



OSB

**Design and
Application Guide**

INTRODUCTION

Oriented strand board (OSB) is commonly used as the primary structural sheathing component in residential construction and low rise commercial applications. OSB panel products give engineers, designers, specifiers and builders a broad array of choices for use as subfloors, combination floors, wall and roof sheathing. Besides the very important function of supporting and transferring loads to the building foundation, OSB panels provide an excellent base for many types of finished flooring and provide a flat, solid base upon which the exterior wall cladding and roofing can be applied.

Performance criteria for specific construction applications for panels used in the United States, including OSB panels, are set out in the U.S. Department of Commerce/National Institute of Standards and Technology Voluntary Product Standard PS 2, *Performance Standard for Wood-Based Structural-Use Panels*. Panels conforming to this standard are identified with a gradestamp that includes the grade, recommended span rating(s) and bond classification for the panel, as well as the trademark of the third-party certification and testing agency with whom the panel was qualified. Once qualified, it is the manufacturer's responsibility to maintain a quality control system that will assure that the gradestamp is applied only to those panels that meet the requirements of PS 2.

This TECO Design and Application Guide is divided into four sections. Section 1 identifies some of the basics in selecting, handling, and storing OSB. Section 2 provides specific details regarding the application of OSB in single or multilayer floor systems, while Section 3 provides similar information for OSB used as wall and roof sheathing. Section 4 provides information on various performance issues concerning OSB.

The information provided in this guide is based on standard industry practice. Users of structural-use panels should always consult the local building code and information provided by the panel manufacturer for more specific requirements and recommendations.

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Panel Selection, Handling and Storage

PANEL SELECTION

PANEL GRADES

OSB panels are available in three grades, identified by a designation of the intended end-use. Sheathing (SHEATHING SPAN[®]) is intended for use as covering material for roofs, subfloors, and walls. Structural I sheathing (Structural I SHEATHING SPAN) meets additional requirements for cross-panel strength and stiffness, as well as requirements for racking shear; it serves in panelized roof systems, diaphragms, and shearwalls. Single-floor (FLOOR SPAN[®]) is used as a combination subfloor and underlayment and may be used under several different types of finish flooring as well as subflooring in a two-layer floor system with underlayment. SPCL-PNL[®] meets HUD requirements for floors designed in manufactured home construction. Table 1 contains application recommendations for each of these panel grades.

BOND CLASSIFICATION

Bond classification is related to the moisture resistance of the glue bond under intended end-use conditions and does not relate to the physical (e.g. erosion, ultraviolet, etc.) or biological (i.e. mold, fungal decay, insect, etc.) resistance of the panel*. OSB panels in conformance with PS 2 must meet the bond classification requirements for Exposure 1.

Note: An Exterior bond classification is not available with OSB products.

Exposure 1 is defined in PS 2 as a bond classification for panels that are suitable for uses not permanently exposed to the weather. Panels classified as Exposure 1 are intended to resist the effects of moisture on structural performance due to construction delays or other conditions of similar severity*.

* U.S. Department of Commerce, National Institute of Standards and Technology, Voluntary Product Standard PS 2 — Performance Standard for Wood-Based Structural-Use Panels

Table 1. Guide to Performance Rated Panels

Panel Gradestamps - Information and Application Recommendations	
<p style="text-align: center;">TECO TESTED[®]</p> <p style="text-align: center;">PS 2-XX PRP-133 EXPOSURE 1 SHEATHING SPAN[®] 7/16" 24/16 RATING SIZED FOR SPACING</p> <p style="text-align: center;">MANUFACTURER'S NAME</p> <p style="text-align: center;">MILL NO.</p>	<p>SHEATHING SPAN[®]</p> <p>Appropriate for a broad range of construction and industrial applications, but specifically designed for wall and roof sheathing and subfloor. Available in thicknesses of 1/4, 5/16, 11/32, 3/8, 25/64, 7/16, 29/64, 15/32, 1/2, 19/32, 5/8, 11/16, 23/32, 3/4, 7/8, 1, and 1-1/8 inch.</p>
<p style="text-align: center;">TECO TESTED[®]</p> <p style="text-align: center;">PS 2-XX PRP-133 EXPOSURE 1 FLOOR SPAN[®] 3/4" 24 INCHES O.C. SIZED FOR SPACING</p> <p style="text-align: center;">MANUFACTURER'S NAME</p> <p style="text-align: center;">MILL NO.</p>	<p>FLOOR SPAN[®]</p> <p>Designed for use as combination subfloor/underlayment. Provides high concentrated and impact load resistance and smooth surface for application under several types of finish flooring. Available in square edge or T&G, in thicknesses of 19/32, 5/8, 23/32, 3/4, 7/8, 1, 1-1/8, and 1-1/4 inch.</p>
<p style="text-align: center;">TECO TESTED[®]</p> <p style="text-align: center;">PS 2-XX PRP-133 SPCL - PNL[®] M.H. DECKING EXPOSURE 1 5/8" 20" O.C. SIZED FOR SPACING</p> <p style="text-align: center;">MANUFACTURER'S NAME</p> <p style="text-align: center;">MILL NO.</p>	<p>SPCL-PNL[®]</p> <p>Designed for use in manufactured home construction. This product meets the HUD-3280 requirements for floors. Available in square edge or T&G in thicknesses of 19/32, 5/8, 23/32 and 3/4 inch.</p>
<p style="text-align: center;">TECO TESTED[®] VIP+[®]</p> <p style="text-align: center;">PS 2-XX PRP-133 EXPOSURE 1 SHEATHING SPAN[®] 7/16" 24/16 RATING SIZED FOR SPACING</p> <p style="text-align: center;">MANUFACTURER'S NAME</p> <p style="text-align: center;">MILL NO.</p>	<p>VIP+[®] PROGRAM</p> <p>The VIP+[®] (Voluntary Inspection Program) on a gradestamp identifies panels from mills that elect to publish higher design capacities under the supervision of TECO. Methods used to assure that panels meet these higher design capacities are based on a two stage process — verification testing and voluntary inspection. The verification testing is conducted according to ASTM standard procedures and expands upon the requirements of PS 2. Manufacturers participating in this program also obtain a code evaluation report that lists the specific design capacities for that product.</p>

Panel Selection, Handling and Storage

SPAN RATING

Span rating numbers for SHEATHING SPAN and FLOOR SPAN indicate the maximum spacing of supports over which the panels should be placed.

The span rating on SHEATHING SPAN panels appears as two numbers separated by a slash (e.g., 32/16 or 48/24). The first number is the maximum on center (o.c.) support spacing in inches for roof sheathing. The second number is the maximum o.c. support spacing when the panel is used for subflooring. A panel marked 32/16 may be used for roof sheathing over supports spaced up to 32 inches o.c. or for floor sheathing over supports spaced up to 16 inches o.c.

The span rating on FLOOR SPAN panels appears as a single number (e.g., 20 o.c.). FLOOR SPAN panels are designed for single-floor applications and are manufactured with span ratings of 16, 20, 24, 32, and 48 inches o.c.

OSB used in structural sheathing applications in the U.S. must meet the requirements contained in the Department of Commerce's Voluntary Product Standard PS 2 "Performance Standard for Wood-Based Structural-Use Panels." In Canada, panels must comply with the Canadian Standards Association's CAN/CSA O325 "Construction Sheathing" or CSA O437 "OSB and Waferboard." Please refer to CSA-O325 for a description of span ratings used in Canada.

SIZES AND AVAILABILITY

Grademark-specified OSB panel thicknesses range from 1/4 inch to 1-1/4 inch. Not all thickness are readily available. Check with suppliers to determine availability. Standard dimensions are nominal 4 feet by 8 feet. Because OSB is made with wood, which will expand or contract when subjected to changes in temperature and relative humidity, a plus 0/minus 1/8-inch tolerance on width and length is permitted for panels manufactured in conformance with PS 2 to allow for possible expansion after installation. In addition, a tolerance of $\pm 1/32$ -inch is allowed on the grademark-specified thickness of 13/16-inch and less and $\pm 5\%$ of the grademark-specified thickness for panels thicker than 13/16-inch. Some mills also produce specialty sizes (e.g., smaller panels for the Japanese market or longer panels for vertical applications on walls, such as panels 4 feet wide by 9 or 10 feet long) and "jumbo" panels, such as required as skins for structural insulated panels. Panels 19/32-inch thick and thicker are manufactured with a square edge or tongue-and-groove (T&G) edge.

Table 2. Metric Equivalents of Panel Dimensions

PANEL WIDTH AND LENGTH	
English (foot)	S.I. (mm)
4 x 8	1220 x 2440
4 x 9	1220 x 2745
4 x 10	1220 x 3050
PANEL THICKNESS	
English (in.)	S.I. (mm)
1/4	6.5
5/16	8.0
11/32	9.0
3/8	9.5
7/16	11.0
15/32	12.0
1/2	12.5
19/32	15.0
5/8	16.0
23/32	18.5
3/4	19.0
25/32	20.0
7/8	22.0
1	25.5
1-1/8	28.5

Note: S.I. thicknesses are metric conversions derived from English measurements and are rounded to the nearest 0.5 mm. Refer to Canadian Standard CSA O325 for nominal thickness tolerances.

Panel Selection, Handling and Storage

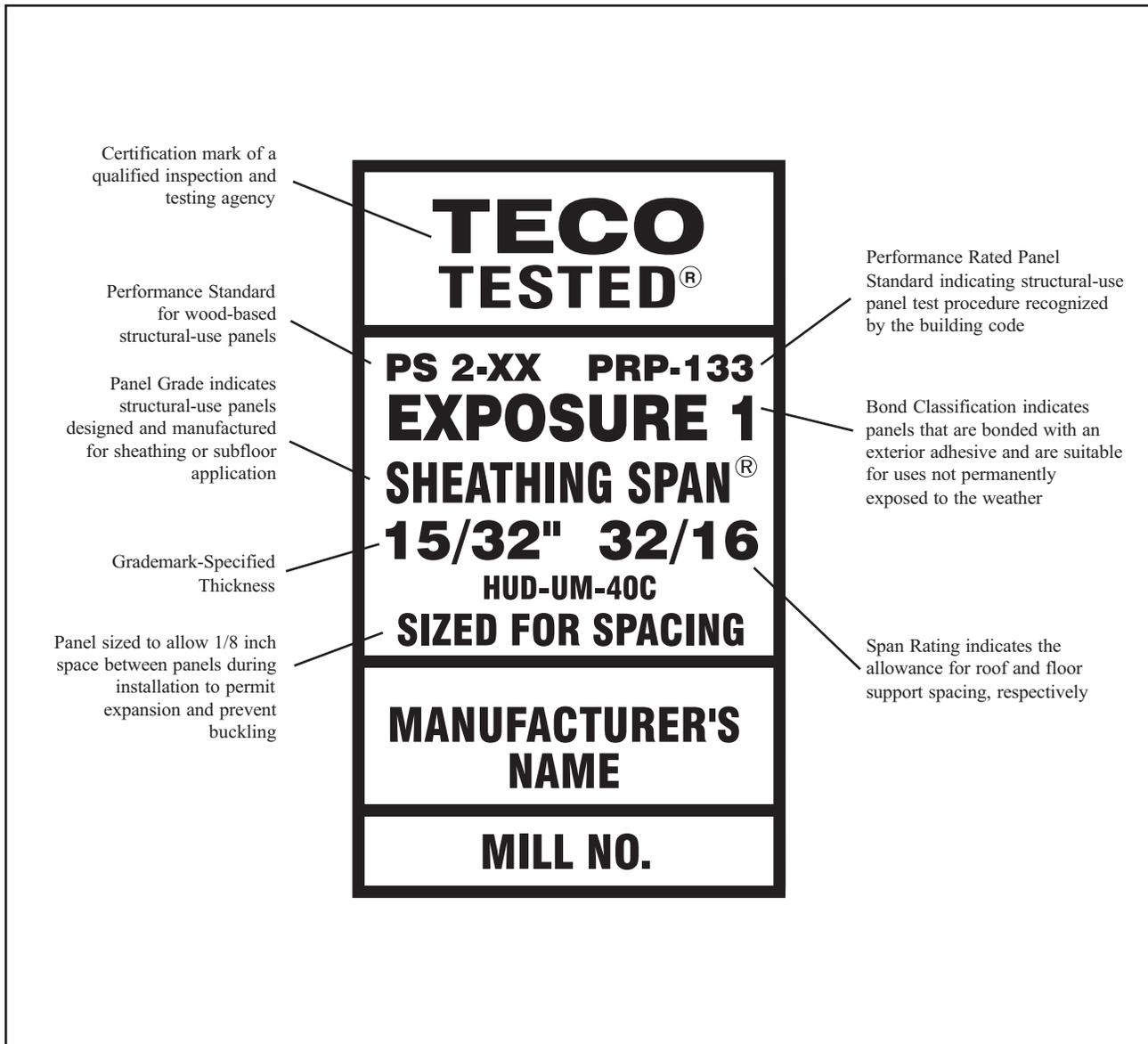


Fig. 1. Typical gradestamp on a certified panel

Unlike plywood, most OSB T&G panels are manufactured to give a full 48-inch face. However, due to manufacturing limitations, some T&G panels have a 47-1/2-inch net face width.

In some areas, certain panel thicknesses or span ratings may be difficult to obtain. OSB suppliers can verify the availability and details of the products they carry. To order OSB panels, the specifier should designate thickness, grade, span rating, bond classification, dimensions, "square edge" or "T&G" (as desired for thicker floor panels), and number of pieces. For example:

7/16-inch SHEATHING SPAN, 24/16
Exposure 1, 48 x 96 inches, square-edge, 200 pcs.

The specifier is wise to identify an alternate panel in the specifications in the event that a certain dimension is not readily available. Fig. 1 illustrates a typical gradestamp that is applied to a certified panel, while Table 2 contains metric equivalents for panel thicknesses.

Panel Selection, Handling and Storage

BASIC SPECIFICATIONS

The use of OSB-panels is governed by several basic guidelines. Details regarding application are presented in later sections of this Guide.

