9
Wood Doors

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EXTERIOR DOORS

Wood doors are not recommended for exterior use. Most flush doors no longer have extended exterior use warranties and most have no warranty at all. Refer to manufacturers' written warranty for specifics.

Exterior doors shall be water repellent treated at the factory after manufacturing. Protect doors according to manufacturers' requirements, which may include flashing of top, bottom and cut outs.

Wood doors shall be protected from the sun and other weather elements by overhangs, deep recesses, etc.

Medium density overlay faced doors shall be used for severe exposure conditions.

All surfaces of exterior doors shall be primed with an exterior enamel primer, followed by a minimum of two additional coats of exterior enamel on all surfaces.

CODE and RULE REQUIREMENTS

The design professional shall be responsible for contract documents which clearly detail products which will comply with applicable codes and rules including, but not limited to, NFPA 80 requirements; ADA national and federal guidelines; local, state, and federal building codes; positive pressure requirements and labeling; glass or glazing; prefitting and/or machining for hardware; prehanging and/or machining for weatherstripping; priming, sealing and/or transparent finishing; and flashing and/or metal edge guards. The door manufacturer is often a valuable assistant in these matters.

Contract documents shall:

- Specify neutral pressure or positive pressure compliance.
- If positive pressure, specify the category of door: A or B assembly.
- Specify whether the smoke and draft label (S label) is validated or not.

FACE MATERIAL SELECTION

The panel face veneer standards of the Hardwood Plywood & Veneer Association HP-1, latest edition, is adopted as the minimum standard for face veneers.

Specifiers need to determine and specify the following:

VENEERS FOR TRANSPARENT FINISHES

SPECIES: There are numerous foreign and domestic species available. Involve your member woodworker early in the design and selection process.

MATCHING: Many different visual effects can be obtained by face veneer matching.

Appearance and layout of individual pieces of veneer

Matching between pieces (leaves) of veneer

Orientation of spliced veneer on a door face

Appearance of doors in pairs or sets

Appearance of doors with transoms

MATERIALS FOR OPAQUE FINISHES

Medium Density Overlay. This provides the optimum paintable surface for architectural doors. The resin saturated paper overlay is designed to paint well and provide an even sheen.

Close Grain Hardwood. Extra preparation will be required by the finisher as there will be grain show-through, open-appearing veneer joints, and other wood characteristics when using this product for a painted finish.

Mill Option. Face materials are determined by the manufacturer.

HIGH PRESSURE DECORATIVE LAMINATES (HPDL)

Virtually any high pressure decorative laminate color and texture can be used in the manufacture of architectural doors with the following cautions:

• High gloss and Vertical Grades of HPDL will highlight minor core and surface imperfections, often unacceptably.

• HPDL doors are not recommended for exterior use due to the potential differences in lineal expansion between the faces and wood components when exposed to the elements.

CORE CONSTRUCTION

The design professional or specification writer has the opportunity to select the door core type. In the absence of specification, particle core (PC) shall be furnished, complying with particleboard standard ANSI A208.1 Particleboard, Grade LD-1 or LD-2. If a specific grade of particleboard is desired, it must be specified. When not specified the manufacturer has the option to use either LD-1 or LD-2 particleboard as core material.

BASIC CORE TYPES

The five most common core types are particleboard core, stave lumber (glued block) core (SLC), structural composite lumber core (SCLC), hollow core, and fire-resistant door core.

Specify one, or a combination of, solid core, hollow core, or fire-resistant core, and acoustical, ballistic resistant, or lead lining when required. The requirements for each core type are illustrated in Section 9. In the absence of clear specifications, the core shall be the option of the manufacturer. Structural composite lumber (SCLC) may be specified in any Grade.

• When solid core is selected, specify one of the following: particleboard (PC), stave lumber (SLC), or structural composite lumber (SCLC). When the weight of the door is a design factor, consult the door manufacturer to determine the differences between PC, SLC, and SCLC core types.

• When hollow core, specify the honeycomb, with the minimum cell size required, grid core, or ladder construction.

• When fire-resistant core is required beyond the 20-minute label level, consult your door manufacturer for code-compliant core types, blocking options, metal edges, cut outs, and astragals.

NOTE: This standard recommends limiting the use of structural composite lumber (SCLC) to interior applications. The use of

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structural composite lumber (SCLC) for top and/or bottom rails, and blocking is acceptable. SCLC is proving to have excellent performance characteristics as a replacement for stave core, as it often minimizes or eliminates telegraphing of the lumber blocks through the face veneers or overlays. When the edge of an SCL-core door will be visible after installation, design professionals may wish to specify a fill-and-paint treatment, or the application of a veneer edgeband to conceal the coarse texture of the edge of the SCL material. It is the responsibility of the design professional to make a selection in the best interests of the client.

Special Core Types

Special cores for X-ray doors, acoustical doors, electrostatic shield doors, ballistic resistant, and others are available. Consult your door manufacturer for information.

CORE TO EDGE ASSEMBLY

These standards provide for multiple types of assembly between the core and the vertical and horizontal edges in solid core doors:

PC, SCLC, SLC or FD: Stiles and rails securely glued to core, abrasively planed flat prior to application of faces.

FPC, FSCLC or FSLC: Stiles and rails not bonded to core prior to application of faces.

IHC or SHC: Stiles and rails placed around hollow core inserts.

FIRE RATINGS

The Model Codes have established a fire door rating and operating classification system for use in protecting door openings in fire-resistive-rated wall constructions. All fire doors must meet certain requirements and bear certifying labels of an independent testing agency approved by the building official. The type of fire-rating (Positive Pressure or Neutral Pressure), and the label required (20, 45, 60 or 90 minute), must be specified. If Positive Pressure is required, the Category of door and validation of the Smoke and Draft Control Label shall be specified and all appropriate fire and smoke gaskets shall be added to the hardware schedule by the design professional.

CRITICAL NOTE and WARNING:

The status of fire-resistant doors and openings is in the process of change. The design professional shall contact the architectural hardware consultant to verify that the total opening complies with both international and local code requirements before finalizing the specification for fire-rated doors, hardware, and openings.

SPECIAL FUNCTION DOORS

Sound retardant (acoustical), lead lined (X-ray), ballistic resistant, and electrostatic shield doors are manufactured by some companies to meet these special needs. Refer to manufacturer's literature for details.

Transom panels and special function doors are available and should be specified carefully, with particular attention to the meeting edge details, operational functions and accessories, and veneer match options. In the absence of clear and complete specifications, fabrication details will be at the option of the manufacturer.

