How to get the most for your money

Choosing and using form panel boards

Plywood still dominates the market, but new products are on the horizon. Shop around with an eye on the reuse factor. The lowest cost per pour may not come with the cheapest board.

Form sheathing—the part of the form that is next to the concrete—can be made of many different materials:

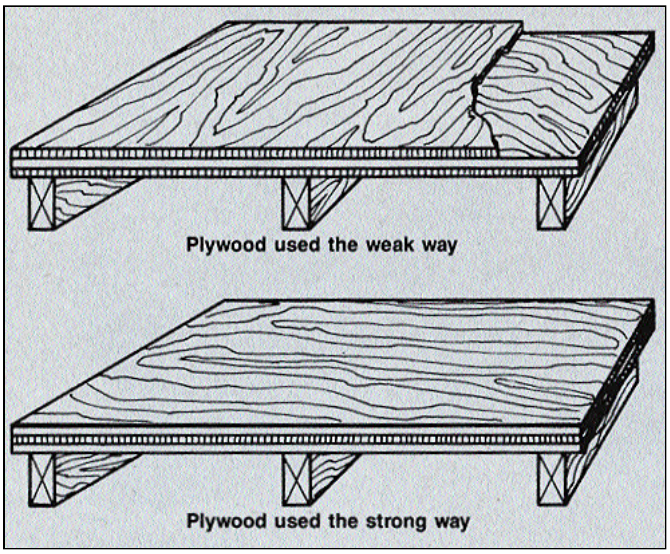
- lumber or plywood
- glass fiber reinforced or unreinforced plastics
- steel and aluminum
- reconstituted wood-base panels
- glass fiber reinforced concrete

Some of these materials are structural; that is they are strong enough to support the load or pressure from the wet concrete. The weaker or thinner materials act as form liners to provide a desired concrete surface smoothness or texture. This article concentrates on the wood and wood-base panels, showing the range of products available, and some factors to consider in choosing the best one for your job.

There are few form builders around who remember the time when all form sheathing was assembled board by board. Today board sheathing is used mainly for small areas and filler pieces, or where specified for special architectural effects. The modern workhorse is plywood. Not only does it reduce the labor of form building; it also gives large joint-free areas that simplify rubbing and finishing the concrete. However, confronted with the problem of dwindling timber resources, the lumber industry today offers several kinds of reconstituted wood-base panels which are beginning to be used in formwork. This development may revolutionize future construction as plywood has done in the past.

TYPES OF PLYWOOD AVAILABLE FOR FORMING

Plywood is a flat panel made of a number of thin sheets of wood. The layers are dried and joined under pressure with glues that make the joints as strong or stronger than the wood itself. The direction of grain is alternated in adjoining layers, and usually the grain direction of the outer layers is parallel to the long dimension of the panel. However, most imported birch plywood has the outer grain running in the short direction. To use plywood the strong way we place the visible grain of the outer layers at right angles to the supporting studs or wales (see drawing).



Remember that plywoods work harder when used the "strong way." Grain of the wood on North American plywood faces usually runs in the long dimension of the panel, while imported birch plywood has the face grain running the short way. Put the grain of the panel face at right angles with supporting studs to make the strongest forms.

Almost any exterior plywood can be used in formwork, since all exterior grades are made with waterproof glue. However, there are big differences in strength, stiffness, durability and concrete surface finish among the different grades. A Department of Commerce product standard establishes standards for manufacture in the U. S. (Reference 1). This and References 2 and 3 will be useful to those who need more details about the differences.

The four principal types of plywood used for formwork are:

- Sanded, non-overlaid B-B concrete forming grade
- Medium density overlaid (MDO)
- High density overlaid (HDO)
- Imported overlaid birch

The first three types are most commonly made of fir, pine, or other softwood, although some hardwoods are also permitted by the standard. Of interest where very smooth surfaces are desired, but currently limited in availability, are plywoods with special overlays such as formica, epoxy resin, or glass fiber reinforced plastic. These special overlays are not covered by the product standard.

B-B form grade plywood

Of plywoods widely used for forming, the sanded B-B forming grade plywood is the least expensive. It generally offers the fewest reuses, because the face is not sealed and protected against abrasion. It absorbs more release agent and imparts more of its own texture (grain, knots, patches) to the concrete surface.

Overlaid plywoods

A translucent or opaque overlay can be used to largely blank out the pattern of grain or knots that B-B plywood may leave on the concrete surface. The standard overlay material is a thermosetting phenolic resin impregnated fiber sheet fused to the panel under heat and pressure. From about 5 to 12 mils thick, the overlay generally improves the abrasion and moisture resistance of the plywood and reduces the amount of release agent needed.

High density overlaid plywood may have overlay on one or both sides. The cellulose fiber sheet or sheets of the overlay must have at least 45 percent resin solids to be considered high density (HDO), while the medium density overlay (MDO) must have 17 to 22 percent resin solids. General purpose MDO plywood is not recommended for forms, but good service can be expected from MDO products designed and designated for formwork. The HDO plywood leaves a smoother surface on the concrete, but the more matte finish attainable with MDO may be preferred by some specifiers.

