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Report
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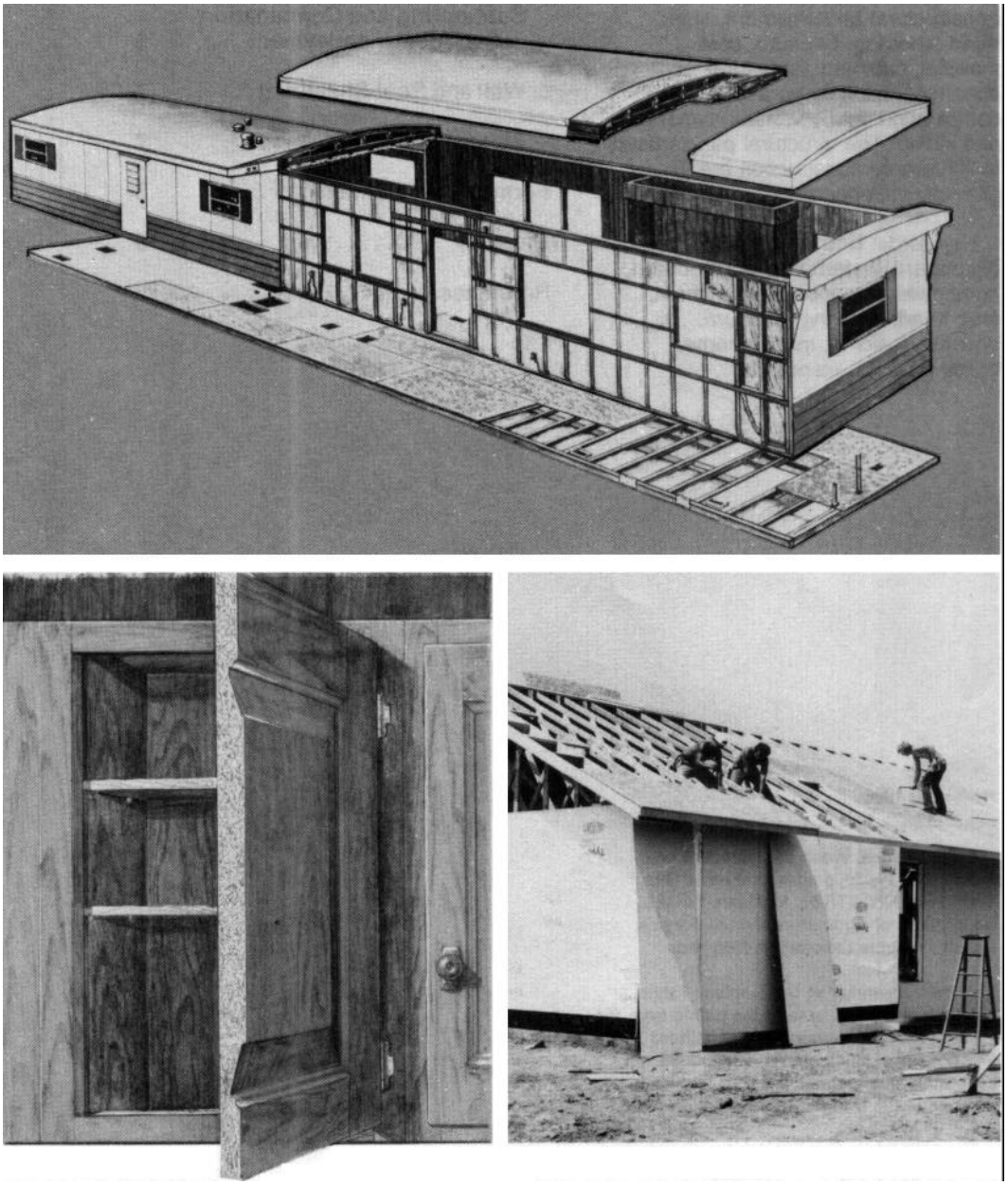
Wood Particleboard and Flakeboard

Types, Grades, and Uses



Abstract

This report is for those who use or may want to use wood particleboard. The term "particleboard" is used as defined in the American Society for Testing and Materials (ASTM) Standard D 1554, which includes flakeboards as a subclass of particleboards, and not as used in the lumber trade where the term is usually reserved for panels made of fine wood particles such as sawdust and planer shavings. Types and grades of particleboard are described and discussed in relation to end uses as nonstructural underlayment, stair tread, shelving, furniture, core material, cabinetry, structural sheathing, subflooring and combination subfloor/underlayment, and siding. The structural panels used in light-frame construction are primarily flakeboards.

Keywords: End uses, particleboard, flakeboard, waferboard, strandboard, composite plywood, underlayment, stair tread, shelving, furniture, sheathing, siding, mobile home, building codes, standards.

Contents

November 1986

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Wood Particleboard and Flakeboard

Types, Grades, and Uses

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Particleboard—What Is It?

