



# Oriented Strandboard (OSB)

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## Introduction

OSB and waferboard are panel products made of aspen or poplar (as well as southern yellow pine in the US) strands or wafers bonded together under heat and pressure using a waterproof phenolic resin adhesive or equivalent waterproof binder.



Oriented strandboard (OSB) was developed in the late seventies. Like waferboard, OSB is made of aspen-poplar strands, southern yellow pine or mixed hardwood species. However, the strands in the outer faces of OSB are normally oriented along the long axis of the panel thereby, like plywood, making it stronger along the long axis as compared to the narrow axis.

The strands used in the manufacture of OSB are from 80 to 150 mm (3-1/8" to 6") long in the grain direction and less than 1 mm (1/32") in thickness. The wafers used in the manufacture of waferboard are generally less than 45 mm long (1-3/4") along the grain direction, and about 1 mm (1/32") in thickness.

In Canada, OSB and waferboard are manufactured to meet the requirements of the Canadian Standards Association (CSA) standard *CAN/CSA O325.0, Construction Sheathing* or the standard *O437 Series on OSB and Waferboard*. For engineered applications, OSB can also be certified to meet the requirements of *CSA O452, Design Rated OSB*. In the U.S., the requirements of *PS 2, Performance Standard for Wood-Based Structural-Use Panels* must be met. PS 2 is a voluntary product standard published by the National Institute of Standards and Technology of the US Department of Commerce.

OSB or waferboard are efficient additions to the family of wood building materials because:

- They are made from abundant, fast growing, small diameter aspen poplar or pine to produce an economical structural panel.
- The manufacturing process can make use of crooked, deformed, small diameter trees which would otherwise have little commercial value, thereby maximizing forest utilization.
- Many strength-reducing defects are removed during manufacturing, and any remaining defects are evenly dispersed throughout the panel, resulting in consistent strength properties.
- The orientation of strands gives increased strength properties along the long panel dimension (strength axis) of OSB. For waferboard, random alignment of the wafers gives more consistent strength properties throughout the panel.
- Specific strength properties can be achieved by adjusting the orientation of strand or wafer layers.



## Uses

Some specialty products are made for siding, rim boards, stair treads, concrete formwork, or treated or foil-faced sheathing.

OSB is also used as the web material for most types of prefabricated wood I-joists, and as outer skins in structural insulated (foam-core) panels.

The panels are cut and machined using regular carpentry tools. Tungsten carbide tipped blades are recommended.

## Species Used

Self-regenerating, fast growing aspen-poplar (*populus tremuloides*) is used for OSB or waferboard in the northern part of North America, while southern yellow pine from plantation stands or mixed hardwood species are used in the south. Other species, such as birch, maple or sweetgum are used in limited quantities to supplement the aspen or southern yellow pine resource.

OSB or waferboard may include fine particles incidentally generated from making strands or wafers, but manufacturers limit the amount of fine material which can be used, typically in the core of the panel. It is not acceptable to use as a filler wood residues from other processes such as sawmilling or planing.

For example, to improve worker safety, manufacturers may impart various skid resistant surfaces to OSB roof sheathing by imprinting with a screen mesh pattern during the press cycle or by skip sanding to give a rough surface.

The process described here is general and may vary in detail from one manufacturer to another but it is always comprised of log conditioning, stranding or waferizing, drying, blending, forming, pressing, and final processing.

After conditioning, the logs are debarked and fed into a machine with sharp knives. This strander or waferizer cuts the log pieces into strands or wafers along the grain.

The strands or wafers are placed in large cylindrical dryers where they are dried to a moisture content of three to seven percent. While in the dryer, the strands or wafers rotate slowly minimizing breakage of the strands while ensuring consistent moisture content.

When dry, the strands or wafers proceed to the blender where they are mixed with resin and wax. The small quantity of hot wax (about 1.0 to 1.5 percent of the weight of wafers) sprayed on the wafers helps to distribute evenly the powdered or liquid phenol-formaldehyde resin or polyurethane binder (2.0 percent to 3.5 percent by weight or more). Resins or binders are of the thermosetting type, which means they can't be softened by heat or moisture once fully cured.