GENERAL PROVISIONS

1. When used structurally, each panel shall conform to the requirements of the appropriate standard as referenced in the building code. Each panel shall be identified by the trademarks of an approved testing and grading agency.
2. OSB panels with an Exposure 1 bond classification are not to be used where they will be permanently exposed to outdoor applications, except where roof sheathing is exposed on the underside such as with open soffits.
3. Panel applications shall meet the minimum requirements of the applicable building code and comply with the manufacturer's recommendations.

ROOF SHEATHING

Panel roof sheathing shall be one of the following grades/bond classification:

SHEATHING SPAN Exposure 1
Structural I SHEATHING SPAN Exposure 1

In constructing pitched roofs, all panel ends must be joined over framing. Suitable edge support must be provided where indicated on drawings or in recommendations by the manufacturer or TECO through use of panel clips, T&G edges, or lumber blocking between joists. Spacing of 1/8 inch is recommended between all panel ends and edges, although occasionally the panel manufacturer may recommend an alternative*.

For safety reasons, most mills produce panels with textured surface treatments for improved traction on sloped roofs.

FLOORING

Subflooring is applied directly to the floor framing and under an additional layer of structural material such as underlayment, hardwood flooring or concrete topping. Panel subflooring shall be one of the following grades/bond classification:

SHEATHING SPAN Exposure 1
Structural I SHEATHING SPAN Exposure 1

Spacing of 1/8 inch is recommended at panel ends and edges, though a panel manufacturer might recommend an alternative*. Before underlayment or finish flooring is installed, subfloor joints should be sanded to a smooth surface.

Combined subfloor/underlayment panels shall be of the following grade/bond classification:

FLOOR SPAN Exposure 1

Panel edges should be tongue-and-groove edged or supported on 2-inch lumber blocking between joists. The tongue-and-groove edges must be protected against damage until the finish floor is installed. Panel ends should meet over framing and joints should be staggered. Spacing of 1/8 inch is recommended at panel ends and edges during installation, although the panel manufacturer might recommend an alternative*.

All edge joints must be thoroughly filled and sanded. The manufacturer of the finish flooring may recommend light sanding of any surface roughness, particularly around fasteners.

* Under in-plant construction conditions, such as manufactured housing, a spacing of 1/16-inch between the edges and ends of panels is acceptable.

Panel Selection, Handling and Storage

PANEL HANDLING AND STORAGE

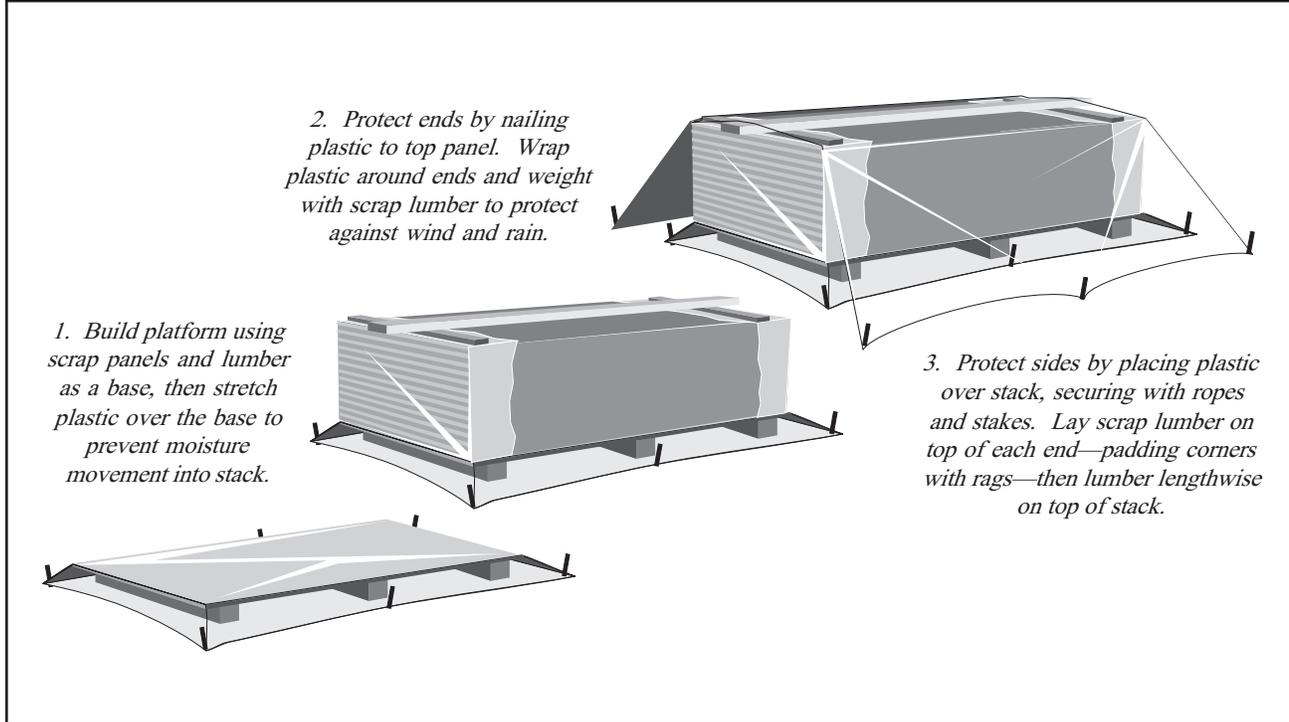


Fig. 2. Panel storage recommendations

Like all building materials, OSB panels should be properly stored and handled carefully to prevent damage and assure reliable performance.

Edges and ends of all panels must be protected. Panels to be moved by a forklift should be placed on pallets or lumber stringers when received to avoid damage by fork tines. When stacking units of panels, ensure that stringers are aligned vertically. Panels to be transported on open truck beds should be covered for protection from weather exposure.

OSB panels should preferably be stored under a roof. The top panel in a stack should be weighted down to

minimize warpage from uneven moisture absorption. If moisture absorption is expected, the steel banding on panel bundles should be cut to prevent edge damage.

As illustrated in Fig. 2, panels to be stored outside should be stacked on a level surface supported by lumber stringers or blocking. Panels should never be in direct contact with the ground. At least three full-width supports should be placed along the 8 foot length of the bundle — one centered and the others 12 to 16 inches from each end. The stack should be covered loosely with plastic sheets or tarps. The covering should be anchored at the top of the stack, but kept open and away from the sides and bottom to allow ventilation.

Floors

OSB FLOOR COMPONENTS

FLOOR SPAN COMBINATION SUBFLOOR / UNDERLAYMENT

FLOOR SPAN is a span-rated product designed specifically for economy and performance in single-layer floor construction. FLOOR SPAN is manufactured with a smooth side (i.e., a sanded or skip-sanded face) ready for several types of finish floor. It is commonly used beneath carpet and pad and is also used as "subflooring" under hardwood flooring, lightweight concrete and ceramic tile. FLOOR SPAN panels are manufactured with span ratings of 16, 20, 24, 32 and 48 inches oc, indicating the maximum recommended spacing of floor joists when the panel is installed with its strength axis across two or more supports.

Glue-nailing is recommended for FLOOR SPAN panels, although panels can be nailed only (see fastening recommendations for glued and nailed and nailed only floor systems in Table 4). The field-glued floor system is further described on page 15.

When greater stiffness in residential and light-frame commercial floors is desired, the addition of straight or diagonal blocking will increase stiffness considerably. However, certain manufacturers of engineered wood I-joists do not recommend this practice as the blocking can potentially create floor squeaks if not properly installed. For higher performance, FLOOR SPAN 32 oc and 48 oc installed over framing spaced at 24 inches on center can provide an improved floor system. Table 5 provides allowable floor live loads for FLOOR SPAN panels installed over various support spacings. Installation guidelines are provided on page 10.

SUBFLOORING

SHEATHING SPAN subfloors are intended to be installed in combination with an additional layer of structural material such as an underlayment, hardwood flooring, or concrete topping. Floor vibration or "bounciness" usually results from a combination of maximum floor joist span and spacing, with minimum subfloor thickness or lack of bracing or blocking. To increase floor stiffness and significantly improve overall floor performance, several options are available:

- increasing the subfloor thickness beyond the minimum code requirements;
- nailing and field-gluing the subfloor to the joists;
- reducing the joist spacing or reducing the joist spans to a smaller deflection limitation to account for live load (e.g., L/480 or L/600); or
- installing an approved bracing system.

The span ratings for SHEATHING SPAN are the maximum recommended for the spans indicated. Spans are limited (Fig. 3) because of the possible effect of concentrated loads.

Heavier concentrated loads and greater traffic may require panel capacity and/or performance in excess of the minimums required. Additional stiffness and strength can be gained by using panels with a floor span rating greater than the support spacing (for example, 40/20 or 48/24 SHEATHING SPAN with floor joists at 16 inches on center). For beams or joists 24 or 32 inches o.c., 1-inch-thick panels may provide the needed stiffness.

UNDERLAYMENT

"Sanded-face" OSB floor panels can be used as underlayment beneath carpet and other types of finished flooring products. Used in this type of application, the OSB panels provide a smooth, firm, uniform surface that ensures finished floor levels are maintained throughout. This added layer also restores a smooth surface over panels that may have been scuffed or roughened during construction, or over panels that may not have received an adequately sanded surface. Underlayment is dimensionally stable and eliminates excessive swelling and subsequent buckling or humps around nails if applied as recommended.

The minimum thickness of underlayment should be 1/4 inch on subfloors on spans up to 24 inches. On spans longer than 24 inches, 11/32 inch or thicker underlayment should be used.

It should be noted that not all OSB manufacturers recommend their panels be used as underlayment directly beneath certain types of finish flooring. Therefore, it is best to check with the manufacturer for specific recommendations.

Floors

INSTALLATION

COMBINATION SUBFLOOR / UNDERLAYMENT (FLOOR SPAN) AND SUBFLOORS (SHEATHING SPAN)

FLOOR SPAN and SHEATHING SPAN panels used in floor applications should be installed continuous over two or more spans with the strength axis perpendicular to the supports. FLOOR SPAN panels should also be installed with the side marked “THIS SIDE DOWN” towards the supports. End joints must be over the supports and should be staggered at least one support. OSB panels should have ends and edges spaced 1/8 inch, unless specific spacing recommendations are provided by the manufacturer. The long edges of single-floor or subfloor panels should be tongue-and-groove or supported with blocking with the following exceptions:

- where a separate underlayment (1/4 inch minimum thickness) is to be installed with its joints offset from those in the subfloor;
- a minimum of 1-1/2 inch of lightweight concrete is to be applied over the subfloor;
- 3/4-inch-thick wood-strip flooring is to be installed over the subfloor.

Fig. 3 shows the recommended installation details for FLOOR SPAN and SHEATHING SPAN along with the maximum support spacing for subfloors and combination subfloor/underlayment.

Power-driven nails can be used to fasten the panels as long as the nails are not over-driven. Standard nail sizes and lengths are given in Table 3. Nailing recommendations for SHEATHING SPAN subflooring are in Table 6. Wood screws are acceptable and other code-approved fasteners can also be used. Subflooring can be glued to improve performance and to reduce squeaks.

FLOOR SPAN 32 oc panels can be installed over dimension lumber joists or engineered wood I-joists spaced up to 32 inches o.c. (Fig. 4). FLOOR SPAN 48 oc can be installed over supports up to 48 inches o.c. (Fig. 5). Supports can be multiple 2x_ joists spiked together, 4x_ lumber, glulams, lightweight steel beams, wood I-joists or floor trusses. Girders of doubled 2x_ members should have top edges flush to permit smooth panel end joints.

If it is desired to have the panels bear directly on the sill plate, the support members can be set in foundation

pockets or on ledgers. If 4x_ lumber girders are used, they should be air dried and/or set higher than the sill plate to allow for shrinkage.

When floor members are dry, fasteners should be installed with the heads set flush with, or slightly below, the surface of the panels. If framing is green, it could present nail popping problems upon drying; in such a case, fasteners should be re-set. Nail holes need not be filled, but edge joints must be filled and thoroughly sanded. This step may not be necessary under certain types of carpet or some other finished flooring products. Check with the flooring manufacturer for further recommendations. Any other damaged or open areas should be filled and all surface roughness sanded.

UNDERLAYMENT

The following information provides general industry guidelines for installing panels as underlayment. As indicated earlier in this document, not all OSB manufacturers recommend their panels be used as underlayment directly beneath certain types of finished flooring products. Therefore, before installing OSB in underlayment applications, it is best to check with the manufacturer for specific recommendations.

When underlayment is installed over subfloors, panels should be applied, smooth side up, immediately prior to installation of the finished flooring.

Before the underlayment is applied, the subfloor must be dry and thoroughly swept or vacuumed. All popped nails must be re-set and any loose panels must be re-nailed.

Underlayment must be protected against physical damage or water prior to installation. Individual panels should be placed on edge for several days before installation to equalize with surrounding temperature and relative humidity conditions. Smooth panel faces and tongue-and-groove edges need to be protected from damage prior to and during installation. The surface of the underlayment should also be protected after installation to ensure a clean, smooth surface for application of the finish flooring.

The underlayment thickness required to bridge an uneven floor will depend on roughness and loads applied.

Floors

Underlayment recommendations for thin flooring products are provided in Table 8. Nailing should begin at the contact corner of the underlayment panels and work should progress diagonally across the panels. Fig. 7 provides the recommended installation details for underlayment along with fastener size and type. Panels must be in firm contact with the subfloor as fasteners are driven. As each panel is determined to be uniformly flat, workers can continue to fully fasten panels toward the opposite edge. End joints of underlayment panels should be offset by at least 4 inches from joints of subfloor panels. Edge joints of subfloor panels should be offset one joist space from the subfloor joint. Nails should be spaced a maximum of 6 inches o.c. along panel edges and 12 inches o.c. within the field of the panel (see Table 8 for recommended spacing with thin flooring). When underlayment is glued to the subfloor, only solvent-based glues are to be used.

In some cases, underlayment panels are applied over lumber board subfloors. In such situations, the panels should be laid parallel to the joists if the boards are perpendicular to the joists. Underlayment panels may be applied in either direction if boards are at an angle less than 75 degrees to joists.