Wood particleboards are manufactured as panels from dry wood particles that have been sprayed or dusted (speckled) with a binder resin, and are bonded together with pressure and heat. Particles for the boards can be made from almost any type of wood, whether whole logs or wood residues such as trimmings and shavings from lumber or plywood manufacturing. Many species are used, although the lower density woods are preferred. In this paper, the term "particleboard" includes a number of different panel types sometimes referred to variously as "chipboard," "flakeboard," "strandboard," or "waferboard," depending on size and shape of the wood particles used. (See Glossary from ASTM D 1554 below.)

Almost all particleboard is produced by pressing a mat of resin-speckled particles flatwise in a heated press. Extruded boards produced by forcing the resin-speckled particles between parallel heated dies represent a miniscule proportion of the particleboard produced.

Standards for Particleboard

Particleboard panels are currently available for many end uses. All but one (oriented strandboard) of the particleboards commercially available are addressed in the American National Standard, ANSI A208.1 for mat-formed wood particleboard. Developed under the auspices of the American National Standards Institute, ANSI A208.1 is a voluntary product standard, which means that producers are not restricted to the manufacture of particleboards conforming to the standard. Conformance to the standard is required only when boards offered for sale are represented as conforming to the standard, or when a customer requests a certain grade from the standard, or when required by a design specification or regulation.

The ANSI Standard A208.1 specifies dimensional tolerances of panels and required minimal levels of physical and mechanical properties for various grades of particleboard.

Tables 1 and 2, reproduced from ANSI Standard A208.1, state property requirements for the panel grades addressed in this standard. The Standard recognizes panel types 1 and 2, indicated by the first number in the grade designation. Type 1 panels (table 1) are manufactured with an adhesive (or binder resin) which has some water resistance but is not waterproof, usually urea-formaldehyde binder resin. Type 2 panels (table 2), including waferboard (2-MW) and flakeboard (2-MF), are manufactured with a waterproof binder resin, usually phenol-formaldehyde. Use of a phenolic binder resin does not necessarily result in a particleboard panel suitable for permanent exterior exposure, just as use of phenolic waterproof adhesive in sheathing plywood does not result in a plywood panel intended for permanent exterior exposure.

Within the two panel types recognized in ANSI Standard 208.1, the grade specification indicates density classes by the letters H (high), M (medium), and L (low). With wood at 7 percent moisture content, these classes approximate density values of over 50 pounds per cubic foot (lb/ft^3) (H), 40 to 50 lb/ft^3 (M), and less than 40 lb/ft^3 (L).

Particleboard Applications

The strength-stiffness requirements for different grades listed in tables 1 and 2 are not intended to be used as design values for construction. The property values listed in the tables are for grade certification and quality control where test conditions and methods are precisely controlled and follow provisions outlined in the American Society for Testing and Materials (ASTM) Standard D 1037. In-service conditions may differ from those specified in this standard. The strength and stiffness values listed in tables 1 and 2 are several times the design values that would be appropriate for use of these materials in engineered applications.

At the date of this writing, revision of ANSI A208.1 is expected to result in separate standards for fine furnish particleboards and for flakeboards.

The American Plywood Association (APA) and Timber Engineering Company (TECO) have published performance standards for sheathing and for combination subfloor and underlayment. The Council of American Building Officials Research Board, which is sponsored jointly by the three model building codes (see reference section), has recognized these APA and TECO performance standards. Certain particleboard panels (most notably a number of flakeboard products) meet these performance standards and thus have model-building-code recognition for use as sheathing or combination subfloor and underlayment. In fact, most of the flakeboard panels marketed for these uses bear gradestamps showing conformance to the APA or TECO performance standards. The model building codes, their authors, and addresses are listed in the reference section of this publication.

Specific uses of board products are discussed in the following sections. For any of these uses it is advisable to purchase panels produced under a certified quality program, where established grade marks on the panel identify the use, grade, or quality of the panel, and the mill at which it was manufactured. Six different organizations administer certified quality programs for particleboard or particleboard-veneer composites manufactured in the United States and Canada. These organizations are listed in the reference section.

Underlayment

Particleboards of grade 1-M-1, ANSI A208.1, are manufactured for floor underlayment where they provide a smooth, level, and indentation-resistant surface for the subsequent application of carpeting or resilient-finish floors such as linoleum, vinyl, or vinyl-asbestos tile.

Underlayment particleboard is nonstructural and has no code approval for use as subflooring or single-layer subflooring/underlayment. Figure 1 shows a specimen of underlayment-grade particleboard. Waferboard (discussed in subsequent paragraphs) is sometimes used as underlayment, particularly under carpeting.

