2001 EDITION
SUPPLEMENT
Special Design
Provisions for
Wind and Seismic

ASD/LRFD
ALLOWABLE STRESS
DESIGN
LOAD AND RESISTANCE
FACTOR DESIGN

MANUAL FOR ENGINEERED
WOOD CONSTRUCTION

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American Forest & Paper Association
DESIGNER FLOWCHART

1.1 Flowchart
1.1 Flowchart

Special Design Provisions for Wind and Seismic Supplement

Select a Trial Design

Design Method

Design Category = ASD
Allowable Stress (Sections 3.0 and 4.0)

Design Category = LRFD
Factored Resistance (Sections 3.0 and 4.0)

Design Capacity ≥ Applicable Load Effect

Yes

Strength Criteria Satisfied

No
GENERAL DESIGN REQUIREMENTS

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2.1 General

2.1.1 Scope

The provisions of this Supplement cover materials, design and construction of wood members, fasteners, and assemblies to resist wind and seismic forces.

2.1.2 Design Methods

Engineered design of wood structures to resist wind or seismic forces shall be by one of the methods described in Section 2.1.2.1 and 2.1.2.2.

Exception: Wood structures shall be permitted to be constructed in accordance with prescriptive provisions permitted by the authority having jurisdiction.

2.1.2.1 Allowable Stress Design: Allowable stress design (ASD) shall be in accordance with the National Design Specification® (NDS®) for Wood Construction (ANSI/AF&PA NDS-2001), its supplements, and provisions of this Supplement.

2.1.2.2 Strength Design: Load and resistance factor design (LRFD) of wood structures shall be in accordance with the Load and Resistance Factor Standard for Engineered Wood Construction (AF&PA/ASCE 16-95), its supplements, and provisions of this Supplement.

2.2 Terminology

ALLOWABLE STRESS DESIGN A method of proportioning structural members such that elastically computed stresses produced in the members by nominal loads do not exceed specific allowable stresses (also called working stress design).

BOUNDARY ELEMENT Diaphragm and shear wall boundary members to which sheathing transfers forces. Boundary elements include chords and collectors at diaphragm and shear wall perimeters, interior openings, discontinuities and re-entrant corners.

CHORD A boundary element perpendicular to the applied load that is assumed to resist axial stresses due to the induced moment.

COLLECTOR A diaphragm or shear wall element parallel and in line with the applied force that collects and transfers diaphragm shear forces to the vertical elements of the lateral force-resisting system and/or distributes forces withing the diaphragm.

DIAPHRAGM A roof, floor or other membrane bracing system acting to transmit lateral forces to the vertical resisting elements. When the term “diaphragm” is used, it includes horizontal bracing systems.

DIAPHRAGM, BLOCKED A diaphragm in which all adjacent sheathing edges are fastened to either common framing or common blocking.

DIAPHRAGM, FLEXIBLE A diaphragm is flexible for the purpose of distribution of story shear when the computed maximum in-plane deflection of the diaphragm itself under lateral load is greater than two times the average deflection of adjoining vertical elements of the lateral force-resisting system of the associated story under equivalent tributary lateral load.

DIAPHRAGM, RIGID A diaphragm is rigid for the purpose of distribution of story shear and torsional moment when the computed maximum in-plane deflection of the diaphragm itself under lateral load is less than or equal to two times the average deflection of adjoining vertical elements of the lateral force-resisting system of the associated story under equivalent tributary lateral load. For analysis purposes, it can be assumed that a rigid diaphragm distributes story shear and torsional moment into lines of shear walls by the relative lateral stiffness of the shear walls.

For the first iteration, an arbitrary load is applied to each line of shear walls to determine the relative stiffness of the lines of walls. Once the relative stiffnesses of the wall lines have been determined, the applied lateral load is distributed proportionally. The shear walls are redesigned and the lateral stiffness is recalculated and the applied load is re-apportioned. This is continued until convergence.

DIAPHRAGM, UNBLOCKED A diaphragm that has edge nailing at supporting members only. Blocking between supporting structural members at panel edges is not...
included. Diaphragm panels are field nailed to supporting members.

**DIAPHRAGM BOUNDARY** A location where shear is transferred into or out of the diaphragm sheathing. Transfer is either to a boundary element or to another force-resisting element.

**FIBERBOARD** A fibrous, homogeneous panel made from lignocellulosic fibers (usually wood or cane) and having a density of less than 31 pounds per cubic foot (497 kg/m³) but more than 10 pounds per cubic foot (160 kg/m³).

**HARDBOARD** A fibrous-felted, homogeneous panel made from lignocellulosic fibers consolidated under heat and pressure in a hot press to a density not less than 31 pounds per cubic foot.

**LATERAL STIFFNESS** The inverse of the deformation of shear walls under an applied unit load, or the force required to deform a shear wall a unit distance.

**NOMINAL STRENGTH** Strength of a member, cross section, or connection before application of any strength reduction factors.

**ORIENTED STRAND BOARD** A mat-formed wood structural panel product composed of thin rectangular wood strands or wafers arranged in oriented layers and bonded with waterproof adhesive.

**PARTICLEBOARD** A generic term for a panel primarily composed of cellulosic materials (usually wood), generally in the form of discrete pieces or particles, as distinguished from fibers. The cellulosic material is combined with synthetic resin or other suitable bonding system by a process in which the interparticle bond is created by the bonding system under heat and pressure.

**PERFORATED SHEAR WALL** A sheathed wall with openings, but which has not been specifically designed and detailed for force transfer around wall openings.

**PERFORATED SHEAR WALL SEGMENT** A section of a perforated shear wall with full height sheathing which meets the requirements for maximum aspect ratio in Section 4.3.4.

**PLYWOOD** A wood structural panel comprised of plies of wood veneer arranged in cross-aligned layers. The plies are bonded with an adhesive that cures on application of heat and pressure.

**REQUIRED STRENGTH** Strength of a member, cross section, or connection required to resist factored loads or related internal moments and forces.

**RESISTANCE FACTOR** A factor that accounts for unavoidable deviations of the actual strength from the nominal value and the manner and consequences of failure.

**SEISMIC DESIGN CATEGORY** A classification assigned to a structure based on its Seismic Use Group and the severity of the design earthquake ground motion at the site.

**SHEAR WALL** A wall designed to resist lateral forces parallel to the plane of a wall.

**SHEAR WALL LINE** A series of shear walls in a line at a given story level.

**SUBDIAPHRAGM** A portion of a larger wood diaphragm designed to anchor and transfer local forces to primary diaphragm struts and the main diaphragm.

**TIE-DOWN (HOLD-DOWN)** A device used to resist uplift of the chords of shear walls.

**WOOD STRUCTURAL PANEL** A panel manufactured from veneers; or wood strands or wafers; or a combination of veneer and wood strands or wafers; bonded together with waterproof synthetic resins or other suitable bonding systems. Examples of wood structural panels are plywood, oriented strand board (OSB), or composite panels.

### 2.3 Notation

- \( A \) = Area of chord cross-section, in.\(^2\)
- \( A_e \) = Area of end post cross-section, in.\(^2\)
- \( C \) = Compression chord force, lbs.
- \( C_o \) = Shear capacity adjustment factor from Table 4.3.3.4.
- \( E \) = Modulus of elasticity of end posts, psi
- \( E_d \) = Modulus of elasticity of diaphragm chords, psi
- \( G \) = Specific gravity
- \( G_a \) = Apparent shear wall shear stiffness from nail slip and panel shear deformation, kips/in. (from Column A, Table 4.3).
2. The maximum clear height from top of diaphragm to bottom of diaphragm framing above.

\( t \) = Uniform uplift force, lbs./ft.

\( v \) = Induced unit shear, lbs./ft.

\( v_s \) = Nominal unit shear capacity for seismic design, lbs./ft.

\( v_{\max} \) = Maximum induced unit shear force, lbs./ft.

\( v_{nc} \) = Combined nominal unit shear capacity of two-sided shear wall for seismic design, lbs./ft.

\( v_{s1} \) = Nominal unit shear capacity for side 1, lbs./ft. (from Column A, Table 4.3).

\( v_{s2} \) = Nominal unit shear capacity for side 2, lbs./ft. (from Column A, Table 4.3).

\( v_w \) = Nominal unit shear capacity for wind design, lbs./ft

\( v_{wc} \) = Combined nominal unit shear capacity of two-sided shear wall for wind design, lbs./ft.

\( \Delta \) = Total vertical elongation of wall anchorage system (including fastener slip, device elongation, rod elongation, etc) at the induced unit shear in the shear wall, in.

\( \Delta_c \) = Diaphragm chord splice slip at the induced unit shear in diaphragm, in.

\( \Delta_{sw} \) = Total vertical elongation of wall anchorage system (including fastener slip, device elongation, rod elongation, etc) at the induced unit shear in the shear wall, in.

\( \delta_{dia} \) = Maximum diaphragm deflection determined by elastic analysis, in.

\( \delta_{sw} \) = Maximum shear wall deflection determined by elastic analysis, in.

\( \phi_b \) = Sheathing resistance factor for out of plane bending

\( \phi_D \) = Sheathing resistance factor for in-plane shear of shearwalls and diaphragms

\( \Omega_o \) = System overstrength factor
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## 3.1 Framing

### 3.1.1 Wall Framing

In addition to gravity loads, wall framing shall be designed to resist induced wind and seismic forces. The framing shall be designed using methods referenced in 2.1.2.1 for allowable stress design (ASD) and 2.1.2.2 for strength design (LRFD).