Table 3. Nail Information

PENNY WEIGHT	LENGTH (inches)	DIAMETER (inch)
<i>Bright, common wire nails</i>		
6d	2	0.113
8d	2 -1/2	0.131
10d	3	0.148
12d	3 -1/4	0.148
16d	3 -1/2	0.162
20d	4	0.192
<i>Deformed¹ Shank Nails</i>		
6d	2	0.120
8d	2 -1/2	0.120
10d	3	0.135
12d	3 -1/4	0.135
16d	3 -1/2	0.148
20d	4	0.177

1. A deformed shank nail shall have either a helical (screw) shank or an annular (ring) shank.

Table 4. FLOOR SPAN Fastening Recommendations¹

SPAN RATING	NOMINAL PANEL THICKNESS ² (inch)	GLUED AND NAILED ⁶				NAILED ONLY	
		Nail size and type ³	Maximum nail spacing (inches)		Nail size and type ³	Maximum nail spacing (inches)	
			Supported panel edges	Intermediate supports		Supported panel edges	Intermediate supports
16 oc	19/32, 5/8	6d deformed shank ⁴	12	12	6d deformed shank	6	12
20 oc	19/32, 5/8						
24 oc	23/32, 3/4	8d deformed shank ⁴	6	(7)	8d deformed shank	6	(7)
24 oc	7/8						
32 oc	7/8, 1						
48 oc	1-1/8, 1-1/4	8d deformed shank ^{4,5}		(7)	8d deformed shank ⁵		(7)

- Fastening guidelines assume application of standard uniform loads. For heavy traffic, concentrated loads, or other special conditions, construction in excess of minimums shown may be required.
- Panels of a given thickness may be produced in multiple span ratings. Panels with a span rating greater than a given joist spacing may be substituted for panels of the same thickness whose span rating matches the joist spacing. For example, 19/32-inch-thick, 20 oc rated FLOOR SPAN may be used over joists spaced at 16 or 20 inches on center. 19/32-inch-thick, 16 oc FLOOR SPAN may be used over joists spaced at 16 inches on center.
- Other code approved fasteners may be used.
- If deformed shank nails are not available, common nails providing equal or greater withdrawal and lateral resistance may be substituted.
- If supports are well seasoned, 10d common nails may be substituted to attach 1-1/8-inch-thick FLOOR SPAN panels.
- Adhesives must be applied according to manufacturer recommendations and must conform to ASTM D3498 (or Specification AFG-01). Use solvent-based glues for OSB with sealed surfaces and edges—check with specific panel manufacturers.
- For supports spaced 48-inch on center, space nails a maximum of 6 inches.

Floors

Table 5. Recommended Uniform Floor Live Loads for FLOOR SPAN With Strength Axis of Panel Perpendicular to Supports ¹

SPAN RATING	NOMINAL PANEL THICKNESS (inch)	MAXIMUM SPAN (inches)	ALLOWABLE LIVE LOAD ² (psf)							
			With edge support ³	Spacing of supports center-to-center (inches)						
		12		16	19.2	24	32	40	48	54
16 oc	19/32, 5/8	16 ⁴	185	100						
20 oc	19/32, 5/8, 3/4	20 ^{4,5}	270	150	100					
24 oc	23/32, 3/4	24		240	160	100				
32 oc	7/8, 1	32			295	185	100			
48 oc	1-1/8, 1-1/4	48				290	160	100	65	

For SI units: 1 inch = 25.4 mm; 1 psf = 47.9 Pa

1. Panels shall be a minimum of 24 inches wide.
2. The allowable spans were determined using a dead load of 10 psf. If the dead load exceeds 10 psf then the live load shall be reduced accordingly.
3. Tongue-and-groove edges or lumber blocking (see also exceptions on page 10). Only lumber blocking will satisfy blocked diaphragm requirements of ER-5637 or IBC 2003 Tables 2306.3.1 and 2306.3.2.
4. Is permitted to be 24 inches on center where 3/4-inch wood strip flooring is installed perpendicular to the supports.
5. Is permitted to be 24 inches on center where 1-1/2 inches of cellular or lightweight concrete is applied over the panels.

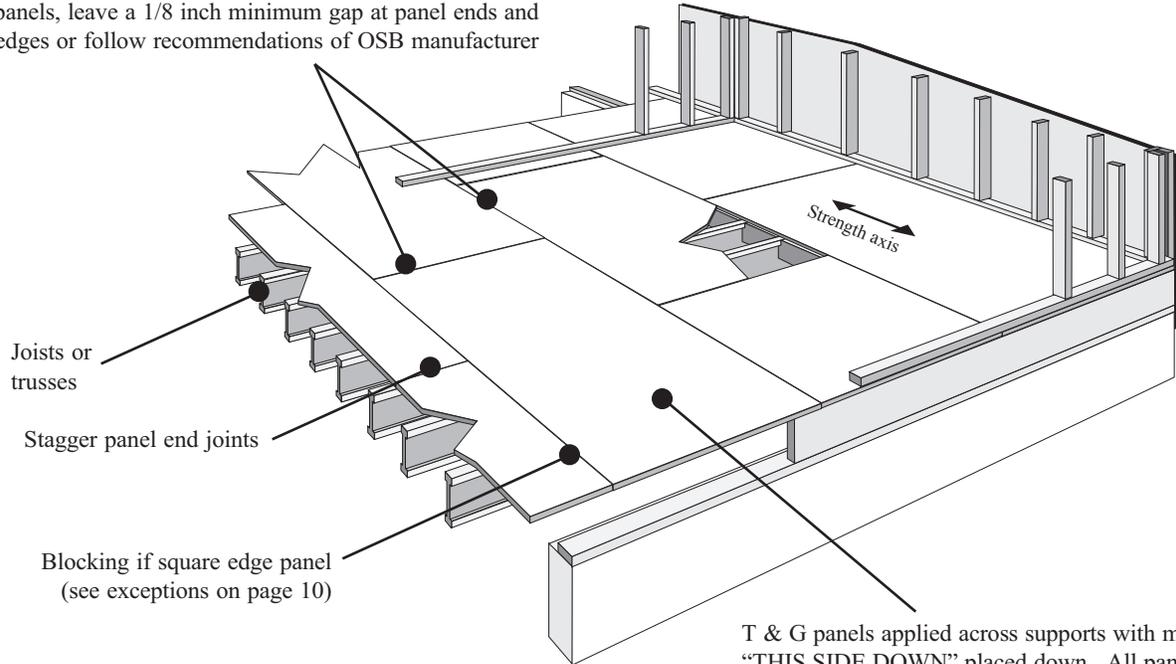
Table 6. SHEATHING SPAN Subfloor and Underlayment Fastening Recommendations ^{1,2}

SPAN RATING	NOMINAL PANEL THICKNESS (inch)	MAXIMUM SPAN ³ (inches)	NAIL TYPE AND SIZE ⁴	MAXIMUM NAIL SPACING (inches)	
				Supported panel edges	Intermediate supports
24/16	7/16	16	6d common or deformed shank	6	12
32/16	15/32, 1/2	16 ⁵			
40/20	19/32, 5/8	20 ^{5,6}	8d common or 6d deformed shank		
48/24	23/32, 3/4	24			
60/32 ⁷	7/8	32	8d common or deformed shank		

1. Refer to Table 9 for subfloor recommendations under ceramic tile. Contact the manufacturer of gypsum concrete for subfloor recommendations.
2. When span rating is equal to or greater than maximum number shown, FLOOR SPAN panels may be substituted.
3. Tongue-and-groove edges or lumber blocking (see also exceptions on page 10). Only lumber blocking will satisfy blocked diaphragm requirements of ER-5637 or IBC 2003 Tables 2306.3.1 and 2306.3.2.
4. Other code-approved fasteners may be used.
5. Is permitted to be 24 inches on center where 3/4-inch wood strip flooring is installed perpendicular to the supports.
6. Is permitted to be 24 inches on center where 1-1/2 inches of cellular or lightweight concrete is applied over the panels.
7. Check with supplier for availability.

Floors

For combination subfloor/underlayment or subfloor panels, leave a 1/8 inch minimum gap at panel ends and edges or follow recommendations of OSB manufacturer



T & G panels applied across supports with mark "THIS SIDE DOWN" placed down. All panels are to be continuous over two or more spans.

Note:
In crawl spaces, provide adequate ventilation and an approved moisture retarder as ground cover.

Maximum Support Spacing

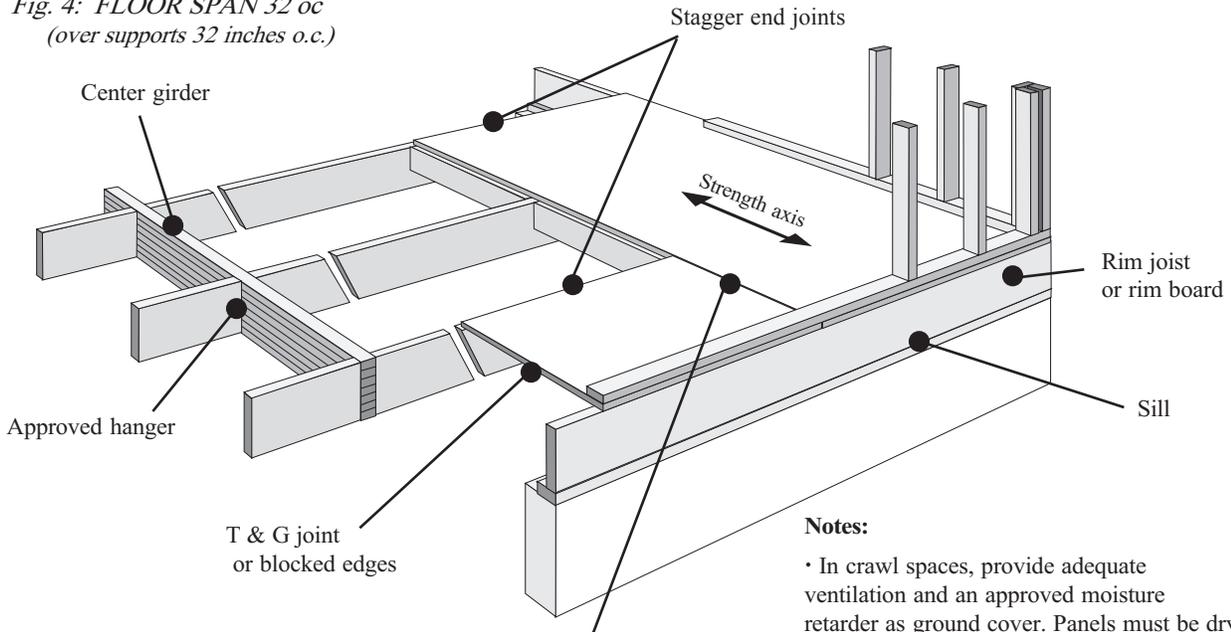
SHEATHING SPAN Subfloor: Sheathing and Structural I			FLOOR SPAN Combination Subfloor / Underlayment		
Support Spacing (inches)	Span Rating	Nominal Panel Thickness (inch)	Support Spacing (inches)	Span Rating	Nominal Panel Thickness (inch)
16 ¹	24/16	7/16, 15/32, 1/2	16 ¹	16 oc	19/32, 5/8
	32/16	15/32, 1/2, 19/32, 5/8	20	20 oc	19/32, 5/8
19.2, 20	40/20	19/32, 5/8, 23/32, 3/4	24	20 oc ²	19/32, 5/8
24	40/20 ²			24 oc	23/32, 3/4
		48/24	23/32, 3/4, 7/8	32	32 oc
			48	48 oc	1-1/8, 1-1/4

1. Is permitted to be 24 inches on center for panels with span ratings of 32/16 or 16 oc where 3/4-inch wood strip flooring is installed perpendicular to the supports.
2. Acceptable where 3/4-inch wood strip flooring is installed perpendicular to supports or where 1-1/2 inches of cellular or lightweight concrete is applied over the panels.

Fig. 3. Floor panel installation and maximum recommended support spacing

Floors

Fig. 4: FLOOR SPAN 32 oc
(over supports 32 inches o.c.)

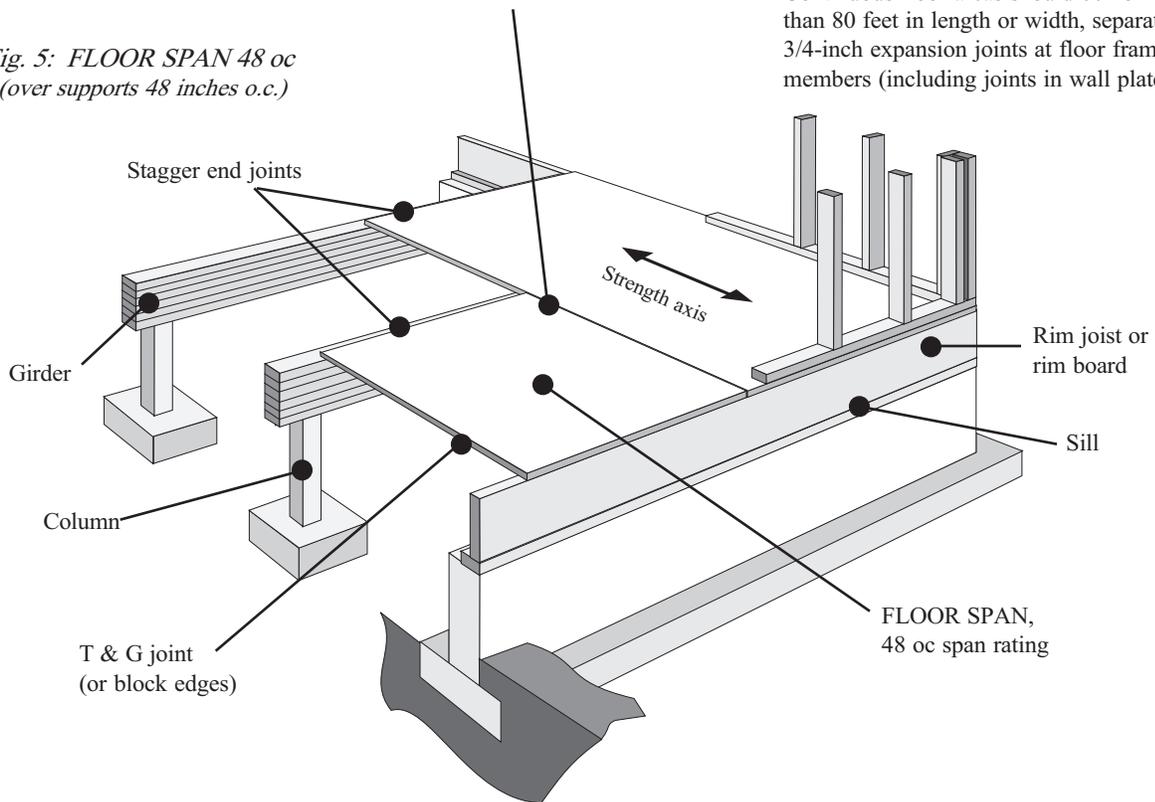


Follow recommendations of the panel manufacturer regarding spacing of panels to allow for expansion. If none are provided, space panels 1/8 inch at all end and edge joints.