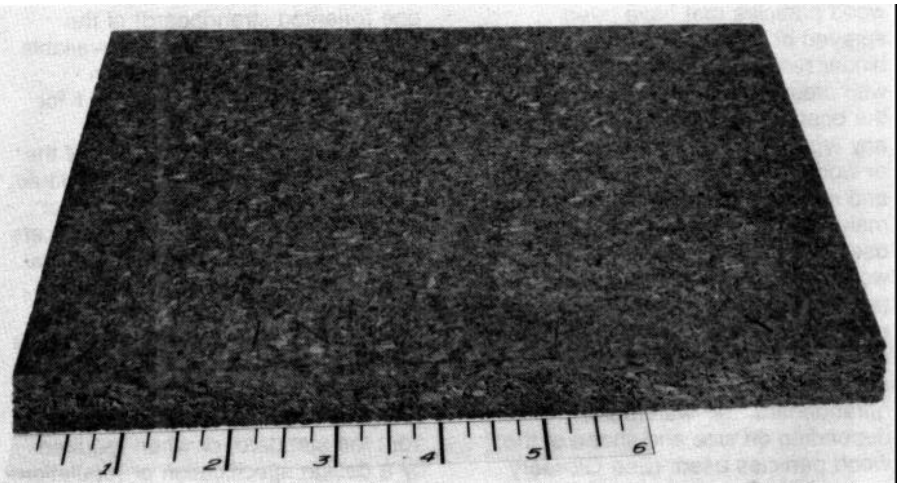

Figure 1—Specimen of underlayment particleboard. (Numbered scale in inches.) (M 150 064)

Table 1.—Property requirements for grades of type 1 mat-formed particleboard[a] (Average values for sample consisting of 5 panels)[b]

Grade	Length and width tolerance	Thickness tolerance		Modulus of rupture	Modulus of elasticity	Internal bond	Hardness	Linear expansion maximum average	Screwholding	
		Panel average[d]	Within panel[e]						Face	Edge
	in			Lb/in.^{2}			*Lb*	*Pct*	*Lb*	
1-H-1	±1/16	±0.010	±0.005	2,400	350,000	130	500	NS[c]	400	300
1-H-2	±1/16	±0.010	±0.005	3,000	350,000	130	1,000	NS	425	350
1-H-3	±1/16	±0.010	±0.005	3,400	400,000	140	1,500	NS	450	350
1-M-1	+0 -1/8	+0.015	±0.010	1,600	250,000	60	500	0.35	NS	NS
1-M-2	±1/16	±0.010	±0.005	2,100	325,000	60	500	0.35	225	200
1-M-3	±1/16	±0.010	±0.005	2,400	400,000	80	500	0.35	250	225
1-L-1	±1/16	+0.005 -0.015	±0.005	800	150,000	20	NS	0.30	125	NS

[a]Made with urea-formaldehyde resin binders or equivalent bonding systems.
[b]Except for dimensional tolerances which are individual panel values.
[c]NS–not specified.
[d]Panel average from nominal.
[e]Individual measurement from panel average.

Table 2.—Property requirements for grades of type 2 mat-formed particleboard[a] (Average values for sample consisting of 5 panels)[b]

Grade	Length and width tolerance	Thickness[e] tolerance		Modulus of rupture	Modulus of elasticity	Internal bond	Hardness	Linear expansion maximum average	Screwholding	
		Panel averages	Within panel[h]						Face	Edge
	in			*Lb/in,^{2}*			*Lb*	*Pct*	*Lb*	
2-H-1	±1/16	±0.015	±0.005	2,400	350,000	125	500	NS[d]	400	300
2-H-2	±1/16	±0.015	±0.005	3,400	400,000	300	1,800	NS	450	350
2-M-1	+0 -1/8	±0.015	±0.010	1,800	250,000	60	500	0.35	225	160
2-M-2	+0 -1/8	±0.015	±0.010	2,500	450,000	60	500	0.35	250	200
2-M-3	+0 -1/8	±0.015	±0.010	3,000	500,000	60	500	0.35	NS	NS
2-MW[c]	+0 -1/8	±0.015	±0.010	2,500	450,000	50	500	0.20	NS	NS
2-MF[f]	+0 -1/8	±0.015	±0.010	3,000	500,000	50	500	0.20	NS	NS

[a]Made with phenol-formaldehyde resins or equivalent bonding systems.
[b]Except for dimensional tolerances which are individual panel values.
[c]"W" indicates that this product is made from wafers.
[d]NS—not specified.
[e]Thickness tolerance values shown are for sanded panels as defined by the manufacturer. Values for unsanded panels for all 2-M Grades shall be ±0.030 for panel average and ±0.030 for within panel.
[f]"F" indicates that this product is made from flakes.
[g]Panel average from nominal.
[h]Individual measurement from panel average.

Particleboard underlayment is attached to lumber or plywood subflooring with ring-grooved underlayment nails or galvanized divergent-chisel-point power-driven staples. Glue-nailing with hard-setting casein glue or polyvinyl acetate floor underlayment glue provides superior attachment. The reader is referred to the booklet "How to Install Particleboard Floor Underlayment" published by the National Particleboard Association. This instruction guide was written before flakeboards came into use as structural subfloor and hence does not mention how to attach underlayment particleboard to a flakeboard subfloor. However, the application would be the same as to lumber or plywood subfloor. In new construction, single-layer subfloor/underlayment is often used, eliminating the need for attachment of underlayment to subflooring.

