An exterior door is by its nature one of the most difficult woodworking projects. The two sides of the door face two different environments: The inside faces a climate which is heated and/or cooled, protected from direct sunlight and rain or fog, and the exterior side of the door may face direct sunlight, fog or driven rain. Obviously, the door manufacturer can't mechanically secure all edges of the door because of the requirement that it open and close. As a result, the construction methods used in stile and rail doors were developed over centuries to deal with these problems. If all the customary methods are used in construction and installation, satisfactory service is likely.

Design of the building itself can have a profound effect on the performance of exterior doors. Doors which are recessed under a porch or overhang so they are not subjected to direct sunlight, rain or fog will have fewer problems than similar doors directly exposed to the elements. In extreme circumstances, a perfectly manufactured and finished door may fail solely because of exposure to a difficult environment.

Wood is an organic material which is not dimensionally stable. Changes in temperature and moisture content cause wood members to expand or contract in a non-uniform manner. Dimensional changes are greatest in the direction which is tangent to the growth rings, less in the direction which is perpendicular to the growth rings, and small (but not negligible) in the direction parallel with the grain. (Fig 1)

If trees were square, a board which absorbs or loses moisture evenly would swell or shrink in a predictable way, but would not warp. Because trees are round and boards are rectangular, a typical board will warp even if changes in moisture content are uniform throughout the piece. (Fig 2)

Woodworkers have developed strategies for dealing with the unstable nature of wood. These techniques can be roughly summarized as follows: Use small pieces, control moisture, allow for movement, limit movement. The traditional stile and rail wood door is an example of all these strategies.

In a stile and rail door, the overall dimensions of the door are controlled by parallel grain to the greatest extent possible. The vertical dimension is controlled by the stiles, which run through. In the horizontal direction, most of the width of the door is controlled by the rails, which are parallel to the grain. In a three-foot-wide door with five-inch stiles, 26 inches of the width of the door is parallel grain. (Fig 3)

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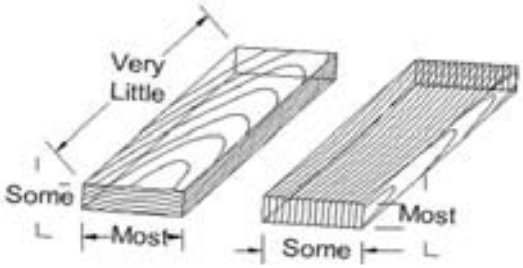
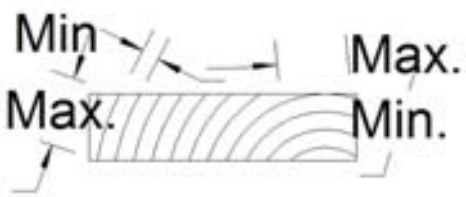


Figure 1



Estimated warpage of the board above with uniform loss of moisture.

Figure 2

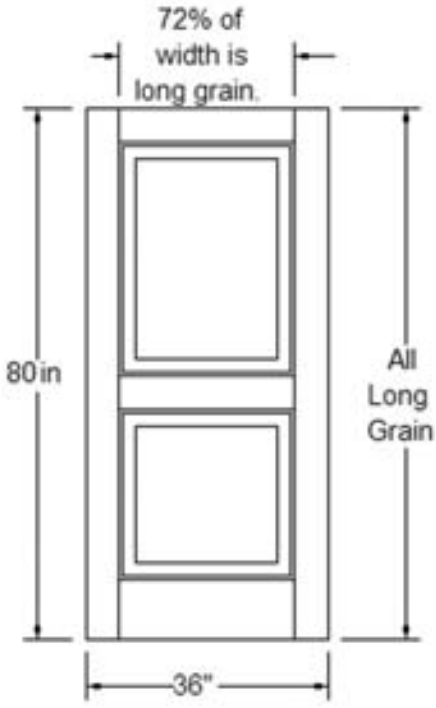


Figure 3

Finished door photos courtesy of The Maiman Company
Door construction photos courtesy of Architectural Millwork of Santa Barbara

GRAND ENTRANCE
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In the assembly of the structural portion (the stiles and rails) of the door, every available method is used to secure the members mechanically. Multiple dowels or wide tenons are used to attach stiles to rails. In addition, the traditional cope-and-stick assembly locks the rails to the stiles in a way that will resist warping in the rails.