The forming machine arranges the strands or wafers in several layers to form a mat on stainless steel press sheets or on a continuous belt. For OSB, the strands for the faces are usually oriented parallel with the long direction of the panel (machine direction) and the core layers are either cross-oriented or laid random. For waferboard, the wafers are randomly deposited.

The size of the mats varies with the press size, but generally, one mat will be large enough to produce several standard sized panels.

In multi-opening presses, the mats are placed in the press accommodating from 10 up to 24 sheets at a time. Each mat sits between a pair of heated platens. When all the mats have been inserted, the press is closed under heavy pressure.

In newer plants, some presses are long and continuous rather than the more conventional stacked multi-opening presses. In those presses a continuous mat enters the front end of the press. Finished board exits the rear end of the press, which is then cut to the required size with flying cross-cut saws.

## **Special Features of OSB and Waferboard Panels**

Panels 15.5mm (5/8") and thicker are manufactured either with a square-edge or tongue and groove on the long edges.

Panels may be sanded smooth on one or both sides for particular end uses such as floor underlayment or interior finish, or they may be spot sanded to meet the required thickness tolerances.

Manufacturers may alter the surface of some of their OSB or waferboard panels to make them more suitable for a particular end-use.

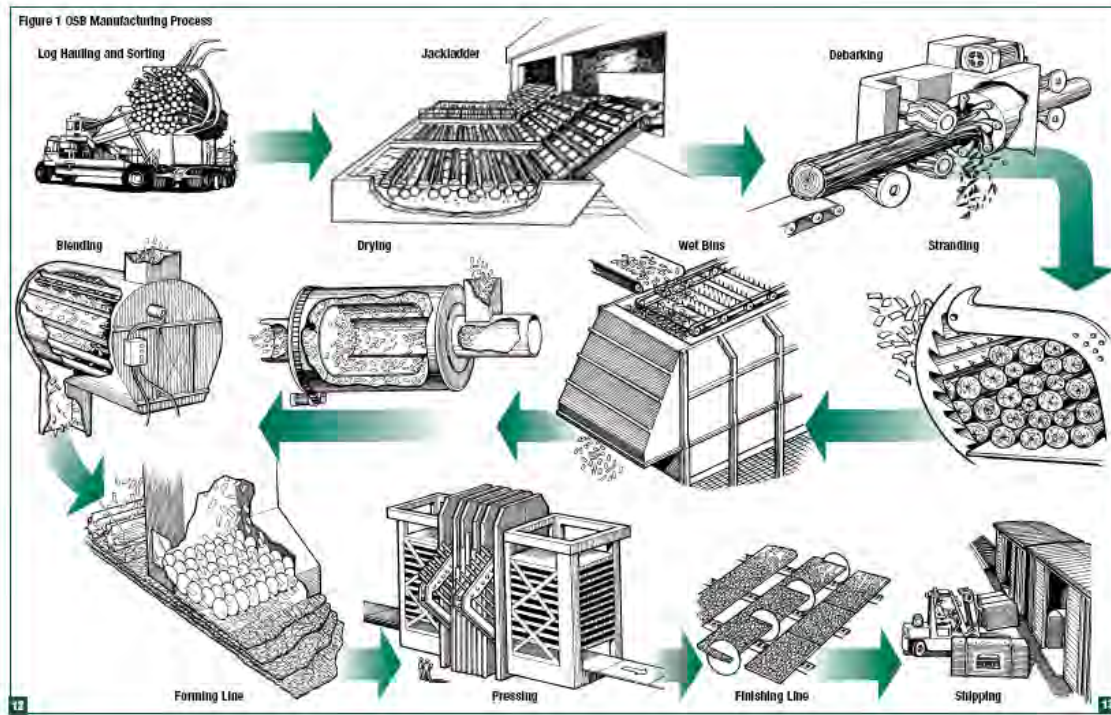
For example, to improve worker safety, manufacturers may impart various skid resistant surfaces to OSB roof sheathing by imprinting with a screen mesh pattern during the press cycle or by skip sanding to give a rough surface.

