Listing and Technical Evaluation Report™

A Duly Authenticated Report from an Approved Agency

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R19 Tstud™ Structural Insulated Wall Stud

Trade Secret Report Holder:

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CSI Designations:

DIVISION: 06 00 00 - WOOD, PLASTICS AND COMPOSITES

Section: 06 10 00 - Rough Carpentry

Section: 06 11 00 - Wood Framing

DIVISION: 07 00 00 - THERMAL AND MOISTURE PROTECTION

Section: 07 21 00 - Thermal Insulation

Section: 07 21 13 - Foam Board Insulation

1 Innovative Product Evaluated[1]

1.1 R19 Tstud Structural Insulated Wall Stud

2 Product Description and Materials

2.1 The innovative product evaluated in this report is shown in **Figure 1**.

Figure 1. R19 Tstud Structural Insulated Wall Stud

2.2 R19 Tstud is made from a minimum of 2 x 3 No. 2 Spruce Pine Fir (SPF) lumber, wooden dowels and approximately $2^1/_2$" of polyisocyanurate (polyiso) insulation.

2.2.1 Overall size of R19 Tstud is $2^1/_2$" x $5^1/_2$".

2.2.2 Any lumber species can be used, as long as the design values of the lumber are equal to or greater than No. 2 SPF or, when higher performance is required and specified by the registered design professional, 1650f – 1.5E SPF.

2.2.3 The lumber is placed in a form that leaves a gap of approximately $2^1/_2$" between members. Wooden dowels are installed through one member into the other at opposing angles, forming a web-like pattern. Dowels are spaced evenly at a distance not to exceed $6^1/_2$" on center and glued in place using an adhesive that conforms to the specifications of ASTM D2559.

2.2.4 Once the lumber has been fastened together, liquid polyiso is poured into the void between members and allowed to fully cure.

2.3 *Materials*

2.3.1 *Lumber:*

2.3.1.1 Grade: No. 2 SPF or 1650f – 1.5E SPF

2.3.1.2 *Thickness:*

2.3.1.2.1 $1^1/_2$" (38.1 mm)

2.3.1.3 *Width:*

2.3.1.3.1 $2^1/_2$" (63.5 mm)

2.3.1.4 *Length:*

2.3.1.4.1 Up to 16' (4.9 m)

2.3.2 *Dowels:*

2.3.2.1 *Grade:*

2.3.2.1.1 No. 2 SPF or 1650f – 1.5E SPF

2.3.2.2 *Diameter:*

2.3.2.2.1 $^{11}/_{16}$" (17.5 mm)

2.3.3 *Polyiso:*

2.3.3.1 The polyiso is manufactured with a minimum density of 2.2 pounds per cubic foot.

2.4 As needed, review material properties for design in **Section 6** and to regulatory evaluation in **Section 8**.

3 Definitions

3.1 New Materials[2] are defined as building materials, equipment, appliances, systems or methods of construction not provided for by prescriptive and/or legislatively adopted regulations, known as alternative materials.[3] The design strengths and permissible stresses shall be established by tests[4] and/or engineering analysis.[5]

3.2 Duly authenticated reports[6] and research reports[7] are test reports and related engineering evaluations, which are written by an approved agency[8] and/or an approved source.[9]

3.2.1 These reports contain intellectual property and/or trade secrets, which are protected by the Defend Trade Secrets Act (DTSA).[10]

3.3 An approved agency is *"approved"* when it is ANAB ISO/IEC 17065 accredited. DrJ Engineering, LLC (DrJ) is listed in the ANAB directory.

3.4 An approved source is *"approved"* when a professional engineer (i.e., Registered Design Professional) is properly licensed to transact engineering commerce. The regulatory authority governing approved sources is the state legislature via its professional engineering regulations.[11]

3.5 Testing and/or inspections conducted for this duly authenticated report were performed by an ISO/IEC 17025 accredited testing laboratory, an ISO/IEC 17020 accredited inspection body and/or a licensed Registered Design Professional (RDP).

3.5.1 The Center for Building Innovation (CBI) is ANAB[12] ISO/IEC 17025 and ISO/IEC 17020 accredited.

3.6 The regulatory authority shall enforce[13] the specific provisions of each legislatively adopted regulation. If there is a non-conformance, the specific regulatory section and language of the non-conformance shall be provided in writing[14] stating the nonconformance and the path to its cure.

3.7 The regulatory authority shall accept duly authenticated reports from an approved agency and/or an approved source with respect to the quality and manner of use of new materials or assemblies as provided for in regulations regarding the use of alternative materials, designs, or methods of construction.[15]

3.8 ANAB is an International Accreditation Forum (IAF) Multilateral Recognition Arrangement (MLA) signatory where recognition of certificates, validation and verification statements issued by conformity assessment bodies accredited by all other signatories of the IAF MLA with the appropriate scope, shall be approved.[16] Therefore, all ANAB ISO/IEC 17065 duly authenticated reports are approval equivalent.[17]

3.9 Approval equity is a fundamental commercial and legal principle.[18]

4 Applicable Standards for the Listing; Regulations for the Regulatory Evaluation[19]

4.1 *Standards*

4.1.1 *ANSI/AWC NDS: National Design Specification (NDS) for Wood Construction*

4.1.2 *ANSI/AWC SDPWS: Special Design Provisions for Wind and Seismic*

4.1.3 *ASCE/SEI 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures*

4.1.4 *ASTM D198: Standard Test Methods of Static Tests of Lumber in Structural Sizes*

4.1.5 *ASTM D2559: Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions*

4.1.6 *ASTM E72: Standard Test Methods of Conducting Strength Tests of Panels for Building Construction*

4.1.7 *ASTM E2126: Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Vertical Elements of the Lateral Force Resisting Systems for Buildings*

4.2 *Regulations*

4.2.1 *IBC – 15, 18, 21: International Building Code®*

4.2.2 *IRC – 15, 18, 21: International Residential Code®*

5 Listed[20]

5.1 Equipment, materials, products or services included in a List published by a nationally recognized testing laboratory (i.e., CBI), approved agency (i.e., CBI and DrJ), and/or approved source (i.e., DrJ) or other organization concerned with product evaluation (i.e., DrJ) that maintains periodic inspection (i.e., CBI) of production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

6 Tabulated Properties Generated from Nationally Recognized Standards

6.1 *Prescriptive Provisions*

6.1.1 R19 Tstud may be used as an alternative to solid sawn 2 x 4 lumber in all cases, and 2 x 6 lumber in most cases, for wall structural members.

6.1.1.1 For use as a 2 x 6, design shall be permitted in accordance with accepted engineering procedures, experience and technical judgment.

6.1.1.2 In these cases, referenced design values as specified in **Table 1**, shall be used in accordance with IBC Section 2308 and IRC Section R602.

6.1.1.3 Polyiso insulation is in accordance with IBC Chapter 26, specifically IBC Section 2603.2, IBC Section 2603.3 and IBC Section 2603.4, in addition to being in accordance with IRC Section R316, specifically IRC Section R316.2, IRC Section R316.3 and IRC Section R316.4.

6.1.2 *Cutting, Notching and Boring:*

6.1.2.1 Notches in structural members (2 x 3 or dowels) are not permitted.

6.1.2.2 Holes may only be bored in polyiso insulation of the R19 Tstud. Holes shall be spaced a minimum of 24" o.c., shall not exceed 2$^1/_2$" (50.8 mm) in diameter, and are not permitted within 24" from either end of the stud.

6.1.3 R19 Tstud used as structural members of a wall shall be fastened as specified in **Table 1**.

Table 1. Acceptable Fastening Schedule for R19 Tstud

Application[1]	Number and Type of Fastener	Fastener Spacing (in)	Installation
Ceiling Joists to Plate (toenail)	3 (4" x 0.131")	-	Fasten two (2) toenails into interior wood member and one (1) toenail into exterior wood member
Rafter or Roof Truss to Plate (toenail)	3 (3$^1/_2$" x 0.135")	-	Where a rafter is fastened to an adjacent parallel ceiling joist in accordance with this schedule, provide two (2) toenails on one (1) side of the rafter and toenails from the ceiling joist to top plate in accordance with this schedule. The toenail on the opposite side of the rafter shall not be required.
	4 (4" x 0.131")		Fasten two (2) toenails into interior wood member and two (2) toenails into exterior wood member
Built-up Studs (face nail)	(4" x 0.131")	16 o.c.	Fasten two (2) face nails, one (1) into each wood member
Abutting Studs at Intersection Wall Corner (face nail)	(4" x 0.131")	12 o.c.	Fasten one (1) face nail into exterior-facing wood member
Double 2x6 Top Plates (face nail)	(4" x 0.131")	12 o.c.	Fasten two (2) face nails, one (1) into each wood member

Table 1. Acceptable Fastening Schedule for R19 Tstud

Application[1]	Number and Type of Fastener	Fastener Spacing (in)	Installation
Double Top Plates, Minimum 24" Offset of End Joints, Face Nail in Lapped Area	12 (4" x 0.131")	-	Fasten twelve (12) face nails on each side of end joint (minimum 24" lap splice length each side of joint)
Stud to Plate (toenail)	4 (4" x 0.131")	-	Fasten two (2) toenails into sole plate on each side of the stud (each wood member)
Plate to Stud (end nail)	3 (4" x 0.135")	-	Fasten two (2) 4" x 0.135" nails into one wood member and one (1) 4" x 0.135" nail into other wood member
	2 (4 1/2" x 0.162")		Fasten two (2) 4 1/2" x 0.162" nails, one (1) into each wood member
Top Plates, Laps at Corners and Intersections (face nail)	2 (4" x 0.135")	-	Fasten two (2) 4" x 0.135" face nails, one into each wood member
Rim Joist to Sill or Top Plate	(2 1/2" x 0.113")	4 o.c.	Fasten by toenailing
	(2 1/2" x 0.131")	6 o.c.	