Stair Tread and Shelving

Some urea-bonded fine-furnish particleboard is produced for use as interior stair tread. The U.S. Department of Housing and Urban Development (HUD) has published a Use of Materials Bulletin (UM 70a) for particleboard interior stair treads. The International Conference of Building Officials (ICBO) has also issued a research report (RR 3390) on the use of particleboard stair treads. Both HUD and ICBO require gradestamping to indicate that particleboard stair treads conform to the material requirements. The HUD and ICBO publications also specify minimum tread thickness of 1-1/16 inches, maximum tread width of 11-1/8 or 12 inches, maximum span between support stringers of 42 inches, and require that all particleboard treads be supported by risers with nails through the riser into the back of the lower tread, and have a nosed (rounded) edge and waterproof protection for treads located near entryways (hence subject to wet foot traffic). The National Particleboard Association has published a bulletin concerning installation of particleboard stair tread.

Some urea-bonded fine-furnish particleboard is sold as shelving. Some shelving is marketed as plain board (usually with a nosed front edge), and some is sold overlaid with high-pressure laminate (as used on countertops) or with veneer. Overlaid panels are stronger, stiffer, and more resistant to sagging. The National Particleboard Association has published guides for particleboard shelving design. These guides indicate how to arrange shelf supports or choose particleboard grade and thickness to support given loads. Their usefulness depends on your knowing the particleboard grade (or more specifically its bending strength and stiffness). Unfortunately, a considerable quantity of particleboard shelving is sold without any indication of its grade (1-M-1, 1-M-2, or 1-M-3) or its bending strength and stiffness. It is obviously prudent to assume that unidentified boards have bending properties no greater than those of grade 1-M-1 panels. Simple rules of thumb are to keep shelf supports close together (this will likely be determined by wall stud spacing) and where possible to support the rear edge of the shelf.

Grades for Industrial Uses

Grades 1-M-2 and 1-M-3 of ANSI A208.1 are manufactured for industrial furniture manufacturers that consume large quantities of urea-formaldehyde-bonded particleboard. The particleboard is usually overlaid in furniture with veneer, plastic, vinyl, printer foil, transfer films, or high-pressure laminate as in kitchen countertops. Some particleboard manufacturers may produce panels bonded with isocyanate (urethane) for industrial furniture manufacturers. The isocyanate adhesive does not release formaldehyde vapors and is waterproof. Grade 1-L-1 panels are manufactured as core material for fabricators of solid doors. Solid doors are used primarily in public buildings or where there are requirements for fire endurance of doors.

Another grade of urea-formaldehyde-bonded particleboard is mobile home floor decking. This board serves as a single-layer or combination subfloor and underlayment in mobile home construction. In this application, the board is installed atop wood floor joists which, in turn, are attached to the mobile home's metal chassis. The board is usually glue-nailed to the mobile home floor joists with power-driven ring-grooved nails and polyvinyl acetate ("white") glue. The industry standard for this special use panel, NPA 1-73, states that the board must pass a concentrated load test described therein. With the exception of interior stair tread, mobile home floor deck is the only structural application where a urea-bonded panel is permitted in North America. The rationale for this is (1) that a mobile home is manufactured indoors and so there is no opportunity for its floor deck to be exposed to rain during construction and (2) that the expected service life is shorter for a mobile home than a house. At least two particleboard manufacturers are now making mobile home floor deck with waterproof isocyanate adhesive.

Particleboard panels of grade 2-M-2 of ANSI A208.1 are manufactured primarily for use as single-layer combination subfloor and underlayment in factory-built housing. Boards intended for this use must pass a concentrated load test. The board is similar to mobile home decking, but has a type 2 bond because of the stricter requirements for factory-built housing. Glue-nailing, with ring-grooved nails and elastomeric construction adhesive, is the approved method of attaching particleboard floor deck to floor joists of factory-built housing.

Subflooring and Combination Subfloor/Underlayment

As floor sheathing, structural panels are subject to bending stress and concentrated static and impact loads. In addition, they provide racking resistance to the floor. Panels in this application must provide racking resistance and must not deflect excessively under load nor fail in bending or punching shear. The requirements for combination subfloor/underlayment are similar, but more stringent. Various structural particleboards, most of them flakeboards, are recognized by the model building codes for use as subfloor or subfloor/underlayment.