## Manufacture

The process described here is general and may vary in detail from one manufacturer to another but it is always comprised of log conditioning, stranding or waferizing, drying, blending, forming, pressing, and final processing.

A schematic representation of a typical manufacturing process is shown in Figure 1.

**Figure 1: Manufacture of OSB / Waferboard**



Freshly cut logs are taken from the log storage yard and placed in hot water ponds. The soaking softens the wood to facilitate debarking and making of strands or wafers, thereby reducing the amount of fines and slivers generated. To maintain effectiveness, hot pond temperatures are increased in cold weather conditions.

After conditioning, the logs are debarked and fed into a machine with sharp knives. This strander or waferizer cuts the log pieces into strands or wafers along the grain.

The strands or wafers are conveyed to wet storage bins and are screened after drying to remove fine particles. Most mills process core and surface strands and wafers separately and then deposit them together in layers to form the mat.

The strands or wafers are placed in large cylindrical dryers where they are dried to a moisture content of three to seven percent. While in the dryer, the strands or wafers rotate slowly minimizing breakage of the strands while ensuring consistent moisture content.

When dry, the strands or wafers proceed to the blender where they are mixed with resin and wax. The small quantity of hot wax (about 1.0 to 1.5 percent of the weight of wafers) sprayed on the wafers helps to distribute evenly the powdered or liquid phenol-formaldehyde resin or

polyurethane binder (2.0 percent to 3.5 percent by weight or more). Resins or binders are of the thermosetting type, which means they can't be softened by heat or moisture once fully cured.

The strands or wafers are continuously weight metered to ensure the proper quantities enter the blenders so that the correct resin coverage is achieved.

The forming machine arranges the strands or wafers in several layers to form a mat on stainless steel press sheets or on a continuous belt. For OSB, the strands for the faces are usually oriented parallel with the long direction of the panel (machine direction) and the core layers are either cross-oriented or laid random. For waferboard, the wafers are randomly deposited.

The size of the mats varies with the press size, but generally, one mat will be large enough to produce several standard sized panels.

In multi-opening presses, the mats are placed in the press accommodating from 10 up to 24 sheets at a time. Each mat sits between a pair of heated platens. When all the mats have been inserted, the press is closed under heavy pressure.

The layup of the mat and the press operation are important in ensuring proper panel thickness. The duration of the press cycle varies from plant to plant and with the desired thickness of the board. For example, a press cycle of 3-1/2 minutes might be required for 6.35mm (1/4") thick panels, and eight minutes for 15.5mm (5/8") panels. The heat and pressure polymerize the resin or binder glueing the strands or wafers together strongly into a rigid panel.

In newer plants, some presses are long and continuous rather than the more conventional stacked multi-opening presses. In those presses a continuous mat enters the front end of the press. Finished board exits the rear end of the press, which is then cut to the required size with flying cross-cut saws.

## Grades and Panel Marks

OSB or waferboard conforming to the Canadian CSA Standard O325.0, or the US Standard PS 2 may be used for subfloors, single floors, roof or wall sheathing in accordance with end uses and spans shown on the panel mark.

The two digit span mark indicates the maximum allowed span between supports in inches. For example, 16 means a maximum span of 16 inches (or 400 mm in Canada).

Several panel marks may appear on the grade stamp. For instance, the panel mark 1R24/2F16/W24 means that the panel may be used without blocking on a roof with trusses at 600mm (24") on centre, or on a floor with underlay on joists spaced at 400mm (16") on centre, or on a wall with studs at 600mm (24") on centre.

