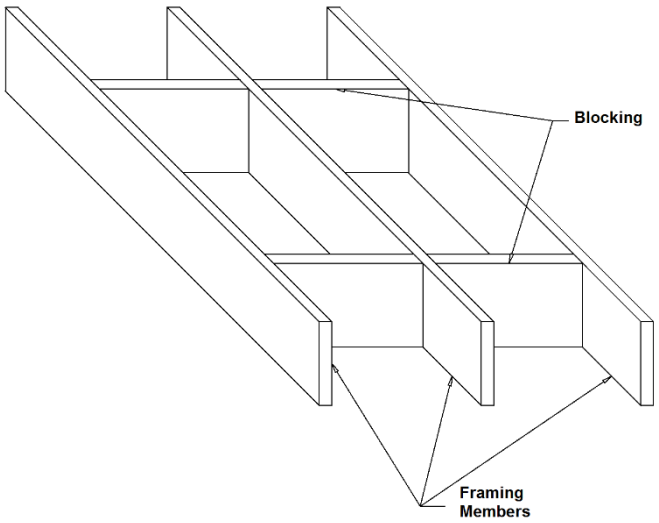
Supplement NDS National Design Specification©® Design Values for Wood Construction. A compendium of reference design values for structural sawn lumber, structural glued laminated timber, and round timber piles and poles.

SDPWS Special Design Provisions for Wind & Seismic 2021 Edition©: provides technical information regarding building systems designed to minimize the effects of wind and seismic forces which act upon them.

NDS©® and SDPWS are extensively referenced in the development of ESR-1539© and the codes. ISANTA is involved in the development, review and commentary on these documents introducing industry input into the process.

Bending Yield Strength (F_{yb}) –When a fastener is subjected to an excessive force or load it will begin to bend. *Yield or failure* occurs when the fastener bends and cannot return to its original shape when the load is removed. The bending yield strength, measured in pounds/in² (psi), is the resisting strength of the material to yielding. When F_{yb} is exceeded, permanent deformation has occurred.

Blocking – A wood member that provides edge support and fastening surfaces for sheathing between horizontal (e.g., joists, rafters etc.) and/or vertical (e.g., studs) framing members.

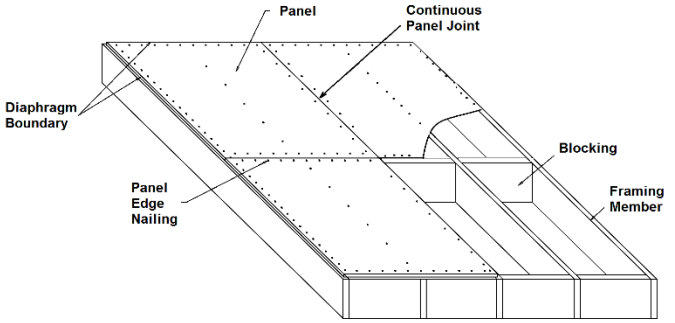


Example of Blocking Between Framing Members

Braced Wall – A wall system specifically designed to resist lateral forces that can cause racking and shape distortion. There are a number of design concepts that can be used to create a braced wall in construction.

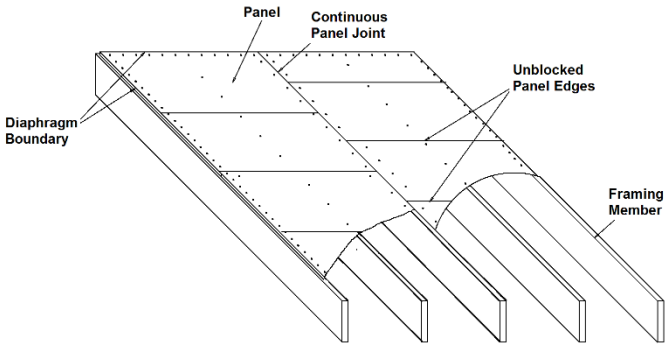
Diaphragm[d] - Diaphragms are a roof, floor or other system transferring lateral forces applied to a building to the vertical elements, such as shear walls. For wood structures, diaphragms are commonly constructed of wood structural panel sheathing or decking applied to the upper face of regularly spaced floor or roof wood framing members.