Above and bottom right: This photo illustrates how the cope on the end of the cross-member fits the detail on the edge of the stile or rail.

In addition to mechanically resisting warping forces using the method above, the Woodwork Institute recommends that rails over seven inches wide (typically bottom rails) be glued for width from members three to four inches wide. The laminations in this member should have the grain reversed in adjoining pieces. (Fig 4)

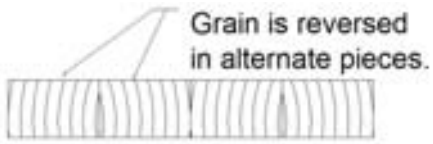
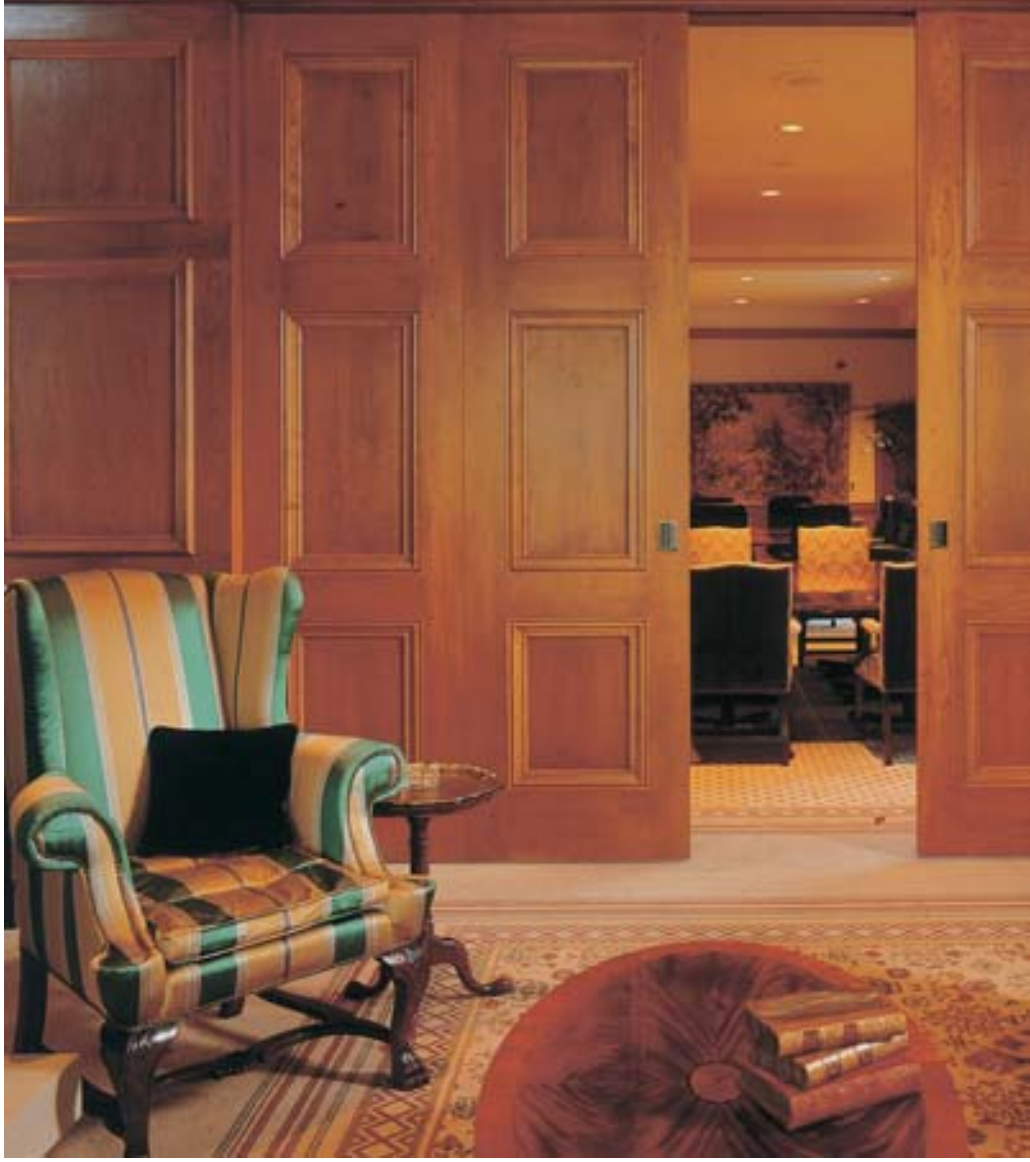