Canadian OSB or waferboard suitable for building construction and meeting the requirements of CSA O437 is identified by a stamp containing the manufacturer's name or logo or mill number; the designation "CSA-O437.0"; the words "EXTERIOR BOND" or "EXT BOND"; the grade, O-2, O-1, or R-1; the nominal thickness in mm; on T & G panels, the words "THIS SIDE DOWN"; and on O-2 or O-1 panels, an arrow showing the direction of face strand orientation. Panels for export are marked MADE IN CANADA.

Other information including the Structural Board Association logo, Canadian Construction Materials Centre Evaluation Report number, other reference standards or installation advice may appear.

Mills may apply the reference standard stamps only when the panels meet the requirements of the standards. Some manufacturers also apply paint lines to their panels to ease installation by framing crews on site.

### Other Marks

Most OSB panels made in Canada are now meeting CSA O325.0. This standard requires that panels meeting this standard must be clearly marked in addition with:

1. The designation CSA O325.0
2. The panel mark denoting the span rating and end use
3. The nominal thickness
4. The certification agency logo



### Panels Meeting PS 2 (US Markings)

For panels intended for export to the US, the third party certification agency stamp will show the following information for panel identification:



1. The span rating
2. The nominal thickness
3. The exposure durability
4. The grade
5. The manufacturer's name or mill number
6. The certification agency logo
7. The symbol PS 2
8. The quality assurance report number
9. The direction of surface strand alignment



The following table shows the relationship between panel mark or span rating and nominal thickness.

Application	Panel Mark (CSA-O325)	Nominal Thickness <sup>a</sup> (CSA-O437)		Span Rating <sup>b</sup> (PS2)
		Metric (mm)	Imperial (in.)	
Walls	W16 or 2R16	6.0, 7.5, 9.5	1/4, 5/16, 3/8	16/0
	W20 or 2R20	7.5, 9.5, 11.0	5/16, 3/8, 7/16	20/0
	W24 or 2R24	9.5, 11.0, 12.0, 12.5	3/8, 7/16, 15/32, 1/2	24/0
	1R24	11.0, 12.0, 12.5	7/16, 15/32, 1/2	24/16
Roofs	2R16	6.0, 7.5, 9.5	1/4, 5/16, 3/8	16/0
	2R20	7.5, 9.5, 11.0	5/16, 3/8, 7/16	20/0
	2R24	9.5, 11.0, 12.0, 12.5	3/8, 7/16, 15/32, 1/2	24/0
	1R24	11.0, 12.0, 12.5	7/16, 15/32, 1/2	24/16
	1R32	12.0, 12.5, 15.0, 16.0	15/32, 1/2, 19/32, 5/8	32/16
	1R40	15.0, 18.0, 19.0	19/32, 23/32, 3/4	40/20
	1R48	18.0, 19.0, 22.0	23/32, 3/4, 7/8	48/24
	1R54	19.0, 22.0, 25.0	3/4, 7/8, 1	54/32
	1R60	25.0, 28.5	1, 1-1/8	60/48
Floors	2F16	12.0, 12.5, 15.0, 16.0	15/32, 1/2, 19/32, 5/8	32/16
	1F16	15.0, 16.0	19/32, 5/8	16 o.c.
	2F20	15.0, 16.0, 18.0, 19.0	19/32, 5/8, 23/32, 3/4	40/20
	1F20	15.0, 16.0	19/32, 5/8	20 o.c.
	2F24	18.0, 19.0, 22.0	23/32, 3/4, 7/8	48/24
	1F24	18.0, 19.0	23/32, 3/4	24 o.c.
	2F32	19.0, 22.0, 25.0	3/4, 7/8, 1	54/32
	1F32	22.0, 25.0	7/8, 1	32 o.c.
	2F48	25.0, 28.5	1, 1-1/8	60/48
	1F48	28.5	1-1/8	48 o.c.

1. The first thickness listed is the predominant thickness for each span rating. The other nominal thicknesses are alternative thicknesses. Check with suppliers for availability.
2. US PS 2 span ratings are equivalent to CSA-O325 panel marks.