DOOR SELECTION and PERFORMANCE CRITERIA

Manufacturers have relied on the natural strength of hardwood lumber and veneer to assure long term performance. The construction minimums required in previous editions of our standards have proved to have superior performance over the long term. Two things have occurred to require a closer look at the performance properties of door parts and incorporate some minimum physical property requirements to all door grades.

Many new engineered wood products are now replacing traditional hardwood to reduce cost and improve production efficiency. Some of these are as good or better than natural hardwood. However, the risk of look-alike and substandard products that do not perform as well is great. Some have no grain direction, increasing the chance of failure due to excessive linear expansion. Some have less than sufficient strength properties.

The materials and construction methods used determine how well a door will resist high use and abuse. With the introduction of materials that are not the traditional hardwood lumber and veneer, this becomes more important. Wood products, whether natural or engineered, have a wide range of strength characteristics.

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APPEARANCE OF INDIVIDUAL PIECES OF VENEER

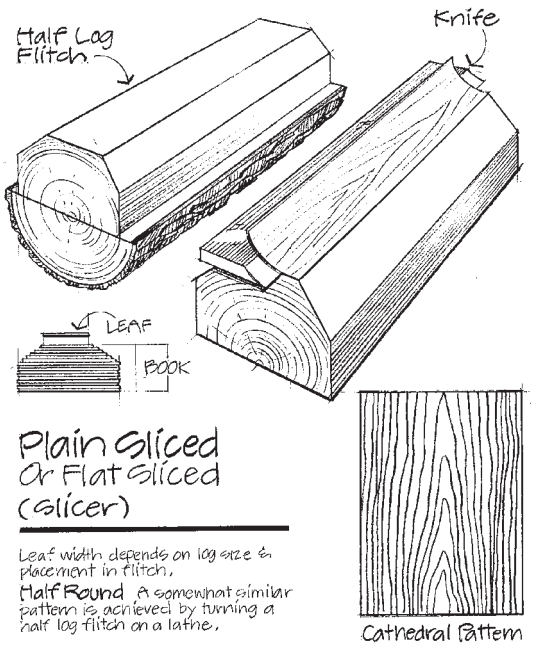
VENEER CUTS

The way in which a log is cut in relation to the annual rings determines the appearance of veneer. The beauty of veneer is in the natural variations of texture, grain, figure, color, and the way it is assembled on a door face.

Faces will have the natural variations in grain inherent in the species and cut. Natural variations of veneer grain and pattern will vary from these illustrations.

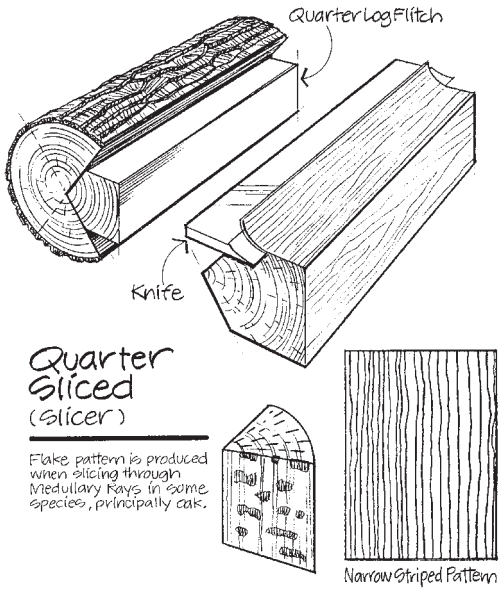
These are representative drawings of real wood veneers. Involve your woodworker early in the design and selection process.

Flat Cut (Plain Sliced)



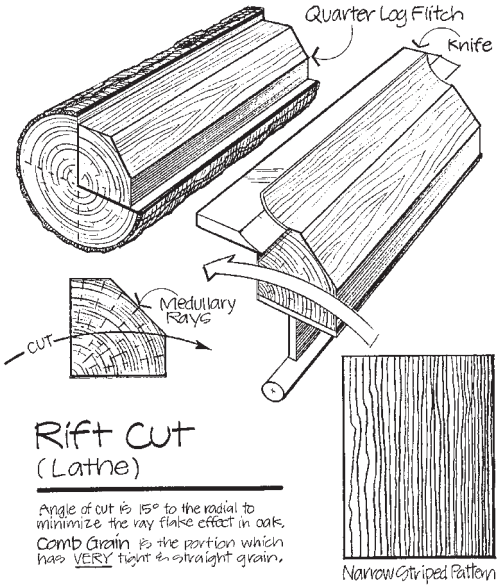
Slicing is done parallel to a line through the center of the log. Cathedral and straight grained patterns result. The individual pieces of veneer are kept in the order they are sliced, permitting a natural grain progression when assembled as veneer faces.

Quarter Cut



A series of stripes is produced. These stripes vary in width from species to species. A natural distribution of ray fleck (flake), is a characteristic of this cut in Red Oak and White Oak.

Rift Cut



The cut slices slightly across the medullary rays, accentuating the vertical grain and minimizing the "fleck." Rift grain is restricted to Red Oak and White Oak.

Comb Grain

Limited availability. This is a rift cut veneer distinguished by the tightness and straightness of the grain along the entire length of the veneer. Slight angle in the grain is allowed. Comb grain is restricted to Red Oak and White Oak. There are occasional cross bars and fleck is minimal.

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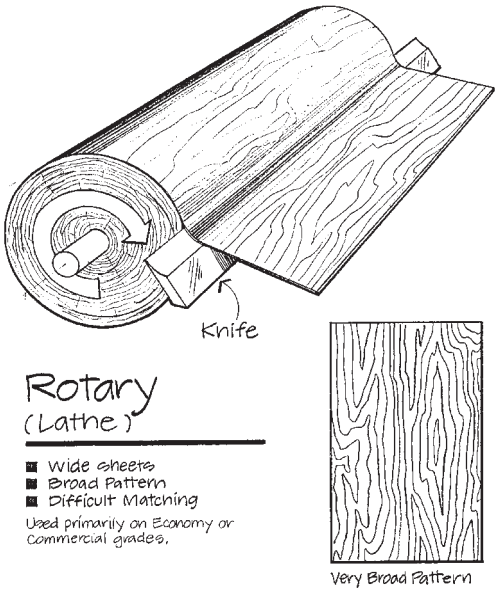
Rotary



This cut follows the log's annual growth rings, providing a generally bold random appearance.