Blocked Diaphragm[c] – A diaphragm in which all adjacent panel edges are fastened to either common framing members or common blocking.



Example of a Blocked Diaphragm

Unblocked Diaphragm[c,d] – A diaphragm with fasteners at boundaries and supporting members only. Blocking between supporting structural members at panel edges is not included and some edges of the sheathing are not supported by framing underneath in the direction perpendicular to the framing (see example below).



Example of an Unblocked Diaphragm

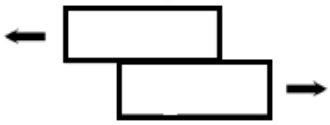
Dowel Bearing Strength[e] **(F_e)**– The property of wood that affects the nominal design value for a single fastener subjected to lateral shear load. Associated with the crushing strength of a wood member under loading from a dowel (fastener), the dowel bearing strength of a member depends on the relative size of the dowel and the specific gravity (G) of the wood and is expressed in pounds/in² (psi).

Lateral Force Resisting Assemby (LFRA) – A *diaphragm*, *shear wall* or *braced wall.*

Lateral Load – Load usually associated with either wind or seismic activity. Lateral loads act upon the members of the connection (wood, fasteners, etc.) to push over an anchored structure (overturning load) or push the structure off its foundation (sliding load).

Lateral Design Value (Z) – A design value used in calculations based on the yielding of connections as wood fibers are crushed and/or fastener shanks are bent. Z is a function of wood type, fastener diameter, dowel bearing strength, bending yield strength, wood thickness and several adjustment factors. Z is derived from the lowest resulting value from the six yield limit equations referenced in Appendix A of ESR-1539©. Lateral design values are expressed in pounds–force (lbf).

Shear or Shear Force – A type of force that causes or tends to cause two parts to slide relative to each other in a direction parallel to their plane of contact (see example below).

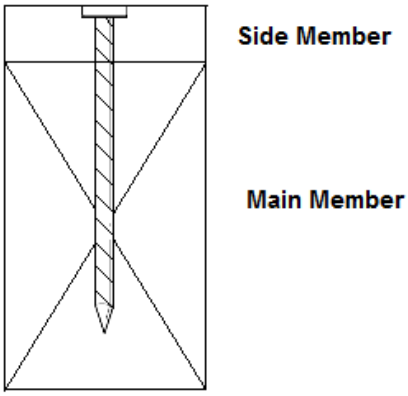


Shear Between Two Members

Shear Strength[i] – The strength of a material or component against the type of yield or structural failure where the material or component fails in shear.

Shear Wall[d] – Wall systems that transfer lateral wind and seismic loads from a roof or floor down to lower levels and then into the foundation. Under prescriptive design codes for conventional construction, shear walls are referred to as braced wall panels.

Main Member – The primary holding member in a wood connection. Normally the member that holds the point of the fastener after being driven, when two or more members are fastened together.

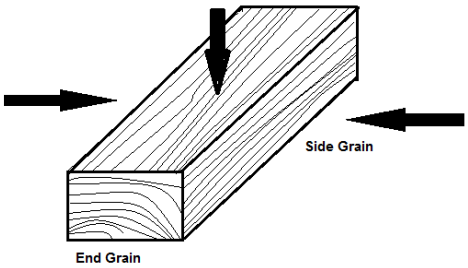


Allowable Shear – Referenced in Tables 6-9 of ESR-1539 for shear values of diaphragm and shear wall assemblies (LRFAs). Allowable shear is calculated by dividing the nominal shear values (referenced in SDPWS) by 2.0 for wind and 2.8 for seismic.

Side Member Nailed to Main Member

Side Member – The member normally attached to the main member, e.g., (plywood attached to a framing member). The fastener is driven completely through the side member and into the main member.

Side Grain –Surfaces that are approximately parallel to the direction of the grain of the wood. Fasteners driven into the side grain are approximately perpendicular to the direction of the grain.



Example of Wood Grain

End Grain – End of a board cut across the wood grain. Fasteners driven into the end grain are approximately parallel to the direction of the grain.

Specific Gravity (G)[b] – The ratio of the oven-dry mass of a specimen (wood) to the mass of a volume of water equal to the volume of the specimen (wood) at a specified moisture content.