Panels that conform to grade 2-M-3 of ANSI A208.1 have obtained model code recognition for use as combination subfloor and underlayment. Grade 2-M-3 panels are made of a fairly fine particle furnish with a generous amount of phenolic adhesive and are denser than most medium-density particleboards. For use as combination subfloor/underlayment 2-M-3 panels must have tongue and groove edges or their edges must be supported with blocking. Panels similar in construction to grade 2-M-3 panels may meet performance requirements of the performance standards for combination subfloor/underlayment and be gradestamped as conforming to one of the performance standards. Because there are three different model-code-writing agencies and because the model codes are not static, it is best for potential users of structural panels first to check with their local building officials. It should be noted that local jurisdictions do not always refer to the latest editions of the model codes.

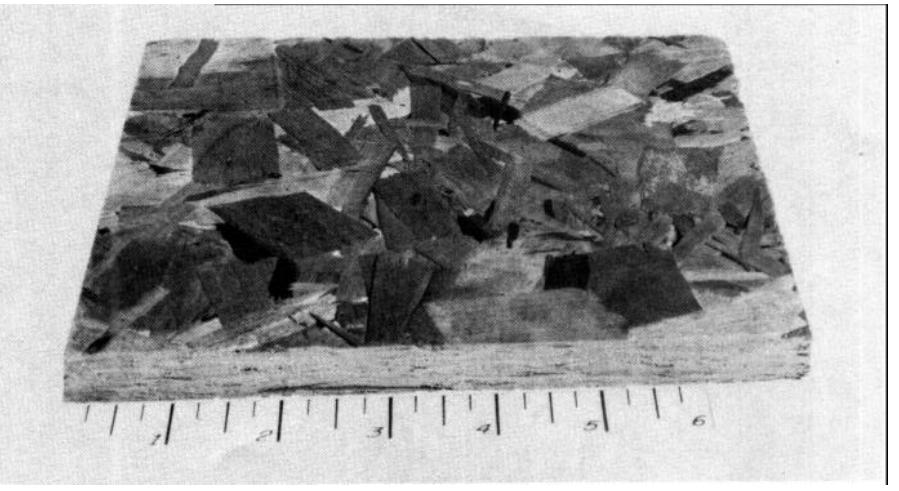

Figure 2—specimen of waferboard. Note the wide wafers, (Numbered scale in inches.) (M 150 065)

Grade 2-MW of ANSI A208.1 is waferboard. This panel grade is recognized by the model codes for use as sheathing or combination subfloor/underlayment (subject, of course, to requirements set out in the codes for panel thickness, and attachment and spacing of framing members). Waferboard is classified as a flakeboard, and figure 2 shows a specimen of this board type. Waferboard panels may also meet performance requirements of APA or TECO performance standards for sheathing and/or for combination subfloor/underlayment (dependent on thickness) and may obtain code recognition for use as subfloor or subfloor underlayment by this route.

Oriented strandboard (OSB) is constructed of wood flakes or strands that are similar to wafers but narrower. Being narrower, the strands can be aligned. OSB is made of strands aligned (oriented) in layers that run perpendicular to each other (fig. 3) as in the cross-laminated construction of plywood. Flake alignment gives the panel superior bending strength and stiffness, but only if surface layer orientation runs perpendicular to the framing members. OSB is most often certified as conforming to the APA or TECO performance standards for sheathing and/or combination subfloor/underlayment (dependent on thickness). The difference between OSB and waferboard is not as distinct as it was in the early 1980's because many waferboard producers are now cutting wafers with some length-width difference and aligning these wafers to some extent in the panel.

