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Structural Particleboard: A New Construction Panel Product

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Structural Particleboard: A New Construction Panel Product

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Builders, homeowners, farm builders—any consumers who are involved in construction, have probably encountered a comparative newcomer to the lumber market—particleboard. This manufactured product looks different and feels different from any other building material, and it is gaining many supporters in the construction trade as a less costly, resource-conserving way of meeting the demands of a growing industry.

Particleboard is a broad term applied to panel products manufactured from wood particles that have been mixed with an adhesive and set (cured) in a heated press. Based on the type and origin of the particles, particleboards are often called flakeboard, chipboard, chip core or waferboard. Particleboards take on different appearances and possess different properties, based on the type and size of particles. These properties influence their end uses.

Particleboard’s history

Particleboard became commercially available in Germany and Switzerland prior to World War II. Its manufacture was introduced into the United States soon after the war. The oldest plant in continuous operation in this country is located at Seymour, Indiana.

In Europe, particleboard was developed as a primary material because of shortages of lumber, veneer and plywood. However, North America had sufficient forest resources to produce the needed quantities of lumber, veneer and plywood. The development of the particleboard industry in the United States and Canada was stimulated by the forest products industries' need to find a commercial use for the vast quantities of wood residue resulting from the manufacture of lumber and veneer.
The U. S. particleboard industry has shown spectacular growth—it consistently has claimed to be the most rapidly growing segment of the forest products industry.

The major traditional uses for particleboard in the United States have been as core stock for furniture and cabinetry and for floor underlayment. Acceptance of particleboard for these uses is based on such characteristics as:

- smooth, dense surfaces
- absence of knots and splits
- less tendency to warp
- availability of large panel sizes
- adequacy as a substrate to which wood veneers and plastic laminates are bonded
- lower prices.

The properties of strength, stiffness and durability are not ordinarily of major importance in selecting a particleboard for use in the manufacture of furniture.

**Structural uses**

In the 1960's the first structural or load-carrying applications of particleboard were made. An upgraded underlayment-type panel was introduced as floor decking in mobile homes.

This particleboard combined the load carrying capacity to safely handle the design floor loads of the mobile home with the previously recognized favorable characteristic of flat, smooth panels available in sizes up to 4 ft. x 12 ft. At the same time, an upgraded underlayment-type board bonded with a waterproof adhesive was introduced as structural floor decking for factory-built housing. These floor deckings for mobile and factory-built housing were the first structural-type particleboards used in the United States.

Although there is presently no universally-agreed upon definition for the term, structural particleboard, it is generally considered to be any particleboard material whose primary function is to safely withstand design loads over the expected life of a structure.

In North America, the quality of logs available for conversion into veneer for the manufacture of construction plywood has decreased dramatically and future shortages of plywood have been projected.

Since the basic "building block" for particleboard is a flake, small, low-quality logs and less desirable timber species can be used.

The shortage of construction plywood in 1972 and 1973 led to the introduction of a general purpose structural particleboard, which was marketed as a replacement for construction plywood. However, the decline in construction in 1974 and 1975, slowed the acceptance of structural particleboard in the construction panel market. In recent months there has been a major resurgence in marketing efforts with the objective of increasing the general acceptance of this relatively new wood-base construction panel material.

This material doesn't look like the conventional type of particleboard — and for good reason! It is manufactured from large, thin flakes of aspen, often referred to as "wafers", and bonded with waterproof phenolic (resin) adhesive, the same type of glue used in exterior plywood. For the same weight panel, the use of large thin flakes in this flakeboard panel promotes greater structural strength and stiffness than the small particles used in the manufacture of the conventional-type particleboards.

This type of particleboard has developed into commercial maturity in Canada over the last ten years, where it is most commonly known as "waferboard". Currently, waferboard has captured 20 per cent of the Canadian sheathing market. Presently, there are six plants in Canada and one in the United States producing waferboard.

The overall manufacturing process of waferboard is similar to other particleboard.

1. In the log-staging area, the logs of aspen are accumulated. Aspen is still widely regarded as an inferior or weed tree species in both Canada and the United States.

2. The logs are debarked and cut (slashed) into blocks, which are forced flat against flaking knives. Straight-grain flakes that are approximately .025 in. thick and 1-3/4 in. long are produced.