"2 by" - When referred to in the ESR-1539©, "2 by" denotes the sizes of typical framing lumber, e.g., 2 x 4, 2 x 6, 2 x 8. Nominal thickness of "2 by" lumber is actually 1½". The width varies from ½" to ¾" less than the reference size depending on the size of the board.

Rated Sheathing[g] – Rated sheathing produced as *plywood* or *OSB* is rated for use as subfloor, wall or roof sheathing. Rated Sheathing is chosen when the application(s) requires strength and stiffness.

Structural I Sheathing[g] – Structural I sheathing is a specifically produced *plywood* or *oriented strand board (OSB)* designed to provide enhanced racking and cross-panel properties for applications such as shear walls, diaphragms and panelized roofs. IBC Section 2303 requires that each panel shall be identified for grade, bond classification and

performance category. This identification requirement applies to Rated Sheathing as well.

Plywood[g,h,i] – Plywood is produced from thin layers of wood sheets referred to as veneer or plies. These plies are arranged to create layers. Each layer may consist of one or more plies that are oriented with the wood grain running in the same direction. There are always an odd number of layers in plywood. The outside layers, referred to as front and back, are oriented with the grain of the wood running parallel to the long dimension of the panel. As additional layers are added, each new layer is oriented approximately 90º to the previous layer.

An adhesive is added between the surface of each ply and once assembled, the sheets are placed in a heated press to cure the adhesive, forming the sheet of plywood.

Oriented Strand Board (OSB)[g] - Oriented Strand Board is a versatile, widely used, structural wood panel. Manufactured from waterproof heat-cured adhesives and rectangular shaped wood strands that are arranged in cross-oriented layers, OSB is an engineered wood panel that shares many of the strength and performance characteristics of plywood. OSB's combination of wood and adhesives creates a strong, dimensionally stable panel that resists deflection, delamination, and warping; likewise, panels resist racking and shape distortion when subjected to demanding wind and seismic conditions.

Yield Modes – When a connection is subjected to a *lateral load*, there are six methods of failure addessed in the ESR-1539©. These are referred to as yield modes and are referenced as Modes **Is, Im, II, IIIs, IIIm & IV.** Each mode is evaluated to determine the *lateral design value Z* for the particular connection.

Withdrawal Design Values – A numerical value defining the amount of force that is required to withdraw a fastener from wood. The value is expressed in pounds force per inch (lbf/in) of fastener penetration into the main member of a connection. The values are for penetration into the side grain (perpendicular to the fiber) and are dependant on wood specific gravity, fastener shank diameter, and shank configuration.

Wood Species – Wood species refers to the types of wood and/or families of wood within the ESR-1539©, NDS® and the codes. References made to specific species of wood may be a combination of trees making up the species family.
Examples:

- Douglas Fir-Larch (consists of Douglas Fir or Western Larch)
- Southern Pine (consists of Loblolly Pine, Longleaf Pine, Shortleaf Pine, Slash Pine)

The various species referenced in the documents are derived from Table 2.1 of the NDS® Supplement 2018 Edition

Head Area Ratio (HAR) – HAR is the ratio of the difference between the area of the nail head (Ah) and the area of the nail shank (As) to the area of the nail head (Ah) as defined in Acceptance Criteria for Nails (AC116), (Ah-As)/ Ah. The HAR of the code prescribed nail of the same shank diameter is compared to the HAR of the alternative nail of the same diameter.

References

[a] *International Code Council® & ICC Evaluation Service®*
3060 Saturn Street, Suite 100
Brea, CA 92821

[b] *ASTM International.*
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959

[c] *American Wood Council*
222 Catoctin Circle SE
Leesburg, VA 20175

[d] *http://www.woodworks.org/*
Wood Products Council
1101 K Street NW Suite 700
Washington, DC 20005

[e] *Washington State University*
Civil and Environmental Engineering
An introduction to the behavior and design of timber structures
http://timber.ce.wsu.edu/Supplements/BearingStrength/default.htm

[f] *Wikipedia an organization of:*
Wikimedia Foundation
149 New Montgomery Street
Floor 6
San Francisco, CA 94105

[g] *The Engineered Wood Association*
7011 S. 19th Street
Tacoma, WA 98466-5333

[h] *http://www2.wisd.net/it/PLYWOOD.htm*

[i] *http://www.madehow.com/Volume-4/Plywood.html*

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