SI: 1 in = 25.4 mm

1. For all connections, care must be taken to avoid splitting.

6.1.4 R19 Tstud may be used as a single top plate in accordance with IRC Section R602.3.2 and the following:

6.1.4.1 Fasteners for R19 Tstud connections shall be distributed in each R19 Tstud wood member (top plate to stud connections shall be fastened using three [3] 4" x 0.131" nails, one [1] into one wood member and two [2] into the other wood member).

6.1.5 R19 Tstud may be used as a flat header.

6.1.5.1 Fasten multi-ply R19 Tstud header members using 4" x 0.131" nails. Drive one nail into each R19 Tstud wood member at 16" o.c. (16" o.c. along each side of the R19 Tstud).

6.1.6 Use of R19 Tstud as jack, trimmer and cripple studs is permitted.

6.1.6.1 Install cripple studs between the bottom plate and rough sill using three (3) 4" x 0.131" nails – one into one wood member and two (2) into the other wood member.

6.1.7 Structural sheathing shall be installed on one side of the wall and minimum 1/2" (12.7 mm) Gypsum Wallboard (GWB) or equivalent, on the other side of the wall fastened in accordance with the applicable building code. Sheathing attached to only one side of the wall is not permitted.

6.1.8 For trusses and rafters placed on R19 Tstud wall studs, see **Table 3** for SPF No. 2 R19 Tstud and **Table 4** for 1650f – 1.5E R19 Tstud design values.

6.1.8.1 For cases where a higher reaction needs to be supported, use of built-up studs fastened in accordance with **Table 1** is permitted with a compression limit per-ply specified in **Table 3** and **Table 4**.

6.1.8.1.1 For example, for SPF No. 2 R19 Tstud and SPF top plate, the maximum compression load is 3,665 lbs. per ply. Therefore, for a 2-ply built-up stud, the maximum reaction is 7,330 lbs.

6.1.8.1.2 In this case, the built-up stud shall be located directly under the applied load.

6.1.8.2 Walls with nominal 2 x 6 lumber top plates shall be in accordance with IRC Section R602.3.2.

6.2 *Engineered Design*

6.2.1 The design provisions for wood construction noted in IBC Section 2302.1[21] and IRC Section R301.1.3 apply to R19 Tstud for Allowable Stress Design (ASD), unless otherwise noted in this report.

6.2.2 *Material Properties:*

6.2.2.1 Reference design values for R19 Tstuds are specified in **Table 2**.

6.2.2.1.1 Reference design values for R19 Tstuds shall be multiplied by the adjustment factors specified in NDS Section 4.3.

Table 2. R19 Tstud Reference Design Values

Reference Design Values	No. 2 SPF R19 Tstud	1650f – 1.5E SPF R19 Tstud
Bending, F_bS	889 lb-ft	889 lb-ft
Compression Parallel to Grain, F_c	1,150 psi	1,700 psi
Tension Parallel to Grain, F_t	450 psi	1,020 psi
Compression Perpendicular to Grain, $F_{c\perp}$	425 psi	425 psi
Shear Force, V	320 lbs	320 lbs
Bending Stiffness, EI	30,300,000 lb-in^2	30,500,000 lb-in^2
Bending Stiffness for Beam and Column Stability, EI_{min}	14,900,000 lb-in^2	15,000,000 lb-in^2
SI: 1 in = 25.4 mm, 1 lb = 4.45 N, 1 lb-ft = 1.36 N-m, 1 psi = 0.00689 MPa		

6.2.3 *Design for Compression Loads:*

6.2.3.1 The maximum allowable compression load for R19 Tstud is specified in **Table 3** for SPF No. 2 R19 Tstud and **Table 4** for 1650Fb-1.5E MSR R19 Tstud.

6.2.3.2 The maximum allowable compression load is based on perpendicular-to-grain crushing of SPF, SP, LVL or LSL top and bottom plates.

6.2.3.3 The allowable axial compression for R19 Tstud can be calculated using the provisions of NDS Section 3.6 and 3.7.

6.2.3.4 For computing the column stability factor, the critical bucking design value, F_{cE}, shall be computed using the formula in **Equation 1**.

Equation 1. Critical Bucking Design Value

$$F_{cE} = \frac{\pi^2 EI_{min}}{A(l_e)^2}$$

where: EI_{min} = bending stiffness for beam and column stability (lb-in^2)

A = minimum net section area of R19 Tstud (in^2) = (2.5" x 1.5") + ((2.5" – 0.6875") x 1.5") = 6.47 in^2

l_e = Effective column length (in) = K_e x h

Table 3. Allowable Compressive Load for Walls Framed with SPF No. 2 R19 Tstud

Stud Height (ft)	Allowable Compressive Load[1] (lbs)			
	Top/Bottom Plate[2]			
	R19 Tstud (SPF) (SG = 0.42)[3]	Southern Pine (SP) (SG = 0.55)[4]	LVL[5]	LSL[6]
8	3,665	4,875	7,070	6,900
9	3,665	4,875	7,035	6,900
10	3,665	4,875	6,565	6,565
11	3,665	4,875	6,045	6,045
12	3,665	4,875	5,505	5,505
13	3,665	4,875	4,975	4,975
14	3,665	4,475	4,475	4,475
15	3,665	4,025	4,025	4,025
16	3,625	3,625	3,625	3,625

SI: 1 in = 25.4 mm, 1 lb = 4.45 N

1. Maximum stud spacing of 24".
2. Compression perpendicular to grain is assumed to be 425 psi for R19 Tstud and SPF, 565 psi for SP, 820 for LVL, and 800 for LSL (adjusted per NDS Section 3.10.4). Adjustment for plates having a higher or lower compression perpendicular to grain value is required.
3. Compression perpendicular to grain of the R19 Tstud or SPF top and bottom plates controls for walls less than or equal to 15 ft. in height.
4. Compression perpendicular to grain of the SP top and bottom plates controls for walls less than or equal to 13 ft. in height.
5. Compression perpendicular to grain of the LVL top and bottom plates controls for walls less than or equal to 8 ft. in height.
6. Compression perpendicular to grain of the LSL top and bottom plates controls for walls less than or equal to 9 ft. in height.

Table 4. Allowable Compressive Load for Walls Framed with 1650Fb-1.5E MSR R19 Tstud

Stud Height (ft)	Allowable Compressive Load[1] (lbs)			
	Top/Bottom Plate[2]			
	R19 Tstud (SPF) (SG = 0.42)[3]	Southern Pine (SP) (SG = 0.55)[4]	LVL[5]	LSL[6]
8	3,665	4,875	7,070	6,900
9	3,665	4,875	7,070	6,900
10	3,665	4,875	7,070	6,900
11	3,665	4,875	6,805	6,805
12	3,665	4,875	6,055	6,055
13	3,665	4,875	5,370	5,370
14	3,665	4,765	4,765	4,765
15	3,665	4,240	4,240	4,240
16	3,665	3,785	3,785	3,785

SI: 1 in = 25.4 mm, 1 lb = 4.45 N

1. Maximum stud spacing of 24".
2. Compression perpendicular to grain is assumed to be 425 psi for R19 Tstud and SPF, 565 psi for SP, 820 for LVL, and 800 for LSL (adjusted per NDS Section 3.10.4). Adjustment for plates having a higher or lower compression perpendicular to grain value is required.
3. Compression perpendicular to grain of the R19 Tstud or SPF top and bottom plates controls for walls less than or equal to 16 ft. in height.
4. Compression perpendicular to grain of the SP top and bottom plates controls for walls less than or equal to 13 ft. in height.
5. Compression perpendicular to grain of the LVL top and bottom plates controls for walls less than or equal to 10 ft. in height.
6. Compression perpendicular to grain of the LSL top and bottom plates controls for walls less than or equal to 10 ft. in height.

6.2.4 *Design for Bending:*

6.2.4.1 The maximum bending moment and shear forces shall not exceed the reference design values for the R19 Tstud specified in **Table 2**.