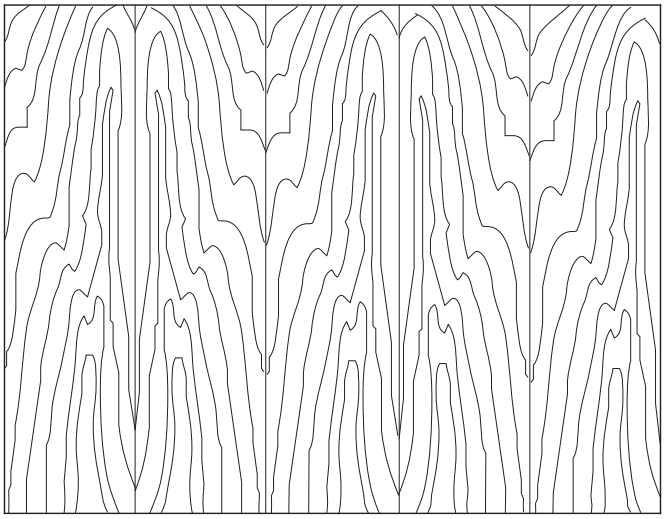
MATCHING BETWEEN INDIVIDUAL PIECES OF VENEER

Leaf Matching

The way in which the individual cuts are placed next to each other during the fabrication of the veneer face is the next factor affecting the appearance of the doors. The type of match at the joint line must be specified.

Natural variations in the leaves and the progression of the grain pattern across the face are the hallmarks of real wood doors.

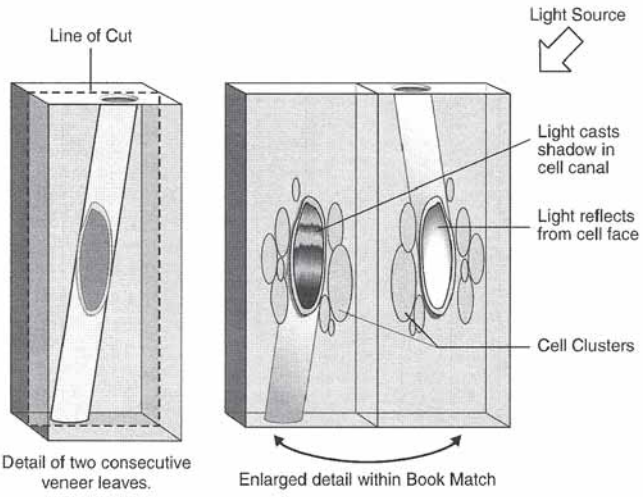
Book Match



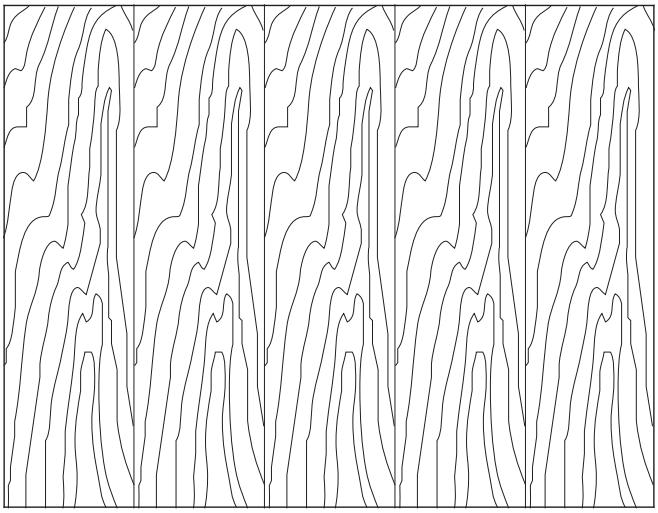
This is the most commonly used match in the industry. Every other piece of veneer is turned over so adjacent pieces are opened like two adjacent pages in a book. The veneer joints match and create a mirrored image pattern at the joint line, yielding a maximum continuity of grain. Book matching is used with plain sliced, and less often with other cuts of veneers.

Barber Pole Effect in Book Match

Because the "tight" and "loose" faces alternate in adjacent pieces of veneer, they may accept stain differently, and this may result in a noticeable color variation. Book matching also accentuates cell polarization, causing the perception of different colors. These natural characteristics are often called barber pole, and are not a manufacturing defect. It is possible, in some instances, to minimize this effect with special finishing techniques.



Slip Match



Adjoining pieces of veneer are placed in sequence without turning over every other piece. The grain figure repeats, but joints won't show mirrored effect. Slip matching is often used in quarter cut, rift cut, and comb grain veneers to minimize the barber pole effect.

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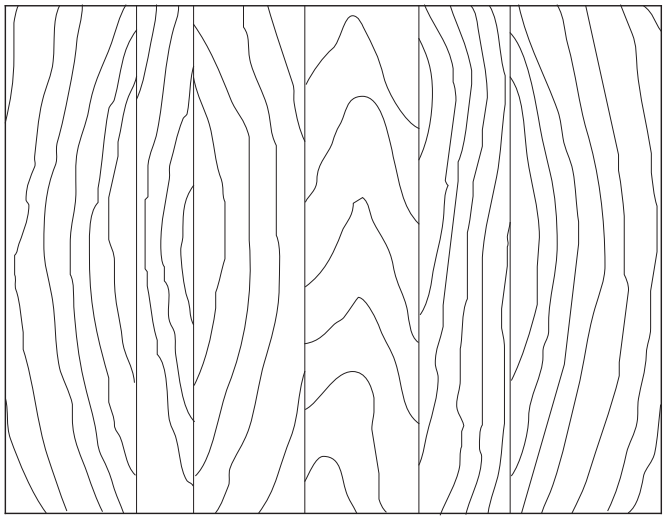
Random Match

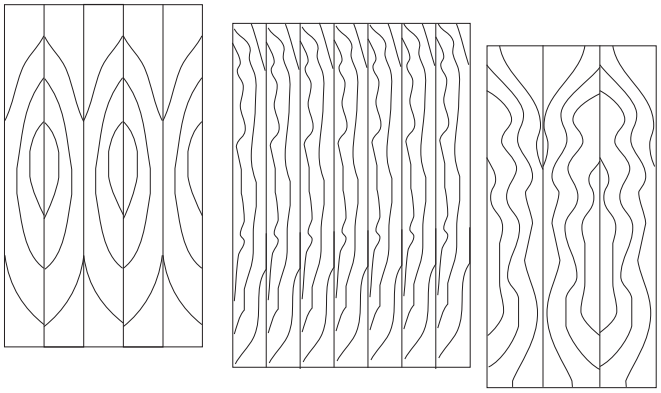


A random selection of individual pieces of veneer from one or more logs. Produces a “board-like” appearance.