Notes:

- In crawl spaces, provide adequate ventilation and an approved moisture retarder as ground cover. Panels must be dry before applying finish floor material.
- Accumulated expansion of panels may occur during construction in wet weather if expansion joints are not incorporated into buildings with wood- or steel-framed walls. Continuous floor areas should be no more than 80 feet in length or width, separated by 3/4-inch expansion joints at floor framing members (including joints in wall plates).

Fig. 5: FLOOR SPAN 48 oc
(over supports 48 inches o.c.)



Figs. 4 and 5. Installation of 32 oc and 48 oc FLOOR SPAN

Floors

FIELD-GLUED FLOOR SYSTEM

The field-glued floor system is based on proven gluing techniques and field-applied construction adhesives. Floor stiffness is increased appreciably over conventional construction, particularly when tongue-and-groove joints are glued. Gluing also helps eliminate squeaks, floor vibration, bounce, and nail-popping.

The system is normally used with FLOOR SPAN panels (Fig. 6), although multi-layer floors incorporating SHEATHING SPAN with a separate underlayment or with structural finish flooring are also candidate systems.

Only adhesives conforming with ASTM D3498 or AFG-01 are recommended for use with the field-glued floor system. Construction adhesives meeting this specification are available from building supply dealers. Specific application recommendations of the adhesive manufacturer must be followed.

INSTALLING THE FIELD-GLUED FLOOR SYSTEM

The following installation instructions for the field-glued floor are appropriate to both single-layer FLOOR SPAN floors and SHEATHING SPAN subfloors:

1. Snap a chalk line across joists 4 feet in from the wall for panel edge alignment and to serve as a boundary for spreading the glue.
2. Wipe any dirt from joists before gluing. Spread only enough glue to lay one or two panels at a time.
3. Lay the first panel with the tongue side to the wall and nail into place. This protects the tongue of the next panel from damage when gently tapped into place with block and sledgehammer.
4. Apply a continuous bead of glue (about 1/4 inch diameter) to framing members. Apply glue in a snake-like pattern on wide surfaces.
5. Apply two beads of glue on joists where panel ends butt to assure proper gluing of each end.
6. After the first row of panels is in place, spread glue in the groove of one or two panels at a time before laying the next row. Apply a thin bead (1/8 inch) to avoid squeeze-out.

7. Gently tap the second row of panels into place, using a block to protect the groove edges.
8. Stagger the end joints in each succeeding row. An 1/8 inch space between all end joints and an 1/8 inch space at all edges, including tongue-and-groove, is recommended. (Use a spacer tool to assure accurate and consistent spacing.)
9. Complete all nailing of each panel before glue sets. Check the manufacturer's recommendations for allowable setting time.
10. If OSB panels with sealed surfaces and edges are used, only solvent-based adhesives are permissible.

Note: Do not attempt to glue panels when it is raining or when joists are wet.

Floors

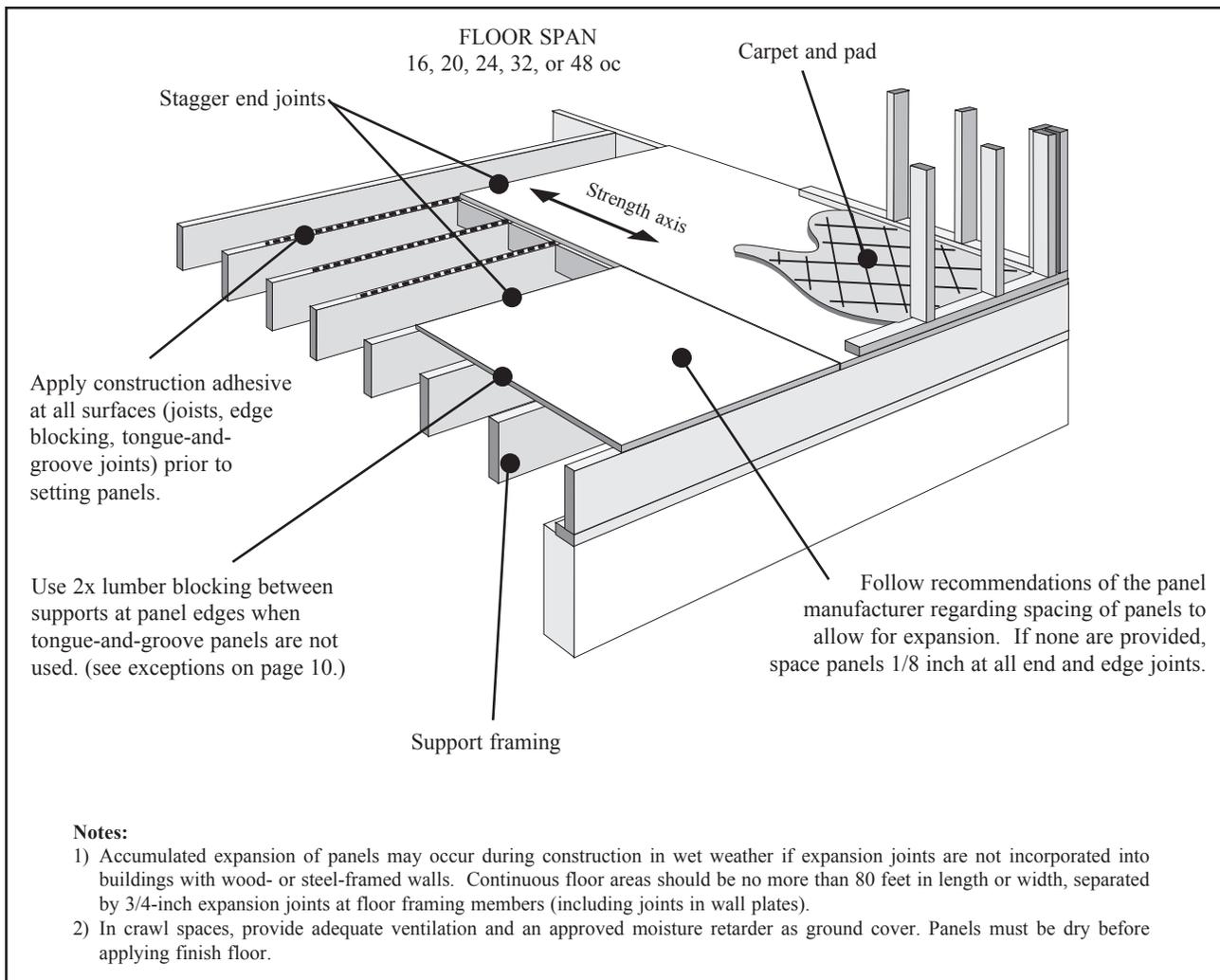


Fig. 6. Glued floor system

HIGH-PERFORMANCE FLOOR

Floors constructed with FLOOR SPAN and/or SHEATHING SPAN in accordance with minimum code provisions provide acceptable performance. For improved performance in subfloors, TECO recommends the following additional practices to create a High-Performance Floor:

1. FLOOR SPAN rating must be at least 24 oc for floor joist spacing up to 20 inches o.c. and 32 oc for joists spaced 24 inches o.c.
2. Panels are to be installed with the field-glued floor system (page 15 and Fig. 6).
3. Panels are to be fastened with 8d nails or other code-approved fasteners spaced 6 inches o.c. at edges, 12 inches at intermediate supports except 6 inches at all supports where spans are 48 inches or more. Nail size and spacing may vary depending on span and sheathing thickness. Deformed shank nails provide superior performance.
4. Panels are to be installed on framing that is dry (moisture content equal to or less than 12%) and is designed to upgraded deflection criteria (e.g., L/480, live load, floor; L/360, live load, roof etc.).

Floors

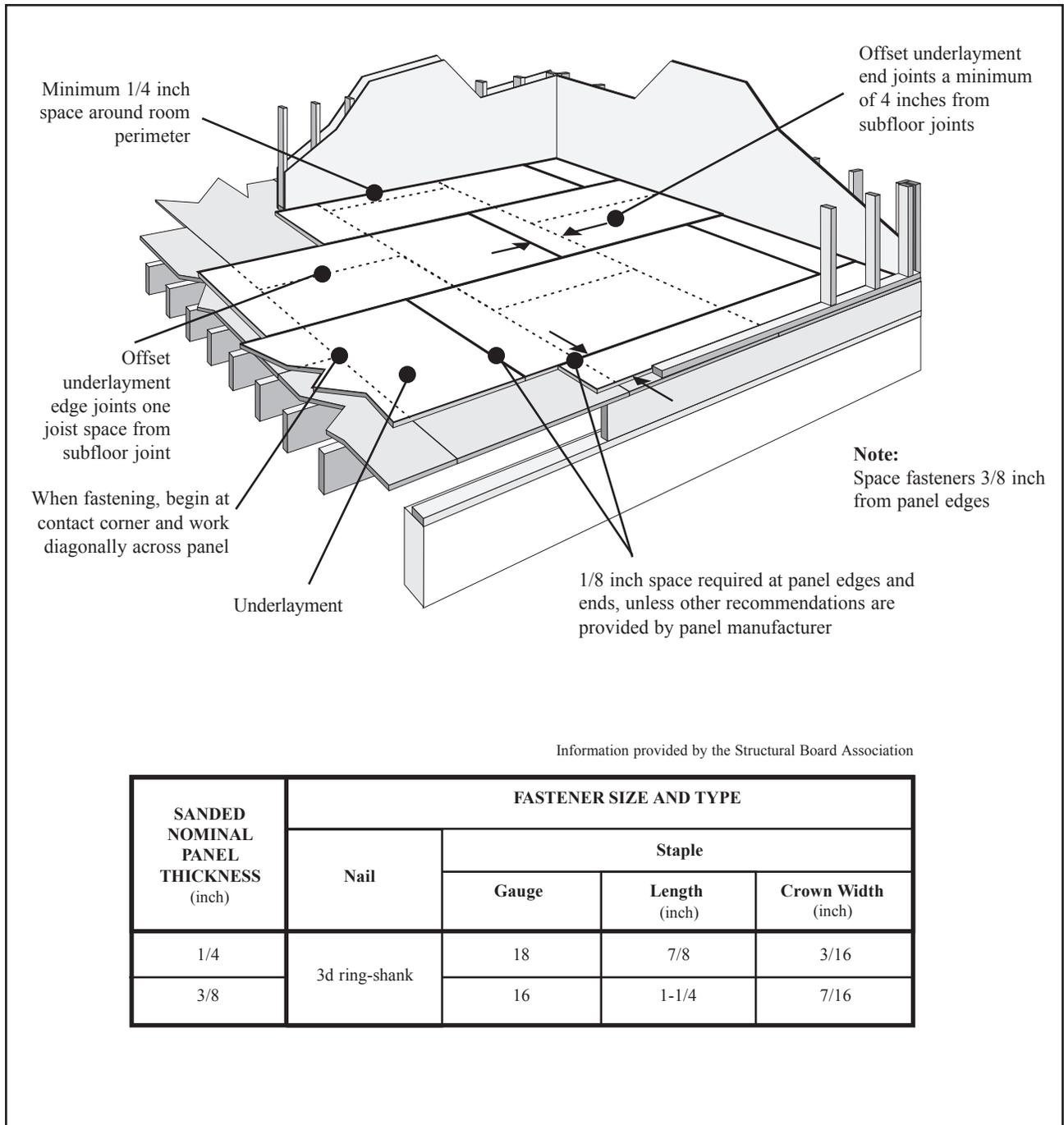


Fig. 7. Floor underlayment installation

Floors

FINISH FLOORS OVER OSB

After the building is closed in and heated and just before the finish floor is laid, OSB panels must be swept and/or vacuumed. The floor surface must be checked for protruding nail heads and all panels must be securely nailed. If the floor became wet during construction, it must be allowed to dry before applying the finish floor. If moisture caused some panel edge swelling, those edges must be sanded. The floor should be checked again for flatness, especially at joints, after it is dry. If panels were subjected to severe moisture conditions during construction, it may be necessary to level the entire surface with a light sanding.

ADHESIVE-APPLIED FLOORING

For adhesive-applied flooring, use an adhesive recommended by the flooring manufacturer. Carpet and parquet flooring may be installed on top of FLOOR SPAN single-layer floor following good practice and the flooring manufacturer's directions.

LIGHTWEIGHT CONCRETE

SHEATHING SPAN and FLOOR SPAN provide an excellent base for lightweight concrete floors. Concrete toppings are often used over subfloors to increase the sound insulation properties and fire resistance of the floor system. Lightweight gypsum concrete manufacturers typically recommend using 3/4 inch of concrete over 23/32- or 3/4-inch-thick tongue-and-groove subfloor with the joists spaced at 16 inches to 24 inches o.c.

However, 3/4 inch of lightweight concrete over 19/32-inch-thick (40/20) subfloor with joists at 19.2 inch o.c., or 1-1/2 inches of lightweight concrete for joists at 24 inch o.c., is often acceptable to local building officials. Panels should be installed continuously over two or more spans with the strength axis across supports. A moisture retarder or seal coat is often recommended by the concrete or OSB manufacturer.

HARDWOOD FLOORING

Because hardwood flooring is sensitive to moisture, it is important that the subfloor be dry when the hardwood is installed. The moisture in a "wet" subfloor will migrate into the drier hardwood flooring causing the flooring to buckle and create squeaks. The moisture content of the panels should be checked with a moisture meter to assure that they are within limits acceptable to the hardwood flooring manufacturer. If the construction is built over a crawl space, the crawl space must be dry, and well drained and ventilated. A minimum 6-mil polyethylene vapor retarder should be installed as ground cover in the crawl space.