3.1.1.1 Wall Stud Bending Stress Increase: The bending stress for sawn lumber wood studs resisting out of plane wind loads shall be permitted to be increased by the factors in Table 3.1.1.1, in lieu of the 1.15 repetitive member factor, to take into consideration the load sharing and composite action provided by wood structural panel sheathing. The factor applies when studs are designed for bending, spaced no more than 16 inches on center, covered on the inside with a minimum of ½-inch gypsum wallboard, and sheathed on the exterior with a minimum of 3/8-inch wood structural panel sheathing that is attached to the studs using a minimum of 8d common nails spaced a maximum of 6 inches o.c. at panel edges and 12 inches o.c. at intermediate framing members.

<table>
<thead>
<tr>
<th>Stud Size</th>
<th>System Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x4</td>
<td>1.5</td>
</tr>
<tr>
<td>2x6</td>
<td>1.4</td>
</tr>
<tr>
<td>2x8</td>
<td>1.3</td>
</tr>
<tr>
<td>2x10</td>
<td>1.2</td>
</tr>
<tr>
<td>2x12</td>
<td>1.15</td>
</tr>
</tbody>
</table>

### 3.1.2 Floor Framing

In addition to gravity loads, floor framing shall be designed to resist induced wind and seismic forces. The framing shall be designed using methods referenced in 2.1.2.1 for allowable stress design (ASD) and 2.1.2.2 for strength design (LRFD).

### 3.1.3 Roof Framing

In addition to gravity loads, roof framing shall be designed to resist induced wind and seismic forces. The framing shall be designed using methods referenced in 2.1.2.1 for allowable stress design (ASD) and 2.1.2.2 for strength design (LRFD).

## 3.2 Sheathing

### 3.2.1 Wall Sheathing

Exterior wall sheathing and its fasteners shall be capable of resisting and transferring out of plane wind loads to the wall framing. Maximum spans and nominal uniform load capacities for wall sheathing materials are given in Table 3.2A. The ASD allowable uniform load capacities to be used for wind design shall be determined by dividing the nominal uniform load capacities by a safety factor of 1.6. The LRFD factored uniform load capacities to be used for wind design shall be determined by multiplying the nominal uniform load capacities by a resistance factor, $\phi_b$, of 0.85. Sheathing used in shear wall assemblies to resist lateral forces shall be designed in accordance with 4.3.

### 3.2.2 Floor Sheathing

Floor sheathing shall be capable of resisting and transferring gravity loads to the floor framing. Sheathing used in diaphragm assemblies to resist lateral forces shall be designed in accordance with 4.2.
Table 3.2A Nominal Uniform Load Capacities, psf, for Wall Sheathing Resisting Wind Loads

<table>
<thead>
<tr>
<th>Sheathing Type \n(Sheathing Grades, C-C, C-D, C-C Plugged, OSB)</th>
<th>Span Rating or Grade</th>
<th>Minimum Thickness (in.)</th>
<th>Sheathing Long Dimension Orientation:</th>
<th>Sheathing Long Dimension Orientation:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Perpendicular to Supports</td>
<td>Parallel to Supports</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Maximum Stud Spacing (in.)</td>
<td>Actual Stud Spacing (in.)</td>
</tr>
<tr>
<td>Wood Structural Panels (Sheathing Grades, C-C, C-D, C-C Plugged, OSB)</td>
<td>24/0</td>
<td>3/8</td>
<td>24</td>
<td>425 240 105</td>
</tr>
<tr>
<td></td>
<td>24/16</td>
<td>7/16</td>
<td>24</td>
<td>540 305 135</td>
</tr>
<tr>
<td></td>
<td>32/16</td>
<td>15/32</td>
<td>24</td>
<td>625 355 155</td>
</tr>
<tr>
<td></td>
<td>40/20</td>
<td>19/32</td>
<td>24</td>
<td>950 595 265</td>
</tr>
<tr>
<td></td>
<td>48/24</td>
<td>23/32</td>
<td>24</td>
<td>1160 805 360</td>
</tr>
<tr>
<td>Particleboard Sheathing (M-S Exterior Glue)</td>
<td>3/8</td>
<td>16</td>
<td>(contact manufacturer)</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>1/2</td>
<td>16</td>
<td>(contact manufacturer)</td>
<td>16</td>
</tr>
<tr>
<td>Particleboard Panel Siding (M-S Exterior Glue)</td>
<td>5/8</td>
<td>16</td>
<td>(contact manufacturer)</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>3/4</td>
<td>24</td>
<td>(contact manufacturer)</td>
<td>24</td>
</tr>
<tr>
<td>Hardboard Siding (Direct to Studs)</td>
<td>Lap Siding</td>
<td>7/16</td>
<td>16</td>
<td>460 260 115</td>
</tr>
<tr>
<td></td>
<td>Shiplap Edge Panel Siding</td>
<td>7/16</td>
<td>24</td>
<td>460 260 115</td>
</tr>
<tr>
<td></td>
<td>Square Edge Panel Siding</td>
<td>7/16</td>
<td>24</td>
<td>460 260 115</td>
</tr>
<tr>
<td>Cellulosic Fiberboard Sheathing</td>
<td>Regular</td>
<td>1/2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Structural</td>
<td>1/2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Structural</td>
<td>25/32</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1. Nominal capacities shall be adjusted in accordance with Section 3.2.1 to determine ASD uniform load capacity and LRFD uniform resistances.
2. Sheathing shall be OSB or plywood with 4 or more plies.
3. Wood structural panels shall conform to the requirements for its type in DOC PS 1 or PS2. Particleboard sheathing shall conform to ANSI A208.1. Hardboard panel and siding shall conform to the requirements of AHA A135.5 or AHA A135.4 as applicable. Cellulosic fiberboard sheathing shall conform to AHA A194.1 or ASTM C208.
4. Tabulated values are for maximum bending loads from wind. Loads are limited by bending or shear stress assuming a 2-span continuous condition. For more information, see the ASD Wood Structural Panels Supplement.
3.2.3 Roof Sheathing

Roof sheathing and its fasteners shall be capable of resisting and transferring out of plane wind and gravity loads to the roof framing. Maximum spans and nominal uniform load capacities for roof sheathing materials are given in Table 3.2B. The ASD allowable uniform load capacities to be used for out of plane wind design shall be determined by dividing the nominal uniform load capacities by a safety factor of 1.6. The LRFD factored uniform load capacities to be used for wind design shall be determined by multiplying the nominal uniform load capacities by a resistance factor, $\phi_b$, of 0.85. Sheathing used in diaphragm assemblies to resist lateral forces shall be designed in accordance with 4.2.

### Table 3.2B Nominal Uniform Load Capacities, psf, for Roof Sheathing Resisting Wind Loads

<table>
<thead>
<tr>
<th>Sheathing Type</th>
<th>Span Rating or Grade</th>
<th>Minimum Thickness (in.)</th>
<th>Sheathing Long Dimension Applied Perpendicular to Supports</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rafter/Truss Spacing (in.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Wood Structural Panels$^{2,3}$ (Sheathing Grades, C-C, C-D, C-C Plugged, OSB)</td>
<td>24/0</td>
<td>3/8</td>
<td>425</td>
</tr>
<tr>
<td></td>
<td>24/16</td>
<td>7/16</td>
<td>540</td>
</tr>
<tr>
<td></td>
<td>32/16</td>
<td>15/32</td>
<td>625</td>
</tr>
<tr>
<td></td>
<td>40/20</td>
<td>19/32</td>
<td>950</td>
</tr>
<tr>
<td></td>
<td>48/24</td>
<td>23/32</td>
<td>1160</td>
</tr>
<tr>
<td>Wood Structural Panels$^{2,3}$ (Single Floor Grades, Underlayment, C-C Plugged)</td>
<td>16 o.c.</td>
<td>19/32</td>
<td>705</td>
</tr>
<tr>
<td></td>
<td>20 o.c.</td>
<td>19/32</td>
<td>815</td>
</tr>
<tr>
<td></td>
<td>24 o.c.</td>
<td>23/32</td>
<td>1085</td>
</tr>
<tr>
<td></td>
<td>32 o.c.</td>
<td>7/8</td>
<td>1390</td>
</tr>
<tr>
<td></td>
<td>48 o.c.</td>
<td>1-3/32</td>
<td>1790</td>
</tr>
</tbody>
</table>

1. Nominal capacities shall be adjusted in accordance with Section 3.2.3 to determine ASD uniform load capacity and LRFD uniform resistances.
2. Wood structural panels shall conform to the requirements for its type in DOC PS 1 or PS 2.
3. Tabulated values are for maximum bending loads from wind. Loads are limited by bending or shear stress assuming a 2-span continuous condition. For more information, see the ASD Wood Structural Panels Supplement.