ASSEMBLY OF SPLICED VENEER ON A FACE

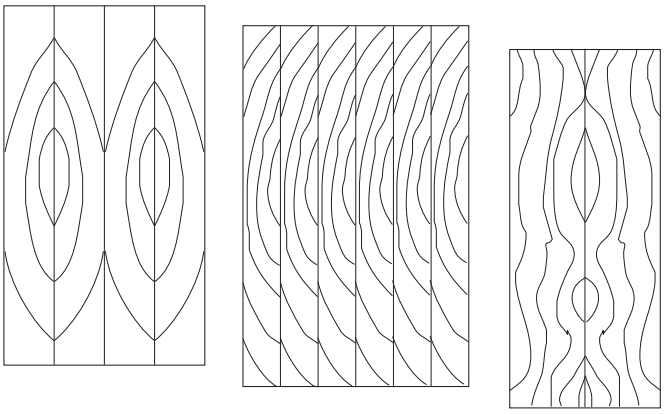
The type of “assembly match” must be specified to obtain a desired appearance. Any sequence matching from opening to opening must be specified. The following three face assembly methods give a wide range of flexibility and cost control to the design professional.

Balance Match



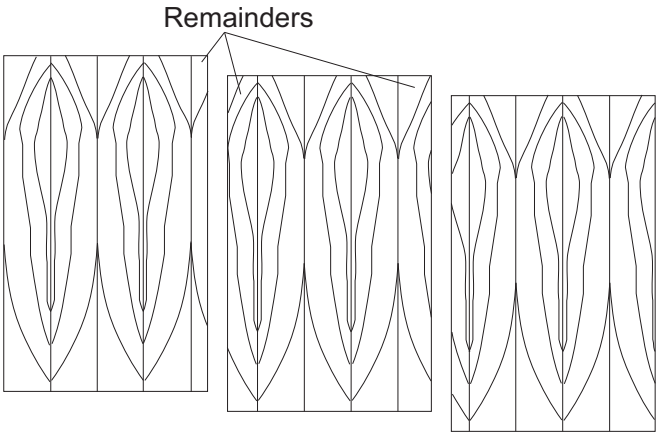
Symmetrical appearance. Each face is assembled from an even or odd number of pieces of uniform width before trimming. This match reduces veneer yield.

Center Balance Match



Symmetrical appearance. Each face is assembled from an even number of veneer pieces of uniform width before trimming. Thus, there is a veneer joint in the center of the panel. This match further reduces veneer yield.

Running Match



Nonsymmetrical appearance on any single door face. Veneer pieces of unequal width are common. Each face is assembled from as many veneer pieces as necessary.

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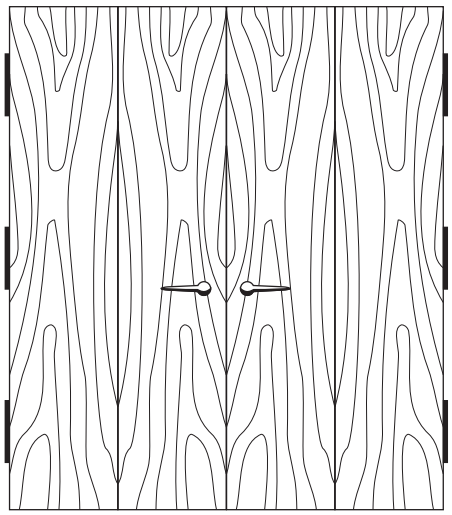
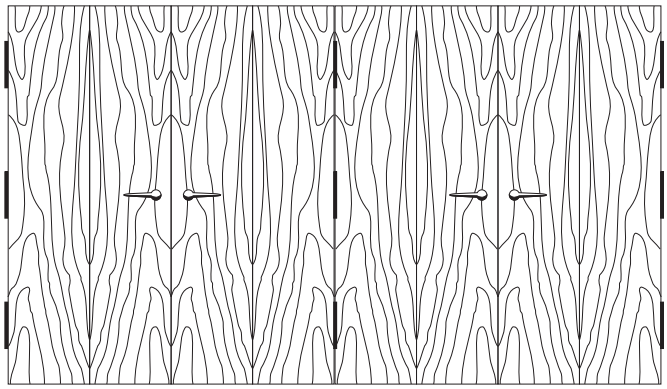
DOORS IN PAIRS OR SETS

Pair Match



Doors hung in adjacent sets or in close proximity may be (and in some Grades, must be), specified as pair matched where appropriate. Note to specifiers: The illustration shows book-matched, center balance matched faces. The *AWS* does not require this condition.

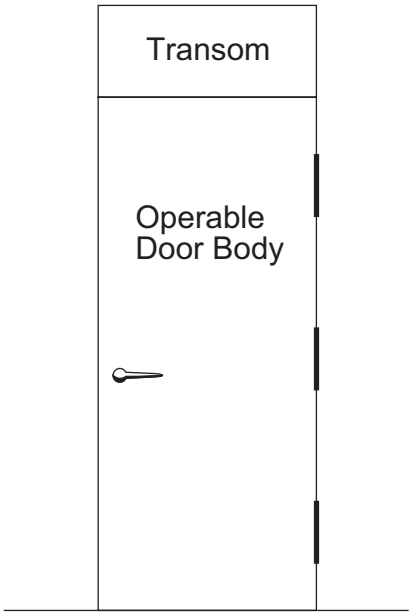
Set Match



Doors hung in adjacent sets may be (and in some Grades, must be), specified as set matched where appropriate.

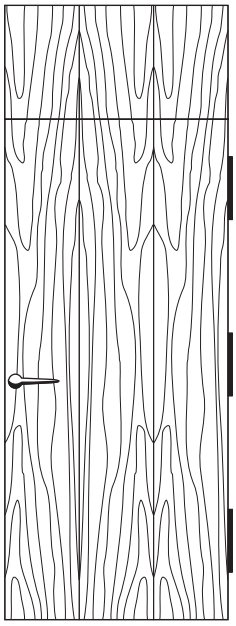
Note to specifiers: The illustration shows book-matched, center balance matched faces. The *AWS* does not require this condition.

