Use of oriented strandboard in construction industry

Nadir Ayrilmis
Department of Wood Mechanics and Technology, Forestry Faculty, Istanbul University-Cerrahpasa, Bahcekoy, Sariyer, 34473, Istanbul, Turkey
nadiray@iuc.edu.tr

Abstract: In recent years, 3D printing has gradually appeared in people's field of vision. The addition of wood in thermoplastics improve their some mechanical properties such as tensile and bending modulus without affecting its biodegradability. The decrease in the cost of filaments may enlarge the utilization of biodegradable filaments after the disposal in near future. Small-scale elements used in furniture production, such as connector fittings or fasteners for shelves, may give functional and structural properties without significant investment. 3D-printed connections are suitable when the the production complex shaped connectors and quick disassembly are required, to reduce the product's weight and price

KEYWORDS: *ORIENTED STRANDBOARD, CONSTRUCTION, WOOD, STRUCTURAL PANEL, ENGINEERED WOOD COMPOSITE*

1. Introduction

Oriented strand board (OSB) is produced with the strands in the surface layers aligned in the direction of the long axis of the panel and with the strands in the inner layer either cross-aligned or randomly oriented. Wood strands of about 80-120 mm are cut tangentially from debarked logs which are held longitudinally against rotating knives. After drying, these flakes are generally sprayed with a synthetic resin binder and wax and then bonded under heat and pressure between steel belts. This orientation of strands gives the panel sufficient strength for its structural applications when it is positioned appropriately [1].

OSB is widely used as a structural wood panel for floors (including subfloors and underlays), walls and ceilings. It is used for interior fittings, furniture, shuttering and packaging and also in the manufacture of I-joists, where it forms the web or support between two flanges of solid wood. OSB is being used not only for its structural properties but also for its aesthetic value, with some designers using it as an interior design feature [2]. The oriented strand board (OSB) market size was estimated at over 31 million cubic meters in 2021, and the market is projected to register a CAGR of more than 4% during the forecast period (2022-2027) [3]. Roughly 95% of OSB produced in North America goes to the construction industry. In Europe, about 50% of OSB is consumed for residential buildings [4].

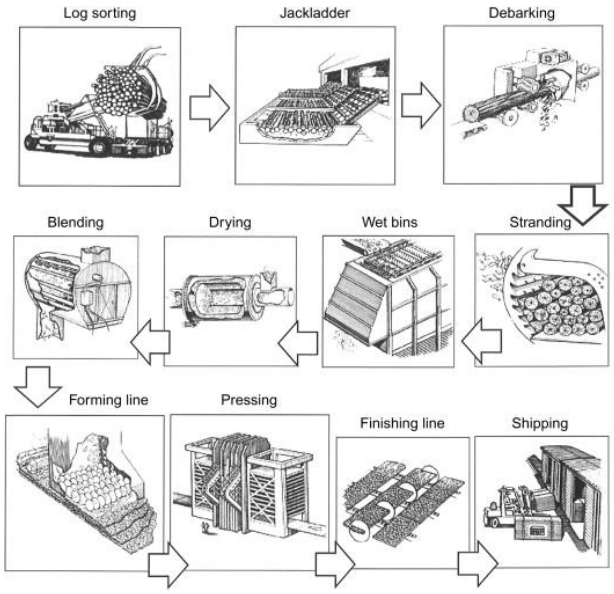

Figure 1. *Production line OSB [5].*

(OSB) is an alternative to plywood in a variety of structural and non-structural applications.. Advantages of OSB over plywood include no core gaps, uniformity, accurate certification (including the Declaration of Performance and CE marking) and reliable technical information and compared with many plywood sources security in the manufacturer; there is little risk of delamination if used properly [6].

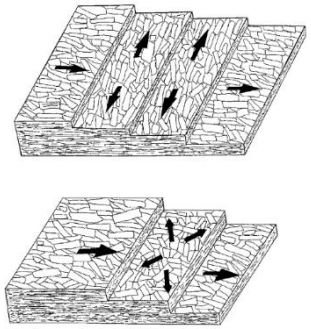

Figure 2. *A schematic illustrating strand orientation of a typical OSB.*

Four grades of OSB are defined in EN 300 in terms of their mechanical performance and relative resistance to moisture. These are:
OSB/1 – General purpose boards and boards for interior fitments (including furniture) for use in dry conditions.
OSB/2 – Load-bearing boards for use in dry conditions.
OSB/3 – Load-bearing boards for use in humid conditions
OSB/4 – Heavy-duty load-bearing boards for use in humid conditions.