The subfloor should be level, especially at the joints between panels. Any ridges at panel edges should be sanded smooth before hardwood installation using a heavy-duty floor sander and a moderately coarse grit sandpaper. Following sanding, any areas of the subfloor that squeak should be re-nailed.

The National Wood Flooring Association (NWFA)* and the Wood Flooring Manufacturers Association (NOFMA)* recognize the use of 23/32-inch-thick OSB subfloor or single-layer floor under hardwood flooring. Recommended support spacings are shown in Table 7. To help eliminate floor squeaks and improve stiffness when hardwood flooring is installed, follow construction recommendations for High-Performance Floors (see page 16).

NWFA and NOFMA provide recommendations for storage, handling, acclimatizing, and installing hardwood on subflooring. Where possible, the hardwood strips should be oriented perpendicular to the floor framing.

** Contact either the National Wood Flooring Association, Manchester, MO, (800) 422-4556, web site: www.woodfloors.org; or The Wood Flooring Manufacturers Association, Memphis, TN, (901) 526-5016, web site: www.nofma.org.*

Floors

Table 7. Maximum Recommended Support Spacing for OSB Panels Used with Hardwood Flooring

FLOOR SPAN	SHEATHING SPAN	Recommended maximum support spacing (inches)
20 oc	40/20	12
24 oc	48/24	19.2
32 oc		24
48 oc		32

Note: 23/32-inch or thicker panels are recommended for best performance

Table 8. Underlayment Application Recommendations for Thin Flooring¹

Application	Thickness (inch)	Fastener size and type (minimum required)	Maximum Fastener Spacing (inches)	
			Panel edges ²	Intermediate
Over smooth subfloor	1/4	3d x 1-1/4 inch ring-shank nails	3	6, each way

1. See Table 9 for underlayment recommendations under ceramic tile.
2. Fasten underlayment 3/8 inch from panel edges.

Floors

CERAMIC TILE

For long-term performance of ceramic tiles, it is important that the floor system be as stiff as possible. Table 9 provides the minimum recommended floor sheathing system for ceramic tiles. Depending on the ceramic tile and mortar type chosen, the specific requirements of the underlayment change as well. Many tile manufacturers recommend that supporting joists or trusses not exceed a spacing of 16 inches on center. They also recommend that the deflection of the floor system be limited to no more than span/360 under total load (i.e., live + dead load). Both of these recommendations are intended to prevent cracking of the tile.

The use of thicker subfloor (e.g., 23/32-inch-thick 48/24 span rating), cross bracing, or underlayment along with closer fastener spacing will enhance the performance of the floor. To avoid cracking, the tile should have no traffic until the mortar or adhesive and grout has set.

Note: For more specific information related to the requirements of ceramic tile, contact the Tile Council of America (Anderson, SC; (864) 646-8453, www.tileusa.com) or the National Tile Contractors Association (Jackson, MS; (601) 939-2071, www.Tile-Assn.com).

Table 9. Recommended Floor Sheathing Systems for Ceramic Tile Flooring ^{1,2}

Minimum subfloor requirements	Underlayment details	Tile installation
19/32 inch thick 40/20 span rating	Bond cementitious backer units (CBU's) to subfloor with latex-portland cement mortar prior to spreading mortar for setting ceramic tile; leave 1/8-inch gap at panel ends and edges.	Dry-set mortar or latex-portland cement mortar
	None	1-1/4-inch-thick cement mortar; use No. 15 asphalt felt or 4-mil polyethylene sheeting over subfloor; reinforce with wire mesh
	Use min. 11/32-inch-thick exterior glue plywood underlayment	Organic adhesive
	Use min. 15/32-inch-thick exterior glue plywood underlayment; leave 1/4-inch gap at panel ends and edges; trim panels as necessary to maintain end spacing and panel support on framing; fill joints with epoxy mortar when it is spread for setting tile.	Epoxy mortar

1. Based on ANSI Standard A108 and specification of the Tile Council of America.
2. Joist or truss spacing not to exceed 16 inches on center.

Floors

STAIR TREADS AND RISERS

OSB can be used for treads and risers of both site-fabricated and prefabricated stairs in open- or closed-riser stairways. Risers support the front and back of the tread, creating a short effective span. OSB stair treads may be used interchangeably with boards when the system is to include closed risers.

Maximum span between stringers is 42 inches, unless further restricted by local code requirements. Rounded nosing can be machined into the tread, but should be covered by a finish flooring material such as carpet and pad to prevent excessive wear or damage to strands

exposed by rounding. Risers can be specified for any available OSB panel grade at least 19/32-inch thick. Treads should be at least 19/32-inch-thick 20 oc FLOOR SPAN if they are glue-nailed and 23/32-inch-thick 24 oc if treads are nailed only. As specified for other OSB construction, gluing is recommended to improve the stiffness of connections and to eliminate squeaks. A construction adhesive that meets the requirements of ASTM D3498 or AFG-01 should be applied to all joints, with particular attention to the connection at the riser. Regardless of where glue is used, all edges of treads must be carefully nailed (see Fig. 8).

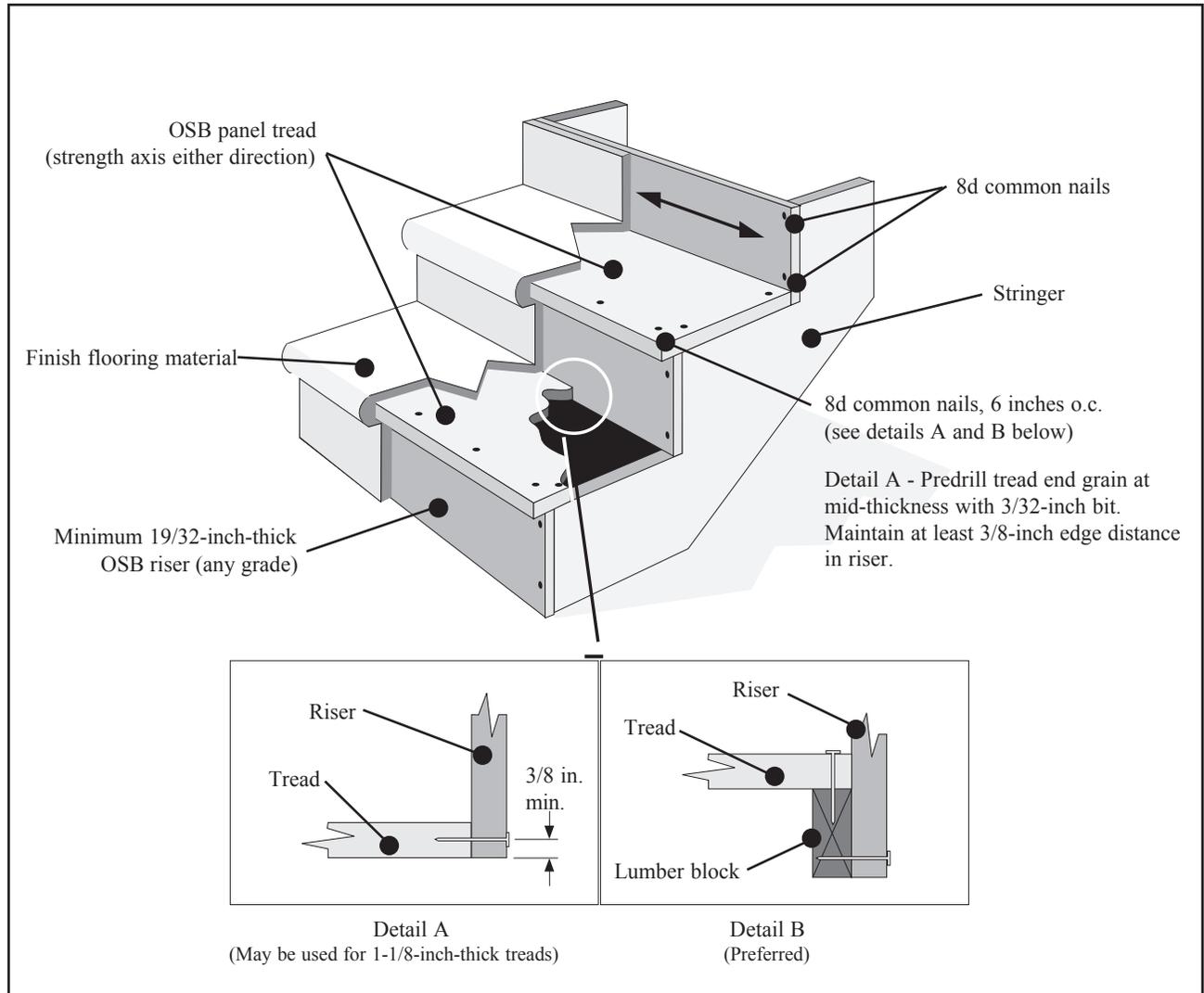


Fig. 8. OSB stair construction recommendations

Walls and Roofs

DIAPHRAGMS AND SHEAR WALLS

Wind and seismic forces are the primary lateral forces that structural building systems must resist and transfer to the building foundation. Structural-use panels such as OSB serve as a principal component of the diaphragms and shear walls that comprise the building system. Diaphragms are horizontal or slanted planes that can be designed to act as deep beams that carry lateral forces applied to walls between floors and roofs. When the

building walls are parallel to an applied lateral force, they act as shear walls to transfer the force down to the foundation (see Fig. 9). Specific design and construction requirements are often necessary in order for a wall system to be designed and behave as a shear wall, while the same is true for a roof or floor system designed as a diaphragm. Basic design and construction methods and recommendations for each of these two systems follow.

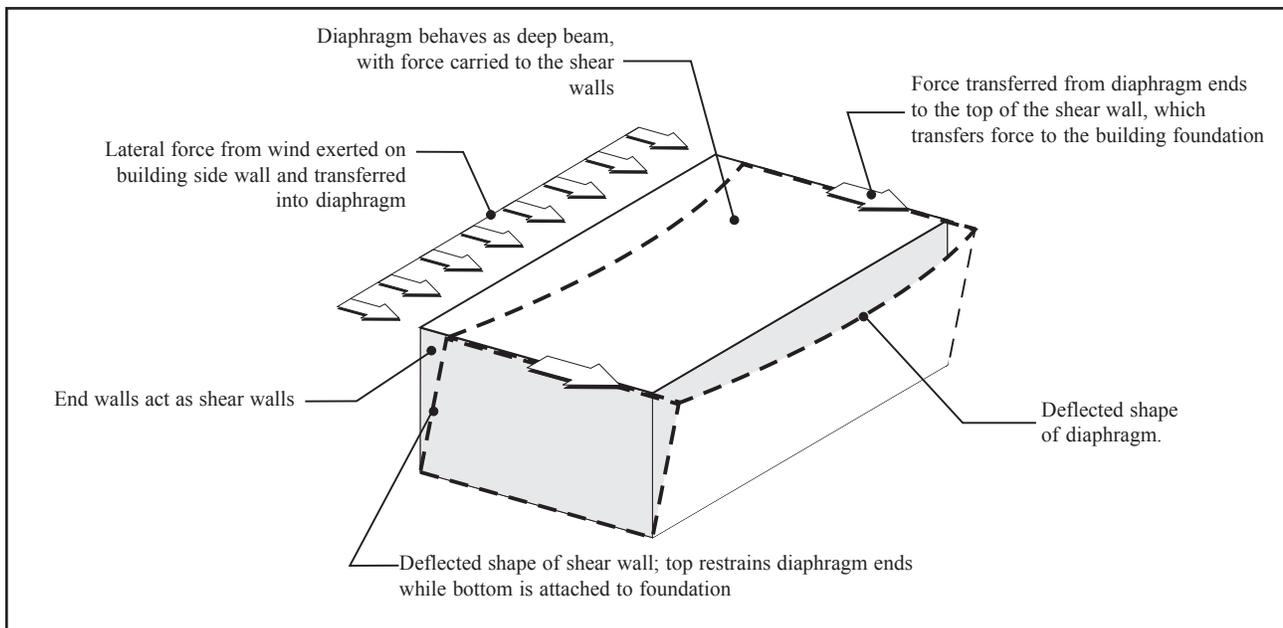


Fig. 9. Illustration of diaphragm and shear wall interaction

WALL SHEATHING

PS 2 certified OSB panels that are used for wall sheathing are permitted to be installed with the strength axis either perpendicular or parallel to the studs. Panels rated for wall spans, such as Wall-16, must be installed over studs spaced no farther apart than the span rating. When panels rated for roof spans are used for wall sheathing, the maximum stud spacing is 16 inches for panels with span ratings of 16 and 20 inches, and 24 inches for 24 inch and greater span ratings. For example, an OSB panel with a 20/0 span rating could be applied as wall sheathing when studs are spaced at 12 or 16 inches, but not 24 inches.

Building codes often require that wall sheathing be at

least 1/2 inch thick when stucco is to be applied (unless the lathe is fastened directly to the wall studs). Sheathing rated as Structural I has greater cross-panel load carrying capacity and is ideal in shear wall and diaphragm applications.