3.3 Connections

3.3.1 Connections

Connections resisting induced wind and seismic forces shall be designed in accordance with methods referenced in 2.1.2.1 for allowable stress design (ASD) and 2.1.2.2 for strength design (LRFD).
LATERAL FORCE-RESISTING SYSTEMS

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B = Unblocked Diaphragms ...................... 17
C = Lumber Diaphragms ......................... 18

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Table 4.3.4 Maximum Shear Wall Aspect Ratios ................. 21

Table 4.3A-C Nominal Unit Shear Values for Wood-Frame Shear Walls:
A = Wood-based Sheathing ...................... 25
B = Gypsum and Cement Plaster .............. 26
C = Lumber Shear Walls ......................... 27
4.1 General

4.1.1 Design Requirements

The proportioning, design, and detailing of engineered wood systems, members, and connections in lateral force-resisting systems shall be in accordance with methods referenced in 2.1.2 and provisions in this Chapter.

A continuous load path, or paths, with adequate strength and stiffness shall be provided to transfer all forces from the point of application to the final point of resistance.

4.1.2 Shear Capacity

Nominal shear capacities of diaphragms and shear walls are provided for reference assemblies in Tables 4.2 and 4.3, respectively. Alternatively, shear capacity of diaphragms and shear walls shall be permitted to be calculated by principles of mechanics using values of fastener strength and sheathing shear capacity.

4.1.3 Deformation Requirements

Deformation of connections within and between structural elements shall be considered in design such that the deformation of each element and connection comprising the lateral force-resisting system is compatible with the deformations of the other lateral force-resisting elements and connections and with the overall system.

4.1.4 Boundary Elements

Shear wall and diaphragm boundary elements shall be provided to transfer the design tension and compression forces. Diaphragm and shear wall sheathing shall not be used to splice boundary elements. Diaphragm chords and collectors shall be placed in, or in contact with, the plane of the diaphragm framing unless it can be demonstrated that the moments, shears, and deflections, considering eccentricities resulting from other configurations, can be tolerated without exceeding the framing capacity and drift limits.

4.1.5 Wood Systems Resisting Horizontal Seismic Forces Contributed by Masonry and Concrete

Wood shear walls, diaphragms, trusses and other wood assemblies shall not be used to resist horizontal seismic forces contributed by masonry or concrete construction in structures over one story in height.

Exceptions:
1. Wood floor and roof assemblies shall be permitted to be used in diaphragms and horizontal trusses to resist horizontal seismic forces (including those due to masonry veneer, fireplaces, and chimneys) provided such forces do not result in torsional force distribution through the truss or diaphragm.
2. Vertical wood structural panel sheathed shear walls shall be permitted to be used to provide resistance to seismic forces in two-story structures of masonry or concrete construction, provided the following requirements are met:
   a. Story-to-story wall heights shall not exceed 12 feet.
   b. Diaphragms shall not be considered to transmit lateral forces by torsional force distribution or cantilever past the outermost supporting shear wall.
   c. Combined deflections of diaphragms and shear walls shall not permit story drift of supported masonry or concrete walls to exceed 0.7% of the story height.
   d. Wood structural panel sheathing in diaphragms shall have all unsupported edges blocked. Wood structural panel sheathing for both stories of shear walls shall have all unsupported edges blocked and, for the lower story, shall have a minimum thickness of 15/32 inch.
   e. There shall be no out-of-plane horizontal offsets between the first and second stories of wood structural panel shear walls.

4.1.6 Toenails

In seismic categories D, E, and F, toenails shall not be used to transfer lateral forces greater than 150 pounds per lineal foot from diaphragms to shearwalls, drag struts to other elements, or from shear walls to other elements.
4.2 Wood Diaphragms

4.2.1 Application Requirements

Wood diaphragms are permitted to be used to resist horizontal forces provided the deflection in the plane of the diaphragm, as determined by calculations, tests, or analogies drawn therefrom, does not exceed the permissible deflection of attached load distributing or resisting elements. Connections and blocking shall extend into the diaphragm a sufficient distance to develop the force transferred into the diaphragm.

4.2.2 Deflection

Permissible deflection shall be that deflection up to which the diaphragm and any attached load distributing or resisting element will maintain its structural integrity under design load conditions, such that the resisting element will continue to support design loads without danger to occupants of the structure.

Calculations of diaphragm deflection shall account for bending and shear deflections, fastener deformation, chord splice slip, and other contributing sources of deflection.

The midspan diaphragm deflection, \( \delta_{\text{dia}} \), is permitted to be calculated by use of the following equation:

\[
\delta_{\text{dia}} = \frac{5vL^2}{8EAW} + 0.25vL \cdot \frac{\sum(x\Delta_c)}{2W} \tag{4.2-1}
\]

where:

- \( E \) = Modulus of elasticity of diaphragm chords, psi
- \( A \) = Area of chord cross-section, in.\(^2\)
- \( G_a \) = Apparent diaphragm shear stiffness from nail slip and panel shear deformation, kips/in. (from Column A, Table 4.2)
- \( L \) = Diaphragm length, ft.
- \( v \) = Induced unit shear in diaphragm, lbs./ft.
- \( W \) = Diaphragm width, ft.
- \( x \) = Distance from chord splice to nearest support, in.
- \( \Delta_c \) = Diaphragm chord splice slip at the induced unit shear in diaphragm, in.
- \( \delta_{\text{dia}} \) = Maximum diaphragm deflection determined by elastic analysis, in.

4.2.3 Shear Capacities

The nominal unit shear capacities for seismic design are provided in Column A of Tables 4.2A, B, and C and for wind design in Column B of Tables 4.2A, B, and C. The ASD allowable unit shear capacity shall be determined by dividing the nominal unit shear capacity by a safety factor of 2.0. No further increases shall be permitted. The LRFD factored unit resistance shall be determined by multiplying the nominal unit shear capacity by a resistance factor, \( \phi_D \), of 0.65.

4.2.4 Diaphragm Aspect Ratios

Size and shape of diaphragms shall be limited to the aspect ratios in Table 4.2.4.

Table 4.2.4 Maximum Diaphragm Aspect Ratios

<table>
<thead>
<tr>
<th>Diaphragm Sheathing Type</th>
<th>Maximum L/W Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood structural panel, unblocked</td>
<td>3:1</td>
</tr>
<tr>
<td>Wood structural panel, blocked</td>
<td>4:1</td>
</tr>
<tr>
<td>Single-layer straight lumber sheathing</td>
<td>2:1</td>
</tr>
<tr>
<td>Single-layer diagonal lumber sheathing</td>
<td>3:1</td>
</tr>
<tr>
<td>Double-layer diagonal lumber sheathing</td>
<td>4:1</td>
</tr>
</tbody>
</table>

4.2.5 Horizontal Distribution of Shear

Diaphragms shall be defined as rigid or flexible for the purposes of distributing shear loads and designing for torsional moments. When a diaphragm is defined as flexible, the diaphragm shear forces shall be distributed to the vertical resisting elements based on tributary area. When a diaphragm is defined as rigid, the diaphragm shear forces shall be distributed based on the relative lateral stiffnesses of the vertical resisting elements for the story below.

4.2.5.1 Torsional Irregularity: Structures with rigid wood diaphragms shall be considered as torsionally ir-
regular when the maximum story drift, computed including accidental torsion, at one end of the structure is more than 1.2 times the average of the story drifts at the two ends of the structure. Where torsional irregularity exists, diaphragms shall meet the following requirements:

1. The diaphragm conforms to 4.2.7.1 - 4.2.7.3.
2. The L/W ratio of the diaphragm is less than 1:1 for one-story structures or 1:1½ for structures over one story in height.

**Exception:** Where calculations show that diaphragm deflections can be tolerated, the length, L, shall be permitted to be increased to an L/W ratio not greater than 1½:1 when sheathed in conformance with 4.2.7.1 or to 1:1 when sheathed in conformance with 4.2.7.2 or 4.2.7.3.

4.2.5.1.1 Open Front Structures: Open front structures utilizing rigid wood diaphragms to distribute shear forces through torsion shall be permitted provided:

1. The diaphragm length, L, (normal to the open side) does not exceed 25 feet.
2. The L/W ratio (as shown in Figure 4.2.5.1) of the diaphragm is less than 1:1 for one-story structures or 1:1½ for structures over one story in height.

**Exception:** Where calculations show that diaphragm deflections can be tolerated, the length, L, (normal to the open side) shall be permitted to be increased to an L/W ratio not greater than 1½:1 when sheathed in conformance with 4.2.7.1 or 4.2.7.3 or to 1:1 when sheathed in conformance with 4.2.7.2.

**Figure 4.2.5.1 Open Front Building**

4.2.5.2 Cantilevered Diaphragms: Rigid wood diaphragms shall be permitted to cantilever past the outermost supporting shear wall (or other vertical resisting element) a distance, Lc, of not more than 25 feet or two thirds of the diaphragm width, W, whichever is smaller. Figure 4.2.5.2 illustrates the dimensions of Lc and W for a cantilevered diaphragm.

**Figure 4.2.5.2 Cantilevered Diaphragm**

4.2.6 Construction Requirements

4.2.6.1 Framing Requirements: Diaphragm boundary elements shall be provided to transmit the design tension, compression and shear forces. Diaphragm sheathing shall not be used to splice boundary elements. Diaphragm chords and collectors shall be placed in, or in contact with, the plane of the diaphragm framing unless it can be demonstrated that the moments, shears, and deflections, considering eccentricities resulting from other configurations, can be tolerated without exceeding the framing capacity and drift limits.

4.2.6.2 Sheathing: Diaphragms shall be sheathed with approved materials. Details on sheathing types and thicknesses for commonly used floor, roof and ceiling diaphragm assemblies are provided in 4.2.7 and Tables 4.2A, B, and C.