6.2.5 *Design for Combined Bending and Axial Compression Loads:*

6.2.5.1 The R19 Tstud resists bending using tension and compression stresses in the wood members.

6.2.5.2 The axial compressive stress due to combined bending and axial load can be computed using **Equation 2**.

Equation 2. Axial Compressive Stress

$$f_a = \frac{P}{A} + \frac{M}{A_m \cdot d_{eff}}$$

where: P = axial load applied to R19 Tstud (lb)

A = minimum net section area of R19 Tstud (in^2) = (2.5" x 1.5") + ((2.5" – 0.6875") x 1.5") = 6.47 in^2

M = bending moment applied to R19 Tstud (lb-in)

A_m = minimum net section area of single R19 Tstud member (in^2) = ((2.5" – 0.6875") x 1.5") = 2.72 in^2

d_{eff} = distance from center to center of R19 Tstud member (in) = 4.00 in

6.2.5.3 The axial stresses in R19 Tstud member shall be checked in accordance with NDS Section 3.6 and 3.7.

6.2.5.4 The R19 Tstud shall also be checked in bending, only to insure the allowable bending moment in **Table 2** is not exceeded.

6.2.5.5 Allowable wind pressures for R19 Tstud subject to axial loads are specified in the following tables:

6.2.5.5.1 *SPF No. 2 R19 Tstud:*

6.2.5.5.1.1 SPF top/bottom plate: **Table 5**

6.2.5.5.1.2 SP top/bottom plate: **Table 6**

6.2.5.5.1.3 LVL top/bottom plate: **Table 7**

6.2.5.5.1.4 LSL top/bottom plate: **Table 8**

6.2.5.5.2 *1650Fb-1.5E MSR R19 Tstud:*

6.2.5.5.2.1 SPF top/bottom plate: **Table 9**

6.2.5.5.2.2 SP top/bottom plate: **Table 10**

6.2.5.5.2.3 LVL top/bottom plate: **Table 11**

6.2.5.5.2.4 LSL top/bottom plate: **Table 12**

6.2.5.6 R19 Tstud used as headers in a wall have the allowable loads as specified in **Table 13**.

Table 5. Allowable (ASD) Compressive Load for Walls Subject to Wind Pressures
(SPF No. 2 R19 Tstud and SPF Top/Bottom Plate)

Stud Spacing (in)	Wall[2] Height (ft)	Allowable Compression Load (lb) and (Deflection Ratio)									
		Components & Cladding Wind Pressure[1] (psf)									
		15	20	25	30	35	40	45	50	55	60
12	8	3665 (L/3401)	3665 (L/2551)	3665 (L/2041)	3665 (L/1701)	3665 (L/1458)	3665 (L/1276)	3665 (L/1134)	3665 (L/1020)	3665 (L/928)	3665 (L/850)
	9	3665 (L/2356)	3665 (L/1767)	3665 (L/1413)	3665 (L/1178)	3665 (L/1010)	3665 (L/883)	3665 (L/785)	3665 (L/707)	3665 (L/642)	3665 (L/589)
	10	3665 (L/1698)	3665 (L/1274)	3665 (L/1019)	3665 (L/849)	3665 (L/728)	3665 (L/637)	3665 (L/566)	3665 (L/509)	3665 (L/463)	3665 (L/425)
	12	3665 (L/967)	3665 (L/725)	3665 (L/580)	3640 (L/483)	3185 (L/414)	2725 (L/362)	2270 (L/322)	1815 (L/290)	1360 (L/264)	900 (L/242)
	14	3030 (L/602)	2405 (L/451)	1780 (L/361)	1155 (L/301)	530 (L/258)	--	--	--	--	--
	16	1385 (L/399)	565 (L/300)	--	--	--	--	--	--	--	--
16	8	3665 (L/2551)	3665 (L/1913)	3665 (L/1531)	3665 (L/1276)	3665 (L/1093)	3665 (L/957)	3665 (L/850)	3665 (L/765)	3665 (L/696)	3665 (L/638)
	9	3665 (L/1767)	3665 (L/1325)	3665 (L/1060)	3665 (L/883)	3665 (L/757)	3665 (L/663)	3665 (L/589)	3665 (L/530)	3665 (L/482)	3665 (L/442)
	10	3665 (L/1274)	3665 (L/955)	3665 (L/764)	3665 (L/637)	3665 (L/546)	3665 (L/478)	3665 (L/425)	3665 (L/382)	3665 (L/347)	3310 (L/318)
	12	3665 (L/725)	3665 (L/544)	3335 (L/435)	2725 (L/362)	2120 (L/311)	1510 (L/272)	900 (L/242)	295 (L/217)	--	--
	14	2405 (L/451)	1570 (L/338)	735 (L/271)	--	--	--	--	--	--	--
	16	565 (L/300)	--	--	--	--	--	--	--	--	--
24	8	3665 (L/1701)	3665 (L/1276)	3665 (L/1020)	3665 (L/850)	3665 (L/729)	3665 (L/638)	3665 (L/567)	3665 (L/510)	3665 (L/464)	3665 (L/425)
	9	3665 (L/1178)	3665 (L/883)	3665 (L/707)	3665 (L/589)	3665 (L/505)	3665 (L/442)	3665 (L/393)	3665 (L/353)	3665 (L/321)	3370 (L/294)
	10	3665 (L/849)	3665 (L/637)	3665 (L/509)	3665 (L/425)	3665 (L/364)	3310 (L/318)	2680 (L/283)	2055 (L/255)	1430 (L/232)	805 (L/212)
	12	3640 (L/483)	2725 (L/362)	1815 (L/290)	900 (L/242)	--	--	--	--	--	--
	14	1155 (L/301)	--	--	--	--	--	--	--	--	--

SI: 1 in = 25.4 mm, 1 psf = 0.0479 kN/m^2

1. Wind pressure provided assumes Exposure Category B, Enclosed Building, Mean Roof Height 30'.
2. Walls constructed with No. 2 R19 Tstud studs and SPF top and bottom plates.

Table 6. Allowable (ASD) Compressive Load for Walls Subject to Wind Pressures
(SPF No. 2 R19 Tstud and SP Top/Bottom Plate)

Stud Spacing (in)	Wall[2] Height (ft)	Allowable Compression Load (lb) and (Deflection Ratio)									
		Components & Cladding Wind Pressure[1] (psf)									
		15	20	25	30	35	40	45	50	55	60
12	8	4875 (L/3401)	4875 (L/2551)	4875 (L/2041)	4875 (L/1701)	4875 (L/1458)	4875 (L/1276)	4875 (L/1134)	4875 (L/1020)	4875 (L/928)	4875 (L/850)
	9	4875 (L/2356)	4875 (L/1767)	4875 (L/1413)	4875 (L/1178)	4875 (L/1010)	4875 (L/883)	4875 (L/785)	4875 (L/707)	4875 (L/642)	4875 (L/589)
	10	4875 (L/1698)	4875 (L/1274)	4875 (L/1019)	4875 (L/849)	4875 (L/728)	4875 (L/637)	4875 (L/566)	4875 (L/509)	4875 (L/463)	4565 (L/425)
	12	4875 (L/967)	4550 (L/725)	4095 (L/580)	3640 (L/483)	3185 (L/414)	2725 (L/362)	2270 (L/322)	1815 (L/290)	1360 (L/264)	900 (L/242)
	14	3030 (L/602)	2405 (L/451)	1780 (L/361)	1155 (L/301)	530 (L/258)	--	--	--	--	--
	16	1385 (L/399)	565 (L/300)	--	--	--	--	--	--	--	--
16	8	4875 (L/2551)	4875 (L/1913)	4875 (L/1531)	4875 (L/1276)	4875 (L/1093)	4875 (L/957)	4875 (L/850)	4875 (L/765)	4875 (L/696)	4875 (L/638)
	9	4875 (L/1767)	4875 (L/1325)	4875 (L/1060)	4875 (L/883)	4875 (L/757)	4875 (L/663)	4875 (L/589)	4875 (L/530)	4875 (L/482)	4875 (L/442)
	10	4875 (L/1274)	4875 (L/955)	4875 (L/764)	4875 (L/637)	4875 (L/546)	4875 (L/478)	4565 (L/425)	4145 (L/382)	3725 (L/347)	3310 (L/318)
	12	4550 (L/725)	3945 (L/544)	3335 (L/435)	2725 (L/362)	2120 (L/311)	1510 (L/272)	900 (L/242)	295 (L/217)	--	--
	14	2405 (L/451)	1570 (L/338)	735 (L/271)	--	--	--	--	--	--	--
	16	565 (L/300)	--	--	--	--	--	--	--	--	--
24	8	4875 (L/1701)	4875 (L/1276)	4875 (L/1020)	4875 (L/850)	4875 (L/729)	4875 (L/638)	4875 (L/567)	4875 (L/510)	4875 (L/464)	4875 (L/425)
	9	4875 (L/1178)	4875 (L/883)	4875 (L/707)	4875 (L/589)	4875 (L/505)	4875 (L/442)	4875 (L/393)	4375 (L/353)	3870 (L/321)	3370 (L/294)
	10	4875 (L/849)	4875 (L/637)	4875 (L/509)	4565 (L/425)	3935 (L/364)	3310 (L/318)	2680 (L/283)	2055 (L/255)	1430 (L/232)	805 (L/212)
	12	3640 (L/483)	2725 (L/362)	1815 (L/290)	900 (L/242)	--	--	--	--	--	--
	14	1155 (L/301)	--	--	--	--	--	--	--	--	--

SI: 1 in = 25.4 mm, 1 psf = 0.0479 kN/m^2

1. Wind pressure provided assumes Exposure Category B, Enclosed Building, Mean Roof Height 30'.
2. Walls constructed with SPF No. 2 R19 Tstud studs and SP top and bottom plates.