Most OSB panels are manufactured with one side rough and the opposite side smooth. If wetted during construction, the smooth side can become slippery. For the safety of construction workers installing these panels in roof or subfloor applications, panel manufacturers stamp the smooth side with a "THIS SIDE DOWN" (or similar) warning. When used in wall applications, this warning has no significance and can be disregarded; that

Walls and Roofs

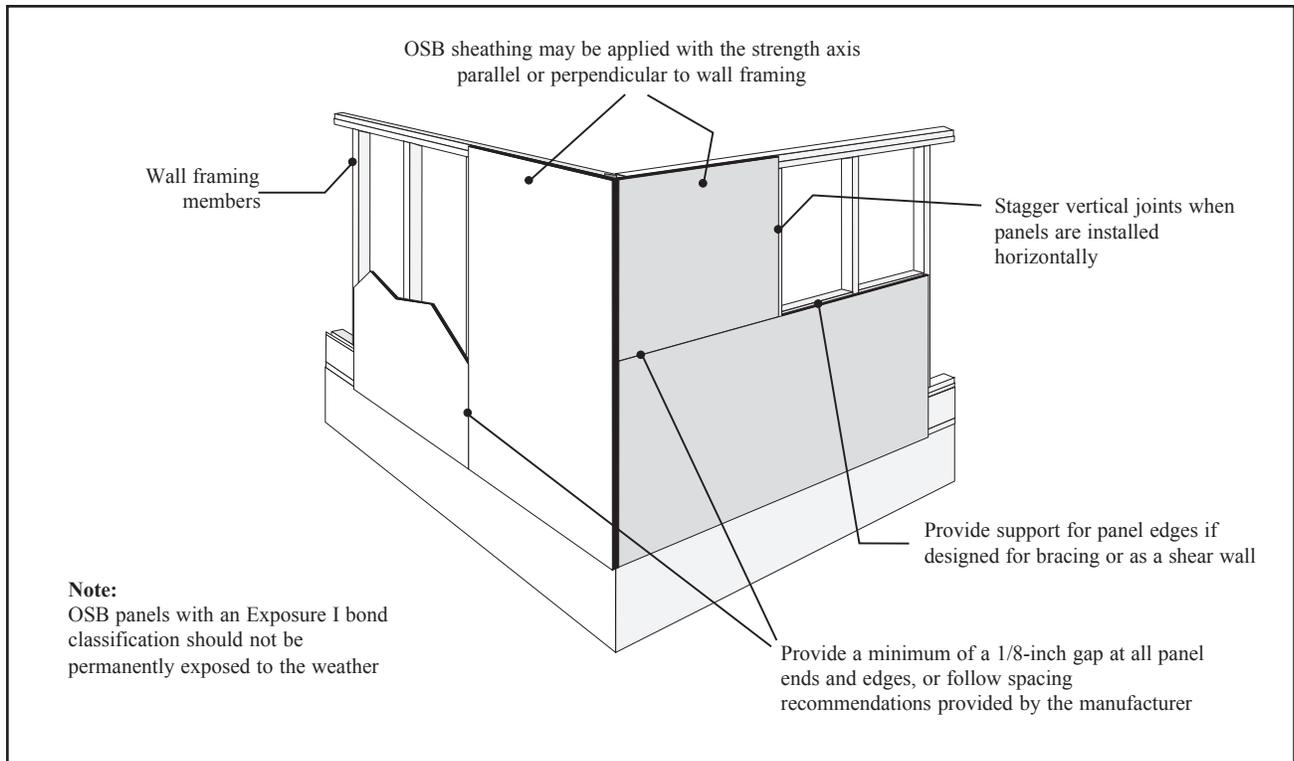


Fig 10. Wall sheathing installation recommendations

is, either face of an OSB panel can be applied outward when used in a wall application. OSB panels used for wall sheathing are an alternative to the plywood sheathing sometimes specified in building codes for wall bracing. Span rated OSB panels meet or exceed corner bracing requirements of bending and racking strength and do not require additional let-in bracing (see Fig. 10).

To prevent problems associated with expansion of panels due to an increase in moisture content, wall sheathing should be installed with 1/8-inch gaps at panel ends and edges and around window and door openings, unless specific spacing recommendations are provided by the panel manufacturer.

OSB panels identified with an Exposure 1 bond classification are not intended for permanent exposure to the weather and need to be covered by an exterior wall covering complying with the applicable code. It is also recommended to apply a weather-resistant sheathing paper to the outside surface of the OSB panels whenever the exterior wall covering is not moisture impermeable.

FASTENING WALL SHEATHING

Field investigations conducted after several hurricanes in the past two decades have confirmed that improper fastening of sheathing, siding, shingles, and other wall and roof covering has been a primary source of failure and damage resulting from the high winds of hurricanes. Using the correct fastener, whether nail, screw, staple or others, and applying them where and as often as required is the first step in preventing and limiting damage from high-wind events.

Wall sheathing panels 1/2 inch thick or less should be fastened with 6d common nails or deformed shank nails. Panels greater than 1/2 inch but less than 7/8 inch thick should be fastened with 6d deformed shank or 8d common nails. Eight penny common or deformed shank nails should be used to attach panels 7/8 inch to 1 inch thick. Panels 1-1/8 inch thick and greater should be attached with 8d deformed shank or 10d common nails. In all cases, other nails, staples, or screws can be substituted for common nails when their capacity is sufficient for the intended purpose and local code allows such substitution. Several OSB manufacturers mark lines on each panel corresponding to support spacing of 12, 16 or 24 inches as guides for workers fastening the panels.

Walls and Roofs

ROOF SHEATHING

SHEATHING SPAN panels are the primary structural sheathing component of roof systems and are effective under a variety of roof coverings including wood, asphalt, or fiberglass shingles, tiles, wood shakes, or built-up roofing. Fig. 11 illustrates a typical roof system with recommendations that will enhance performance of the entire roof structure. Additionally, the surface of the roof sheathing should be dry prior to installing any portion of the roof covering

Follow these steps when installing the roof:

- Step 1** Install the roof framing and ensure that it provides a level surface; add blocking if needed to fix any twisted areas of framing.
- Step 2** Ensure proper ventilation that meets or exceeds all applicable building codes.
- Step 3** Space and fasten panels; place panel ends over supports; space panels 1/8 inch (the diameter of a 10d box nail) apart to allow for possible moisture expansion; install fasteners 3/8 inch from the edge of the panel at the appropriate on-center spacing. Install panel clips when required*.
- Step 4** Install shingle underlayment or No. 15 roofing

felt to minimize exposure to weather prior to applying shingles (use No. 30 roofing felt if prolonged exposure is expected); apply evenly, leaving a smooth surface.

- Step 5** Install shingles or other roof covering according to the manufacturer's recommendations; heavyweight, laminated and textured shingles create the best appearance.

FASTENING ROOF SHEATHING

It is recommended that roof sheathing less than 1-1/8 inch thick be fastened with a minimum of 8d common or deformed shank nails (although some code jurisdictions allow the use of 6d common or deformed shank nails); for panels that are 1-1/8 inch thick or greater, use 10d common nails.

Fastener spacing requirements may vary with building codes that recognize the potential for high-wind and seismic forces. Consult with your local code authority for these requirements. In all cases, other nail types, staples, or screws can be substituted for common nails when their capacity is sufficient for the intended purpose and local codes allow such substitution.

* Refer to footnote 3 of Table 10 for edge support requirements for panels used as roof sheathing.

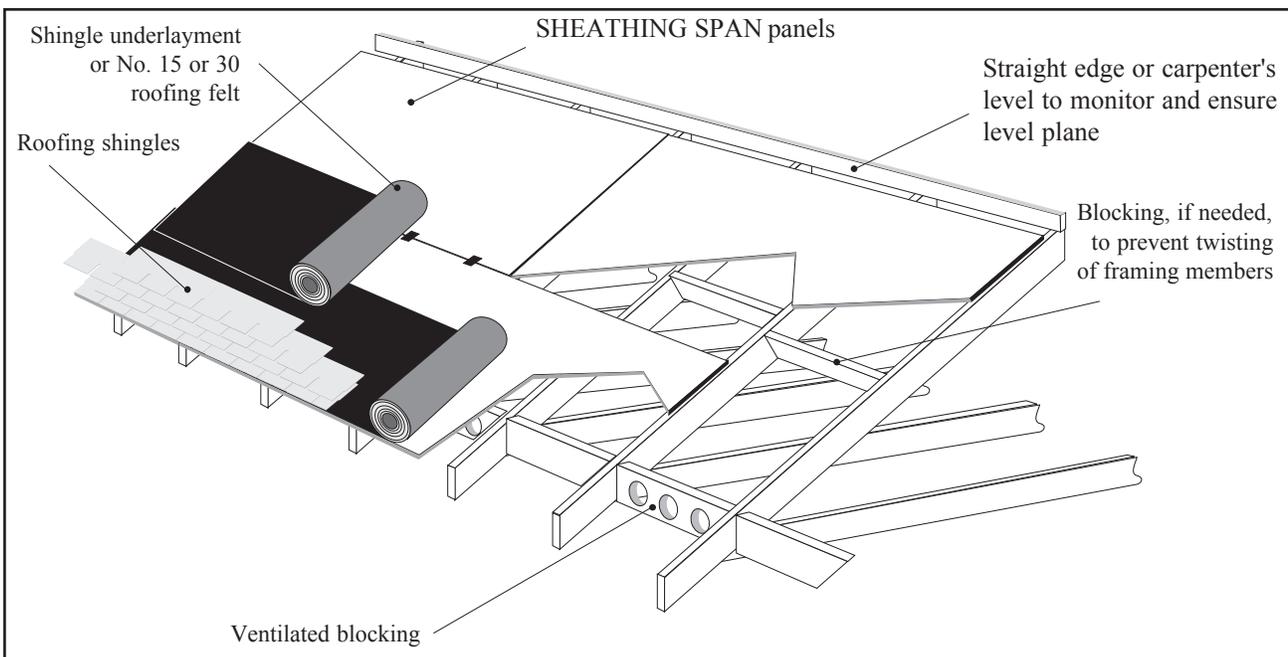


Fig.11. Installation of roof sheathing with felt and shingles

Walls and Roofs

DESIGN CONSIDERATIONS

Tables 10, 11, 12, 13, and 14 are taken from either TECO's Evaluation Report ER-5637 or the 2003 International Building Code® and contain information for SHEATHING SPAN and FLOOR SPAN panels when used as roof or wall sheathing. Table 10 contains allowable roof live loads when panels are oriented with their strength axis perpendicular to supports, as is typically the case. Table 11 lists similar load information when the strength axis is parallel to supports. Tables 12 and 13 provide allowable shear values when panels are used in diaphragm applications, while shear wall allowable loads are provided in Table 14. The values in these tables are applicable to panels that comply with the requirements of PRP-133 or PS 2.

The allowable loads listed in Tables 10 and 11 are derived assuming a dead load of 10 psf. Applications with heavier dead loads must be considered appropriately.

As an example, let's assume that an architect is designing a roof system for a commercial structure. They determine that the sheathing panels must support 60 psf of live load and 15 psf of dead load, i.e., a total load of 75 psf. What are the choices if they want to specify a panel with supports spaced no more than 32 inches on center?

Since the allowable roof live loads in Table 10 assume a dead load of 10 psf, and the design requires a 15 psf dead load, the architect must increase the design live load by an equal amount, (specifically 5 psf), to 65 psf. Doing so will ensure that the chosen panel is capable of carrying a total load of 75 psf.

Entering the table, our architect has the following choices:

- 7/16" 24/16 rated panels with supports at 19.2" o.c.
- 15/32" 32/16 rated panels with supports at 24" o.c.
- 23/32" 48/24 rated panels with supports at 32" o.c.

Notice that the first of these choices is the most efficient since the panels are rated for 65 psf and therefore utilize their entire structural capacity. Still, other considerations, like the choice of the supporting trusses or joists (due to cost or appearance, for instance), may lead to one of the other options.

Notice also that if the architect had not made the adjustment for excess dead load, he or she may have chosen 19/32-inch panels rated at 40/20, which have a tabular live load capacity of 60 psf. This choice would have resulted in panels that exceeded their capacity by 5 psf, or more than 8 percent.

Looking at the diaphragm and shear wall tables (Tables 12, 13 and 14 respectively), notice that the top section of each table applies to Structural I SHEATHING SPAN, while the lower section applies to regular sheathing (and FLOOR SPAN in Tables 12 and 13). Notice too that when framing species such as Spruce-Pine-Fir are used, shear values must be adjusted to account for the difference in density between that species and Douglas Fir-Larch or Southern Pine.

Walls and Roofs

NARROW-WIDTH ROOF PANELS

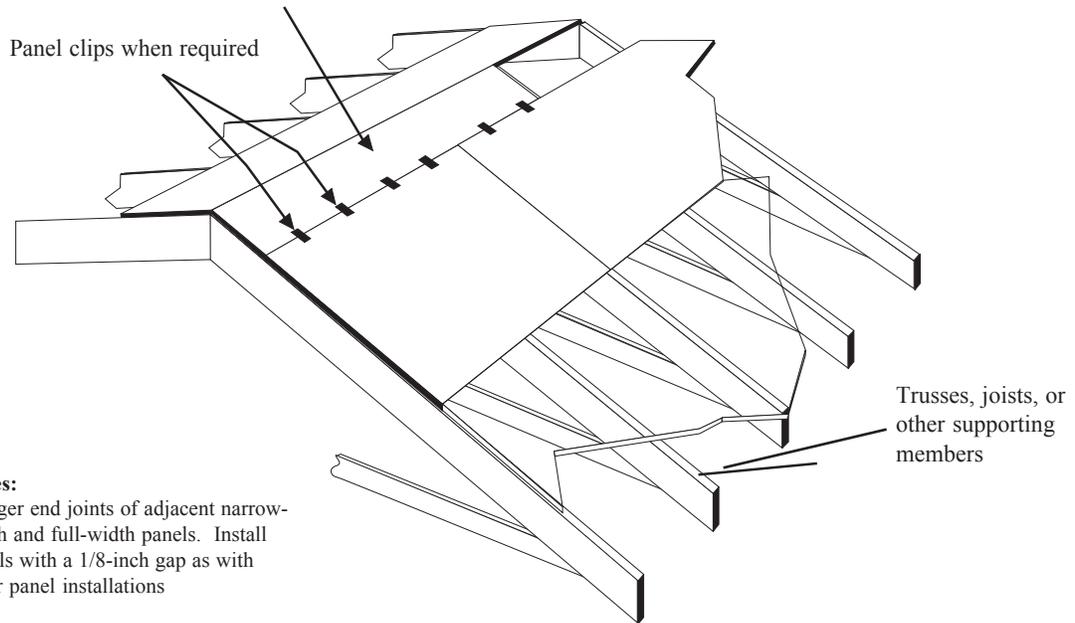
The overwhelming majority of structural-use panels used in construction today are four feet wide. Yet OSB panels must often be cut to a width less than four feet to accommodate the size and shape of the roof system. Fig. 12 illustrates this situation, where full-width panels are installed beginning at the soffit, continuing up the roof and creating the need for a run of narrow-width panels at the ridge. It is not uncommon, especially in specialized industrial construction, for these narrow-width panels to be less than 12 inches in width.