4.2.6.3 Fasteners: Sheathing shall be attached to framing using approved fasteners and/or adhesives. Nails or other approved sheathing connectors shall be driven flush with the surface of the sheathing. Details on type, size, and spacing of mechanical fasteners for typical floor, roof, and ceiling diaphragm assemblies are provided in 4.2.7 and Tables 4.2A, B, and C.

4.2.7 Diaphragm Assemblies

4.2.7.1 Wood Structural Panel Diaphragms: Diaphragms sheathed with wood structural panel sheathing shall be permitted to be used to resist seismic and wind forces. Wood structural panel sheathing used for diaphragms that are part of the lateral force-resisting system shall be applied directly to the framing members.

**Exception:** Wood structural panel sheathing in a diaphragm is permitted to be fastened over solid lumber planking or laminated decking provided the panel joints and lumber planking or laminated
decking joints do not coincide. In addition, adjacent panel edges shall be fastened to a common member and fasteners shall not be spaced less than 3/8 inches from the edges of panels or joints in the substrate.

Where diaphragms are designated as blocked, all joints in sheathing shall occur over and be fastened to common framing members. The size and spacing of fasteners at wood diaphragm boundaries, panel edges, and intermediate supports shall be as prescribed in Tables 4.2A and B. The diaphragm shall be constructed as follows:

1. Panels not less than 4 ft. x 8 ft. except at ends where reduced widths are permitted.
2. Nails spaced not less than 3/8 inches from edges and ends of panels and framing. Maximum nail spacing of 6 inches along intermediate framing members when supports are spaced 48 inches o.c. Maximum nail spacing along intermediate framing of 12 inches for other conditions.
3. 2x nominal or wider framing at adjoining panel edges except that 3x nominal or wider framing and staggered nailing are required where:
   a) nails are spaced 2 inches o.c. or 2 ½ inches o.c., or
   b) 10d nails having penetration into framing of more than 1-1/2 in. are spaced 3 inches o.c. or less
4. Wood structural panels shall conform to the requirements for its type in DOC PS1 or PS2.

4.2.7.2 Diaphragms Diagonally Sheathed with Single-Layer of Lumber: Single diagonally sheathed lumber diaphragms are permitted to be used to resist seismic and wind forces. Single diagonally sheathed lumber diaphragms shall be constructed of minimum 1-inch thick nominal sheathing boards or 2-inch thick nominal lumber laid at an angle of approximately 45° to the supports. End joints in adjacent boards shall be separated by at least one joist space and there shall be at least two boards between joints on the same support. Nailing of diagonally sheathed lumber diaphragms shall be in accordance with Table 4.2C.

4.2.7.3 Diaphragms Diagonally Sheathed with Double-Layer of Lumber: Double diagonally sheathed lumber diaphragms are permitted to be used to resist seismic and wind forces. Double diagonally sheathed lumber diaphragms shall be constructed of two layers of diagonal sheathing boards laid perpendicular to each other on the same face of the supporting members. Each chord shall be considered as a beam with uniform load per foot equal to 50% of the unit shear due to diaphragm action. The load shall be assumed as acting normal to the chord in the plane of the diaphragm in either direction. Nailing of diagonally sheathed lumber diaphragms shall be in accordance with Table 4.2C.

4.2.7.4 Diaphragms Horizontally Sheathed with Single-Layer of Lumber: Horizontally sheathed lumber diaphragms are permitted to be used to resist seismic and wind forces. Horizontally sheathed lumber diaphragms shall be constructed of minimum 1-inch thick nominal sheathing boards or minimum 2-inch thick nominal lumber laid perpendicular to the supports. End joints in adjacent boards shall be separated by at least one joist space and there shall be at least two boards between joints on the same support. Nailing of horizontally sheathed lumber diaphragms shall be in accordance with Table 4.2C.
Table 4.2A  Nominal Unit Shear Values for Wood-Frame Diaphragms

<table>
<thead>
<tr>
<th>Sheathing Grade</th>
<th>Common Nail Size</th>
<th>Minimum Fastener Penetration in Framing (inches)</th>
<th>Minimum Nominal Panel Thickness (inches)</th>
<th>Minimum Nominal Framing Width (inches)</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural f</td>
<td>6d</td>
<td>1 1/4</td>
<td>5/16</td>
<td>2</td>
<td>370 (plf)</td>
<td>500 (plf)</td>
</tr>
<tr>
<td></td>
<td>8d</td>
<td>1 3/8</td>
<td>3/8</td>
<td>2</td>
<td>540 (plf)</td>
<td>600 (plf)</td>
</tr>
<tr>
<td></td>
<td>10d</td>
<td>1 1/2</td>
<td>15/32</td>
<td>2</td>
<td>640 (plf)</td>
<td>850 (plf)</td>
</tr>
<tr>
<td></td>
<td>6d</td>
<td>1 1/4</td>
<td>5/16</td>
<td>2</td>
<td>340 (plf)</td>
<td>450 (plf)</td>
</tr>
<tr>
<td></td>
<td>8d</td>
<td>1 3/8</td>
<td>3/8</td>
<td>2</td>
<td>420 (plf)</td>
<td>500 (plf)</td>
</tr>
<tr>
<td></td>
<td>10d</td>
<td>1 1/2</td>
<td>15/32</td>
<td>2</td>
<td>520 (plf)</td>
<td>650 (plf)</td>
</tr>
<tr>
<td>Sheathing and Single-Floor f</td>
<td>6d</td>
<td>1 1/4</td>
<td>5/16</td>
<td>2</td>
<td>370 (plf)</td>
<td>500 (plf)</td>
</tr>
<tr>
<td></td>
<td>8d</td>
<td>1 3/8</td>
<td>3/8</td>
<td>2</td>
<td>420 (plf)</td>
<td>500 (plf)</td>
</tr>
<tr>
<td></td>
<td>10d</td>
<td>1 1/2</td>
<td>15/32</td>
<td>2</td>
<td>520 (plf)</td>
<td>650 (plf)</td>
</tr>
</tbody>
</table>

a. Nominal unit shear values shall be adjusted in accordance with 4.2.3 to determine ASD allowable unit shear capacity and LRFD factored unit resistance. For general construction requirements see 4.2.6. For specific requirements see 4.2.7.1 for wood structural panel diaphragms.
b. For framing grades other than Douglas-Fir-Larch or Southern Pine, reduced nominal unit shear capacities shall be determined by multiplying the tabulated nominal unit shear capacity by the Specific Gravity Adjustment Factor = [1+(0.5-G)], where G = Specific Gravity of the framing lumber from the NDS. The Specific Gravity Adjustment Factor shall not be greater than 1.
c. Apparent shear stiffness values, G_a, are based on nail slip and panel stiffness values for diaphragms constructed with OSB panels. When plywood panels are used, diaphragm deflections should be calculated in accordance with the ASD Wood Structural Panels Supplement.
Table 4.2B Nominal Unit Shear Values for Wood-Frame Diaphragms

Unblocked Wood Structural Panel Diaphragms \(^a,b\)

<table>
<thead>
<tr>
<th>Sheathing Grade</th>
<th>Common Nail Size</th>
<th>Minimum Fastener in Framing (inches)</th>
<th>Minimum Nominal Panel Thickness (inches)</th>
<th>Minimum Nominal Framing Width</th>
<th>SEISMIC</th>
<th>(v_s) (plf)</th>
<th>G(_a) (kip/in)</th>
<th>(v_s) (plf)</th>
<th>G(_a) (kip/in)</th>
<th>(v_w) (plf)</th>
<th>(v_w) (plf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6d</td>
<td>1 1/4</td>
<td>5/16</td>
<td>2</td>
<td>3</td>
<td>C1</td>
<td>3.30</td>
<td>6.5</td>
<td>250</td>
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<td>280</td>
<td>4.5</td>
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<td>3/8</td>
<td>2</td>
<td>3</td>
<td>C1</td>
<td>4.80</td>
<td>8.5</td>
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<td>6.0</td>
<td>360</td>
<td>6.0</td>
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<td>10d</td>
<td>1 1/2</td>
<td>15/32</td>
<td>2</td>
<td>3</td>
<td>C1</td>
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<td>14.0</td>
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<td>9.5</td>
<td>480</td>
<td>8.0</td>
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<td>1 1/4</td>
<td>5/16</td>
<td>2</td>
<td>3</td>
<td>C1</td>
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<td>5.0</td>
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<td>3</td>
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<td>6.0</td>
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<td>15/32</td>
<td>2</td>
<td>3</td>
<td>C1</td>
<td>5.70</td>
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<td>5.0</td>
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<tr>
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<td>C1</td>
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<td>7.5</td>
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<tr>
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<td>2</td>
<td>3</td>
<td>3</td>
<td>C1</td>
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<td>5.5</td>
<td>400</td>
<td>6.5</td>
<td>400</td>
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<tr>
<td>10d</td>
<td>19/32</td>
<td>3</td>
<td>3</td>
<td>3</td>
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<td>8.0</td>
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<td>3</td>
<td>3</td>
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<td>3</td>
<td>3</td>
<td>C1</td>
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<td>480</td>
<td>7.0</td>
</tr>
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<td>10d</td>
<td>15/32</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>C1</td>
<td>5.70</td>
<td>13.0</td>
<td>430</td>
<td>8.5</td>
<td>430</td>
<td>8.5</td>
</tr>
</tbody>
</table>

a. Nominal unit shear values shall be adjusted in accordance with 4.2.3 to determine ASD allowable unit shear capacity and LRFD factored unit resistance. For general construction requirements see 4.2.6. For specific requirements, see 4.2.7.1 for wood structural panel diaphragms.
b. For framing grades other than Douglas-Fir-Larch or Southern Pine, reduced nominal unit shear capacities shall be determined by multiplying the tabulated nominal unit shear capacity by the Specific Gravity Adjustment Factor = \(1-(0.5-G)\), where \(G\) = Specific Gravity of the framing lumber from the NDS. The Specific Gravity Adjustment Factor shall not be greater than 1.
c. Apparent shear stiffness values, \(G_a\), are based on nail slip and panel stiffness values for diaphragms constructed with OSB panels. When plywood panels are used, diaphragm deflections should be calculated in accordance with the ASD Wood Structural Panels Supplement.