Table 7. Allowable (ASD) Compressive Load for Walls Subject to Wind Pressures
(SPF No. 2 R19 Tstud and LVL Top/Bottom Plate)

Stud Spacing (in)	Wall[2] Height (ft)	Allowable Compression Load (lb) and (Deflection Ratio)									
		Components and Cladding Wind Pressure[1] (psf)									
		15	20	25	30	35	40	45	50	55	60
12	8	7070 (L/3401)	7070 (L/2551)	7070 (L/2041)	7070 (L/1701)	7070 (L/1458)	7070 (L/1276)	7070 (L/1134)	7070 (L/1020)	7070 (L/928)	7070 (L/850)
	9	7035 (L/2356)	7035 (L/1767)	7035 (L/1413)	7035 (L/1178)	7035 (L/1010)	7035 (L/883)	7035 (L/785)	6895 (L/707)	6645 (L/642)	6390 (L/589)
	10	6565 (L/1698)	6565 (L/1274)	6565 (L/1019)	6445 (L/849)	6130 (L/728)	5815 (L/637)	5505 (L/566)	5190 (L/509)	4875 (L/463)	4565 (L/425)
	12	5010 (L/967)	4550 (L/725)	4095 (L/580)	3640 (L/483)	3185 (L/414)	2725 (L/362)	2270 (L/322)	1815 (L/290)	1360 (L/264)	900 (L/242)
	14	3030 (L/602)	2405 (L/451)	1780 (L/361)	1155 (L/301)	530 (L/258)	--	--	--	--	--
	16	1385 (L/399)	565 (L/300)	--	--	--	--	--	--	--	--
16	8	7070 (L/2551)	7070 (L/1913)	7070 (L/1531)	7070 (L/1276)	7070 (L/1093)	7070 (L/957)	7070 (L/850)	7070 (L/765)	7070 (L/696)	7070 (L/638)
	9	7035 (L/1767)	7035 (L/1325)	7035 (L/1060)	7035 (L/883)	7035 (L/757)	6730 (L/663)	6390 (L/589)	6055 (L/530)	5720 (L/482)	5385 (L/442)
	10	6565 (L/1274)	6565 (L/955)	6235 (L/764)	5815 (L/637)	5400 (L/546)	4980 (L/478)	4565 (L/425)	4145 (L/382)	3725 (L/347)	3310 (L/318)
	12	4550 (L/725)	3945 (L/544)	3335 (L/435)	2725 (L/362)	2120 (L/311)	1510 (L/272)	900 (L/242)	295 (L/217)	--	--
	14	2405 (L/451)	1570 (L/338)	735 (L/271)	--	--	--	--	--	--	--
	16	565 (L/300)	--	--	--	--	--	--	--	--	--
24	8	7070 (L/1701)	7070 (L/1276)	7070 (L/1020)	7070 (L/850)	7070 (L/729)	7070 (L/638)	6930 (L/567)	6535 (L/510)	6140 (L/464)	5750 (L/425)
	9	7035 (L/1178)	7035 (L/883)	6895 (L/707)	6390 (L/589)	5890 (L/505)	5385 (L/442)	4880 (L/393)	4375 (L/353)	3870 (L/321)	3370 (L/294)
	10	6445 (L/849)	5815 (L/637)	5190 (L/509)	4565 (L/425)	3935 (L/364)	3310 (L/318)	2680 (L/283)	2055 (L/255)	1430 (L/232)	805 (L/212)
	12	3640 (L/483)	2725 (L/362)	1815 (L/290)	900 (L/242)	--	--	--	--	--	--
	14	1155 (L/301)	--	--	--	--	--	--	--	--	--

SI: 1 in = 25.4 mm, 1 psf = 0.0479 kN/m^2

1. Wind pressure provided assumes Exposure Category B, Enclosed Building, Mean Roof Height 30'.
2. Walls constructed with SPF No. 2 R19 Tstud studs and LVL (compression perpendicular to grain is assumed to be 820 psi) top and bottom plates.

Table 8. Allowable (ASD) Compressive Load for Walls Subject to Wind Pressures
(SPF No. 2 R19 Tstud and LSL Top/Bottom Plate)

Stud Spacing (in)	Wall[2] Height (ft)	Allowable Compression Load (lb) and (Deflection Ratio)									
		Components AND Cladding Wind Pressure[1] (psf)									
		15	20	25	30	35	40	45	50	55	60
12	8	6900 (L/3401)	6900 (L/2551)	6900 (L/2041)	6900 (L/1701)	6900 (L/1458)	6900 (L/1276)	6900 (L/1134)	6900 (L/1020)	6900 (L/928)	6900 (L/850)
	9	6900 (L/2356)	6900 (L/1767)	6900 (L/1413)	6900 (L/1178)	6900 (L/1010)	6900 (L/883)	6900 (L/785)	6895 (L/707)	6645 (L/642)	6390 (L/589)
	10	6565 (L/1698)	6565 (L/1274)	6565 (L/1019)	6445 (L/849)	6130 (L/728)	5815 (L/637)	5505 (L/566)	5190 (L/509)	4875 (L/463)	4565 (L/425)
	12	5010 (L/967)	4550 (L/725)	4095 (L/580)	3640 (L/483)	3185 (L/414)	2725 (L/362)	2270 (L/322)	1815 (L/290)	1360 (L/264)	900 (L/242)
	14	3030 (L/602)	2405 (L/451)	1780 (L/361)	1155 (L/301)	530 (L/258)	--	--	--	--	--
	16	1385 (L/399)	565 (L/300)	--	--	--	--	--	--	--	--
16	8	6900 (L/2551)	6900 (L/1913)	6900 (L/1531)	6900 (L/1276)	6900 (L/1093)	6900 (L/957)	6900 (L/850)	6900 (L/765)	6900 (L/696)	6900 (L/638)
	9	6900 (L/1767)	6900 (L/1325)	6900 (L/1060)	6900 (L/883)	6900 (L/757)	6730 (L/663)	6390 (L/589)	6055 (L/530)	5720 (L/482)	5385 (L/442)
	10	6565 (L/1274)	6565 (L/955)	6235 (L/764)	5815 (L/637)	5400 (L/546)	4980 (L/478)	4565 (L/425)	4145 (L/382)	3725 (L/347)	3310 (L/318)
	12	4550 (L/725)	3945 (L/544)	3335 (L/435)	2725 (L/362)	2120 (L/311)	1510 (L/272)	900 (L/242)	295 (L/217)	--	--
	14	2405 (L/451)	1570 (L/338)	735 (L/271)	--	--	--	--	--	--	--
	16	565 (L/300)	--	--	--	--	--	--	--	--	--
24	8	6900 (L/1701)	6900 (L/1276)	6900 (L/1020)	6900 (L/850)	6900 (L/729)	6900 (L/638)	6900 (L/567)	6535 (L/510)	6140 (L/464)	5750 (L/425)
	9	6900 (L/1178)	6900 (L/883)	6895 (L/707)	6390 (L/589)	5890 (L/505)	5385 (L/442)	4880 (L/393)	4375 (L/353)	3870 (L/321)	3370 (L/294)
	10	6445 (L/849)	5815 (L/637)	5190 (L/509)	4565 (L/425)	3935 (L/364)	3310 (L/318)	2680 (L/283)	2055 (L/255)	1430 (L/232)	805 (L/212)
	12	3640 (L/483)	2725 (L/362)	1815 (L/290)	900 (L/242)	--	--	--	--	--	--
	14	1155 (L/301)	--	--	--	--	--	--	--	--	--

SI: 1 in = 25.4 mm, 1 psf = 0.0479 kN/m^2

1. Wind pressure provided assumes Exposure Category B, Enclosed Building, Mean Roof Height 30'.
2. Walls constructed with SPF No. 2 R19 Tstud studs and LSL (compression perpendicular to grain is assumed to be 800 psi) top and bottom plates.