## OSB Roof Sheathing Table

Roof Sheathing				
Minimum nominal required panel thickness or panel mark for specified roof loads $\leq 2.0$ kPa.				
Support spacing mm	Edges unsupported		Edges supported	
	CSA O325 panel mark		CSA O325 panel mark	
300	1R16		2R16	
400	1R16		2R16	
500	1R20		2R20	
600	1R24		2R24	
Minimum nominal required panel thickness or panel mark for specified roof loads $\leq 4.0$ kPa.				
Support spacing mm	Edges unsupported		Edges supported	
	CSA O452 Type 1 Rated grade C* mm	CSA O325 panel mark	CSA O452 Type 1 Rated grade C* mm	CSA O325 panel mark
300	9.5	1R20	9.5	1R20
400	9.5	2R24	9.5	2R24
500	12.5	1R24	11.0	1R24
600	15.5	2R40	15.5	2R40
<b>Notes:</b>				
<ul style="list-style-type: none"> <li>• These recommendations include consideration of the 1.3 kN point load specified in Part 4 of the NBCC</li> <li>• Install sheathing with at least a 2 mm gap between panel edges</li> <li>• Where sheathing requires edge support, the support may consist of metal H-clips, a tongue and groove joint, or not less than 38 x 38 mm blocking securely nailed between framing members.</li> <li>• For a flat roof used as a walking deck, use the recommended thicknesses for floor sheathing.</li> <li>• *Also applicable to CSA 0437 Grade O-2 OSB, based on information from the Structural Board Association (published design values do not exist for CSA 0437 products). Check availability of Design Rated OSB or O-2 Grades before specifying.</li> </ul>				

## OSB Floor Sheathing Table

Floor Sheathing				
Minimum nominal required panel thickness or panel mark for specified live floor loads 2.4 kPa. or less				
Support spacing mm	CSA O325 panel mark			
400	1F16			
500	1F20			
600	1F24			
Minimum nominal required panel thickness or panel mark				
Support spacing mm	Floor live load up to 4.8 kPa		Floor live load up to 4.8 kPa Specified Concentrated Live load 9kN	
	CSA O452 Type 1 Rated grade C* mm	CSA O325 panel mark	CSA O452 Type 1 Rated grade C* mm	CSA O325 panel mark
400	15.5	1F16	18.5	1F24
500	18.5	1F20	22	1F32
600	22	1F32	28.5	1F48
<b>Notes:</b>				
<ul style="list-style-type: none"> <li>• Edge support is required except where a separate panel-type underlay is applied to a subfloor. Edge support must consist of not less than 38 x 38 mm blocking securely nailed between framing members, or tongue and groove edge joint.</li> <li>• Where panel-type underlay is installed over the sheathing, offset the underlay end joints at least 200 mm from the sheathing end joints.</li> <li>• *Also applicable to CSA 0437 Grade O-2 OSB, based on information from the Structural Board Association (published design values do not exist for CSA 0437 products). Check availability of Design Rated OSB or O-2 Grades before specifying.</li> </ul>				

## OSB Sizes

OSB and waferboard are available in a variety of thicknesses and sizes as shown in Table 2 (for panels meeting CSA O437.0). The most common panel size is 1220 x 2440mm (4' x 8'). Panels are sized for spacing (3 mm or 1/8" short). Panels may be specially ordered up to 2440 x 7320mm (8' x 24'). For instance, manufacturers of wood I-joists desire larger panel sizes because the long lengths reduce the need for web splicing.