Figure 4



An alternative to traditional solid wood construction of stiles and rails is a composite veneered construction. Just as a composite panel will be more stable than solid wood construction, stiles and rails can be constructed around an engineered core. Edge bands must be thick enough to allow sticking where required. Edge bands at the outside edges of the door must also be wide enough to allow for fitting. The Woodwork Institute requires veneered construction for premium grade hardwood doors. It's important to note that while engineered cores are more predictable than solid lumber, they are not immune to changes in humidity and temperature.

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Having produced a framework that's as dimensionally stable as possible, an equal amount of care must be used in filling the door openings. The members that frame each opening run parallel to the grain. Consequently, the opening sizes are the most dimensionally stable elements of a door. It is essential that the attachment of the panel take into account any differences in stability between the panel and the opening.

Plywood or medium density fiberboard (MDF) at least 1/4-inch thick is recommended for flat panels. Face veneers for transparent finish should be the same species and cut as the stiles and rails. Panels must be installed in the openings so they float, allowing the panels to expand or contract independently of the door.

For raised panels with an opaque finish (paint), MDF is an excellent choice. For exterior doors, an exterior grade MDF must be used. For transparent finish, several construction methods are acceptable. Solid wood panels are as susceptible to warping as any other wide member. To minimize warping, the Woodwork Institute requires that panels be glued for width from alternating staves similar to the construction of wide rails.

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Above: Raised panels that are ready to install. Note the dowels hold the panels only at the center top and bottom. It's important these panels be allowed to move.

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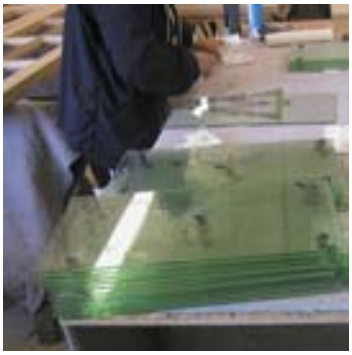
If the mismatched grain associated with stave construction is objectionable, several systems of veneered construction of panels are allowed by the *Manual of Millwork*. For example, the raise detail can be made as a separate molding and mitered around the edge of a plywood or MDF panel. A tongue and groove or spline detail with glue should be used to attach the molding to the panel. This assembly is then sanded and veneered to make either a three- or five-ply panel.



Above: Glass being prepared for installation in a French door.

Wood panels may be installed in the door at the time of assembly, eliminating the need for stops. To allow for breakage, glass panels must be installed with stops or glazing putty. Lights should fit loosely in the opening to allow for changes in the door. The glazing material must be an approved safety product, and each pane must be embedded in a quality elastic glazing sealant manufactured specifically for that purpose. The glass may be held in place with wood glazing beads, clips and glazing putty, or glazing gasket within a channel in the stiles and rails.

When glass or panels are held in place with moldings, it's recommended that doors be hung with the glass stop to the exterior. Wind can build significant pressure against the panes, and in the case of a wind-driven rain, hydraulic action can force the glass away from the sticking and cause leakage around the stops. If the door is hung with the molding to the outside, the pressure can only push the glass more solidly against the bedding material. This is also a good practice for wood panels that are stopped in on one side.

Proper finishing is essential to performance. Whether solid stock, veneer, or fiber, wood will absorb or lose moisture with changes in the environment. The primary purpose of finish is to slow this process, although no finishing system is perfectly impermeable. It's crucial that all surfaces of a door, including the top and bottom, all cutouts, and behind all hardware, be sealed with at least two coats of exterior paint or varnish. The Woodwork Institute recommends that water-based finishes not be used. It's recommended that both sides of the door receive the same treatment. If opposite sides of a door are to be finished differently, the two finishes should have similar characteristics and the same number of coats should be applied to each side. Because dark colors will absorb and radiate heat more efficiently, it's recommended that they not be used on exterior doors that will be exposed to direct sunlight.

In the next issue of *Archetype*, we'll examine slab doors and the issues surrounding their construction. ■