Flakeboard is a term that also includes waferboard (WB) and oriented strandboard (OSB).

They are structural panels produced from wafers obtained from logs.

The first waferboard plant was opened in 1943 by MacMillan Bloedel in Canada. Aspen was the raw material, and the wafers were randomly oriented.

In the late 1980s, most wafers were oriented, resulting in oriented waferboard (OWB).

Long and narrow strands are now used in OSB, which typically have 3 or 5 layers.

Oriented strand board (OSB) is a performance-rated structural wood-based panel engineered for uniformity, strength, versatility and workability.

It is utilized internationally in a wide array of applications including residential and commercial construction and renovation, packaging/crating, furniture and shelving, and do-it-yourself projects.
Oriented Strand Board

WHAT IS OSB?

- Because it is engineered, OSB can be custom manufactured to meet specific requirements in thickness, density, panel size, surface texture, strength and rigidity.
- This engineering process makes OSB the most widely accepted and preferred structural panel among architects, specifiers and contractors.

Jyh-Horning Wu
In fact, in many areas of North America, OSB has virtually replaced other panels in new residential construction.

Today, all model building codes in the U.S. and Canada recognize OSB panels for the same uses as plywood.

Since the early 1980s, the North American OSB industry has experienced a period of tremendous growth.

One limitation with OSB is edge swelling. Although the edges are coated during transport, subsequent cutting causes limitations in high humidity applications.

Property Values for Sheathing-Grade Oriented Strandboard

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear hygroscopic expansion</td>
<td>0.15%</td>
</tr>
<tr>
<td>Linear thermal expansion</td>
<td>$6.1 \times 10^{-6} \text{ m/mK}$</td>
</tr>
<tr>
<td>Flexure</td>
<td>$6.1 \times 10^{-6} \text{ m/min°F}$</td>
</tr>
<tr>
<td>Strength</td>
<td>21–48 MPa (3000–7000 lb/ft²)</td>
</tr>
<tr>
<td>Modulus of elasticity</td>
<td>6.9–13 GPa (1.19–2.19 x 10^6 lb/ft²)</td>
</tr>
<tr>
<td>Tensile strength</td>
<td>10–28 MPa (1500–4000 lb/ft²)</td>
</tr>
<tr>
<td>Compressive strength</td>
<td>21–35 MPa (3000–5000 lb/ft²)</td>
</tr>
<tr>
<td>Edgewise shear</td>
<td></td>
</tr>
<tr>
<td>Shear strength</td>
<td>4.1–7.6 MPa (600–1100 lb/ft²)</td>
</tr>
<tr>
<td>Shear modulus</td>
<td>470–760 MPa (68–110 x 10^3 lb/ft²)</td>
</tr>
</tbody>
</table>

Source: Adapted from Youngquist, 1999.
Oriented Strand Board

- One advantage, however, is that OSB is more consistent than plywood. (Soft spots caused by overlapping knots do not exist, nor do knot holes at edges, and delamination does not take place)
- Since one OSB sheet may consist of 50 strands, properties are homogeneous, and there are only minor stiffness variations with location in the panel.
- Through-thickness shear strength is approximately twice as high with OSB.

OSB is increasing its market share as a result of its lower cost as compared with plywood.
OSB is now used for about 70 percent of all floor, wall and roof sheathing in North America.

OSB production

Structural Panels

Log Sorting
After harvest, whole logs are hauled to the mill’s wood yard, then sorted.

Jackladder
Logs are soaked, to remove ice and prepare wood for stranding, then sent up the jackladder.
**Debarking**

Logs are run through the debarker to remove bark. Bark is later used as fuel in the mill's energy supply.

**Stranding**

The strands are cut from whole logs into precise dimensions of up to six inches long.

The principal reasons used to justify debarking are:

1. To remove bark from wood that is to be chipped for board use since any substantial quantity in the chips is detrimental to board quality.
2. To prolong the life of cutting tools in the sawmill. The sand, grit, and rocks in bark cause dulling and tool wear.
3. To reduce debris in the mill that otherwise would require more frequent cleanup and higher maintenance.
4. To enable the sawyer to see and evaluate the log for breakdown.