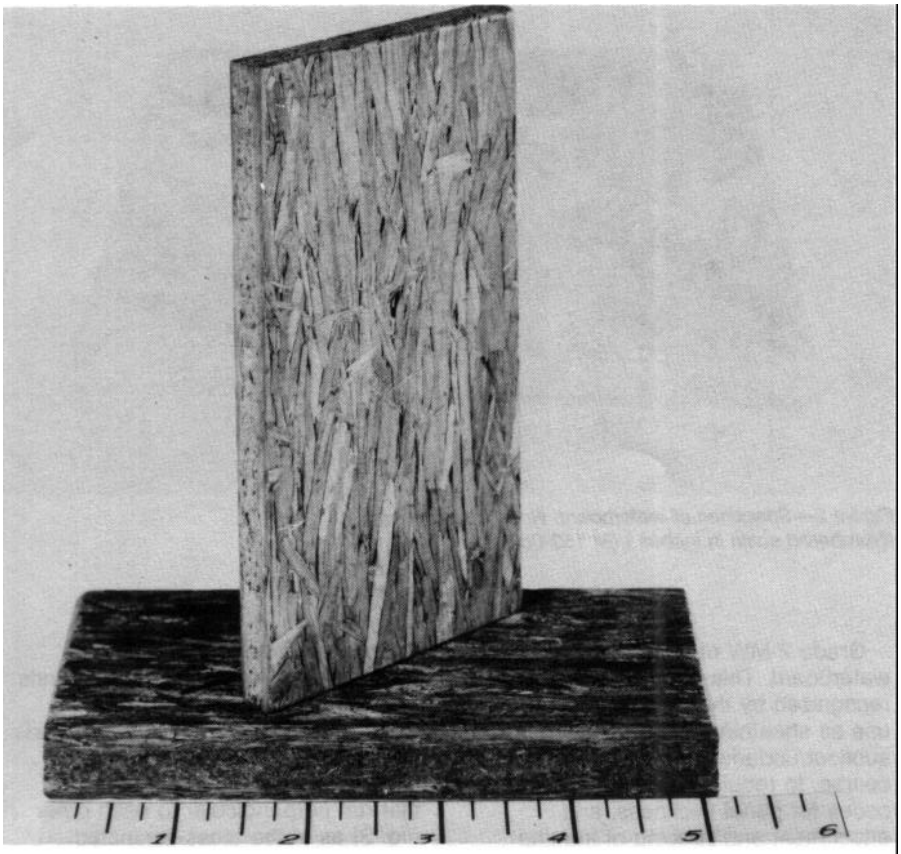

Figure 3—Two small specimens of oriented strandboard. This shows the board's three-layer construction and alignment of strands in each layer. (Numbered scale in inches.) (M 150 062)

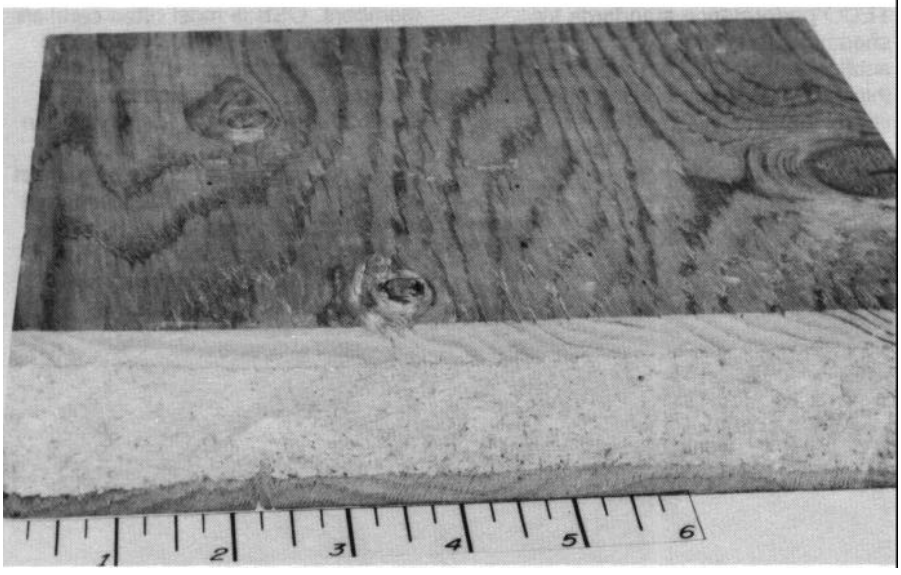

Figure 4—Specimen of a composite plywood panel. The edge has been bevel-cut to accentuate the wood-particle core. (Numbered scale in inches.) (M 150 063)

Composite plywood panels first became commercially available in 1976. Figure 4 shows a specimen of this panel type comprising a wood particle core sandwiched between veneer faces. As can be seen from the figure, these panels look much like "traditional" softwood plywood. Composite plywood panels are included here because they have a particleboard core. Composite plywood production has not enjoyed the large growth of flakeboard production over the last 5 years, apparently for economic reasons; composite plywood costs more to produce, and plants that produce it are usually farther removed from major markets than competing flakeboard plants. Building-code recognition of composite plywood panels for use as subfloor or combination subfloor/underlayment is given either on a proprietary-product basis or by conformance to performance standards for these end uses.

Particleboard subfloor panels are attached to floor joists with deformed shank nails or common nails or cement-coated sinker nails. Particleboard combination subfloor and underlayment panels are usually attached to floor joists with deformed shank nails. Glue nailing with elastomeric construction adhesive generally permits wider spacing of nails and provides a more rigid floor. Local building codes should be checked for specific information regarding panel usage and installation. APA, NPA, or TECO also can provide more current and specific information than is contained in this report. Panels approved for structural use in light-frame construction always (or almost always) have face stamps to indicate span rating (maximum allowable distance between support framing members).

Wall and Roof Sheathing

As wall sheathing, structural particleboards generally provide more racking resistance than required. Consequently, panels are usually used that are less expensive (wood fiber) or provide better insulation (foam). Waferboard, OSB, and composite plywood, when applied as wall sheathing, provide a nail base for application of shingle siding.

Roof sheathing must take bending stress and provide racking resistance to the roof. As roof sheathing, structural panels must support their own weight and that of roofing materials, snow loads, and persons on the roof and also resist wind and other racking loads. Although the requirements are not as stringent as for subfloor applications, roof sheathing panels must be reasonably strong and stiff in bending and resistant to punching shear failure. Waferboard, OSB, and composite plywood are frequently used as roof sheathing and this is the biggest market for these panels.