Table 9. Allowable (ASD) Compressive Load for Walls Subject to Wind Pressures
(1650f – 1.5E R19 Tstud and SPF Top/Bottom Plate)

Stud Spacing (in)	Wall[2] Height (ft)	Allowable Compression Load (lb) and (Deflection Ratio)									
		Components and Cladding Wind Pressure[1] (psf)									
		15	20	25	30	35	40	45	50	55	60
12	8	3665 (L/3424)	3665 (L/2568)	3665 (L/2054)	3665 (L/1712)	3665 (L/1467)	3665 (L/1284)	3665 (L/1141)	3665 (L/1027)	3665 (L/934)	3665 (L/856)
	9	3665 (L/2371)	3665 (L/1778)	3665 (L/1423)	3665 (L/1186)	3665 (L/1016)	3665 (L/889)	3665 (L/790)	3665 (L/711)	3665 (L/647)	3665 (L/593)
	10	3665 (L/1710)	3665 (L/1282)	3665 (L/1026)	3665 (L/855)	3665 (L/733)	3665 (L/641)	3665 (L/570)	3665 (L/513)	3665 (L/466)	3665 (L/427)
	12	3665 (L/973)	3665 (L/730)	3665 (L/584)	3665 (L/486)	3520 (L/417)	3060 (L/365)	2605 (L/324)	2150 (L/292)	1690 (L/265)	1235 (L/243)
	14	3205 (L/606)	2580 (L/454)	1955 (L/363)	1325 (L/303)	700 (L/260)	75 (L/227)	--	--	--	--
	16	1485 (L/402)	665 (L/302)	--	--	--	--	--	--	--	--
16	8	3665 (L/2568)	3665 (L/1926)	3665 (L/1541)	3665 (L/1284)	3665 (L/1101)	3665 (L/963)	3665 (L/856)	3665 (L/770)	3665 (L/700)	3665 (L/642)
	9	3665 (L/1778)	3665 (L/1334)	3665 (L/1067)	3665 (L/889)	3665 (L/762)	3665 (L/667)	3665 (L/593)	3665 (L/534)	3665 (L/485)	3665 (L/445)
	10	3665 (L/1282)	3665 (L/962)	3665 (L/769)	3665 (L/641)	3665 (L/549)	3665 (L/481)	3665 (L/427)	3665 (L/385)	3665 (L/350)	3665 (L/321)
	12	3665 (L/730)	3665 (L/547)	3665 (L/438)	3060 (L/365)	2455 (L/313)	1845 (L/274)	1235 (L/243)	630 (L/219)	20 (L/199)	--
	14	2580 (L/454)	1745 (L/341)	910 (L/272)	75 (L/227)	--	--	--	--	--	--
	16	665 (L/302)	--	--	--	--	--	--	--	--	--
24	8	3665 (L/1712)	3665 (L/1284)	3665 (L/1027)	3665 (L/856)	3665 (L/734)	3665 (L/642)	3665 (L/571)	3665 (L/514)	3665 (L/467)	3665 (L/428)
	9	3665 (L/1186)	3665 (L/889)	3665 (L/711)	3665 (L/593)	3665 (L/508)	3665 (L/445)	3665 (L/395)	3665 (L/356)	3665 (L/323)	3665 (L/296)
	10	3665 (L/855)	3665 (L/641)	3665 (L/513)	3665 (L/427)	3665 (L/366)	3665 (L/321)	3415 (L/285)	2790 (L/256)	2160 (L/233)	1535 (L/214)
	12	3665 (L/486)	3060 (L/365)	2150 (L/292)	1235 (L/243)	325 (L/208)	--	--	--	--	--
	14	1325 (L/303)	75 (L/227)	--	--	--	--	--	--	--	--

SI: 1 in = 25.4 mm, 1 psf = 0.0479 kN/m^2

1. Wind pressure provided assumes Exposure Category B, Enclosed Building, Mean Roof Height 30'.
2. Walls constructed with 1650f – 1.5E R19 Tstud studs and SPF top and bottom plates.

Table 10. Allowable (ASD) Compressive Load for Walls Subject to Wind Pressures
(1650f – 1.5E R19 Tstud and SP Top/Bottom Plate)

Stud Spacing (in)	Wall[2] Height (ft)	Allowable Compression Load (lb) and (Deflection Ratio)									
		Components and Cladding Wind Pressure[1] (psf)									
		15	20	25	30	35	40	45	50	55	60
12	8	4875 (L/3424)	4875 (L/2568)	4875 (L/2054)	4875 (L/1712)	4875 (L/1467)	4875 (L/1284)	4875 (L/1141)	4875 (L/1027)	4875 (L/934)	4875 (L/856)
	9	4875 (L/2371)	4875 (L/1778)	4875 (L/1423)	4875 (L/1186)	4875 (L/1016)	4875 (L/889)	4875 (L/790)	4875 (L/711)	4875 (L/647)	4875 (L/593)
	10	4875 (L/1710)	4875 (L/1282)	4875 (L/1026)	4875 (L/855)	4875 (L/733)	4875 (L/641)	4875 (L/570)	4875 (L/513)	4875 (L/466)	4875 (L/427)
	12	4875 (L/973)	4875 (L/730)	4430 (L/584)	3975 (L/486)	3520 (L/417)	3060 (L/365)	2605 (L/324)	2150 (L/292)	1690 (L/265)	1235 (L/243)
	14	3205 (L/606)	2580 (L/454)	1955 (L/363)	1325 (L/303)	700 (L/260)	75 (L/227)	--	--	--	--
	16	1485 (L/402)	665 (L/302)	--	--	--	--	--	--	--	--
16	8	4875 (L/2568)	4875 (L/1926)	4875 (L/1541)	4875 (L/1284)	4875 (L/1101)	4875 (L/963)	4875 (L/856)	4875 (L/770)	4875 (L/700)	4875 (L/642)
	9	4875 (L/1778)	4875 (L/1334)	4875 (L/1067)	4875 (L/889)	4875 (L/762)	4875 (L/667)	4875 (L/593)	4875 (L/534)	4875 (L/485)	4875 (L/445)
	10	4875 (L/1282)	4875 (L/962)	4875 (L/769)	4875 (L/641)	4875 (L/549)	4875 (L/481)	4875 (L/427)	4875 (L/385)	4460 (L/350)	4045 (L/321)
	12	4875 (L/730)	4280 (L/547)	3670 (L/438)	3060 (L/365)	2455 (L/313)	1845 (L/274)	1235 (L/243)	630 (L/219)	20 (L/199)	--
	14	2580 (L/454)	1745 (L/341)	910 (L/272)	75 (L/227)	--	--	--	--	--	--
	16	665 (L/302)	--	--	--	--	--	--	--	--	--
24	8	4875 (L/1712)	4875 (L/1284)	4875 (L/1027)	4875 (L/856)	4875 (L/734)	4875 (L/642)	4875 (L/571)	4875 (L/514)	4875 (L/467)	4875 (L/428)
	9	4875 (L/1186)	4875 (L/889)	4875 (L/711)	4875 (L/593)	4875 (L/508)	4875 (L/445)	4875 (L/395)	4875 (L/356)	4875 (L/323)	4475 (L/296)
	10	4875 (L/855)	4875 (L/641)	4875 (L/513)	4875 (L/427)	4670 (L/366)	4045 (L/321)	3415 (L/285)	2790 (L/256)	2160 (L/233)	1535 (L/214)
	12	3975 (L/486)	3060 (L/365)	2150 (L/292)	1235 (L/243)	325 (L/208)	--	--	--	--	--
	14	1325 (L/303)	75 (L/227)	--	--	--	--	--	--	--	--

SI: 1 in = 25.4 mm, 1 psf = 0.0479 kN/m^2

1. Wind pressure provided assumes Exposure Category B, Enclosed Building, Mean Roof Height 30'.
2. Walls constructed with 1650f – 1.5E R19 Tstud studs and SP top and bottom plates.

Table 11. Allowable (ASD) Compressive Load for Walls Subject to Wind Pressures
(1650f – 1.5E R19 Tstud and LVL Top/Bottom Plate)

Stud Spacing (in)	Wall[2] Height (ft)	Allowable Compression Load (lb) and (Deflection Ratio)									
		Components and Cladding Wind Pressure[1] (psf)									
		15	20	25	30	35	40	45	50	55	60
12	8	7070 (L/3424)	7070 (L/2568)	7070 (L/2054)	7070 (L/1712)	7070 (L/1467)	7070 (L/1284)	7070 (L/1141)	7070 (L/1027)	7070 (L/934)	7070 (L/856)
	9	7070 (L/2371)	7070 (L/1778)	7070 (L/1423)	7070 (L/1186)	7070 (L/1016)	7070 (L/889)	7070 (L/790)	7070 (L/711)	7070 (L/647)	7070 (L/593)
	10	7070 (L/1710)	7070 (L/1282)	7070 (L/1026)	7070 (L/855)	6865 (L/733)	6550 (L/641)	6240 (L/570)	5925 (L/513)	5610 (L/466)	5300 (L/427)
	12	5345 (L/973)	4885 (L/730)	4430 (L/584)	3975 (L/486)	3520 (L/417)	3060 (L/365)	2605 (L/324)	2150 (L/292)	1690 (L/265)	1235 (L/243)
	14	3205 (L/606)	2580 (L/454)	1955 (L/363)	1325 (L/303)	700 (L/260)	75 (L/227)	--	--	--	--
	16	1485 (L/402)	665 (L/302)	--	--	--	--	--	--	--	--
16	8	7070 (L/2568)	7070 (L/1926)	7070 (L/1541)	7070 (L/1284)	7070 (L/1101)	7070 (L/963)	7070 (L/856)	7070 (L/770)	7070 (L/700)	7070 (L/642)
	9	7070 (L/1778)	7070 (L/1334)	7070 (L/1067)	7070 (L/889)	7070 (L/762)	7070 (L/667)	7070 (L/593)	7070 (L/534)	6830 (L/485)	6495 (L/445)
	10	7070 (L/1282)	7070 (L/962)	6970 (L/769)	6550 (L/641)	6135 (L/549)	5715 (L/481)	5300 (L/427)	4880 (L/385)	4460 (L/350)	4045 (L/321)
	12	4885 (L/730)	4280 (L/547)	3670 (L/438)	3060 (L/365)	2455 (L/313)	1845 (L/274)	1235 (L/243)	630 (L/219)	20 (L/199)	--
	14	2580 (L/454)	1745 (L/341)	910 (L/272)	75 (L/227)	--	--	--	--	--	--
	16	665 (L/302)	--	--	--	--	--	--	--	--	--
24	8	7070 (L/1712)	7070 (L/1284)	7070 (L/1027)	7070 (L/856)	7070 (L/734)	7070 (L/642)	7070 (L/571)	7070 (L/514)	7070 (L/467)	7070 (L/428)
	9	7070 (L/1186)	7070 (L/889)	7070 (L/711)	7070 (L/593)	6995 (L/508)	6495 (L/445)	5990 (L/395)	5485 (L/356)	4980 (L/323)	4475 (L/296)
	10	7070 (L/855)	6550 (L/641)	5925 (L/513)	5300 (L/427)	4670 (L/366)	4045 (L/321)	3415 (L/285)	2790 (L/256)	2160 (L/233)	1535 (L/214)
	12	3975 (L/486)	3060 (L/365)	2150 (L/292)	1235 (L/243)	325 (L/208)	--	--	--	--	--
	14	1325 (L/303)	75 (L/227)	--	--	--	--	--	--	--	--