Cambio debarker

Mechanical ring debarker
Debarking

Logs are run through the debarker to remove bark. Bark is later used as fuel in the mill’s energy supply.

Stranding
The strands are cut from whole logs into precise dimensions of up to six inches long.
Structural Panels

**Wet Bins**
Strands are deposited into wet bins.

**Drying**
Strands are then dried until the appropriate moisture content is reached.

**Blending**
Strands are blended with resin binders and a small amount of wax, which improves the efficiency of the resin binder and enhances the panel's resistance to moisture and water absorption.

**Forming Line**
Strands go through the forming line where cross-directional layers are formed.

**Pressing**
Layers of cross-directional strands are pressed under intense heat and pressure to form a rigid, dense structural panel of oriented strand board (OSB). Presses are primarily multiple opening allowing 8 to 16 master panels to be pressed in one operation for increased efficiency. Since 1997, continuous presses producing a ribbon of OSB commenced operation on certain sites.

**Finishing Line**
Panels are cooled, cut to size, grade stamped, stacked in bundles and edge coated. All graded panels bear a mandatory certification agency stamp, plus the SBA logo if applicable.

**Shipping**
Finally, the panels are ready to be loaded and shipped to destinations around the world. Panels can be ordered smooth sanded for special uses or with tongue and groove edges.
Structural Panels

Oriented Strand Board

It advances into side of clamped bolts cutting long strands parallel to the long axis

Strand length of 15 cm common and four of these can be produced by the 60 cm long knife

Thickness is 0.75 mm (provides a reasonable balance between board properties)

Width 2 to 5 cm

A commercial disk strander

Cutting the strands

Oriented Strand Board

Cutting the strands

Strands
Oriented Strand Board

**Drying of the strands**

- For good adhesion, MC must be **2 to 6%**
- Rotary (like tumble clothes dryer) and flat screen driers are used
- Flat screen driers cause less strand breakage, retain better strand surface quality
- Hot air enters the dryer (540°C)
- Evaporating moisture cools the air
- Exiting temperatures are lower (200°C)

**Blending and forming**

- **Blending**
  - Addition of wax, resin adhesive, is called *blending*
  - Wax 0.25 to 2% to add water repellency
  - Resin 2 to 5% by weight
  - Resin applied by spray – like “spot welding”
  - Blending of surface and core furnish often done separately

- **Forming**
  - Process of depositing strands onto surface to form a mat is called “*forming*”
  - Try to make it uniform
  - To align the strands parallel to the belt they drop through series of spinning discs (like farmers harrow) onto belt below
  - To align strands perpendicular to the belt they drop onto a series of spinning discs (like paddle wheel) where they self align and land on the belt
Oriented Strand Board

**Blending and forming**

**Formation of the mat**

Common to use four forming heads
- First aligns strands 25% parallel
- Next two deposit the flakes 50% perpendicular
- Fourth deposits strands 25% parallel
- Final board thickness, dimension and density determined during forming
- To produce a 12.5 mm thick panel, loose mat is 100 mm thick

**OSB Lay-up**

**Blending and forming**

OSB (O-1) strands aligned in four layers and sheets in lignocellulose.

OSB (O-2) sheets aligned in four layers and sheets in lignocellulose.