Doors with Transoms



The use of the transom increases the apparent height of the wood door and often enhances the appearance of the opening. The type of match should be specified, and a slight misalignment of veneer grain may occur between the transom and the door. Industry practice allows a variation in grain alignment from side to side of 3/8” (9.5 mm) on a single door, and 1/2” (12.7 mm) on pairs of doors with a single transom. Tighter tolerances must be specified as a part of Premium Grade doors.

Continuous Match



Provides optimum veneer utilization as each single piece of veneer extends from the top of the transom to the bottom of the door. Available veneer length in the species may limit this option.

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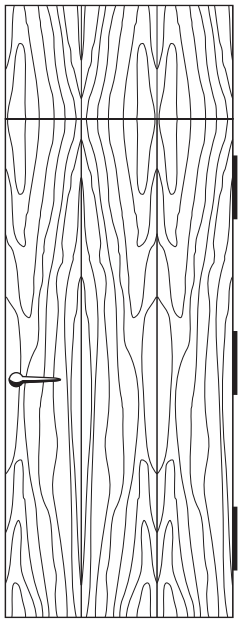
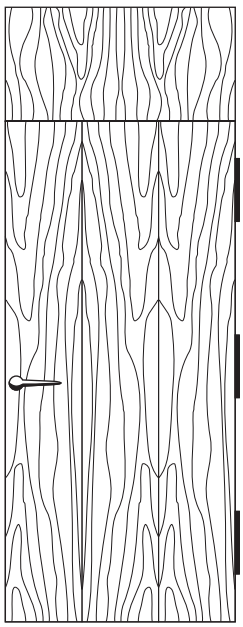
End Match



A single piece of veneer extends from the bottom to the top of the door with a mirror image at the transom.

No Match



Alignment Criteria

Grain pattern alignment between the door and transom, even when cut from the same panel, will vary to some extent. This is due to the natural progression of the annual rings which create the figure in the wood. Misalignment will be more apparent in doors veneered with open grain species than with close grain.

Misalignment of up to 3/8" (9 mm) is permitted in every Grade.

Hardwood Veneer Face Grade Summary

Read Section 4 for the complete description of veneer face grades.

NOTE: When veneers are specified as "natural," they may contain any amount or combination of sapwood and heartwood, with the resultant contrast in color in many species.

The industry recognizes that cost is an important factor, and having lower veneer standards can result in some savings. Specifying *Architectural Woodwork Standards* Custom Grade meets that need. However, when doors are a part of an overall design scheme and/or are adjacent to other fine architectural woodwork specified under these standards, the level of quality of those doors must be consistent with other millwork components.

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Construction Details

General Moulding Requirements

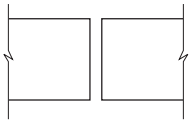
Species shall match or be compatible with face veneer or laminate.

Specify transparent or opaque finish.

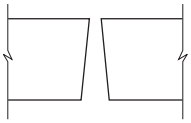
Moulding shall be free of open defects, shake, splits, or doze.

Moulding must be smooth and free of visible knife, saw, or sanding marks. Specify from following options:

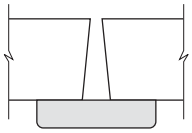
MEETING EDGE OPTIONS



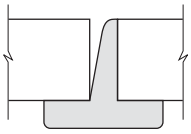
No bevel



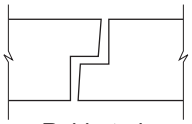
Bevel



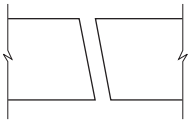
Flat astragal



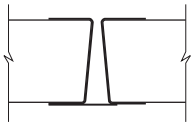
Tee astragal



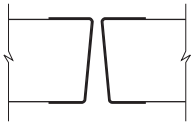
Rabbeted



Parallel bevel
Double egress

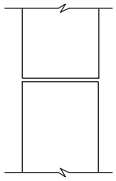


Metal edge guards
and astragal

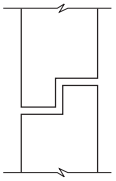


Metal edge guards

TRANSOM MEETING EDGE OPTIONS

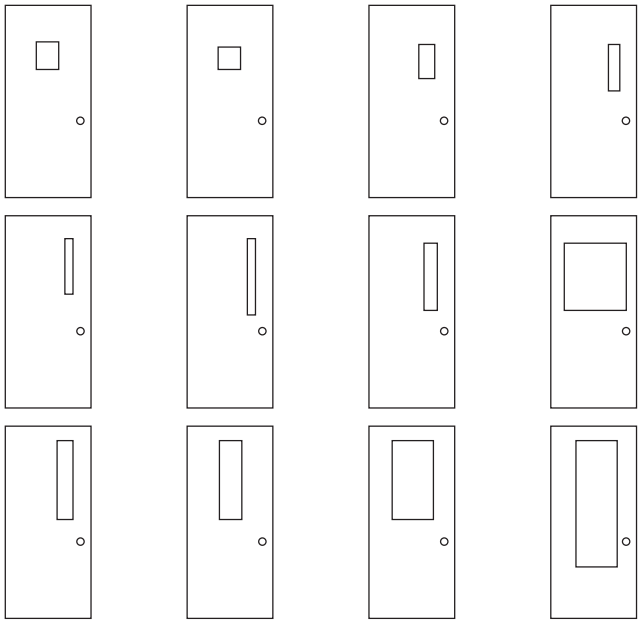


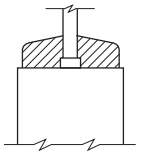
Non-rabbeted

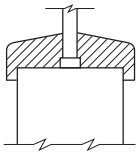


Rabbeted

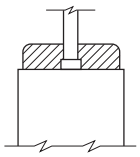
Glazing Options

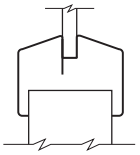






Lip Moulding





Flush Mouldings

Metal vision frame

W = Wood mouldings

M = Metal vision frames

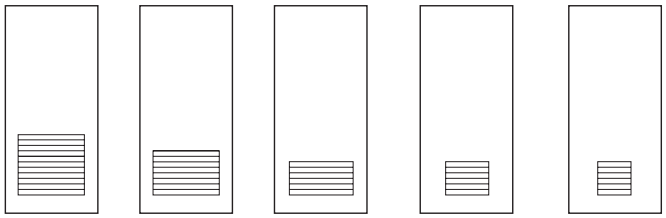
All cutouts for metal or wood vision panels must be a minimum of 6” (152 mm) from the edge of the door and/or other cutouts for louvers, locks, closers, or other hardware for 45-minute though 90-minute doors. 20-minute PC and SLC doors must be a minimum of 5” (127 mm) [5”], and 20 minute SCLC doors must be a minimum of 1-1/2” (38 mm).