Building code recognition of waferboard and OSB for use as wall and roof sheathing is by conformance to the ANSI A208.1 grade 2-MW for waferboard or to the APA or TECO performance standard for sheathing. Building-code recognition of composite plywood for these uses may be by performance standards for sheathing or by proprietary product.

Carpenters perceive that waferboard, OSB, and composite plywood feel stiffer underfoot (i.e. when spanning framing members) than do equal thicknesses of plywood, although static concentrated load tests do not indicate that these products are stiffer. They provide a more uniform nail base for roof shingles than plywood and deflect less under hammer blow. However, waferboard and OSB are more subject to punching shear failure than plywood and their surfaces often slide easily on one another (a stack of these panels is much more likely to slide off a sloped framed roof than is a stack of plywood or composite plywood).

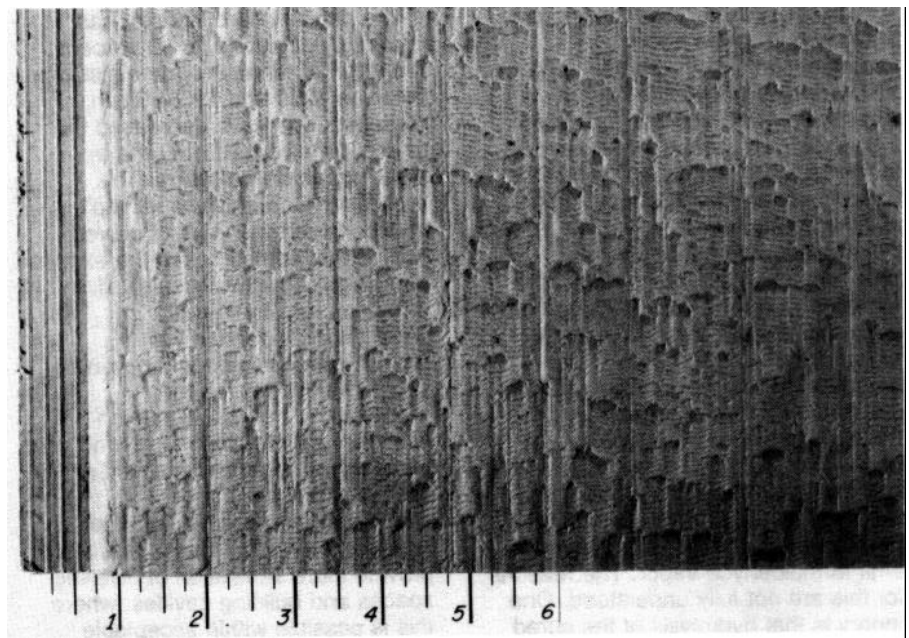

Figure 5—Specimen of grade 2-M-1 board produced for vertical exterior siding. This specimen has a textured surface and is overlaid with phenolic-resin impregnated paper. (Numbered scale in inches.) (M 150 061)

Waferboard and OSB panels are often manufactured with one surface roughened or coated with an anti-skid coating to alleviate this problem. All these panels are attached to framing members as construction plywood would be (i.e. with common nails, or more frequently, with cement-coated sinker nails).

ANSI A208.1 grades 2-M-1, 2-M-2, and 2-M-3 find little use as wall or roof sheathing, being heavier and hence more difficult to apply than waferboard, OSB, or composite plywood.

Siding

The model building codes recognize ANSI A208.1 2-M grades of particleboard for use as exterior siding. Having fairly smooth faces, the 2-M-1, 2-M-2, and 2-M-3 panels are easy to paint. Grade 2-MW (waferboard) has rougher surfaces and is more difficult to paint. Some siding manufacturers overlay their panels with resin-impregnated paper.

The paper overlay provides a uniform, easily paintable surface. Figure 5 shows a specimen of a paper-overlaid siding particleboard. Whenever particleboard is used as exterior siding, it is important to prevent panel edges from absorbing water. This appears to be particularly important with decay-prone wood species such as aspen. The model building codes require that joints between panels be covered with wood batten strips or otherwise be made waterproof to the satisfaction of the building official. Codes specify the stud spacing and attachment. Depending on stud spacing, particleboard sheets can be nailed either directly to studs or to approved sheathing. Attachment should be with galvanized siding nails.

Formaldehyde Emissions

Over the past decade considerable publicity has arisen about formaldehyde vapor contaminating air in dwellings. This contamination can come from many sources, including tobacco smoke, urea-formaldehyde foam insulation, carpeting, softgoods furnishings, and particleboard and decorative plywood.