**Pressing**

- In batch processed OSB loose strand mat is transferred to press charger
- Multi-opening presses used 3.66 x 12.2 m platen size and can produce sheets 2.74 x 7.62 m
- Platen conduct heat to mat (175 to 205°C)
- Press times are generally between 3 and 6 min depending on board density and thickness
- Conductive heat transfer is approximately a function of the square of panel distance (Press time for 38 mm OSB is 4x19 mm OSB)
Oriented Strand Board

Pressing

- Long, hot press cycles damage board surfaces and substantially impede production volumes
- To accelerate the cure of thicker mats, both high-frequency curing and steam injection are sometimes used
- Pressures 4,800 to 5,500 kPa
- After pressing, panels are hot stacked in bulk for about twenty-four hours to assure complete adhesive cure

Oriented Strand Board

Adhesives

- Only thermosetting resins used for structural panels
- Phenol-formaldehyde (PF) is primary resin in North America used for plywood and OSB
- Diphenylmethane diisocyanate (MDI) is used for OSB
- Both form waterproof bonding necessary for structural panels

Oriented Strand Board

Adhesives

Typical Choices of Structural Adhesives in Different Service Environments

<table>
<thead>
<tr>
<th>Service Environment</th>
<th>Adhesive Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully exterior</td>
<td>Phenol-formaldehyde</td>
</tr>
<tr>
<td>(withstands long-term soaking and drying)</td>
<td>Resorcinol-formaldehyde</td>
</tr>
<tr>
<td></td>
<td>Phenol-resorcinol-formaldehyde</td>
</tr>
<tr>
<td></td>
<td>Epoxy</td>
</tr>
<tr>
<td>Limited exterior</td>
<td>Melamine-formaldehyde</td>
</tr>
<tr>
<td>(withstands short-term water soaking)</td>
<td>Melamine-urea-formaldehyde</td>
</tr>
<tr>
<td></td>
<td>Isocyanate</td>
</tr>
<tr>
<td>Interior</td>
<td>Epoxy</td>
</tr>
<tr>
<td>(withstands short-term high humidity)</td>
<td>Urea-formaldehyde</td>
</tr>
<tr>
<td></td>
<td>Casein</td>
</tr>
</tbody>
</table>

Source: Data from USDA, 1999.
Oriented Strand Board

- Both derived from petroleum industry
- Cost of PF is 25% of MDI and is available in powdered form
- MDI is clear, and does not contain any water
- MDI uses water in wood to cure, can tolerate >MC than PF and can cure faster than PF
- In practice use PF for face and MDI for core which increases production

Adhesives

Plywood resins are not pure
- Includes fillers and extenders
- **Extenders** have adhesive value (e.g. furfural)
- **Fillers** are additives to prevent over-penetration of adhesive and have no (or little) adhesive value (e.g. wood flour)

An adhesive mix for southern pine plywood

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight (kg)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenol – formaldehyde</td>
<td>2,883</td>
<td>66.5</td>
</tr>
<tr>
<td>Water</td>
<td>726</td>
<td>16.7</td>
</tr>
<tr>
<td>Furfural</td>
<td>386</td>
<td>8.9</td>
</tr>
<tr>
<td>Wheat flour</td>
<td>204</td>
<td>4.7</td>
</tr>
<tr>
<td>Caustic soda</td>
<td>136</td>
<td>3.1</td>
</tr>
<tr>
<td>Total mix</td>
<td>4,335</td>
<td>100</td>
</tr>
</tbody>
</table>

There are five primary considerations when selecting structural panels for a specific use:

1. Durability of the glueline needed to avoid delamination;
2. Strength requirements for panels to be used structurally;
3. Quality needed on the faces to accomplish the appearance desired;
4. Special requirements such as fire or decay resistance;
5. Market cost differences.

Applications

- **Sheathing**
  Oriented Strand Board (OSB) can be used for roof, floor, and wall sheathing in engineered construction.

- **Engineered Components**
  OSB is extensively used for the webs of prefabricated wood I-joists (預鑄式工字樑).

- **Shearwalls and Diaphragms**
  OSB can be fastened to wood floors and walls to create structural shearwalls and diaphragms capable of resisting lateral loads (wind or earthquake).
Oriented Strand Board

Applications

- Gussets for Frames and Trusses
  OSB can be used as gussets for trusses or frames constructed with dimension lumber.

Formwork

Standard grades of OSB sheathing are sometimes used in applications where the forms are left in place after the concrete sets.