Imported birch plywood, generally the strongest of the plywoods with the heaviest overlay, also has a phenolic material in the overlay. This is the most expensive of the plywoods, and potentially the most durable if handled properly. Recently some manufacturers in Finland have introduced alternate grades of overlay, making a product line similar to the range of quality levels in domestic production.

Other overlays and laminates not covered by the product standard have been used from time to time. These include epoxies and glass fiber reinforced plastics. Frequently they are found in panel materials developed for other industries and adapted by the form builder.

RECONSTITUTED WOOD-BASE PANELS

The lumber industry is expanding production of reconstituted wood panels for several reasons. The material to make them is cheap and plentiful in locations which don't require costly transportation to the market areas. There is a large supply of so-called waste trees such as aspen, red oak and alder as well as the tops of low quality logs ordinarily left in the forest during logging operations. Wood particle products generally make more efficient use of trees than plywood, and they are made from trees which can be cut more quickly than pine or fir commonly used in plywood. Labor costs to make the reconstituted panels are lower than for plywood, and so the user can hope for a price advantage with these new products.

Some of the stronger reconstituted panel products are suitable for formwork. Properly backed with supporting members, the weaker ones may be used as liners to impart a desired finish to the concrete. They must be purchased on the basis of structural properties, not just panel thickness. However, only those materials specially manufactured for forming applications—with edge sealing and surface treatment—can be expected to give durability comparable to treated plywoods.

Since the industry is still sorting out the names for many of these products, there is sometimes a confusion of terms. There are several subgroups of reconstituted wood materials described below using the names which appear to be most widely accepted today. Some are not yet officially standardized.

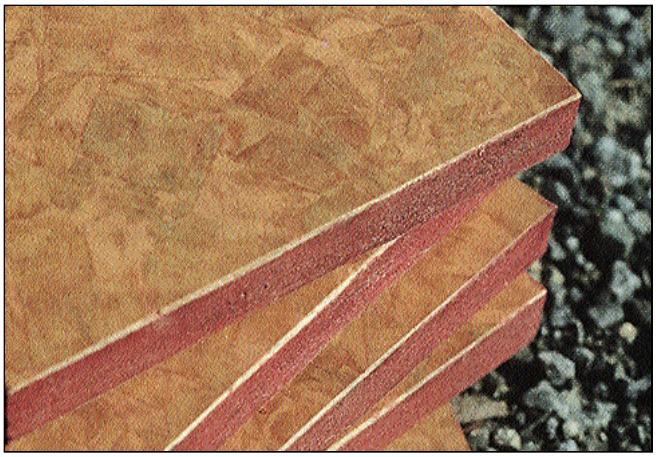
Hardboard

Hardboard is a fibrous-felted board usually made from wood fibers which have been consolidated under heat and pressure to a density of more than 30 pounds per cubic foot. Unlike other reconstituted wood products, the fibers are bonded entirely by natural ingredients of the wood. Tempered hardboard, impregnated with materials such as drying oils, has improved strength, abrasion resistance, and lower rate of water absorption. It therefore may be used as a form liner or facing material. Screen back hardboard, with the reverse impression of a wire screen on the back, has been used to impart surface texture to concrete.

At one time a special grade of hardboard for forming applications was manufactured. This is no longer available.

Particleboard and fiberboard

Particleboard normally refers to a product made up of smaller particles bonded with urea or phenolic resin, although loosely speaking the term can be used for any panel containing particles of wood.



Form-grade waferboard panels have sealed edges and either a medium density or a high performance overlay. They are factory treated with a chemically reactive concrete form release agent, and a light application of the same release agent is recommended before each use of the panel. Standard 4x8-foot sheets are available in thicknesses of 5/8, 11/16, and 3/4 inch.

Fiberboard is sometimes considered a type of particleboard, but here the wood materials are usually broken down and combined so that some of the individual fibers are linked in a natural wood-like bond. Less synthetic resin is used in the manufacture.

Particleboard and fiberboard as now manufactured have limited applications for forming.

Waferboard

Waferboard is a structural panel made from large thin wafers of wood, mixed with waterproof phenolic resin glue, interleaved together in thick mats and bonded under heat and pressure. If the panel is made with wafers deliberately aligned, it has improved properties in the parallel-to-the-grain direction. The strength, uniformity, and weather resistance make it suitable for many of the same purposes as exterior grade plywood and softwood lumber. Although the manufacturing process is similar to that for particleboard, waferboard is generally stronger because of the uninterrupted wood fiber of the large wafers.

About three years ago, a specially enriched, overlaid waferboard engineered for use as a form panel was introduced. It is reported to give a more uniform surface than B-B plywood panels, but some slight wafer pattern may be transferred to the concrete. In ¾-inch thickness, the forming grade now available weighs about 90 pounds for a 4x8-foot panel, as compared with 70 pounds for plywood of the same thickness.