Particleboards bonded with urea-formaldehyde resins emit more formaldehyde than do particleboards bonded with phenol-formaldehyde resins. When urea-formaldehyde-bonded particleboards first emerge from the heated press where they are produced, they emit more formaldehyde vapor than they do after aging for a few months but, if they are installed in hot and damp environments, they may continue to emit formaldehyde vapor. The reasons for this are not fully understood. One theory is that hydrolysis of the cured urea-formaldehyde occurs in such an environment, and results in release of formaldehyde vapors and loss of board strength. Hydrolysis can theoretically continue indefinitely if humidity and temperature remain at high levels.

In February 1985, HUD initiated new product emission standards for particleboard and hardwood plywood used in manufactured homes. The maximum allowable formaldehyde emission from particleboard is 0.3 part per million (ppm) when measured in a large chamber under conditions that simulate a single-width mobile home. The National Particleboard Association estimates that, since implementation of the Federal rule, roughly 80 percent of particleboard production conforms to the 0.3 ppm standard. Each panel from a production lot that has been certified as meeting the standard receives a stamp indicating compliance.

The particleboard industry has reportedly achieved an 80 percent reduction of formaldehyde emissions between 1980 and 1985. Resin manufacturers have decreased the ratio of formaldehyde to urea in urea-formaldehyde resins. This reduces the “free formaldehyde” release from newly manufactured boards, but sometimes at the expense of strength and thickness swell. In hot and damp environments, particleboards bonded with phenol-formaldehyde or isocyanate should be substituted for urea-bonded boards. Research continues on reducing fume emissions by adjusting resin formulations or adding scavengers.

Methods to reduce existent air contamination in dwellings are (1) to provide more ventilation of dwelling spaces and building cavities, where this is possible within acceptable energy-loss limits, (2) placing pans of ammonia inside the dwelling as formaldehyde scavenger (which requires professional application and temporary evacuation of the dwelling, and, because ammonia is a heart stimulant, may be hazardous to some individuals), (3) using air purification equipment, and (4) coating board surfaces and edges.

Glossary

The terms below are taken verbatim from American Society for Testing and Materials (ASTM) D 1554, standard definitions of terms relating to wood-base fiber and particle panel materials. This standard is also an American National Standard.

Particleboard—A generic term for a panel manufactured from lignocellulosic materials (usually wood) primarily in the form of discrete pieces or particles, as distinguished from fibers, combined with a synthetic resin or other suitable binder and bonded together under heat and pressure in a hot press by a process in which the entire interparticle bond is created by the added binder, and to which other materials may have been added during manufacture to improve certain properties. Particleboards are further defined by the method of pressing. When the pressure is applied in the direction perpendicular to the faces as in a conventional multiplaten hot press, they are defined as flat-platen pressed and when the applied pressure is parallel to the faces, they are defined as extruded.

Flake—A small wood particle of predetermined dimensions specifically produced as a primary function of specialized equipment of various types, with the cutting action across the direction of the grain (either radially, tangentially, or at an angle between), the action being such as to produce a particle of uniform thickness, essentially flat, and having the fiber direction essentially in the plane of the flakes, in overall character resembling a small piece of veneer.

Particle—The aggregate component of a particleboard manufactured by mechanical means from wood or other ligno-cellulosic material (comparable to the aggregate in concrete) including all small subdivisions of wood such as chips, curls, flakes, sawdust, shavings, slivers, strands, wood flour, and wood wool. Particle size may be measured by the screen mesh that permits passage of the particles and another screen upon which they are retained, or by the measured dimensions as for flakes and strands.

References

Administrators of Certified Quality Assurance Programs[1]

American Plywood Association
P.O. Box 11700
Tacoma, WA 98411

Columbia Research and Testing Corp.
P.O. Box 968
Santa Rosa, CA 95402

National Particleboard Association
18928 Premiere Court
Gaithersburg, MD 20879

PFS Corporation
2402 Daniels Street
Madison, WI 53704

Pittsburgh Testing Laboratories
850 Poplar Street
Pittsburgh, PA 15220

Timber Engineering Company (TECO)
5530 Wisconsin Avenue, NW.
Washington, DC 20015

Model Building Codes and Their Administrating Organizations[2]

Basic Building Code (BBC)
Administered by the Building Officials and Code Administrators International, Inc. (BOCA)
17926 South Halsted Street
Homewood, IL 60430

Uniform Building Code (UBC)
Administered by the International Conference of Building Officials (ICBO)
5360 South Workman Mill Road
Whittier, CA 90601

The Standard Building Code (SBC), formerly the Southern Standard Building Code (SSBC)
Administered by The Southern Building Code Congress International
900 Montclair Road
Birmingham, AL 35213

[1]The American Plywood Association and National Particleboard Association are industrial trade associations. Timber Engineering Company, Pittsburgh Testing Laboratories, and Columbia Research and Testing Corporation, and PFS Corporation are commercial enterprises.

[2]These building codes apply to permanent structures only, not to mobile homes. Mandatory Federal standards for mobile home construction were published by the Department of Housing and Urban Development (HUD) in the Federal Register of December 18, 1975, and August 9, 1984.

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