These distances must be maintained or the fire label and warranty will be voided.

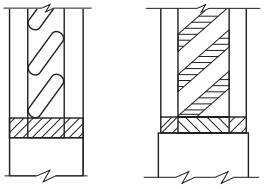
Using a 10” (254 mm) margin between the edge of the door and the edge of any cutout near the lock area will eliminate most label and warranty conflicts.

9 - Wood Doors

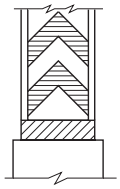
Louver Options



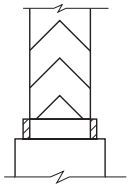
Variety of sizes



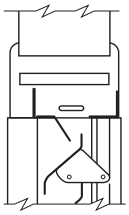
Wood slats



Wood chevrons



Metal chevrons



Fusible link

WL = Wood louver. Not allowed by NFPA 80 in fire-rated doors.

FL = Fusible link louver.

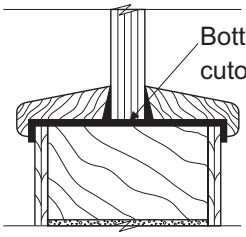
Not allowed by NFPA 80 in means-of-egress fire doors. Generally, fusible link louvers installed in 45, 60, and 90 minute fire-rated doors must comply with individual fire door authorities and ADA requirements.

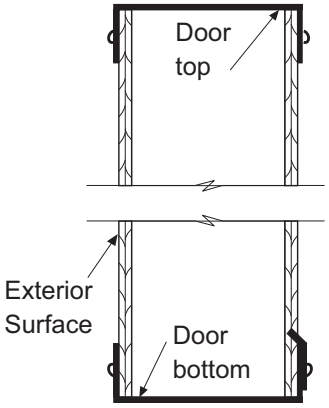
All fusible link louvers must be minimum 8” (203 mm) from the bottom of the door to the bottom of the louver cutout, and 6” (152 mm) from the edge of the louver cutout to the edge of the door and/or other cutouts for vision panels, locks, closers, or other hardware.

These minimum dimensions must be maintained or the fire rating label and warranty will be voided.

Sizes and details other than those illustrated are available.

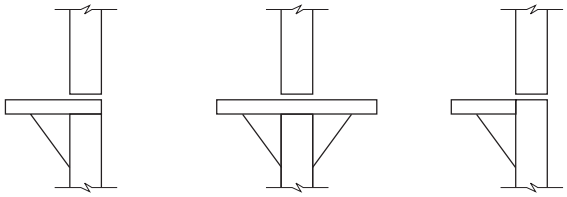
Flashings



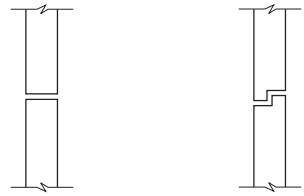


If the woodworker is to flash the top of the door or the bottom edge of cutouts for exterior doors, it must be specified.

Dutch Door Options



One sideshelf Two sideshelf 20-Min. shelf

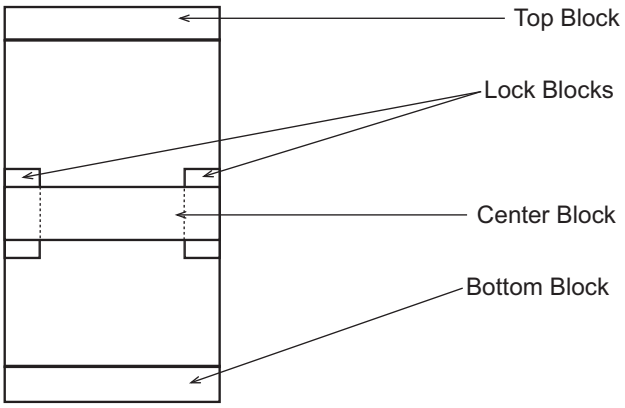


No shelf Rabbeted meeting rails

9 - Wood Doors

Blocking Options (Particle Core and Fire-Resistant Core)

For undercutting flexibility and specialized hardware applications, a number of internal blocking options are available from most manufacturers. Among them are such options as 5" (127 mm) top rail, 5" (127 mm) bottom rail, 5" x 18" (127 x 457 mm) lock blocks (may be one side only), 2-1/2" (64 mm) cross blocking. Other options may be available. Consult your manufacturer early in the design process to determine availability.



Dimensional Tolerances

NOTE: These dimensions given as typical industry tolerances.

The dimensions usually apply in the absence of specifications.

Doors Not Prefit

- Width, Height, Thickness: ± 1/16" (1.6 mm)
- Out of Square: max. 1/8" (3.2 mm) measured from corner to corner on the diagonal

Doors Machined for Hardware

- Width: ± 1/32" (0.8 mm)
- Height: ± 1/16" (1.6 mm)
- Thickness: ± 1/16" (1.6 mm)
- Hardware location: ± 1/32" (0.8 mm)
- Locks and hinges: ± 1/32" (0.8 mm)

Typical Prefit Clearances

- Top and hinge edges: 1/8" (3.2 mm)
- Single door, lock edge: 1/8" (3.2 mm)
- Pair meeting edge: 1/16" (1.6 mm) per leaf
- Bottom (rated or nonrated): 1/2" (13 mm) from top of decorative floor covering; 3/4" (19 mm) maximum from top of non-combustible floor; 3/8" (10 mm) maximum from top of non-combustible sill or threshold.

Sample Submission

Woodwork manufacturers will provide standard colors for selection.

To specify nonstandard colors and sheens, the architect shall provide two or more samples at least 8" x 10" (200 x 250 mm) showing the desired finish effect on the wood species and cut to be used.

Samples are to bear identification of the project, architect, general contractor, and door supplier. The manufacturer may elect to submit samples in sets of two or more, illustrating the possible range of variations. The finished sample sets then become the final criteria for evaluating color and finish appearance conformity. However, variations can be expected due to the nature of wood.

Sample Protection

Approved samples must be protected from the effect of light. Cover faces and place samples in closed storage during the period between approval and fabrication, finishing, and delivery of the finished product.