SI: 1 in = 25.4 mm, 1 psf = 0.0479 kN/m^2

1. Wind pressure provided assumes Exposure Category B, Enclosed Building, Mean Roof Height 30'.
2. Walls constructed with 1650f – 1.5E R19 Tstud studs and LVL (compression perpendicular to grain is assumed to be 820 psi) top and bottom plates.

Table 12. Allowable (ASD) Compressive Load for Walls Subject to Wind Pressures
(1650f – 1.5E R19 Tstud and LSL Top/Bottom Plate)

Stud Spacing (in)	Wall[2] Height (ft)	Allowable Compression Load (lb) and (Deflection Ratio)									
		Components and Cladding Wind Pressure[1] (psf)									
		15	20	25	30	35	40	45	50	55	60
12	8	6900 (L/3424)	6900 (L/2568)	6900 (L/2054)	6900 (L/1712)	6900 (L/1467)	6900 (L/1284)	6900 (L/1141)	6900 (L/1027)	6900 (L/934)	6900 (L/856)
	9	6900 (L/2371)	6900 (L/1778)	6900 (L/1423)	6900 (L/1186)	6900 (L/1016)	6900 (L/889)	6900 (L/790)	6900 (L/711)	6900 (L/647)	6900 (L/593)
	10	6900 (L/1710)	6900 (L/1282)	6900 (L/1026)	6900 (L/855)	6865 (L/733)	6550 (L/641)	6240 (L/570)	5925 (L/513)	5610 (L/466)	5300 (L/427)
	12	5345 (L/973)	4885 (L/730)	4430 (L/584)	3975 (L/486)	3520 (L/417)	3060 (L/365)	2605 (L/324)	2150 (L/292)	1690 (L/265)	1235 (L/243)
	14	3205 (L/606)	2580 (L/454)	1955 (L/363)	1325 (L/303)	700 (L/260)	75 (L/227)	--	--	--	--
	16	1485 (L/402)	665 (L/302)	--	--	--	--	--	--	--	--
16	8	6900 (L/2568)	6900 (L/1926)	6900 (L/1541)	6900 (L/1284)	6900 (L/1101)	6900 (L/963)	6900 (L/856)	6900 (L/770)	6900 (L/700)	6900 (L/642)
	9	6900 (L/1778)	6900 (L/1334)	6900 (L/1067)	6900 (L/889)	6900 (L/762)	6900 (L/667)	6900 (L/593)	6900 (L/534)	6830 (L/485)	6495 (L/445)
	10	6900 (L/1282)	6900 (L/962)	6900 (L/769)	6550 (L/641)	6135 (L/549)	5715 (L/481)	5300 (L/427)	4880 (L/385)	4460 (L/350)	4045 (L/321)
	12	4885 (L/730)	4280 (L/547)	3670 (L/438)	3060 (L/365)	2455 (L/313)	1845 (L/274)	1235 (L/243)	630 (L/219)	20 (L/199)	--
	14	2580 (L/454)	1745 (L/341)	910 (L/272)	75 (L/227)	--	--	--	--	--	--
	16	665 (L/302)	--	--	--	--	--	--	--	--	--
24	8	6900 (L/1712)	6900 (L/1284)	6900 (L/1027)	6900 (L/856)	6900 (L/734)	6900 (L/642)	6900 (L/571)	6900 (L/514)	6900 (L/467)	6900 (L/428)
	9	6900 (L/1186)	6900 (L/889)	6900 (L/711)	6900 (L/593)	6900 (L/508)	6495 (L/445)	5990 (L/395)	5485 (L/356)	4980 (L/323)	4475 (L/296)
	10	6900 (L/855)	6550 (L/641)	5925 (L/513)	5300 (L/427)	4670 (L/366)	4045 (L/321)	3415 (L/285)	2790 (L/256)	2160 (L/233)	1535 (L/214)
	12	3975 (L/486)	3060 (L/365)	2150 (L/292)	1235 (L/243)	325 (L/208)	--	--	--	--	--
	14	1325 (L/303)	75 (L/227)	--	--	--	--	--	--	--	--

SI: 1 in = 25.4 mm, 1 psf = 0.0479 kN/m2

1. Wind pressure provided assumes Exposure Category B, Enclosed Building, Mean Roof Height 30'.
2. Walls constructed with 1650f – 1.5E R19 Tstud studs and LSL (compression perpendicular to grain is assumed to be 800 psi) top and bottom plates.

Table 13. Allowable Loads for R19 Tstud Used as Headers[1,2,3]

Number of Members	Allowable Load (plf) and (Deflection Ratio)						
	Span (ft)						
	3	4	5	6	7	8	9
1	304 (L/356)	171 (L/267)	97 (L/240)	56 (L/240)	35 (L/240)	24 (L/240)	17 (L/240)
2	608 (L/356)	342 (L/267)	194 (L/240)	113 (L/240)	71 (L/240)	47 (L/240)	33 (L/240)
3	911 (L/356)	513 (L/267)	292 (L/240)	169 (L/240)	106 (L/240)	71 (L/240)	50 (L/240)
4	1215 (L/356)	684 (L/267)	389 (L/240)	225 (L/240)	142 (L/240)	95 (L/240)	67 (L/240)
5	1519 (L/356)	854 (L/267)	486 (L/240)	281 (L/240)	177 (L/240)	119 (L/240)	83 (L/240)
6	1823 (L/356)	1025 (L/267)	583 (L/240)	338 (L/240)	213 (L/240)	142 (L/240)	100 (L/240)
7	2127 (L/356)	1196 (L/267)	681 (L/240)	394 (L/240)	248 (L/240)	166 (L/240)	117 (L/240)

SI: 1 in = 25.4 mm

1. Table values are based on R19 Tstud of No. 2 SPF lumber
2. Table values are based on a load duration factor of 1.0
3. Deflection checks of L/360 for live load and L/240 for total load are based on a live load to dead load ratio of 2:1.

6.2.6 *Use of R19 Tstud in Shear Walls:*

6.2.6.1 R19 Tstud used in wall assemblies designed as shear walls are permitted to be designed in accordance with the methodology used in SDPWS for WSP using the seismic parameters shown in **Table 14**.

6.2.6.1.1 The response modification coefficient, R; system overstrength factor, Ω_0; and deflection amplification factor, C_d, indicated in **Table 14** shall be used to determine the base shear, element design forces, and design story drift in accordance with ASCE 7 Chapter 12 and Section 14.5.

Table 14. Seismic Design Coefficients for R19 Tstud Shear Walls

Wall System	Response Modification Coefficient,[1] R	Overstrength Factor,[2] Ω_0	Deflection Amplification Factor,[3] C_d	Structural Height Limits[4] (ft)				
				Seismic Design Category				
				B	C	D	E	F
R19 Tstud Framed Walls Sheathed with Wood Structural Panels Rated for Shear Resistance	6.5	3	4	NL	NL	65	65	65

SI: 1 in = 25.4 mm, 1 lb/ft = 0.0146 kN/m

1. Response modification coefficient, R, for use throughout ASCE 7.
2. The tabulated value of the overstrength factor, Ω_0, is permitted to be reduced by subtracting one-half (0.5) for structures with flexible diaphragms.
3. Deflection amplification factor, C_d, for use with ASCE 7 Section 12.8.6, 12.8.7, and 12.9.2.
4. NL = Not Limited. Heights are measured from the base of the structure as defined in ASCE 7 Section 11.2.

6.3 Where the application falls outside of the performance evaluation, conditions of use and/or installation requirements set forth herein, alternative techniques shall be permitted in accordance with accepted engineering practice and experience. This includes but is not limited to the following areas of engineering: mechanics or materials, structural, building science and fire science.