3. The flakes, after being dried to four per cent moisture content, are blended with phenolic adhesive and a small amount of wax emulsion. Other additives, such as preservatives, are possible.

4. The flake-adhesive mixture is next spread on a conveyor. The grain directions of the flakes are randomly distributed. A mat thickness of uncompressed flakes of 2-1/2 inches is required to produce a finished board of 1/2 inch thickness.

5. Simultaneously, mats are loaded into a huge multiple-opening hot press. The mats are pressed at 415°F and at more than 500 psi pressure.

6. After discharging from the press, the panels are cooled and cut to size. Available sizes of panel vary with the manufacturer, but generally, thicknesses range from 1/4" to 3/4" and panel dimensions of 4' x 8' up to 8' x 24'.
Particleboard vs. plywood

In the thicknesses and panel sizes presently being manufactured, wafer-type structural particleboard is being marketed in competition with construction plywood in the sheathing grades. Therefore, a natural question is how do the structural properties of the two panel types compare? In the direction of grain of the face plies, CDX plywood has greater bending strength and stiffness than waferboard of equal thickness.

Since waferboard, as it is presently manufactured, has the same value for bending properties along and across the panel length, it compares more favorably with the across-the-panel-width properties of plywood. The “no-grain” feature of waferboard also results in greater resistance to racking or shear-type forces than plywood. However, waferboard has been noted to be more susceptible to damage by impact loads than plywood.

To meet the Canadian National Building Code, the thicknesses of waferboard panels have been adjusted for specific construction uses.

With minor variations, nailing and cutting of waferboard is the same as plywood. The board is bonded with a phenolic adhesive, so it is weather resistant. It has the same fire performance characteristics as other wood building materials.

To gain widespread acceptance in the United States building market, a new construction material must secure the approval of one or more of the four model building codes, or the Federal Housing Authority or the Farmers Home Administration. The Building Officials and Code Administrators International, Inc. (BOCA), one of these model code agencies, has issued Research Reports to building officials recommending waferboard-type particleboard for use as wall and roof sheathing. Although variations exist between code approvals for the two currently available brands, the following is one set of BOCA applications recommendations for waferboard:

**BOCA Recommended Applications**

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Minimum Thickness</th>
<th>Maximum Support Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roof Sheathing</td>
<td>3/8”</td>
<td>16” o.c.</td>
</tr>
<tr>
<td></td>
<td>7/16”</td>
<td>24” o.c. (wood blocking or metal “H” clips required)</td>
</tr>
<tr>
<td>Wall Sheathing</td>
<td>5/16”</td>
<td>16” o.c.</td>
</tr>
<tr>
<td></td>
<td>3/8”</td>
<td>24” o.c.</td>
</tr>
</tbody>
</table>
Looking to the future, it becomes apparent that structural particleboard is in a state of evolution.

Particleboard, being a manufactured composite, can be produced with a wide assortment of engineering properties. Interest in developing the great potential of structural particleboard as an engineering material is keen among researchers in industry, government and universities.

One manufacturer has test marketed a board made of layers of oriented wood flakes. Its construction mimics the layered construction of plywood. This panel is much stronger and stiffer and hence can be used in a greater variety of structural applications.

The Forest Products Laboratory of the U.S. Forest Service is researching the potential of producing a high-performance type structural flakeboard from the forest residues generated by timber harvesting, thinnings and natural mortality.

In its present form, waferboard shows very favorable resistance to shear-type forces. To capitalize on this potential, the Purdue Department of Forestry and Natural Resources is researching the use of waferboard for the webbing in composite beams. Full scale tests are underway.

Also at Purdue, in cooperation with the Forest Products Laboratory of the U.S. Forest Service, a structural particleboard is being designed and developed for use as roof decking in industrial and commercial buildings. Normally, spans between supports are much longer than in residential construction, so a high-performance panel is required. Currently, a 1-1/8 inch layered flakeboard designed to be used as a panel continuous over two six foot spans is being evaluated. The panel is fabricated entirely from flakes of low quality red oak—a greatly underutilized species available in the Midwest and North Central areas.

Structural particleboard has a tremendous future. It provides a means for stretching the available wood resource to help meet the demand for construction materials.