Care and Installation at Job Site

In the absence of specific requirements from the door manufacturer, the criteria shall prevail.

Storing

- Store at least 4" (101.6 mm) off floor, flat on a level surface in a clean, dry, well-ventilated area protected from sunlight, wide swings in relative humidity, and abnormal heat or cold. Relative humidity should not be less than 25% or more than 55%.
- Store doors in closed-in building with operational HVAC system.
- Cover doors to keep clean, but allow air circulation.
- Seal at earliest possible moment. Edge sealing is particularly important.
- Lift or carry door. Do not drag one door against another.
- Handle doors with clean hands or clean gloves.

Installation

- Allow doors to become acclimated to finished building heat and humidity before fitting and hanging.
- Utility or strength of doors must not be impaired by fitting to the opening, applying hardware, plant-ons, louvers, or other detailing.
- In fitting for width, trim equally from both sides.
- In fitting for height, do not trim top or bottom edge more than 3/4" (19 mm), unless accommodated by additional blocking.
- Threaded-to-the-head wood screws are preferable for fastening all hardware on nonrated doors and required on all rated doors. Pilot holes must be drilled for all screws to avoid splitting.
- Use two hinges for doors up to 60" (1524 mm) in height, three hinges for doors up to 90" (2286 mm) in height, and an additional hinge for every additional 30" (762 mm) of door height or portion thereof.
- Light or louver cuts in exterior doors must be treated or flashed to prevent moisture from entering the door core.

9 - Wood Doors

Fire Door Requirements

Install doors as required by NFPA Pamphlet 80.

All 45-, 60-, and 90-minute rated doors may be hung with either half surface or full mortise hinges. Core reinforcements (blocking) can be specified to permit hardware to be surface mounted with screws. Labels shall not be removed from fire-rated doors.

Preparation of Labeled Door

Preparation of 20-, 45-, 60-, and 90-minute rated doors must be done under label service in accordance with the manufacturer's service procedure. This includes trimming for size except a maximum of 3/4" (19 mm) off the bottom of the door. Preparation of locks, latches, hinges, closers, lights, louvers, astragals, and any fabrication must be done under licensed label service. Refer to NFPA 80, Standards for Fire Doors and Fire Windows for requirements and exceptions.

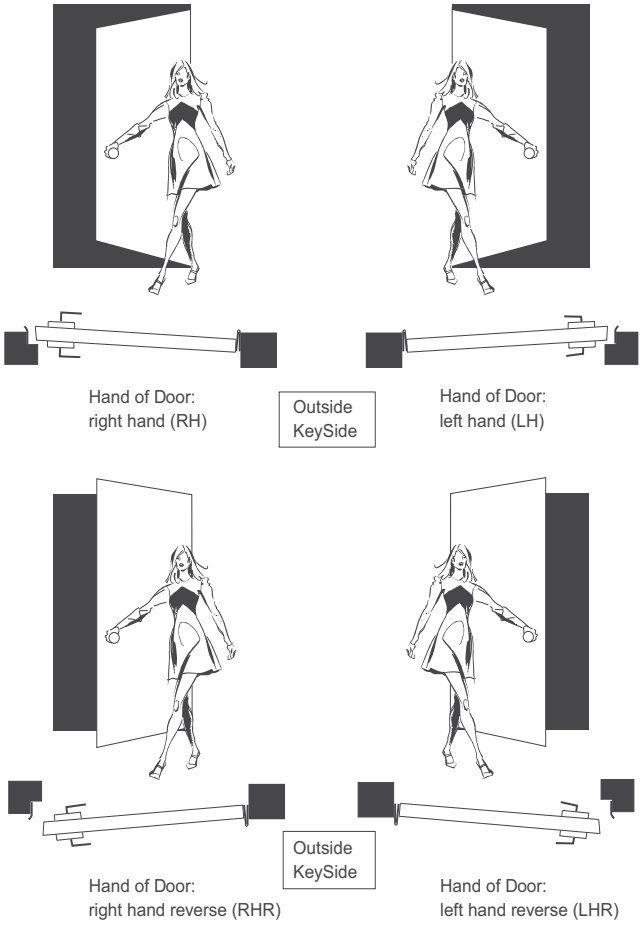
Fire-Retardant Salts

The edge and crossbands of some rated doors contain salts which attract moisture. When exposed to high humidity, they appear on the surfaces as white crystals. Clear finishes will highlight these crystals. Remove the crystals by light sanding after the doors are thoroughly dried. If the crystal build-up is heavy, clean with a damp sponge and allow to dry before sanding. At that point, seal and refinish. Avoid the use of steel wool on fire-rated wood doors.

Hand and Bevel of Doors

The "hand" of a door is always determined from the outside. The outside of an exterior door is the street or entrance (key) side. The outside of an interior room or auditorium door is the corridor or hall (key or imaginary key) side. The outside of a closet door is the side opposite the closet; the room, corridor or hall side. The outside of a single communicating door is the side from which the butts are invisible when the door is closed. The outside of twin communicating doors is the space between the two doors.

Standard-handed doors push away from the person standing on the outside/key side. Reverse-handed doors pull toward the person standing on the outside/key side.



Door Symbols and Abbreviations

Door style descriptors were assigned in previous editions to facilitate specifying. They were found to be more confusing than helpful. They have been discontinued. The following short list of abbreviations applies to some door companies:

ME = Matching edges; i.e., vertical edges same as decorative faces.

CE = Compatible edges; i.e., vertical edges selected for compatibility with decorative faces.

PC = Particleboard core, solid core door with stiles and rails bonded to the core and abrasive planed flat prior to the application of the faces.

PC-5 = Core with 2 layers on each side

PC-7 = Core with 3 layers on each side

PC-HPDL-3 = Core with laminate to each side

PC-HPDL-5 = Core with crossband and laminate each side

SCLC = Structural composite lumber core, solid core door with stiles and rails bonded to the core and abrasive planed flat prior to the application of the faces.

SCLC-5 = Core with 2 layers on each side

SCLC-7 = Core with 3 layers on each side

9 - Wood Doors

SCLC-HPDL-5 = Core with crossband and laminate each side

SLC = Staved lumber core, solid core door with stiles and rails bonded to the core and abrasive planed flat prior to the application of the faces.

SLC-5 = Core with 2 layers on each side

SLC-7 = Core with 3 layers on each side

SLC-HPDL-5 = Core with crossband and laminate each side

FPC = Floating particleboard core, solid core placed within a stile and rail frame, bonded together by the faces.