7 Certified Performance[22]

7.1 All construction methods shall conform to accepted engineering practices to ensure durable, livable, and safe construction and shall demonstrate acceptable workmanship reflecting journeyman quality of work of the various trades.[23]

7.2 The strength and rigidity of the component parts and/or the integrated structure shall be determined by engineering analysis or by suitable load tests to simulate the actual loads and conditions of application that occur.[24]

8 Regulatory Evaluation and Accepted Engineering Practice

8.1 R19 Tstud Structural Insulated Wall Stud complies with the following legislatively adopted regulations and/or accepted engineering practice for the following reasons:

8.1.1 R19 Tstud was evaluated to determine its applicability for use as an alternative material where nominal 2 x 4 and 2 x 6 solid sawn lumber is specified in accordance with the IBC and IRC including use as wall studs, top and bottom wall plates, and headers.

8.1.2 R19 Tstud testing and analysis was conducted to determine its compression, flexural strengths and flexural stiffness.

8.2 This report examines R19 Tstud for the following:

8.2.1 Use as an alternative material to that described in IBC Chapter 23, in particular, compliance with requirements for the design and construction of wood-based products as described in IBC Section 2301.2 for ASD.

8.2.2 Structural performance under lateral load conditions for use with the IBC performance-based provisions, IBC Section 2306.1 and IBC Section 2306.3, for light-frame wood wall assemblies.

8.2.2.1 **Table 14** provides Seismic Design Coefficients (SDC) that conform to the requirements in ASCE 7 Section 12.2.1 and Table 12.2-1 for design of wall assemblies in buildings that require seismic design in accordance with ASCE 7 (i.e., all seismic design categories).

8.2.2.2 The basis for equivalency testing is outlined in Section 12.2.1 of ASCE 7:

> **12.2.1.1 Alternative Structural Systems.** Use of seismic force-resisting systems not contained in Table 12.2-1 shall be permitted contingent on submittal to and approval by the Authority Having Jurisdiction and independent structural design review of an accompanying set of design criteria and substantiating analytical and test data. The design criteria shall specify any limitations on system use, including Seismic Design Category and height; required procedures for designing the system's components and connections; required detailing; and the values of the response modification coefficient, R; overstrength factor, Ω_0; and deflection amplification factor, C_d.

8.2.3 Structural performance under lateral load conditions for use as an alternative to SDPWS Section 4.3 Wood Frame Shear Walls.

8.2.4 Compliance with IBC Section 2308, IBC Section 2304 and IRC Chapter 6 for conventional light-frame construction applications.

8.2.5 Use as an alternative material and method of construction as permitted in accordance with IBC Section 104.11 and IRC Section R104.11.

8.2.6 When used in an application that exceeds the limits of IBC Section 2308 or IRC Section R301, an engineered design shall be submitted in accordance with IRC Section R301.1.3 and this report.

8.3 Any building code, regulation and/or accepted engineering evaluations (i.e., research reports, duly authenticated reports, etc.) that are conducted for this Listing were performed by DrJ Engineering, LLC (DrJ), an ISO/IEC 17065 accredited certification body and a professional engineering company operated by RDP/approved sources. DrJ is qualified[25] to practice product and regulatory compliance services within its scope of accreditation and engineering expertise, respectively.

8.4 Engineering evaluations are conducted with DrJ's ANAB accredited ICS code scope of expertise, which are also its areas of professional engineering competence.

8.5 Any regulation specific issues not addressed in this section are outside the scope of this report.

9 Installation

9.1 Installation shall comply with the approved construction documents, the manufacturer installation instructions, this report and the applicable building code.

9.2 In the event of a conflict between the manufacturer installation instructions and this report, the more restrictive shall govern.

9.3 *Installation Procedure*

9.3.1 R19 Tstud is pre-assembled and designed to be used as a direct replacement of nominal 2 x 4 (38 mm x 89 mm) solid sawn lumber, and in most cases, but not all, nominal 2 x 6 (38 mm x 140 mm) solid sawn lumber, as wall studs, top and bottom plates and headers.

9.3.1.1 For use as a 2 x 6, design shall be permitted in accordance with accepted engineering procedures, experience and technical judgment. In these cases, referenced design values as specified in **Table 2** shall be used in accordance with IBC Section 2308 and IRC Section R602.

9.3.2 Install R19 Tstud in the same manner as solid sawn lumber, except as noted herein.

9.3.2.1 For IBC Section 2308 and IRC Section R602, installation shall be in accordance with the provisions therein, except as noted in this report.

9.3.2.2 For engineered design, walls shall be designed in accordance with the applicable codes in IBC, IRC and the referenced standards therein using the material properties and design limitations as noted in **Section 6**.

9.3.2.3 Design of connections using R19 Tstud shall be in accordance with NDS.

9.3.3 *Anchorage:*

9.3.3.1 Stand walls and set into correct position. Ensure anchor bolts in foundation penetrate the center of the foam in the R19 Tstud bottom plate.

9.3.3.2 Place metal plate over anchor bolts and fasten with a washer and nut. Once nut is tightened and the wall has been sufficiently anchored tight to the sill plate, drive four (4) #12 x $2^1/_2$" (0.216" dia.) screws (two screws in each wood member) into the pre-drilled holes in the metal plate.

10 Substantiating Data

10.1 Testing has been performed under the supervision of a professional engineer and/or under the requirements of ISO/IEC 17025 as follows:

10.1.1 Compressive load testing of R19 Tstud in accordance with ASTM E72

10.1.2 Bending tests in accordance with ASTM D198

10.1.3 Bending tests of R19 Tstud top plates

10.1.4 Lateral load resistance in accordance with ASTM E2126

10.2 Information contained herein may include the result of testing and/or data analysis by sources that are approved agencies, approved sources and/or RDPs. Accuracy of external test data and resulting analysis is relied upon.

10.3 Where applicable, testing and/or engineering analysis are based upon provisions that have been codified into law through state or local adoption of regulations and standards. The developers of these regulations and standards are responsible for the reliability of published content. DrJ's engineering practice may use a regulation-adopted provision as the control. A regulation-endorsed control versus a simulation of the conditions of application to occur establishes a new material as being equivalent to the regulatory provision in terms of quality, strength, effectiveness, fire resistance, durability and safety.

10.4 The accuracy of the provisions provided herein may be reliant upon the published properties of raw materials, which are defined by the grade mark, grade stamp, mill certificate or duly authenticated reports from approved agencies and/or approved sources provided by the supplier. These are presumed to be minimum properties and relied upon to be accurate. The reliability of DrJ's engineering practice, as contained in this duly authenticated report, may be dependent upon published design properties by others.

10.5 Testing and engineering analysis: The strength, rigidity, and/or general performance of component parts and/or the integrated structure are determined by suitable tests that simulate the actual conditions of application that occur and/or by accepted engineering practice and experience.[26]

10.6 Where additional condition of use and/or regulatory compliance information is required, please search for R19 Tstud on the DrJ Certification website.

11 Findings

11.1 As outlined in **Section 6**, R19 Tstud has performance characteristics that were tested and/or meet applicable regulations and is suitable for use pursuant to its specified purpose.

11.2 When used and installed in accordance with this duly authenticated report and the manufacturer installation instructions, R19 Tstud shall be approved for the following applications:

11.2.1 R19 Tstud insulated wall studs installed as framing members in walls as described in this report, are compliant with the codes listed in **Section 4** and are approved for use as an alternative to nominal 2 x 4 (38 mm x 89 mm) solid sawn lumber in all cases, and 2 x 6 (38 mm x 140 mm) solid sawn lumber in most cases for wall structural members.

11.2.2 For use as a 2 x 6, design shall be permitted in accordance with accepted engineering procedures, experience and technical judgment. In these cases, referenced design values as specified in **Table 2** shall be used in accordance with IBC Section 2308 and IRC Section R602.

11.3 Unless exempt by state statute, when R19 Tstud is to be used as a structural and/or building envelope component in the design of a specific building, the design shall be performed by an RDP.

11.4 Any application specific issues not addressed herein can be engineered by an RDP. Assistance with engineering is available from Envirobon, Inc.

11.5 IBC Section 104.11 (IRC Section R104.11 and IFC Section 104.10[27] are similar) in pertinent part states:

> **104.11 Alternative materials, design and methods of construction and equipment.** The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code. Where the alternative material, design or method of construction is not approved, the building official shall respond in writing, stating the reasons the alternative was not approved.

11.6 **Approved**:[28] Building regulations require that the building official shall accept duly authenticated reports.[29]

11.6.1 An approved agency is *"approved"* when it is ANAB ISO/IEC 17065 accredited.

11.6.2 An approved source is *"approved"* when an RDP is properly licensed to transact engineering commerce.

11.6.3 Federal law, Title 18 US Code Section 242, requires that where the alternative product, material, service, design, assembly and/or method of construction is not approved, the building official shall respond in writing, stating the reasons why the alternative was not approved. Denial without written reason deprives a protected right to free and fair competition in the marketplace.

11.7 DrJ is a licensed engineering company, employs licensed RDPs and is an ANAB-Accredited Product Certification Body – Accreditation #1131.