---

Load | Case 1 | Framing
---
Load | Case 2 | Blocking, if used
---
Load | Case 3 | Framing
---
Load | Case 4 | Continuous panel joints
---
Load | Case 5 | Continuous panel joints
---
Load | Case 6 | Framing

---

**ASD/LRFD SUPPLEMENT — SPECIAL DESIGN PROVISIONS FOR WIND AND SEISMIC**
### Table 4.2C Nominal Unit Shear Values for Wood-Frame Diaphragms

#### Lumber Diaphragms

<table>
<thead>
<tr>
<th>Sheathing Material</th>
<th>Sheathing Nominal Dimensions</th>
<th>Nailing at Intermediate and End Bearing Supports (Nails/board/support)</th>
<th>Nailing at Boundary Members (Nails/board/end)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal Lumber Sheathing</td>
<td>1x6</td>
<td>2-8d common nails (3-8d box nails)</td>
<td>3-8d common nails (5-8d box nails)</td>
<td>v_s</td>
<td>G_a</td>
<td>v_w</td>
<td>plf</td>
</tr>
<tr>
<td>1x8</td>
<td>3-8d common nails (4-8d box nails)</td>
<td>4-8d common nails (6-8d box nails)</td>
<td>100</td>
<td>1.5</td>
<td>140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2x6</td>
<td>2-16d common nails (3-16d box nails)</td>
<td>3-16d common nails (5-16d box nails)</td>
<td>600</td>
<td>6.0</td>
<td>840</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2x8</td>
<td>3-16d common nails (4-16d box nails)</td>
<td>4-16d common nails (6-16d box nails)</td>
<td>1200</td>
<td>9.5</td>
<td>1680</td>
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<td></td>
</tr>
<tr>
<td>Diagonal Lumber Sheathing</td>
<td>1x6</td>
<td>3-8d common nails (4-8d box nails)</td>
<td>3-8d common nails (5-8d box nails)</td>
<td>2-16d common nails (3-16d box nails)</td>
<td>3-16d common nails (5-16d box nails)</td>
<td>3-8d common nails (4-8d box nails)</td>
<td>4-16d common nails (6-16d box nails)</td>
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<td>1x8</td>
<td>2-8d common nails (3-8d box nails)</td>
<td>3-8d common nails (5-8d box nails)</td>
<td>4-8d common nails (6-8d box nails)</td>
<td>2-16d common nails (3-16d box nails)</td>
<td>3-16d common nails (5-16d box nails)</td>
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<td>4-16d common nails (6-16d box nails)</td>
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<td>3-8d common nails (5-8d box nails)</td>
<td>4-8d common nails (6-8d box nails)</td>
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<td>3-8d common nails (4-8d box nails)</td>
<td>4-16d common nails (6-16d box nails)</td>
</tr>
<tr>
<td>2x8</td>
<td>3-8d common nails (4-8d box nails)</td>
<td>3-8d common nails (5-8d box nails)</td>
<td>4-8d common nails (6-8d box nails)</td>
<td>2-16d common nails (3-16d box nails)</td>
<td>3-16d common nails (5-16d box nails)</td>
<td>3-8d common nails (4-8d box nails)</td>
<td>4-16d common nails (6-16d box nails)</td>
</tr>
</tbody>
</table>

**Note:** Nominal unit shear values shall be adjusted in accordance with 4.2.3 to determine ASD allowable unit shear capacity and LRFD factored unit resistance. For general construction requirements see 4.2.6. For specific requirements, see 4.2.7.2 for diaphragms diagonally sheathed with a single layer of lumber, see 4.2.7.3 for diaphragms diagonally sheathed with a double layer of lumber, and see 4.2.7.4 for diaphragms horizontally sheathed with a single layer of lumber.
4.3 Wood Shear Walls

4.3.1 Application Requirements

Wood shear walls are permitted to resist horizontal forces provided the deflection of the shear wall, as determined by calculations, tests, or analogies drawn therefrom, does not exceed the permissible deflection.

4.3.2 Deflection

Permissible deflection shall be that deflection up to which the shear wall and any attached distributing or resisting element will maintain its structural integrity under design load conditions and continue to support design loads without danger to occupants of the structure.

Calculations of shear wall deflection shall account for bending and shear deflections, fastener deformation, anchorage slip, and other contributing sources of deflection.

The shear wall deflection, \( \delta_{sw} \), is permitted to be calculated by use of the following equation:

\[
\delta_{sw} = \frac{8v h^3}{EA b} + \frac{v h}{1000 G_a} + \frac{h \Delta_a}{b}
\]

where:
- \( b \) = Shear wall length, ft.
- \( \Delta_a \) = Total vertical elongation of wall anchorage system (including fastener slip, device elongation, rod elongation, etc.), at the induced unit shear in the shear wall, in.
- \( E \) = Modulus of elasticity of end posts, psi
- \( A \) = Area of end post cross-section, in.\(^2\)
- \( G_a \) = Apparent shear wall shear stiffness from nail slip and panel shear deformation, (from Column A, Table 4.3), kips/in.
- \( h \) = Shear wall height, ft.
- \( v \) = Induced unit shear, lbs./ft.
- \( \delta_{sw} \) = Maximum shear wall deflection determined by elastic analysis, in.

Alternatively, for wood structural panel shear walls, deflection is permitted to be calculated using a rational analysis where apparent shear stiffness accounts for panel shear deformation and non-linear nail slip in the sheathing to framing connection.

4.3.2.1 Deflection of Perforated Shear Walls: The deflection of a perforated shear wall shall be calculated in accordance with Section 4.3.2, where \( v \) is equal to \( v_{\text{max}} \) in Equation 4.3-1 and \( b \) is taken as the sum of the perforated shear wall segments \( \sum L_i \).

4.3.3 Shear Capacities

The ASD allowable unit shear capacity shall be determined by dividing the nominal unit shear capacity by a safety factor of 2.0. No further increases shall be permitted. The LRFD factored unit resistance shall be determined by multiplying the nominal unit shear capacity by a resistance factor, \( \phi_D \), of 0.65.

4.3.3.1 Tabulated Nominal Unit Shear Capacities: Tabulated nominal unit shear capacities for seismic design are provided in Column A of Tables 4.3A, B, and C and for wind design in Column B of Tables 4.3A, B, and C.

4.3.3.2 Summing Shear Capacities: For shear walls sheathed with the same construction and materials on opposite sides of the same wall, the combined nominal unit shear capacity, \( \nu_{sc} \) or \( \nu_{wc} \), shall be permitted to be taken as twice the nominal unit shear capacity for an equivalent shear wall sheathed on one side.

For seismic design of shear walls sheathed with the same construction and materials on opposite sides of a shear wall, the shear wall deflection shall be calculated using the combined apparent shear wall shear stiffness, \( G_{ac} \), and the combined nominal unit shear capacity, \( \nu_{sc} \), shall be calculated using the following equations:

\[
G_{ac} = G_{a1} + G_{a2}
\]

\[
V_{sc} = K_{\text{min}} G_{ac}
\]

where:
- \( G_{ac} \) = Combined apparent shear wall shear stiffness of two-sided shear wall, kips/in.
- \( G_{a1} \) = Apparent shear wall shear stiffness for side 1, kips/in. (from Column A, Table 4.3)
- \( G_{a2} \) = Apparent shear wall shear stiffness for side 2, kips/in. (from Column A, Table 4.3)
- \( K_{\text{min}} \) = Minimum ratio of \( v_{s1}/G_{a2} \) or \( v_{s2}/G_{a1} \)
- \( v_{s1} \) = Nominal unit shear capacity for side 1, lbs./ft. (from Column A, Table 4.3)
\[ \nu_{s2} = \text{Nominal unit shear capacity for side 2, lbs./ft.} \]
(from Column A, Table 4.3)
\[ \nu_{sc} = \text{Combined nominal unit shear capacity of two-sided shear wall for seismic design, lbs./ft.} \]

Nominal unit shear capacities for shear walls sheathed with dissimilar materials on the same side of the wall are not cumulative. For shear walls sheathed with dissimilar materials on opposite sides, the combined nominal unit shear capacity, \( \nu_{sc} \) or \( \nu_{wc} \), shall be either two times the smaller nominal unit shear capacity or the larger nominal unit shear capacity, whichever is greater.