OSB panels may be square edged or tongue-and-grooved to aid in the connection of adjacent panels on site. OSB has particularly good nail-holding properties and can be glued withregular wood adhesives. OSB tongue and groove panels primarily fulfill the load-bearing and reinforcing function during construction.

Figure 3. *The or tongue-and-grooved OSB.*

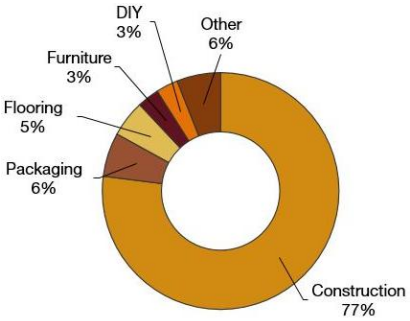

Figure 4. *End-use of OSB in 2020 year [8].*

Considerations on the use of OSB in construction

Mechanical joints and fixings

Parallel core screws should be used because they have greater holding power than conventional wood screws. A high ratio of overall diameter to core diameter is desirable. Drill pilot holes for all screw fixings. Typically, the holes should be 85 to 90% of the screw core diameter. Fixings into the board face should not be within 8 mm of edges and 25 mm of the corners. Nails and staples can be used for lightly loaded fixings or to hold glued joints while the adhesive sets [1].

Adhesive-bonded joints

A wide variety of jointing methods can be used, provided the following simple guidelines are observed [1]:

- Use sharp cutters to avoid tearing or burnishing the surfaces to be bonded.
- The joint parts should be accurately machined.
- Use a high solids content adhesive with low flowing properties such as polyvinyl acetate or urea formaldehyde.
- Locate mating pieces accurately and hold them under pressure while the adhesive sets.
- The width of grooves machined in OSB should be limited to about one-third of the thickness of the board. The depth of groove is typically about one-half of the board thickness.
- Allow adhesive-bonded joints to condition for several days before sanding and finishing; this avoids the appearance of sunken joints and is essential with high-gloss finishes.
- A tongue and groove joint is very efficient, provided the fit of the joints is not too tight to cause a split along the edge.
- When attaching lippings, the tongue should be machined on the solid wood piece

Finishing

Where smooth surfaces are required pre-sanded panels should be specified.

Like other wood-based panel products, OSB is hygroscopic and its dimensions change in response to a change in humidity. A 1% change in moisture content increases or decreases the length, width and thickness of the different grades of OSB by the amounts set out in the table below [1].

Table 1. Dimensional change of OSB panel depending on the 1% change moisture content [1].

Type of panel	Specification	Dimensional change at 1% change in panel moisture content		
		Length %	Width %	Thickness %
OSB	EN 300, OSB/2	0.03	0.04	0.7
	EN 300, OSB/3	0.02	0.03	0.5
	EN 300, OSB/4	0.02	0.03	0.5

OSB must be conditioned to bring it into equilibrium with its environment before it is fixed. This is usually achieved by loose stacking of the panels in the room where they will be used prior to fixing them. In a building with continuous central heating: 5-7%. In a building with intermittent central heating: 8-10%. In an unheated building: up to 15%. When components are factory produced for installation on site, it is essential that the site conditions are suitable to receive the components with wet trades completed and the building dried out [1].

Table *2. Approximate equilibrium moisture content depend on the relative humidty [1].*

Relative humidity at 20Â° C	Approximate equilibrium moisture content
30%	5%
65%	10%
85%	15%

Figure 5. *Flooring application of OSB panel.*

All OSB is manufactured to meet the Exposure 1 durability classification, which means panels are appropriate for use where construction delays may occur. Structural 1 panels are for use where shear and cross-panel strength are extra important. For enhanced roof performance, SBA recommends panels with greater span ratings than the minimum required. In fact, by increasing a span rating from 24/16 to 32/16, you can raise the allowable live load of a roof by 75 percent [7].

OSB roof sheathing is characterized by quick and easy installation (Fig. 6). Standard panels are 4' x 8' and come in a variety of thicknesses. Panels must be spaced with a minimum 1/8" gap on all butting edges, and edge clips should be applied when specified. Minimum fastening schedule is 8d nails spaced 6" o.c. at supported edges and 12" o.c. intermediate. Increased panel thicknesses, longer nails, and closer spacing are necessary in high wind areas [7].