Allowable uniform roof live loads in Table 10 apply to panels that are at least 24 inches wide. Whenever possible, panels should be laid out so that the minimum panel is 24 inches, even if it creates two panels less than full width. It is further recommended to install the narrow-width panels away from the ridge at intermediate locations within the roof system, with both edges supported as recommended in the table in Fig. 12.

However, if panels must be cut to less than 24 inches in width, the recommendations in Fig. 12 are suggested to provide sufficient edge support to ensure adequate panel performance. These recommendations apply to panels installed over two or more spans (i.e., three or more supports) with the strength axis of the panel perpendicular to the supports. When panel clips are recommended, one clip should be centered between supports for support spacing 16 inches on center or less; use at least two clips, equally spaced, when support spacing is greater than 16 inches on center. If lumber blocking is recommended, a 2x4 or greater (any grade except Utility) may be installed edge- or flat-wise, adequately attached to supporting members.

Walls and Roofs

Narrow-width panel. When feasible, intersperse narrow width panels at intermediate locations within the roof system and support both edges as recommended in the Table below.



Panel Width, PW	Support Recommendations
$16'' \leq PW < 24''$	Panel clips or lumber blocking as described above. If the edge adjacent to a full-width panel is supported as recommended, the edge adjacent to a ridge or valley need not be supported, unless specifically required by code.
$12'' \leq PW < 16''$	Lumber blocking as described above on edge adjacent to full-width panel; support opposite edge if required by code.
$PW < 12''$	Lumber blocking as described above on both edges, even if one is adjacent to a ridge or valley. Both edges are considered blocked by a single piece of lumber when each edge is no further than 1-1/2'' from the lumber edge (e.g., a single nominal 2x4 lumber block on edge centered under a 4-1/2-inch-wide panel is considered sufficient for support).

Note: Panel section widths are nominal and may be 1/8 inch less than specified to allow for saw kerf.

Fig.12. Illustration of narrow-width roof panels with recommendations for support

Walls and Roofs

Table 10. Allowable Uniform Roof Live Load for SHEATHING SPAN and FLOOR SPAN Panels with Strength Axis Perpendicular to Supports¹

SHEATHING SPAN

SPAN RATING	NOMINAL PANEL THICKNESS (inch)	MAXIMUM SPAN (inches)		ALLOWABLE LIVE LOAD ² (psf)										
		With edge support ³	Without edge support	Spacing of supports center-to-center (inches)										
				12	16	19.2	24	32	40	48	54	60		
20/0	5/16, 11/32	20	20	120	50	30								
24/0	3/8	24	20	190	100	60	30							
24/16	7/16	24	24	190	100	65	40							
32/16	15/32, 1/2	32	28		180	120	70	30						
40/20	19/32, 5/8	40	32			205	130	60	30					
48/24	23/32, 3/4	48	36				175	95	45	35				
54/32	7/8, 1	54	40					130	75	50	35			
60/32	7/8, 1	60	40					165	100	70	50	35		
60/48	7/8, 1, 1-1/8	60	48					165	100	70	50	35		

FLOOR SPAN

SPAN RATING	NOMINAL PANEL THICKNESS (inch)	MAXIMUM SPAN (inches)		ALLOWABLE LIVE LOAD ² (psf)										
		With edge support ³	Without edge support	Spacing of supports center-to-center (inches)										
				12	16	19.2	24	32	40	48	54	60		
16 oc	19/32, 5/8	24	24	185	100	65	40							
20 oc	19/32, 5/8, 3/4	32	32	270	150	100	60	30						
24 oc	23/32, 3/4	48	36		240	160	100	50	30	25				
32 oc	7/8, 1	48	40			295	185	100	60	40				
48 oc	1-1/8, 1-1/4	60	48				290	160	100	65	50	40		

SI units: 1 inch = 25.4 mm; 1 psf = 47.9 Pa

1. Panels shall be a minimum of 24 inches wide.
2. The allowable spans were determined using a dead load of 10 psf. If the dead load exceeds 10 psf then the live load shall be reduced accordingly.
3. Tongue-and-groove edges, panel edge clips (one between each support, except two between supports 48 inches on center), lumber blocking or other. Only lumber blocking will satisfy blocked diaphragm requirements of ER-5637 or IBC 2003 Tables 2306.3.1 and 2306.3.2.

Walls and Roofs

Table 11. Allowable Uniform Roof Live Loads for SHEATHING SPAN Panels with Primary Axis Parallel to Supports¹

SPAN RATING	NOMINAL PANEL THICKNESS (inch)	STRUCTURAL I ² SHEATHING SPAN		SHEATHING SPAN	
		Maximum span with edge support ³ (inches)	Live load ⁴ (psf)	Maximum span with edge support ³ (inches)	Live load ⁴ (psf)
24/16	7/16	24	20	16	40
32/16	15/32	24	20	24	20 ⁵
32/16	1/2	24	25	24	25 ⁵
40/20	19/32	24	70	24	25
	5/8				30
48/24	23/32, 3/4	24	90	24	45 ⁵

* Values per 2003 International Building Code®

SI units: 1 inch = 25.4 mm; 1 psf = 47.9 Pa

1. Panels shall be continuous over two or more spans.
2. Structural I rated panels have greater stiffness in the cross panel direction than sheathing panels.
3. Tongue-and-groove edges, panel edge clips (one between each support, except two between supports 48 inches on center), lumber blocking or other.
4. The allowable spans were determined using a dead load of 10 psf. If the dead load exceeds 10 psf then the live load shall be reduced accordingly.
5. The allowable spans were determined using a dead load of 5 psf. If the dead load exceeds 5 psf then the live load shall be reduced accordingly.

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Table 12. Allowable Shear (pounds per foot) for OSB Panel Diaphragms with Framing of Douglas Fir-Larch or Southern Pine¹ for Wind or Seismic Loading

PANEL GRADE	COMMON NAIL SIZE OR STAPLE ⁷ LENGTH AND GAGE	MINIMUM FASTENER PENETRATION IN FRAMING (inches)	MINIMUM NOMINAL PANEL THICKNESS (inch)	MINIMUM NOMINAL WIDTH OF FRAMING MEMBER (inches)	BLOCKED DIAPHRAGMS				UNBLOCKED DIAPHRAGMS	
					Fastener spacing (in.) at diaphragm boundaries (all Cases) at continuous panel edges parallel to load (Cases 3 and 4) and at all panel edges (Cases 5 and 6) ²				Fasteners spaced 6 inches maximum at supported edges ²	
					6	4	2½ ³	2 ³	Case 1 ⁴	Cases 2, 3, 4, 5 and 6
					Fastener spacing (inches) at other panel edges (Cases 1, 2, 3 and 4) ²					
6	6	4	3							
Structural I SHEATHING SPAN® (Exposure 1)	6d ⁶	1-1/4	5/16	2 3	185 210	250 280	375 420	420 475	165 185	125 140
	1-1/2 16 Gage	1		2 3	155 175	205 230	310 345	350 390	135 155	105 115
	8d	1-3/8	3/8	2 3	270 300	360 400	530 600	600 675	240 265	180 200
	1-1/2 16 Gage	1		2 3	175 200	235 265	350 395	400 450	155 175	115 130
	10d ⁵	1-1/2	15/32	2 3	320 360	425 480	640 720	730 820	285 320	215 240
	1-1/2 16 Gage	1		2 3	175 200	235 265	350 395	400 450	155 175	120 130
SHEATHING SPAN®, FLOOR SPAN® (Exposure 1)	6d ⁶	1-1/4	5/16	2 3	170 190	225 250	335 380	380 430	150 170	110 125
	1-1/2 16 Gage	1		2 3	140 155	185 205	275 310	315 350	125 140	90 105
	6d ⁶	1-1/4	3/8	2 3	185 210	250 280	375 420	420 475	165 185	125 140
	8d	1-3/8		2 3	240 270	320 360	480 540	545 610	215 240	160 180
	1-1/2 16 Gage	1		2 3	160 180	210 235	315 355	360 400	140 160	105 120
	8d	1-3/8	7/16	2 3	255 285	340 380	505 570	575 645	230 255	170 190
	1-1/2 16 Gage	1		2 3	165 190	225 250	335 375	380 425	150 165	110 125
	8d	1-3/8	15/32	2 3	270 300	360 400	530 600	600 675	240 265	180 200
	10d ⁵	1-1/2		2 3	290 325	385 430	575 650	655 735	255 290	190 215
	1-1/2 16 Gage	1		2 3	160 180	210 235	315 355	360 405	140 160	105 120
	10d ⁵	1-1/2	19/32	2 3	320 360	425 480	640 720	730 820	285 320	215 240
	1-3/4 16 Gage	1		2 3	175 200	235 265	350 395	400 450	155 175	115 130

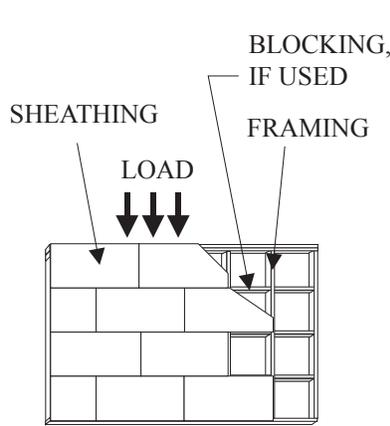
* Values per 2003 International Building Code®

Walls and Roofs

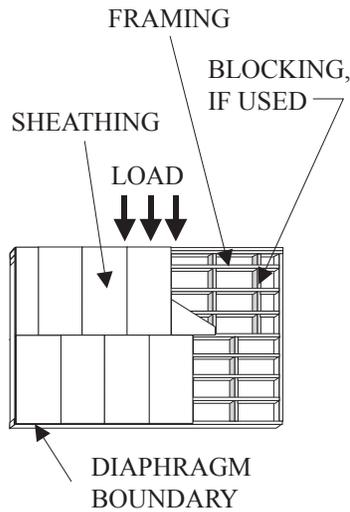
Table 12. (continued)

For SI: 1 inch = 25.4 mm, 1 pound = 14.5939 N/m

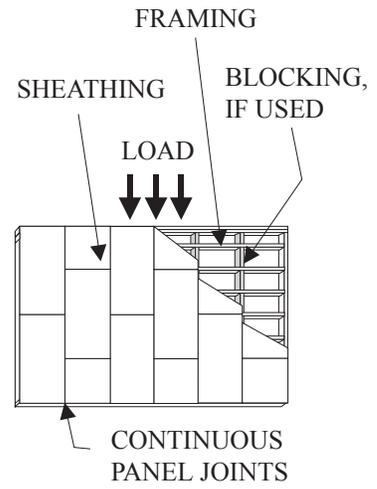
1. For framing of other species: (a) find specific gravity for the species of lumber in the AF&PA National Design Specification; (b) For staples find shear value from above table for Structural I panels (regardless of actual grade) and multiply value by 0.82 for species with specific gravity of 0.42 or greater, or multiply by 0.65 for all other species; (c) for nails find shear value from above table for nail size for actual grade and multiply value by the following factor: Specific Gravity Adjustment Factor = $[1 - (0.5 - SG)]$, where SG = Specific Gravity of the framing lumber. This adjustment factor shall not be greater than 1.
2. Space fasteners maximum 12 inches o.c. along intermediate framing members (6 inches o.c. when supports are spaced 48 inches o.c.).
3. Framing at adjoining panel edges shall be 3-inches nominal or wider and nails shall be staggered where nails are spaced 2 inches o.c. or 2-1/2 inches o.c.
4. No unblocked edges or continuous joints parallel to load.
5. Framing at adjoining panel edges shall be 3-inches nominal or wider and nails shall be staggered where both of the following conditions are met: (a) 10d nails having a penetration into framing of more than 1-1/2 inches and (b) nails are spaced 3 inches o.c. or less.
6. 8d is recommended minimum for roofs due to negative pressures of high winds.
7. Staples shall have a minimum crown width of 7/16-inch.



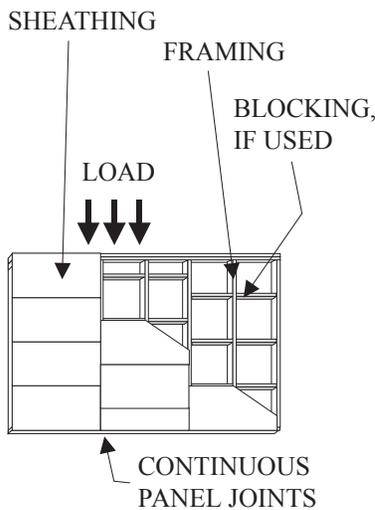
CASE 1



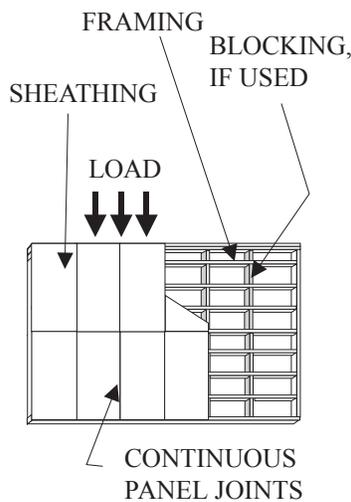
CASE 2



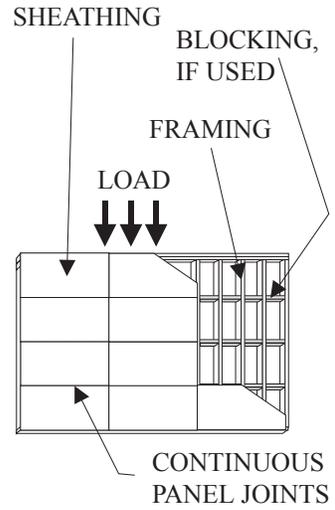
CASE 3



CASE 4



CASE 5



CASE 6

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Table 13. Allowable Shear in pounds per foot for Horizontal Blocked Diaphragms Utilizing Multiple Rows of Fasteners (High Load Diaphragms) with Framing of Douglas Fir-Larch or Southern Pine¹ for Wind or Seismic Loading²