**Exception:** For wind design, the combined nominal unit shear capacity \( \nu_{wc} \) of shear walls sheathed with a combination of wood structural panels and gypsum wall-board on opposite sides shall equal the sum of the sheathing capacities of each side separately.

### Table 4.3.3.4 Shear Capacity Adjustment Factor, C_o

<table>
<thead>
<tr>
<th>WALL HEIGHT, h</th>
<th>MAXIMUM OPENING HEIGHT^1</th>
<th>EFFECTIVE SHEAR CAPACITY RATIO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>h/3</td>
<td>h/2</td>
</tr>
<tr>
<td>8' Wall</td>
<td>2'-8&quot;</td>
<td>4'-0&quot;</td>
</tr>
<tr>
<td>10' Wall</td>
<td>3'-4&quot;</td>
<td>5'-0&quot;</td>
</tr>
<tr>
<td>Percent Full-Height Sheathing^2</td>
<td>Effective Shear Capacity Ratio</td>
<td>1.00</td>
</tr>
<tr>
<td>10%</td>
<td>1.00</td>
<td>0.71</td>
</tr>
<tr>
<td>20%</td>
<td>1.00</td>
<td>0.74</td>
</tr>
<tr>
<td>30%</td>
<td>1.00</td>
<td>0.77</td>
</tr>
<tr>
<td>40%</td>
<td>1.00</td>
<td>0.80</td>
</tr>
<tr>
<td>50%</td>
<td>1.00</td>
<td>0.83</td>
</tr>
<tr>
<td>60%</td>
<td>1.00</td>
<td>0.87</td>
</tr>
<tr>
<td>70%</td>
<td>1.00</td>
<td>0.91</td>
</tr>
<tr>
<td>80%</td>
<td>1.00</td>
<td>0.95</td>
</tr>
<tr>
<td>90%</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>100%</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

^1 The maximum opening height shall be taken as the maximum opening clear height in a perforated shear wall. Where areas above and below an opening remain unsheathed, the height of the opening shall be defined as the height of the wall.

^2 The sum of the lengths of the perforated shear wall segments divided by the total length of the perforated shear wall.
4.3.4 Shear Wall Aspect Ratios

Size and shape of shear walls shall be limited to the aspect ratios in Table 4.3.4.

Table 4.3.4 Maximum Shear Wall Aspect Ratios

<table>
<thead>
<tr>
<th>Shear Wall Sheathing Type</th>
<th>Maximum h/b Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood structural panels, all edges nailed</td>
<td>3½:1\textsuperscript{1}</td>
</tr>
<tr>
<td>Particleboard, all edges nailed</td>
<td>2:1</td>
</tr>
<tr>
<td>Diagonal Sheathing, conventional</td>
<td>2:1</td>
</tr>
<tr>
<td>Gypsum wallboard\textsuperscript{2}</td>
<td>2:1</td>
</tr>
<tr>
<td>Portland Cement Plaster\textsuperscript{2}</td>
<td>2:1</td>
</tr>
<tr>
<td>Fiberboard</td>
<td>1½:1</td>
</tr>
</tbody>
</table>

\textsuperscript{1} For design to resist seismic forces, the shear wall aspect ratio shall not exceed 2:1 unless the nominal unit shear capacity is multiplied by 2bs/h. In no case shall the aspect ratio exceed 3½:1.

\textsuperscript{2} Walls having aspect ratios exceeding 1½:1 shall be blocked.

4.3.5.2 Perforated Shear Walls: Where wood structural panel shear walls with openings are not designed for force transfer around the opening, they shall be designed as perforated shear walls. The following limitations shall apply:

a. A perforated shear wall segment shall be located at each end of a perforated shear wall. Openings shall be permitted to occur beyond the ends of the perforated shear wall, however the length of such openings shall not be included in the length of the perforated shear wall.

b. The nominal unit shear capacity shall not exceed 2,000 plf.

c. Where out of plane offsets occur, portions of the wall on each side of the offset shall be considered as separate perforated shear walls.

d. Collectors for shear transfer shall be provided through the full length of the perforated shear wall.

e. A perforated shear wall shall have uniform top of wall and bottom of wall elevations. Perforated shear walls not having uniform elevations shall be designed by other methods.

f. Perforated shear wall height, h, shall not exceed 20 feet.

4.3.6 Construction Requirements

4.3.6.1 Framing Requirements: All framing used for shear wall construction shall be 2x nominal or larger members. Shear wall boundary elements, such as end posts, shall be provided to transmit the design tension and compression forces. Shear wall sheathing shall not be used to splice boundary elements. End posts (studs or columns) shall be framed to provide full end bearing.

a. Tension and Compression Chords: Tension force, T, and a compression force, C, resulting from shear wall overturning forces at each story level shall be calculated in accordance with the following:

\[ T = C = \nu h \]  

(4.3-4)

where:

- C = Compression chord force, lbs.
- h = Shear wall height, ft.
- T = Tension chord force, lbs.
- \( \nu \) = Induced unit shear, lbs./ft.
Each end of each perforated shear wall shall be designed for a tension force, \( T \), and a compression force, \( C \). Each end of each perforated shear wall segment shall be designed for a compression force, \( C_i \), in each segment. For perforated shear walls, the values for \( T \) and \( C \) resulting from shear wall overturning forces at each story level shall be calculated in accordance with the following:

\[
T = C = \frac{Vh}{C_o \sum L_i}
\]

where:
- \( C_o \) = Shear capacity adjustment factor from Table 4.3.3.4
- \( V \) = Induced shear force in perforated shear wall, lbs.
- \( \sum L_i \) = Sum of perforated shear wall segment lengths, ft.

### 4.3.6.2 Sheathing
Shear walls shall be sheathed with approved materials. Sheathing nails or other approved sheathing connectors shall be driven flush with the surface of the sheathing. Details on sheathing types and thicknesses for commonly used shear wall assemblies are provided in 4.3.7 and Tables 4.3A, B, and C.

### 4.3.6.3 Fasteners
Sheathing shall be attached to framing using approved fasteners. Details on type, size, and spacing of mechanical fasteners in commonly used shear wall assemblies are provided in 4.3.7 and Tables 4.3A, B, and C.

a. Adhesives: Adhesive attachment of shear wall sheathing is not permitted as a substitute for mechanical fasteners. Approved adhesive attachment systems shall be permitted in Seismic Design Categories A and B where \( R = 1.5 \) and \( \Omega_0 = 2.5 \) unless other values are approved. In Seismic Design Categories C-F, adhesive attachment of shear wall sheathing is not permitted.

### 4.3.6.4 Shear Wall Anchorage and Load Path
Design of shear wall anchorage and load path shall conform to the requirements of this section, or shall be calculated using principles of mechanics.

a. Anchorage for In-plane Shear: Connections shall be provided to transfer the induced unit shear force, \( \nu \), into and out of each shear wall.

1. In-plane Shear Anchorage for Perforated Shear Walls: The maximum induced unit shear force, \( \nu_{\text{max}} \), transmitted into the top of a perforated shear wall, out of the base of the perforated shear wall at full height sheathing, and into collectors (drag struts) connecting shear wall segments, shall be calculated in accordance with the following:

\[
\nu_{\text{max}} = \frac{V}{C_o \sum L_i}
\]

b. Uplift Anchorage at Shear Wall Ends: Where the dead load stabilizing moment is not sufficient to prevent uplift due to overturning moments on the wall (from 4.3.6.1a), an anchoring device shall be provided at the end of each shear wall.

1. Uplift Anchorage for Perforated Shear Walls: In addition to the requirements of 4.3.6.4.b, perforated shear wall bottom plates at full height sheathing shall be anchored for a uniform uplift force, \( t \), equal to the unit shear force, \( \nu \), determined in Section 4.3.6.4.a.(1) or calculated by rational analysis.

c. Anchor Bolts: Foundation anchor bolts shall have a steel plate washer under each nut not less than \( 2\frac{1}{2}'' \times 2\frac{1}{2}'' \times \frac{1}{4}'' \). The plate washer shall extend to within \( \frac{1}{2}'' \) of the edge of the bottom plate on the sheathed side.

d. Load Path: A load path to the foundation shall be provided for uplift, shear, and compression forces. Elements resisting shear wall forces contributed by multiple stories shall be designed for the sum of forces contributed by each story.

### 4.3.7 Shear Wall Systems

#### 4.3.7.1 Wood Structural Panel Shear Walls
Shear walls sheathed with wood structural panel sheathing shall be permitted to be used to resist seismic and wind forces. The size and spacing of fasteners at shear wall boundaries, panel edges, and intermediate supports shall be as provided in Table 4.3A. The shear wall shall be constructed as follows:

a. Panels installed either horizontally or vertically with panel joints occurring over common studs or blocking. Panels not less than 4 ft. x 8 ft. except that a single panel with a minimum dimension of 1 foot is permitted if it is fully blocked and nailed.

b. Nails spaced not less than \( 3/8 \) inch from edges and ends of panels, studs, blocking, and top and bottom plates. Maximum nail spacing
of 6 inches along intermediate framing members for 3/8-inch and 7/16-inch panels installed on studs spaced 24 inches o.c. Maximum nail spacing along intermediate framing of 12 inches for other conditions.

c. 2x or wider framing at adjoining panel edges except that 3x or wider framing and staggered nailing are required where:
   (1) nails are spaced 2 inches o.c., or
   (2) 10d nails having penetration into framing of more than 1-1/2 inches are spaced 3 inches o.c., or less, or
   (3) nominal unit shear capacity exceeds 700 plf in seismic Design Category D, E, or F.

d. Maximum stud spacing of 24 inches.

e. Wood structural panels shall conform to the requirements for its type in DOC PS1 or PS2.