11.8 Through the IAF Multilateral Agreements (MLA), this duly authenticated report can be used to obtain product approval in any jurisdiction or country because all ANAB ISO/IEC 17065 duly authenticated reports are equivalent.[30]

12 Conditions of Use

12.1 Material properties shall not fall outside the boundaries defined in **Section 6**.

12.2 As defined in **Section 6**, where material and/or engineering mechanics properties are created for load resisting design purposes, the resistance to the applied load shall not exceed the ability of the defined properties to resist those loads using the principles of accepted engineering practice.

12.3 As listed herein, R19 Tstud shall not be used:

12.3.1 If walls exceed the maximum wall height for R19 Tstud which is 16' (3.05 m)

12.4 Increases for duration of load shall be in accordance with the limitations of the applicable building code for sawn lumber.

12.5 Creep factors applicable to sawn lumber may be applied to this product, in accordance with the applicable building code.

12.6 Where R19 Tstud is used as a top plate, a separate means of fireblocking shall be provided in accordance with IBC Section 718 and IRC Section R302.11.

12.7 When required by adopted legislation and enforced by the building official, also known as the authority having jurisdiction (AHJ) in which the project is to be constructed:

12.7.1 Any calculations incorporated into the construction documents shall conform to accepted engineering practice and, when prepared by an approved source, shall be approved when signed and sealed.

12.7.2 This report and the installation instructions shall be submitted at the time of permit application.

12.7.3 This innovative product has an internal quality control program and a third-party quality assurance program.

12.7.4 At a minimum, this innovative product shall be installed per **Section 9** of this report.

12.7.5 The review of this report by the AHJ shall comply with IBC Section 104 and IBC Section 105.4.

12.7.6 This innovative product has an internal quality control program and a third party quality assurance program in accordance with IBC Section 104.4, IBC Section 110.4, IBC Section 1703, IRC Section R104.4 and IRC Section R109.2.

12.7.7 The application of this innovative product in the context of this report is dependent upon the accuracy of the construction documents, implementation of installation instructions, inspection as required by IBC Section 110.3, IRC Section R109.2 and any other regulatory requirements that may apply.

12.8 The approval of this report by the AHJ shall comply with IBC Section 1707.1, where legislation states in part, "*the building official shall accept duly authenticated reports from approved agencies in respect to the quality and manner of use of new material or assemblies as provided for in Section 104.11*," all of IBC Section 104, and IBC Section 105.4.

12.9 Design loads shall be determined in accordance with the regulations adopted by the jurisdiction in which the project is to be constructed and/or by the building designer (i.e., owner or RDP).

12.10 The actual design, suitability, and use of this report for any particular building, is the responsibility of the owner or the authorized agent of the owner.

13 Identification

13.1 The innovative product listed in **Section 1.1** is identified by a label on the board or packaging material bearing the manufacturer name, product name, this report number and other information to confirm code compliance.

13.2 Additional technical information can be found at www.envirobon.com.

14 Review Schedule

14.1 This report is subject to periodic review and revision. For the latest version, visit drjcertification.org.

14.2 For information on the status of this report, please contact DrJ Certification.

Notes

1 For more information, visit drjcertification.org or call us at 608-310-6748.

2 https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1702

3 Alternative Materials, Design and Methods of Construction and Equipment: The provisions of any regulation code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by a regulation. Please review https://www.justice.gov/atr/mission and https://up.codes/viewer/colorado/ibc-2021/chapter/1/scope-and-administration#104.11

4 https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1706:~:text=the%20design%20strengths%20and%20permissible%20stresses%20shall%20be%20established%20by%20tests%20as

5 The design strengths and permissible stresses of any structural material shall conform to the specifications and methods of design of accepted engineering practice. https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1706:~:text=shall%20conform%20to%20the%20specifications%20and%20methods%20of%20design%20of%20accepted%20engineering%20practice

6 https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1707.1:~:text=the%20building%20official%20shall%20accept%20duly%20authenticated%20reports%20from%20approved%20agencies

7 https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1703.4.2

8 https://up.codes/viewer/wyoming/ibc-2021/chapter/2/definitions#approved_agency

9 https://up.codes/viewer/wyoming/ibc-2021/chapter/2/definitions#approved_source

10 https://www.law.cornell.edu/uscode/text/18/1832 (b) Any organization that commits any offense described in subsection (a) shall be fined not more than the greater of $5,000,000 or 3 times the value of the stolen trade secret to the organization, including expenses for research and design and other costs of reproducing the trade secret that the organization has thereby avoided. The federal government and each state have a public records act. To follow DTSA and comply state public records and trade secret legislation requires approval through ANAB ISO/IEC 17065 accredited certification bodies or approved sources. For more information, please review this website: Intellectual Property and Trade Secrets.

11 https://www.nspe.org/resources/issues-and-advocacy/professional-policies-and-position-statements/regulation-professional AND https://apassociation.org/list-of-engineering-boards-in-each-state-archive/

12 https://www.cbitest.com/accreditation/

13 https://up.codes/viewer/colorado/ibc-2021/chapter/1/scope-and-administration#104:~:text=to%20enforce%20the%20provisions%20of%20this%20code

14 https://up.codes/viewer/colorado/ibc-2021/chapter/1/scope-and-administration#104.11:~:text=Where%20the%20alternative%20material%2C%20design%20or%20method%20of%20construction%20is%20not%20approved%2C%20the%20building%20official%20shall%20respond%20in%20writing%2C%20stating%20the%20reasons%20why%20the%20alternative%20was%20not%20approved AND https://up.codes/viewer/colorado/ibc-2021/chapter/1/scope-and-administration#105.3.1:~:text=If%20the%20application%20or%20the%20construction%20documents%20do%20not%20conform%20to%20the%20requirements%20of%20pertinent%20laws%2C%20the%20building%20official%20shall%20reject%20such%20application%20in%20writing%2C%20stating%20the%20reasons%20therefore

15 https://up.codes/viewer/colorado/ibc-2021/chapter/17/special-inspections-and-tests#1707.1:~:text=the%20building%20official%20shall%20accept%20duly%20authenticated%20reports%20from%20approved%20agencies%20in%20respect%20to%20the%20quality%20and%20manner%20of%20use%20of%20new%20materials%20or%20assemblies%20as%20provided%20for%20in%20Section%20104.11

16 https://iaf.nu/en/about-iaf-mla/#:~:text=it%20is%20required%20to%20recognise%20certificates%20and%20validation%20and%20verification%20statements%20issued%20by%20conformity%20assessment%20bodies%20accredited%20by%20all%20other%20signatories%20of%20the%20IAF%20MLA%2C%20with%20the%20appropriate%20scope

17 True for all ANAB accredited product evaluation agencies and all International Trade Agreements.

18 https://www.justice.gov/crt/deprivation-rights-under-color-law AND https://www.justice.gov/atr/mission

19 Unless otherwise noted, all references in this Listing are from the 2021 version of the codes and the standards referenced therein. This material, product, design, service and/or method of construction also complies with the 2000-2021 versions of the referenced codes and the standards referenced therein.

20 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#p-3280.2(Listed%20or%20certified); https://up.codes/viewer/colorado/ibc-2021/chapter/2/definitions#listed AND https://up.codes/viewer/colorado/ibc-2021/chapter/2/definitions#labeled

21 2015 IBC Section 2301.2

22 https://up.codes/viewer/colorado/ibc-2021/chapter/17/special-inspections-and-tests#1703.4

23 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#:~:text=All%20construction%20methods%20shall%20be%20in%20conformance%20with%20accepted%20engineering%20practices%20to%20insure%20durable%2C%20livable%2C%20and%20safe%20housing%20and%20shall%20demonstrate%20acceptable%20workmanship%20reflecting%20journeyman%20quality%20of%20work%20of%20the%20various%20trades

24 https://www.ecfr.gov/current/title-24/subtitle-B/chapter-XX/part-3280#:~:text=The%20strength%20and%20rigidity%20of%20the%20component%20parts%20and/or%20the%20integrated%20structure%20shall%20be%20determined%20by%20engineering%20analysis%20or%20by%20suitable%20load%20tests%20to%20simulate%20the%20actual%20loads%20and%20conditions%20of%20application%20that%20occur

25 Qualification is performed by a legislatively defined Accreditation Body. ANSI National Accreditation Board (ANAB) is the largest independent accreditation body in North America and provides services in more than 75 countries. DrJ is an ANAB accredited product certification body.

26 See Code of Federal Regulations (CFR) Title 24 Subtitle B Chapter XX Part 3280 for definition.

27 2018 IFC Section 104.9

28 Approved is an adjective that modifies the noun after it. For example, Approved Agency means that the Agency is accepted officially as being suitable in a particular situation. This example conforms to IBC/IRC/IFC Section 201.4 where the building code authorizes sentences to have an ordinarily accepted meaning such as the context implies.

29 https://up.codes/viewer/wyoming/ibc-2021/chapter/17/special-inspections-and-tests#1707.1

30 Multilateral approval is true for all ANAB accredited product evaluation agencies and all International Trade Agreements.