PANEL GRADE ³	FASTENER AND SIZE	MINIMUM NAIL PENETRATION IN FRAMING (inches)	MINIMUM NOMINAL PANEL THICKNESS (inch)	MINIMUM NOMINAL WIDTH OF FRAMING MEMBER ⁵ (inches)	LINES OF FASTENERS	BLOCKED DIAPHRAGMS					
						Cases 1 and 2 ⁴					
						Fastener spacing per line at boundaries (inches)					
						4		2½		2	
						Fastener spacing per line at other panel edges (inches)					
6	4	4	3	3	2						
Structural I SHEATHING SPAN® (Exposure 1)	10d common nails	1-1/2	15/32	3	2	605	815	875	1150	—	—
				4	2	700	915	1005	1290	—	—
				4	3	875	1220	1285	1395	—	—
			19/32	3	2	670	880	965	1255	—	—
				4	2	780	990	1110	1440	—	—
				4	3	965	1320	1405	1790	—	—
	23/32	3	2	730	955	1050	1365	—	—		
		4	2	855	1070	1210	1565	—	—		
		4	3	1050	1430	1525	1800	—	—		
	14 gage staples	2	15/32	3	2	600	600	860	960	1060	1200
				4	3	860	900	1160	1295	1295	1400
				4	3	875	900	1175	1440	1475	1795
19/32			3	2	600	600	875	960	1075	1200	
			4	3	875	900	1175	1440	1475	1795	
			4	3	875	900	1175	1440	1475	1795	
SHEATHING SPAN®, FLOOR SPAN® (Exposure 1)	10d common nails	1-1/2	15/32	3	2	525	725	765	1010	—	—
				4	2	605	815	875	1105	—	—
				4	3	765	1085	1130	1195	—	—
			19/32	3	2	650	860	935	1225	—	—
				4	2	755	965	1080	1370	—	—
				4	3	935	1290	1365	1485	—	—
	23/32	3	2	710	935	1020	1335	—	—		
		4	2	825	1050	1175	1445	—	—		
		4	3	1020	1400	1480	1565	—	—		
	14 gage staples	2	15/32	3	2	540	540	735	865	915	1080
				4	3	735	810	1005	1105	1105	1195
				4	3	865	900	1130	1430	1370	1485
19/32			3	2	600	600	865	960	1065	1200	
			4	3	865	900	1130	1430	1370	1485	
			4	3	865	900	1130	1490	1430	1545	

* Values per 2003 International Building Code®

For SI: 1 inch = 25.4 mm

1. For framing of other species: (a) find specific gravity for the species of lumber in the AF&PA National Design Specification, (b) Find shear value from table above for nail size of actual grade, and (c) Multiply value by the following adjustment factor = [1-(0.5 - SG)], where SG = Specific Gravity of the framing lumber. This adjustment factor shall not be greater than 1.
2. Fastening along intermediate framing members: Space fasteners 12 inches on center, except 6 inches on center for spans greater than 32 inches.
3. Panels conforming to PS 2.
4. This table gives shear values for Cases 1 and 2 as shown in Table 12. The values shown are applicable to Cases 3,4, 5 and 6 as shown in Table 12, providing fasteners at all continuous panel edges are spaced in accordance with the boundary fastener spacing.
5. The minimum depth of framing members shall be 3 inches.

Walls and Roofs

Table 14. Allowable Shear (pounds per foot) for OSB Panel Shear Walls with Framing of Douglas Fir-Larch or Southern Pine¹ for Wind or Seismic Loading^{2,6,7,8}

PANEL GRADE	MINIMUM NOMINAL PANEL THICKNESS (inch)	MINIMUM FASTENER PENETRATION IN FRAMING (inches)	PANELS APPLIED DIRECT TO FRAMING				PANELS APPLIED OVER 1/2 or 5/8-INCH GYPSUM SHEATHING						
			Nail (Common, galvanized box) or (Staple size ⁹)	Fastener Spacing at Panel Edges (inches)				Nail (Common, galvanized box) or (Staple size ⁹)	Fastener Spacing at Panel Edges (inches)				
				6	4	3	2 ⁴		6	4	3	2 ⁴	
Structural I SHEATHING SPAN® (Exposure 1)	5/16	1-1/4	6d	200	300	390	510	8d	200	300	390	510	
		1	1-1/2 16 Gage	165	245	325	415	2 16 Gage	125	185	245	315	
	3/8	1-3/8	8d	230 ³	360 ³	460 ³	610 ³	10d	280	430	550 ⁵	730	
		1	1-1/2 16 Gage	155	235	315	400	2 16 Gage	155	235	310	400	
	7/16	1-3/8	8d	255 ³	395 ³	505 ³	670 ³	10d	280	430	550 ⁵	730	
		1	1-1/2 16 Gage	170	260	345	440	2 16 Gage	155	235	310	400	
		15/32	1-3/8	8d	280	430	550	730	10d	280	430	550 ⁵	730
			1	1-1/2 16 Gage	185	280	375	475	2 16 Gage	155	235	300	400
			1-1/2	10d	340	510	665 ⁵	870	10d	-	-	-	-
	SHEATHING SPAN® (Exposure 1)	5/16 or 1/4	1-1/4	6d	180	270	350	450	8d	180	270	350	450
1			1-1/2 16 Gage	145	220	295	375	2 16 Gage	110	165	220	285	
3/8		1-1/4	6d	200	300	390	510	8d	200	300	390	510	
		1-3/8	8d	220 ³	320 ³	410 ³	530 ³	10d	260	380	490 ⁵	640	
		1	1-1/2 16 Gage	140	210	280	360	2 16 Gage	140	210	280	360	
7/16		1-3/8	8d	240 ³	350 ³	450 ³	585 ³	10d	260	380	490 ⁵	640	
		1	1-1/2 16 Gage	155	230	310	395	2 16 Gage	140	210	280	360	
15/32		1-3/8	8d	260	380	490	640	10d	260	380	490 ⁵	640	
		1-1/2	10d	310	460	600 ⁵	770	-	-	-	-	-	
		1	1-1/2 16 Gage	170	255	335	430	2 16 Gage	140	210	280	360	
19/32		1-1/2	10d	340	510	665 ⁵	870	-	-	-	-	-	
		1	1-3/4 16 Gage	185	280	375	475	-	-	-	-	-	
				Nail Size (Galvanized Casing)					Nail Size (Galvanized Casing)				
		5/16	1-1/4	6d	140	210	275	360	8d	140	210	275	360
		3/8	1-3/8	8d	160	240	310	410	10d	160	240	310 ⁵	410

* Values per 2003 International Building Code®

For SI: 1 inch = 25.4 mm, 1 pound = 14.5939 N/m

1. For framing of other species: (a) find specific gravity for the species of lumber in the AF&PA National Design Specification; (b) For staples find shear value from above tables for Structural I panels (regardless of actual grade) and multiply value by 0.82 for species with specific gravity of 0.42 or greater, or multiply by 0.65 for all other species; (c) for nails find shear value from above table for nail size for actual grade and multiply value by the following factor: Specific Gravity Adjustment Factor = [1-(0.5 - SG)], where SG = Specific Gravity of the framing lumber. This adjustment factor shall not be greater than 1.
2. Panel edges backed with 2-inch nominal or wider framing. Install panels either horizontally or vertically. Space fasteners a maximum of 6 inches o.c. along intermediate framing members for 3/8- and 7/16-inch panels installed on studs spaced 24 inches o.c. For other conditions and panel thicknesses, space fasteners a maximum of 12 inches o.c. on intermediate supports.
3. Shears may be increased to values shown for 15/32-inch sheathing with same nailing, provided (1) studs are spaced a maximum of 16 inches o.c. or (2) if panels are applied with long dimension across studs.
4. Framing at adjoining panel edges shall be 3-inch nominal or wider and nails shall be staggered where nails are spaced 2 inches o.c.
5. Framing at adjoining panel edges shall be 3-inch nominal or wider, and nails shall be staggered where both of the following conditions are met: (a) 10d nails having penetration into framing of more than 1-1/2 inches and (b) nails are spaced 3 inches o.c.
6. Where panels are applied on both faces of a wall and nail spacing is less than 6 inches o.c. on either side, panel joints shall be offset to fall on different framing members or framing shall be 3-inch nominal or thicker and nails on each side shall be staggered.
7. In seismic Design Category D, E, or F where shear design values exceed 490 plf (LRFD) or 350 plf (ASD) all framing members receiving edge nailing from abutting panels shall not be less than a single 3-inch nominal member. Panel joint and sill plate nailing shall be staggered in all cases. Refer to building code for sill plate size and anchorage requirements.
8. Galvanized nails shall be hot-dipped or tumbled.
9. Staples shall have a minimum crown width of 7/16-inch.

Other Performance Issues

FLAME SPREAD AND "SMOKE DEVELOPED" RATING FOR OSB

ASTM E84 is used to determine a product's tendency to permit the travel of a flame along its surface as well as provide a measure of how much smoke is developed when it burns. A gas flame is applied to the underside of products at one end of a 25-foot-long tunnel. The rate of flame spread and the amount of smoke developed are measured. Each is given a separate rating, with the following standardized scale being used for both. The higher the flame spread rating, the higher the tendency for the material being tested to spread flames during a fire. Similarly, a higher smoke developed rating means that a material tends to generate more smoke when subject to fire. Inorganic reinforced cement board is assigned a flame spread and smoke developed rating of zero, while red oak is rated a 100 for both.

Rating classes:

- 0 to 25 - Class I (or A)
- 26 to 75 - Class II (or B)
- 76 to 200 - Class III (or C)
- 201 to 500 - Class IV (or D)

Test results for OSB panels, both uncoated and coated with one coat of acrylic latex interior household paint, indicate that OSB falls into the Class III (or C) rating for both flame spread and smoke developed*. A Class III (or C) rating is typical for most untreated wood products. Fire-retardant coating that can be applied to the surface of the panels are also available from various coating manufacturers that reduce the flame spread and smoke development characteristics of the panels, thereby improving the rating class to Class I or II.

* Refer to "Design for Code Acceptance No. 1 - Flame Spread Performance of Wood Products" - published by the American Forest and Paper Association, 1111 Nineteenth Street, NW, Suite 800, Washington DC 20036. (202) 463-2766, web site: www.awc.org and "Technical Bulletin No. 100 - Surface Flammability of OSB (Flame Spread Study)" - published by the Structural Board Association, 25 Valleywood Drive, Unit 27, Markham, Ontario, Canada L3R 5L9, (905) 475-1101, web site: www.osbguide.com.

OSB IN FIRE-RATED ASSEMBLIES

Architects and engineers specify fire-rated wall, floor and roof assemblies extensively in structures where one- and two-hour fire protection is required. Many fire-rated assemblies specified and built today were originally tested and approved with plywood as the covering. In 2000, engineers at Underwriters Laboratories (UL) of Northbrook, IL., determined that OSB of an equivalent thickness could be substituted for plywood in these designs. Going one step further, UL revised its UL fire-rated assemblies to no longer limit use of structural panels to those of a single certification agency. While never intending to restrict panel use to a single agency, UL recognized this language as exclusionary and modified the assembly designs to include the use of all panels meeting PS 1 and PS 2 standards.

The new, revised language is included in the 2000 edition of the *UL Fire Resistance Directory**. A subsection 13 has been added to the General section at the beginning of Volume I and includes the following:

"Wood Structural Panel is a structural panel product composed primarily of wood and meeting the

requirements of the U.S. Department of Commerce Voluntary Standard PS 1, *Construction and Industrial Plywood* or the U.S. Department of Commerce Voluntary Product Standard PS 2, *Performance Standard for Wood-Based Structural-Use Panels*. Wood structural panels include all-veneer plywood, composite panels containing a combination of veneer and wood-based material, and mat-formed panels such as oriented strand board and waferboard. The panels are to bear the label of a code-recognized certification organization with a specific reference to the PS 1 or PS 2 standard. The panels shall also be marked Exposure 1 or Exterior. Some individual designs may limit the type of panel that can be used.

As an alternate, wood structural panels evaluated in accordance with APA - The Engineered Wood Association Standard PRP-108, *Performance Standards and Policies for Structural-Use Panels*, or PFS Research Foundation Standard PRP-133, *Performance Standards and Policies for Wood-Based Structural-Use Panels*, and meeting the description for the panel type in the individual designs, may be used."

Other Performance Issues

In addition, all references to trade names have been removed from the individual design assembly descriptions and replaced with more generic terminology. Examples include:

"19/32 in. thick wood structural panels, min. grade "C-D" or "Sheathing". Face grain of plywood or strength axis of panels...."

"23/32 in. thick wood structural panels, min. grade "Underlayment" or "Single-Floor". Face grain"

** The UL Fire Resistance Directory is available from Underwriters Laboratories by calling (847) 272-8800. The complete UL Fire Resistance Directory is also available on the Internet at UL's website (www.ul.com).*

FORMALDEHYDE EMISSIONS FROM OSB PANELS

Structural panels, such as OSB, manufactured with exterior type phenol formaldehyde and isocyanate adhesives do not "off gas" like other types of wood-based panels and therefore do not require certification for formaldehyde emissions. Phenolic-based adhesives are specifically exempted in Section II.C.3 of HUD Rule 24 CFR 3280 (of the August 9, 1984 Federal Register), which states that HUD "has decided to exempt products

that are formulated exclusively with phenol-formaldehyde resins and surface finishes from the testing and certification provision of the rule." The amount of formaldehyde emitted from panels using phenolic-based adhesives is considered too small to be significant and has therefore been exempted. Isocyanate resin panels do not contain formaldehyde so no risk of formaldehyde emissions exists.

THERMAL RESISTANCE AND PERMEABILITY OF OSB PANELS

The thermal resistance, or R-value, and the vapor permeance (perms) of OSB panels are listed in Table 15. Both properties are proportional to the density and thickness of the panels; therefore, thicker panels tend to have more insulating value and a greater resistance to moisture vapor passage.

Table 15. Thermal Resistance and Vapor Permeance of OSB¹

OSB thickness (inch)	R-value (in ft ² -hr-°F/BTU)	Vapor Permeance (perms)
3/8	0.45	2.55
7/16	0.51	1.95
1/2	0.62	1.55
5/8	0.74	1.1
3/4	0.91	1.1 ²

1. Values per Structural Board Association *OSB in Wood Frame Construction* (U.S. Edition 1996/97).
2. Values for panels up to 5/8-inch are based on test. Panels thicker than 5/8-inch can be assumed to provide equal or better permeability resistance.