4.3.7.2 Particleboard Shear Walls: Shear walls sheathed with particleboard sheathing shall be permitted to be used to resist wind forces and seismic forces in Seismic Design Categories A, B, and C. The size and spacing of fasteners at shear wall boundaries, panel edges, and intermediate supports shall be as provided in Table 4.3A. The shear wall shall be constructed as follows:
   a. Panels installed either horizontally or vertically with panel joints occurring over common studs or blocking. Panels not less than 4 feet x 8 feet except that a single panel with a minimum dimension of 1 foot is permitted if it is fully blocked and nailed.
   b. Nails spaced not less than 3/8 inch from edges and ends of panels, studs, blocking, and top and bottom plates. Maximum nail spacing of 6 inches along intermediate framing members for 3/8-inch panels installed on studs spaced 24 inches o.c. Maximum nail spacing along intermediate framing of 12 inches for other conditions.
   c. 2x or wider framing at adjoining panel edges.
   d. Maximum stud spacing of 24 inches.
   e. Particleboard shall conform to ANSI A208.1.

4.3.7.3 Fiberboard Shear Walls: Shear walls sheathed with fiberboard sheathing shall be permitted to be used to resist wind forces and seismic forces in Seismic Design Categories A, B, and C. The size and spacing of fasteners at shear wall boundaries, panel edges, and intermediate supports shall be as provided in Table 4.3A. The shear wall shall be constructed as follows:
   a. 4 feet x 8 feet fiberboard sheathing shall be applied vertically (long dimension parallel to studs) with panel joints occurring over common studs or blocking.
   b. Nails spaced not less than 3/8 inch from edges and ends of panels, studs, blocking, and top and bottom plates. Maximum nail spacing 6 inches along intermediate framing members.
   c. 2x or wider framing at adjoining panel edges.
   d. Maximum stud spacing of 16 inches.
   e. Minimum length of galvanized roofing nails is 1½" for ½ inch thick sheathing and 1¾" for 25/32 inch thick sheathing.
   f. Fiberboard sheathing shall conform to either AHA 194.1 or ASTM C208.

4.3.7.4 Gypsum Wallboard, Gypsum Veneer Base, Water-Resistant Backing Board, Gypsum Sheathing, Gypsum Lath and Plaster, or Portland Cement Plaster Shear Walls: Shear walls sheathed with gypsum wallboard, gypsum veneer base, water-resistant backing board, gypsum sheathing, gypsum lath and plaster, or portland cement plaster shall be permitted to be used to resist wind forces and seismic forces in Seismic Design Categories A-D. End joints of adjacent courses of gypsum wallboard or sheathing shall not occur over the same stud. The size and spacing of fasteners at shear wall boundaries, panel edges, and intermediate supports shall be as provided in Table 4.3B. Nails shall be spaced not less than 3/8 inch from edges and ends of panels, studs, blocking, and top and bottom plates. Wood framing shall be 2x or wider.
   a. Gypsum Wallboard, Gypsum Veneer Base, Water-Resistant Backing Board: Gypsum wallboard, gypsum veneer base, or water-resistant backing board shall be applied parallel or perpendicular to studs. Gypsum wallboard shall conform to ASTM C36 and shall be installed in accordance with ASTM C 840. Gypsum veneer base shall conform to ASTM C 588 and shall be installed in accordance with ASTM C 1280.
   b. Gypsum Sheathing: Four-foot-wide pieces of gypsum sheathing shall be applied parallel or perpendicular to studs. Two-foot-wide pieces of gypsum sheathing shall be applied perpendicular to the studs. Gypsum sheathing shall conform to ASTM C79 and shall be installed in accordance with ASTM C 1280.
   c. Gypsum Lath and Plaster: Gypsum lath shall be applied perpendicular to the studs. Gypsum lath shall conform to ASTM C37 and
shall be installed in accordance with ASTM C 841. Gypsum plaster shall conform to the requirements of ASTM C 28.

d. Expanded Metal or Woven Wire Lath and Portland Cement: Expanded metal or woven wire lath and portland cement shall conform to ASTM C847, ASTM 1032, and ASTM C 150 and shall be installed in accordance with ASTM C 926 and ASTM C 1063. Metal lath and lath attachments shall be of corrosion-resistant material.

4.3.7.5 Shear Walls Diagonally Sheathed with Single-Layer of Lumber: Single diagonally sheathed lumber shear walls are permitted to be used to resist wind forces and seismic forces in Seismic Design Categories A, B, C, and D. Single diagonally sheathed lumber shear walls shall be constructed of minimum 1-inch thick nominal sheathing boards laid at an angle of approximately 45° to the supports. End joints in adjacent boards shall be separated by at least one stud space and there shall be at least two boards between joints on the same support. Nailing of diagonally sheathed lumber shear walls shall be in accordance with Table 4.3C.

4.3.7.6 Shear Walls Diagonally Sheathed with Double-Layer of Lumber: Double diagonally sheathed lumber shear walls are permitted to be used to resist wind forces and seismic forces in Seismic Design Categories A, B, C, and D. Double diagonally sheathed lumber shear walls shall be constructed of two layers of 1-inch thick nominal diagonal sheathing boards laid perpendicular to each other on the same face of the supporting members. Nailing of diagonally sheathed lumber shear walls shall be in accordance with Table 4.3C.

4.3.7.7 Shear Walls Horizontally Sheathed with Single-Layer of Lumber: Horizontally sheathed lumber shear walls are permitted to be used to resist wind forces and seismic forces in Seismic Design Categories A, B, and C. Horizontally sheathed lumber shear walls shall be constructed of minimum 1-inch thick nominal sheathing boards applied perpendicular to the supports. End joints in adjacent boards shall be separated by at least one stud space and there shall be at least two boards between joints on the same support. Nailing of horizontally sheathed lumber shear walls shall be in accordance with Table 4.3C.

4.3.7.8 Shear Walls Sheathed with Vertical Board Siding: Vertical board siding shear walls are permitted to be used to resist wind forces and seismic forces in Seismic Design Categories A, B, and C. Vertical board siding shear walls shall be constructed of minimum 1-inch thick nominal sheathing boards applied directly to studs and blocking. Nailing of vertical board siding shear walls shall be in accordance with Table 4.3C.
Table 4.3A Nominal Unit Shear Values for Wood-Frame Shear Walls<sup>a,c</sup>

### Wood-based Sheathing

<table>
<thead>
<tr>
<th>Sheathing Material</th>
<th>Minimum Nominal Panel Thickness (inches)</th>
<th>Minimum Fastener Penetration in Framing (inches)</th>
<th>Fastener Type &amp; Size</th>
<th>Panel Edge Fastener Spacing (inches)</th>
<th>Number of Rows</th>
<th>Number of Columns</th>
<th>Shear Stiffness Values (kips/in)</th>
<th>Shear Wall Deflections (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Structural Panels - Structural&lt;sup&gt;f&lt;/sup&gt;</td>
<td>5/16</td>
<td>1-1/4</td>
<td>6d</td>
<td></td>
<td></td>
<td></td>
<td>400</td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td>3/8</td>
<td>1-3/8</td>
<td>6d</td>
<td></td>
<td></td>
<td></td>
<td>460</td>
<td>19.0</td>
</tr>
<tr>
<td></td>
<td>7/16</td>
<td>1-3/8</td>
<td>8d</td>
<td></td>
<td></td>
<td></td>
<td>510</td>
<td>16.0</td>
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<td></td>
<td>15/32</td>
<td>1-1/2</td>
<td>10d</td>
<td></td>
<td></td>
<td></td>
<td>680</td>
<td>22.0</td>
</tr>
<tr>
<td></td>
<td>5/16</td>
<td>1-1/2</td>
<td>6d</td>
<td></td>
<td></td>
<td></td>
<td>360</td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td>3/8</td>
<td>1-3/8</td>
<td>6d</td>
<td></td>
<td></td>
<td></td>
<td>400</td>
<td>11.0</td>
</tr>
<tr>
<td></td>
<td>7/16</td>
<td>1-3/8</td>
<td>8d</td>
<td></td>
<td></td>
<td></td>
<td>440</td>
<td>17.0</td>
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<tr>
<td></td>
<td>15/32</td>
<td>1-1/2</td>
<td>10d</td>
<td></td>
<td></td>
<td></td>
<td>620</td>
<td>22.0</td>
</tr>
<tr>
<td>Plywood Siding</td>
<td>5/16</td>
<td>1-1/4</td>
<td>6d</td>
<td></td>
<td></td>
<td></td>
<td>280</td>
<td>13.0</td>
</tr>
<tr>
<td></td>
<td>3/8</td>
<td>1-3/8</td>
<td>6d</td>
<td></td>
<td></td>
<td></td>
<td>320</td>
<td>16.0</td>
</tr>
<tr>
<td>Particleboard Sheathing - (M-S &quot;Exterior Glue&quot; and M-2 &quot;Exterior Glue&quot;)</td>
<td>3/8</td>
<td>1-1/2</td>
<td>8d</td>
<td></td>
<td></td>
<td></td>
<td>240</td>
<td>15.0</td>
</tr>
<tr>
<td></td>
<td>3/8</td>
<td>1-1/2</td>
<td>8d</td>
<td></td>
<td></td>
<td></td>
<td>260</td>
<td>18.0</td>
</tr>
<tr>
<td></td>
<td>1/2</td>
<td>10d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>280</td>
<td>18.0</td>
</tr>
<tr>
<td></td>
<td>1/2</td>
<td>20d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>370</td>
<td>21.0</td>
</tr>
<tr>
<td></td>
<td>5/8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>400</td>
<td>21.0</td>
</tr>
<tr>
<td>Fiberboard Sheathing Structural</td>
<td>1/2</td>
<td>6d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>340</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>25/32</td>
<td>6d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>380</td>
<td>4.0</td>
</tr>
</tbody>
</table>

---

<sup>a</sup> Nominal unit shear values shall be adjusted in accordance with 4.3.3 to determine ASD allowable unit shear capacity and LRFD factored unit resistance. For general construction requirements see 4.3.6. For specific requirements, see 4.3.7.1 for wood structural panel shear walls, 4.3.7.2 for particleboard shear walls, and 4.3.7.3 for fiberboard shear walls.