Figure 6: *Roof application of OSB panel (Fig. 6).*

In order to minimize the impact of moisture build-up in attic spaces, it is essential that adequate ventilation be installed with 50 percent of the ventilation at the roof ridge and 50 percent at the soffit area. Building codes specify that the minimum unobstructed vent area equal not less than 1/300 of the total insulated ceiling area. For roof slopes of less than 1 in 6, the free vent area must equal not less than 1/150 of the insulated ceiling area.

SPAN RATINGS (Minimum Panel Width – 24")

Support Spacing	Performance Based OSB Sheathing	
Edges Supported[1]	Span Rating	Common Thicknesses[2]
16"	16/0 24/0	5/16", 3/8" 3/8", 7/16"
24"	24/0 24/16	3/8", 7/16" 7/16", 15/32", 1/2"
32"	32/16 32/20	15/32", 1/2" 19/32", 5/8"
40"	40/20 40/24	19/32", 5/8" 23/32", 3/4"
48"	48/24	23/32", 3/4"
Edges Unsupported		
16"	16/0	5/16", 3/8"
20"	24/0	3/8", 7/16"
24"[3]	24/16	7/16", 15/32", 1/2"
32"	40/20	19/32", 5/8"

[1] Tongue-and-groove edges, panel edge clips, lumber blocking or other approved support methods.
[2] Panel thicknesses and span ratings apply for pitched or flat roofs; where flat roofs are used as walking decks, the requirements for floors shall apply.
NOTE: OSB sheathing panels are performance rated for, generally, a 30 psf live load (40 psf for 24/16; 35 psf for 48/24). (1 psf = 0.048 kPa)
[3] 7/16" (24/16) panels with unsupported edges allowed in some jurisdictions only. Check with local building officials. (1" = 25.4 mm)

Wood frame structures with OSB-sheathed walls perform well against seismic forces or racking shear – much better than concrete or masonry (Fig. 7). Where high winds are of concern, OSB wall sheathing provides peace of mind because of its strength and density. Under all types of exterior cladding, OSB provides extra thermal resistance and acoustic control [8]

Figure 7.

Timber I-joists comprise a timber flange (typically solid timber or LVL – laminated veneer lumber) and a panel product web (usually OSB). Structurally the I-joist works on the principle that the greatest forces in a beam under bending are at the outer faces. Hence, if the stronger tensile and compressive material is positioned at the outside edges, the central zone can be reduced in size as it carries very little of the bending forces. However, the central zone (web) carries the reaction and shear forces [9]. (Fig. 8).

Figure 8.

OSB SIPS (Oriented Strand Board Structural Insulated Panels) are high-performance building systems that consist of an insulating foam core sandwiched between two sheathing layers of oriented strand board. SIPS are an advanced method of construction offering excellent thermal performance, light-weight structural strength and time and cost saving benefits over traditional construction methods. SIPs contribute both insulation value and structural strength to the wall. Walls and ceilings made of SIPs can be constructed quickly by assembling the pre-manufactured panels. SBS Structural Insulated Panels offer extremely high thermal performance, the Polyurethane (PUR) core of rigid insulation and OSB/3 achieves U-Values as low as 0.10 Watts per Meter Squared Kelvin (W/m²K) or better, making significant savings on your annual heating costs [10]. The foam core can be made with expanded polystyrene foam (EPS), extruded polystyrene foam (XPS), polyisocyanurate foam, polyurethane foam, or be composite honeycomb (HSC) (Fig. 9). Vapor barriers are not required in SIP homes, but an interior wall covering must be added [9].

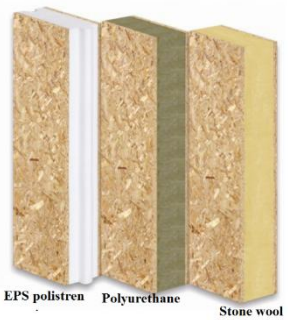

Figure 9. *Thermal insulation of OSB panel.*

In Canada, OSB panels are manufactured to meet the requirements of the CSA O325 standard. This standard sets performance ratings for specific end uses such as floor, roof and wall sheathing in light-frame wood construction. There are two product standards covering the manufacture of US wood-based panel products:

- US Voluntary Product Standard PS1-19.
- US Product Standard PS2-18.
- APA-trademarked plywood panels are covered by PS 1-19 and PS 2-18.
- APA OSB panels are manufactured to US PS 2-18.

4. Conclusions

OSB is one of the best materials for structural application in the construction industry. Due to its significant advantages. It is cost-effective, practical and much more versatile than plywood. OSB is a dimensionally stable wood-based panel that has the ability to resist delamination and warping. OSB is also used as the web material for some types of prefabricated wood I-joists and the skin material for structural insulated panels

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