Thicknesses are available from 6mm (1/4") to 28.5mm (1-1/8"). For panels meeting CSA O325.0 or PS 2, the typical nominal sizes are 6 mm (1/4"), 9.5 mm (3/8"), 11 mm (7/16"), 12 mm (15/32"), 12.5 mm (1/2"), 15 mm (19/32"), 16 mm (5/8"), 18 mm (23/32"), and 19 mm (3/4")

<b>Table 2: OSB and Waferboard - Thicknesses and Weights</b>			
<b>OSB (O-1) and Waferboard (R-1)</b>			
Thickness		1220 x 2440mm (4' x 8')	
		Panel Weight	
mm	in.	kg	lb.
6.35	1/4	12	27
7.9	5/16	15	33
9.5	3/8	18	40
11.1	7/16	21	47
12.7	1/2	24	53
15.9	5/8	30	67
19	3/4	36	80
<b>OSB (O-2)</b>			
Thickness		1220 x 2440mm (4' x 8')	
		Panel Weight	
mm	in.	kg	lb.
6	1/4	12	26
7.5	5/16	15	32
9.5	3/8	18	39
11	7/16	21	46
12.5	1/2	24	52
15.5	5/8	30	66
18.5	3/4	36	78
28.5	1-1/8	54	120
<b>Notes:</b>			
1. Panel weight calculated on the basis of 640 kg/m <sup>3</sup> (40 lbs/cu.ft.) density and nominal thickness.			
2. Panels in thickness of 15.5, 15.9, 18.5 and 19mm (5/8" and 3/4") are available in either square-edged or tongue and groove on the long edges.			
3. Other thicknesses are available on special order.			

## Quality Control

The quality of OSB and waferboard is the responsibility of the individual manufacturer. Each mill must establish its own program of in-plant quality control to ensure the finished product meets or exceeds the requirements for the grade specified in the applicable standard. Panel quality is affected by every process in the plant and by the quality and consistency of the raw materials used to manufacture the panels.

Process control is uniquely designed for each mill and reflects the particular combination of machinery, control devices, materials and product mix. Continuous monitoring of all process variables by the plant quality control staff maintains the product as required by the applicable standards.



Among the factors most carefully monitored and controlled are the sorting of logs by species, size, and moisture content, strand or wafer size and thickness, moisture content following drying, the consistent blending of strands or wafers, resin and wax, the uniformity of the mat leaving the forming machine, the press temperature, pressures, closing speed, thickness control and pressure release control, quality of panel faces and edges, panel dimensions and the appearance of the finished panel.

Physical testing of the panels according to standard test procedures is necessary to verify that production conforms to the applicable standard. In addition, mills monitor panel quality on a continuing basis by carrying out such tests on hot panels right off the production line to ensure process control is maintained. These hot tests are correlated to the standard conformance tests.

All OSB or waferboard manufactured in Canada must be quality certified by an independent quality assurance organization that monitors manufacturing performance and mill quality control programs. All construction grade panels show the stamp of the quality assurance agency on the panel face or edge.

## Storage and Handling

Panels should be protected from excessive wetting during storage and construction. Manufacturers protect the panel edges with a special coating, and recommend a 3 mm (1/8") gap be left between panels during installation to accommodate linear expansion.

In summary, points to watch for when storing and handling OSB and waferboard are:

- Store bundles indoors or under cover with enough support to keep panels flat and off the ground.
- Protect panel edges and corners. This is especially true for tongue and groove panels.

For more technical information on this topic, visit <http://osbguide.com/reflibrary.html>



## Fire Safety

OSB/waferboard products are used in wood-frame floor, wall, and roof assemblies having a fire-resistance rating and for fire stops in concealed spaces. For more information on the fire performance characteristics of these panels, contact the Structural Board Association.

The Fire Safety Design in Buildings book provides information on how fire-rated Wood-Frame construction which incorporates OSB/waferboard can be used in all types of buildings.



## Guidelines

- Require that panels carry a CSA, TECO, or APA panel marks and quality assurance stamp.
- Specify the appropriate grade or the performance standard required.
- Specify the panel size, and the panel thickness or panel mark and support spacing in accordance with the local building code.
- Indicate special requirements such as tongue and groove.
- Indicate fastening type, length, and spacing.

For more technical information on this topic, visit <http://osbguide.com/reflibrary.html>