<sup>b</sup> Shears are permitted to be increased to values shown for 15/32 inch sheathing with same nailing provided (a) studs are spaced a maximum of 16 inches o.c., or (b) if panels are applied with long dimension across studs.

<sup>c</sup> For framing grades other than Douglas-Fir-Larch or Southern Pine, reduced nominal unit shear capacities shall be determined by multiplying the tabulated nominal unit shear capacity by the Specific Gravity Adjustment Factor = [1 - (0.5-G)], where G = Specific Gravity of the framing lumber from the NDS. The Specific Gravity Adjustment Factor shall not be greater than 1.

<sup>d</sup> Apparent shear stiffness values, G<sub>a</sub>, are based on nail slip and panel stiffness values for shear walls constructed with OSB panels. When plywood panels are used, shear wall deflections should be calculated in accordance with the ASD Wood Structural Panels Supplement.
### Table 4.3B Nominal Unit Shear Values for Wood-Frame Shear Walls

#### Gypsum and Cement Plaster

<table>
<thead>
<tr>
<th>Sheathing Material</th>
<th>Material Thickness</th>
<th>Fastener Type &amp; Size</th>
<th>Max. Fastener Edge Spacing</th>
<th>Max. Stud Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gyprock wallboard, gypsum veneer base, or water-resistant gypsum backing board</td>
<td>1/2&quot;</td>
<td>5d cooler (0.092&quot; x 1-7/8&quot; long, 1/4&quot; head) or wallboard nail (0.0915&quot; x 1-7/8&quot; long, 19/64&quot; head) or 0.120&quot; nail x 1-3/8&quot; long, min 3/8&quot; head</td>
<td>No. 6 Type S or W drywall screws 1-1/4&quot; long</td>
<td>7&quot; 24&quot; unblocked</td>
</tr>
<tr>
<td></td>
<td>8/12&quot;</td>
<td>6d cooler (0.092&quot; x 1-7/8&quot; long, 1/4&quot; head) or wallboard nail (0.0915&quot; x 1-7/8&quot; long, 19/64&quot; head) or 0.120&quot; nail x 1-3/8&quot; long, min 3/8&quot; head</td>
<td>No. 6 Type S or W drywall screws 1-1/4&quot; long</td>
<td>8/12&quot; 16&quot; unblocked</td>
</tr>
<tr>
<td></td>
<td>5/8&quot;</td>
<td>5d cooler (0.092&quot; x 1-7/8&quot; long, 1/4&quot; head) or wallboard nail (0.0915&quot; x 1-7/8&quot; long, 19/64&quot; head) or 0.120&quot; nail x 1-3/8&quot; long, min 3/8&quot; head</td>
<td>No. 6 Type S or W drywall screws 1-1/4&quot; long</td>
<td>8/12&quot; 16&quot; unblocked</td>
</tr>
<tr>
<td>Gyprock sheathing</td>
<td>1/2&quot; x 2' x 8'</td>
<td>0.120&quot; nail x 1 3/4&quot; long, 7/16&quot; head, diamond-point, galvanized</td>
<td>No. 6 Type S or W drywall screws 1-1/4&quot; long</td>
<td>7&quot; 16&quot; unblocked</td>
</tr>
<tr>
<td></td>
<td>1/2&quot; x 4'</td>
<td>5d cooler (0.092&quot; x 1-7/8&quot; long, 1/4&quot; head) or wallboard nail (0.0915&quot; x 1-7/8&quot; long, 19/64&quot; head) or 0.120&quot; nail x 1-3/8&quot; long, min 3/8&quot; head</td>
<td>No. 6 Type S or W drywall screws 1-1/4&quot; long</td>
<td>8/12&quot; 16&quot; unblocked</td>
</tr>
<tr>
<td></td>
<td>5/8&quot; x 4'</td>
<td>5d cooler (0.092&quot; x 1-7/8&quot; long, 1/4&quot; head) or wallboard nail (0.0915&quot; x 1-7/8&quot; long, 19/64&quot; head) or 0.120&quot; nail x 1-3/8&quot; long, min 3/8&quot; head</td>
<td>No. 6 Type S or W drywall screws 1-1/4&quot; long</td>
<td>8/12&quot; 16&quot; unblocked</td>
</tr>
<tr>
<td>Gypsum lath, plain or perforated</td>
<td>3/8&quot; x 1-1/2&quot; plaster</td>
<td>0.092&quot; x 1-1/8&quot; long, 7/16&quot; head, gypsum wallboard nail or 0.120&quot; nail x 1 3/8&quot; long, min 3/8&quot; head</td>
<td>7&quot; 16&quot; unblocked</td>
<td></td>
</tr>
<tr>
<td>Expanded metal or woven wire lath and portland cement plaster</td>
<td>7/8&quot;</td>
<td>0.120&quot; nail x 1 1/2&quot; long, 7/16&quot; head</td>
<td>8/12&quot; 16&quot; unblocked</td>
<td></td>
</tr>
</tbody>
</table>

a. Nominal unit shear values shall be adjusted in accordance with 4.3.3 to determine ASD allowable unit shear capacity and LRFD factored unit resistance. For general construction requirements see 4.3.6. For specific requirements, see 4.3.7.4.
b. Type S or W drywall screws shall conform to requirements of ASTM C 1002.
c. Where two numbers are given for maximum fastener edge spacing, the first number denotes fastener spacing at the edges and the second number denotes fastener spacing in the field.
Table 4.3C Nominal Unit Shear Values for Wood-Frame Shear Walls

Lumber Shear Walls

<table>
<thead>
<tr>
<th>Sheathing Material</th>
<th>Sheathing Dimensions</th>
<th>Nailing at Intermediate Studs (nails/board'support)</th>
<th>Nailing at Shear Wall Boundary Members (nails/board/end)</th>
<th>( v_s ) ( G_a ) ( v_w )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal Lumber Sheathing</td>
<td>1x6 &amp; smaller</td>
<td>2-8d common nails (8d box nails)</td>
<td>3-8d common nails (8d box nails)</td>
<td>100 1.5 140</td>
</tr>
<tr>
<td></td>
<td>1x8 &amp; larger</td>
<td>3-8d common nails (8d box nails)</td>
<td>4-8d common nails (8d box nails)</td>
<td>600 6.0 840</td>
</tr>
<tr>
<td>Diagonal Lumber Sheathing</td>
<td>1x6 &amp; smaller</td>
<td>2-8d common nails (8d box nails)</td>
<td>3-8d common nails (8d box nails)</td>
<td>1200 10.0 1680</td>
</tr>
<tr>
<td></td>
<td>1x8 &amp; larger</td>
<td>3-8d common nails (8d box nails)</td>
<td>4-8d common nails (8d box nails)</td>
<td></td>
</tr>
<tr>
<td>Double Diagonal Lumber Sheathing</td>
<td>1x6 &amp; smaller</td>
<td>2-8d common nails (8d box nails)</td>
<td>3-8d common nails (8d box nails)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1x8 &amp; larger</td>
<td>3-8d common nails (8d box nails)</td>
<td>4-8d common nails (8d box nails)</td>
<td></td>
</tr>
<tr>
<td>Vertical Lumber Siding</td>
<td>1x6 &amp; smaller</td>
<td>2-8d common nails (8d box nails)</td>
<td>3-8d common nails (8d box nails)</td>
<td>90 1.0 125</td>
</tr>
<tr>
<td></td>
<td>1x8 &amp; larger</td>
<td>3-8d common nails (8d box nails)</td>
<td>4-8d common nails (8d box nails)</td>
<td></td>
</tr>
</tbody>
</table>

a. Nominal unit shear values shall be adjusted in accordance with 4.3.3 to determine ASD allowable unit shear capacity and LRFD factored unit resistance. For general construction requirements see 4.3.6. For specific requirements, see 4.3.7.5 - 4.3.7.8.
REFERENCES
References

4. ANSI A208.1-93, Particleboard, ANSI, New York, NY, 1993
21. PS1-95 Construction and Industrial Plywood, United States Department of Commerce, National Institute of Standards and Technology, Gaithersburg, MD, 1995.