

2021 Virginia Construction Code

CHAPTER 23 WOOD

SECTION 2305 GENERAL DESIGN REQUIREMENTS FOR LATERAL FORCE-RESISTING SYSTEMS

2305.1 General.

Structures using wood-frame *shear walls* or wood-framed *diaphragms* to resist wind, seismic or other lateral loads shall be designed and constructed in accordance with [AWC SDPWS](#) and the applicable provisions of [Sections 2305, 2306](#) and [2307](#).

2305.1.1 Openings in shear panels.

Openings in shear panels that materially affect their strength shall be detailed on the plans and shall have their edges adequately reinforced to transfer all shearing stresses.

2305.2 Diaphragm deflection.

The deflection of wood-framed *diaphragms* shall be determined in accordance with [AWC SDPWS](#). The deflection (Δ_{dia}) of a blocked wood structural panel diaphragm uniformly fastened throughout with staples is permitted to be calculated in accordance with [Equation 23-1](#). If not uniformly fastened, the constant 0.188 (For SI: 1/1627) in the third term shall be modified by an approved method.

$$\Delta_{dia} = 5vL^3/8EAW + vL/4Gt + 0.188Le_n + \sum(x\Delta_c)/2W$$

For SI: $\Delta_{dia} = 0.052 vL^3/ EAW + vL/4 Gt + Le_n/1627 + \sum(x\Delta_c)/2 W$

(Equation 23-1)

where:

A = Area of chord cross section, in square inches (mm²).

E = Modulus of elasticity of *diaphragm* chords, in pounds per square inch (N/mm²).

e_n = Staple slip, in inches (mm) [see [Table 2305.2\(1\)](#)].

Gt = Panel rigidity through the thickness, in pounds per inch (N/mm) of panel width or depth [see [Table 2305.2\(2\)](#)].

L = *Diaphragm* length (dimension perpendicular to the direction of the applied load), in feet (mm).

v = Induced unit shear in pounds per linear foot (plf) (N/mm).

W = *Diaphragm* width [in the direction of applied force, in feet (mm)].

x = Distance from chord splice to nearest support, in feet (mm).

Δ_c = *Diaphragm* chord splice slip at the induced unit shear, in inches (mm).

Δ_{dia} = Maximum mid-span *diaphragm* deflection determined by elastic analysis, in inches (mm).

TABLE 2305.2(1)

e_n VALUES (inches) FOR USE IN CALCULATING DIAPHRAGM AND SHEAR WALL DEFLECTION DUE TO FASTENER SLIP (Structural I)^{a, c}

LOAD PER FASTENER ^b (pounds)	FASTENER DESIGNATIONS
	14-Ga staple × 2 inches long
60	0.011
80	0.018
100	0.028
120	0.04
140	0.053
160	0.068

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound = 4.448 N.

- Increase e_n values 20 percent for plywood grades other than Structural I.
- Load per fastener = maximum shear per foot divided by the number of fasteners per foot at interior panel edges.
- Decrease e_n values 50 percent for seasoned lumber (moisture content < 19 percent).

TABLE 2305.2(2)

VALUES OF Gt FOR USE IN CALCULATING DEFLECTION OF WOOD STRUCTURAL PANEL SHEAR WALLS AND

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DIAPHRAGMS

PANEL TYPE	SPAN RATING	VALUES OF Gt (lb/in. panel depth or width)							
		Structural Sheathing				Structural I			
		Plywood			OSB	Plywood			OSB
		3-ply	4-ply	5-ply ^a		3-ply	4-ply	5-ply ^a	
Sheathing	24/0	25,000	32,500	37,500	77,500	32,500	42,500	41,500	77,500
	24/16	27,000	35,000	40,500	83,500	35,000	45,500	44,500	83,500
	32/16	27,000	35,000	40,500	83,500	35,000	45,500	44,500	83,500
	40/20	28,500	37,000	43,000	88,500	37,000	48,000	47,500	88,500
	48/24	31,000	40,500	46,500	96,000	40,500	52,500	51,000	96,000
Single Floor	16 o.c.	27,000	35,000	40,500	83,500	35,000	45,500	44,500	83,500
	20 o.c.	28,000	36,500	42,000	87,000	36,500	47,500	46,000	87,000
	24 o.c.	30,000	39,000	45,000	93,000	39,000	50,500	49,500	93,000
	32 o.c.	36,000	47,000	54,000	110,000	47,000	61,000	59,500	110,000
	48 o.c.	50,500	65,500	76,000	155,000	65,500	85,000	83,500	155,000

	Thickness (in.)	Structural Sheathing			Structural I		
		A-A, A-C	Marine	All Other Grades	A-A, A-C	Marine	All Other Grades
Sanded Plywood	$\frac{1}{4}$	24,000	31,000	24,000	31,000	31,000	31,000
	$\frac{11}{32}$	25,500	33,000	25,500	33,000	33,000	33,000
	$\frac{3}{8}$	26,000	34,000	26,000	34,000	34,000	34,000
	$\frac{15}{32}$	38,000	49,500	38,000	49,500	49,500	49,500
	$\frac{1}{2}$	38,500	50,000	38,500	50,000	50,000	50,000
	$\frac{19}{32}$	49,000	63,500	49,000	63,500	63,500	63,500
	$\frac{5}{8}$	49,500	64,500	49,500	64,500	64,500	64,500
	$\frac{23}{32}$	50,500	65,500	50,500	65,500	65,500	65,500
	$\frac{3}{4}$	51,000	66,500	51,000	66,500	66,500	66,500
	$\frac{7}{8}$	52,500	68,500	52,500	68,500	68,500	68,500
	1	73,500	95,500	73,500	95,500	95,500	95,500
	$1\frac{1}{8}$	75,000	97,500	75,000	97,500	97,500	97,500

For SI: 1 inch = 25.4 mm, 1 pound/inch = 0.1751 N/mm.

- a. 5-ply applies to plywood with five or more layers. For 5-ply plywood with three layers, use values for 4-ply panels.

2305.3 Shear wall deflection.

The deflection of wood-frame *shear walls* shall be determined in accordance with [AWC SDPWS](#). The deflection (Δ_{sw}) of a blocked *wood structural panel* shear wall uniformly fastened throughout with staples is permitted to be calculated in accordance with [Equation 23-2](#).

$$\Delta_{sw} = 8vh^3/EA b + vh/4Gt + 0.75he_n + d_a h/b$$

$$\text{For SI: } \Delta_{sw} = \frac{vh^3}{3EA b} + \frac{vh}{Gt} + \frac{he_n}{407.6} + d_a h/b$$

(Equation 23-2)

where:

A = Area of end-post cross section in square inches (mm^2).

b = Shear wall length, in feet (mm).

d_a = Total vertical elongation of wall anchorage system (such as fastener slip, device elongation, rod elongation) in inches (mm), at the induced unit shear in the shear wall (v).

E = Modulus of elasticity of end posts, in pounds persquare inch (N/mm^2).

e_n = Staple slip, in inches (mm) [see [Table 2305.2\(1\)](#)].

Gt = Panel rigidity through the thickness, in pounds per inch (N/mm) of panel width or depth [see [Table 2305.2\(2\)](#)].

h = *Shear wall* height, in feet (mm).

v = Induced unit shear, in pounds per linear foot (N/mm).

Δ_{sw} = Maximum *shear wall* deflection determined by elastic analysis, in inches (mm).

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