Flakeboard or strandboard

Flakeboard or strandboard is made with wood flakes or strands cut in the direction of the grain. These particles are longer and thinner than wafers and can be aligned in the panels for greater strength. Oriented strandboard consists of layers of aligned strands bonded with phenolic resin. Strand direction is perpendicular from one layer to the next, and resulting panels are reportedly as strong as plywood of the same thickness. CONCRETE CONSTRUCTION has been informed that at least one manufacturer is developing a concrete forming grade of oriented strandboard.

FIGURE PANEL COSTS ON A PER USE BASIS

It is impossible to give a definite number of reuses that can be expected with a particular type of panel material, since each builder handles the forms differently. The type of form influences the number of reuses to be expected, too. Panels used for vertical forming usually can

COST OF ¾-INCH PANEL BOARD MATERIALS PER SQUARE FOOT PER POUR

	Recent cost per square foot, in dollars	Producer's estimated number of reuses	Cost per square foot of pour, in cents
B-B form plywood Class 1	0.43 to 0.70	5 to 10	4.3 to 14
Medium density overlaid plywood			
Standard	0.60 to 0.70	10 to 25	2.4 to 7.5
Premium	0.78 to 1.05	15 to 35	2.2 to 7.0
High density overlaid plywood	1.23 to 1.55	25 to 75	1.6 to 6.2
Epoxy coated plywood	1.18 to 1.67	30 to 50	2.4 to 5.6
Imported birch overlaid plywood	2.10 to 2.50	75 to 200	1 to 3.3
Form grade waferboard	0.60 to 0.70	25 to 30	2 to 2.8

NOTE: Number of reuses depends on the type of form and the builder's methods of handling the material. Upper end of the estimated range cannot be expected without extreme care.

be used more times than deck form panels. Panels in a well-built gang form should give longer service than loose panel forming systems.

Reuse is always the key to savings in form costs, and panel boards are no exception. It is surprising to see how much can be saved if the right panel is chosen for multiple uses. A higher quality board may be cheaper to use. For example:

If B-B plywood costing 65 cents per square foot is used seven times, the cost per square foot per pour is about 9 cents.

A more expensive high density overlaid plywood—$1.40 cents per square foot—may be used 25 times and costs less than 6 cents per square foot per pour.

A table like the one on page 241 can help compare costs of the panel materials described in this article. Each builder should make similar calculations based on his own reuse experience and local prices. Remember to consider the strength as well as the surface characteristics attainable with each board and how both of these affect the overall form costs.

HOW TO ASSURE MAXIMUM REUSE OF PANEL BOARDS

With some engineered systems, up to 200 reuses for premium grades of plywood have been reported; at the other extreme, good panels are damaged beyond reuse after only one or two pours. Much depends on the builder's field practices. One industry expert has offered some tips (Reference 3) for getting the best use from your panels, whatever quality you decide to buy.

1. PROTECT THE EDGES with proper sealers and support. Much form grade plywood is supplied with sealed edges, but when panels are cut the raw edges should be sealed with paints, polyurethane or other material. If this is not done, you will see swelling, warping, buckling or general breakdown of the edges. For best quality surfaces, edges of the plywood panels in form assemblies should be supported on blocking or backed up by studs or stringers. Taping joints helps keep water out of panels, as does a compressible foam edge-tape gasket.

2. HANDLE WITH CARE. The method of stripping is important, and panels should be carefully lowered, not just dropped.

3. PLAN TO USE WHOLE SHEETS WHEREVER POSSIBLE. Many times it is possible to leave a panel overhanging instead of cutting to exact shape. Then it can easily be used for some other job.

4. DURING STORAGE PROTECT PANELS from both the weather and physical damage caused by lift trucks and other equipment.

5. AVOID OVERLOADING THE FORMS. This means observing the pour rates for which forms were designed, and keeping heavy construction loading off the decks, unless they were specifically designed to take it. Few designers plan for more than 75 psf construction loading, and that doesn't allow for placing tons of rebars or a compressor in one small area.

6. USE ADEQUATE AND PROPER RELEASE AGENT. Recoating for each use of plywood is necessary if its full service potential is to be achieved.

7. BE CAREFUL DURING VIBRATION TO AVOID DAMAGE. A vibrator burn will mar the concrete surface and cut the panel life. Although the overlaid plywoods have greater resistance to vibrator damage than regular B-B form plywood, they can still be torn up by an overly aggressive vibrator operator.

References

1. "U.S. Product Standard PS 1-83 for Construction and Industrial Plywood." Single copies are available free from the American Plywood Association, P.O. Box 11700, Tacoma, Washington 98411.

2. "Concrete Forming," APA Design/Construction Guild, revised in January 1984. Single copies of this illustrated booklet are also available without cost from the American Plywood Association at the address listed in Reference 1.

3. Gould, John, "Designing with Plywood: Considerations for Selecting and Using Plywood Correctly," presented at the Second International Conference for Forming Economical Concrete Buildings, Chicago, Illinois, November 1984. Publication of these proceedings by the American Concrete Institute is planned.

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