FPC-5 = Core with 2 layers on each side

FPC-7 = Core with 3 layers on each side

FSLC = Floating staved lumber core, solid core placed within a stile and rail frame, bonded together by the faces.

FSLC-7 = Core with 3 layers on each side

FD = Fire-resistant core, fire-resistant materials assembled to stiles and rails according to methods prescribed by the testing agency to meet rigorous smoke, flame, and pressure tests.

Labeled fire doors are specified by their resistance ratings.

FD-5 = Core with 2 layers on each side

FD-7 = Core with 3 layers on each side

FD-HPDL-3 = Core with laminate to each side

FD-HPDL-5 = Core with crossband and laminate each side

IHC-7 = Institutional hollow core, honey comb, ladder, or grid type cores inside stiles and rails, bonded together by the faces.

SHC-7 = Standard hollow core, honey comb, ladder, or grid type cores inside stiles and rails, bonded together by the faces.

SR = Sound retardant doors, specified by their performance characteristics.

LL = Lead lined doors, designed to resist penetration by radiation of various types, and specified by their performance.

ES = Electrostatic shielded doors.

BR = Ballistic resistant doors.

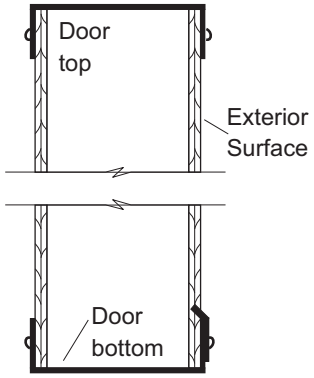
NOTE: Your door manufacturer is the best source of specific guidance when writing door specifications.

Exterior Doors

Careful consideration must precede specification of wood doors for exterior use. The selection of a wood species suited for exterior exposure is critical. Exterior doors shall be water repellent treated at the factory after manufacturing. Protect doors according to manufacturers' requirements, which may include flashing of top, bottom and cut outs. Exterior doors shall be properly sealed immediately after sizing and machining for fit in the field. Wood doors shall be protected from the sun and other weather elements by overhangs, deep recesses, etc. While wood stile and rail entry doors have performed well for centuries, the selection of a wood door places a burden on the owner to maintain the door be keeping it painted or sealed, protected from moisture, and properly adjusted in the opening.

Some door companies limit their warranties on exterior doors; some will provide no warranty.

Flashing



If the woodworker is to flash the top of the door or the bottom edge of cutouts for exterior doors, it must be specified.

Fire Ratings (when specified)

The traditional model codes have established a fire door rating and operating classification system for use in protecting door openings in fire-resistive-rated wall constructions. All fire doors must meet the requirements of current codes and bear certifying labels of an independent testing agency approved by the building official.

Code and Rule Requirements

The design professional shall be responsible for contract documents which clearly detail products which will comply with applicable codes and rules including, but not limited to, NFPA 80 requirements; ADA national and federal guidelines; local, state, and federal building codes; positive pressure requirements and labeling; glass or glazing; prefitting and/or machining for hardware; prehanging and/or machining for weatherstripping; priming, sealing and/or transparent finishing; and flashing and/or metal edge guards. The door manufacturer is often a valuable assistant in these matters.

Factory Finishing (when specified)

Firms differ in the variety of factory finishes offered. Some finishes may not be available from all manufacturers.

Finishes protect wood from moisture, handling, or harsh chemicals. The sooner moisture is restricted from entering or leaving, the longer wood lasts and the finer it looks.

Transparent finishes without stain provide a protective coating for the wood, maintaining its natural look. Transparent finishes with stain provide the architect or designer an opportunity to create a striking visual effect by modifying color, texture, and sheen.

Finishing Options

Section 5 of the *AWS* defines the finishing systems and performance characteristics.

Note: Carefully study Section 5, and consult with your woodworker early in the design phase can result in both high quality and cost savings.

Factory finishing is generally specified when a project requires high quality performance and superior appearance.

9 - Wood Doors

Factory finishing offers many benefits, including:

- State-of-the-art equipment in a well-lighted, dust-free environment (conditions normally not available in the field), which provides uniform color, texture, and sheen.
- Proper sanding prior to the application of stains and finishes. Field conditions often hinder surface preparation resulting in a lack of clarity and uniformity in finish and color.
- Protection from unfavorable relative humidity conditions at the earliest possible time.
- Cost savings (in most cases) over the total cost of field-applied finishes by a separate contractor.
- Shorter installation time on the job site, resulting in faster project completion.

Stile and Rail Door Construction Details

Stiles

Stiles are the vertical outside members. They may be solid wood or veneered. Stiles usually have solid sticking (solid stuck, solid moulded). Sticking is usually of two profiles: “cove and bead” or “ovolo.” Other profiles may be used. The stiles are ploughed or grooved along the edge to receive the panels, rails, and/or glass. If the door is to be assembled by dowelled construction, the stiles are bored to receive the dowels. If the door is to be assembled by lag screw construction, the stiles shall be solid hardwood lumber. The stiles will contain much of the hardware for the door, and must be sized and fabricated to fit the intended hardware, locks, and latches.

Rails

Rails are the cross or horizontal members of the door. They may be solid wood or veneered. Rails are coped on both ends to fit the sticking of the stile. Tenons or dowels are machined into the rails to fit mortises or dowel boring in the stiles.

The top and bottom rails are required, with the addition of intermediate cross rails or lock rails as appropriate. The bottom rail is usually the widest of the members, made of edge glued lumber or veneered, depending on the door construction. The top rail is often the same face dimension as the stiles.

The lock rail, if there is one, is usually a wide member located at lock height. In the case of narrow stiles or large hardware, this rail serves to house the lock and latch mechanisms.

Mullions

The mullion is an upright or vertical member between panels. It is similar to a cross rail in the way it is fit and machined.

Panels

The door panels are either solid lumber or panel products that fill the frame formed by the stiles, rails, and mullions. When the figure of the wood is visible in the finished product, the grain direction of the panels usually runs along their longest dimension; vertical for tall panels and horizontal for wide (or laying) panels.

Muntins and Bars

Stile and rail door with glass panels often utilize muntins and bars, which are smaller in section than mullions. A bar is a rabbeted moulding, which extends the total height or width of the glass opening. A muntin is a short bar, either horizontal or vertical, extending from a full bar to a stile, rail, or another bar. Muntins and bars are traditionally coped and mortised joinery.

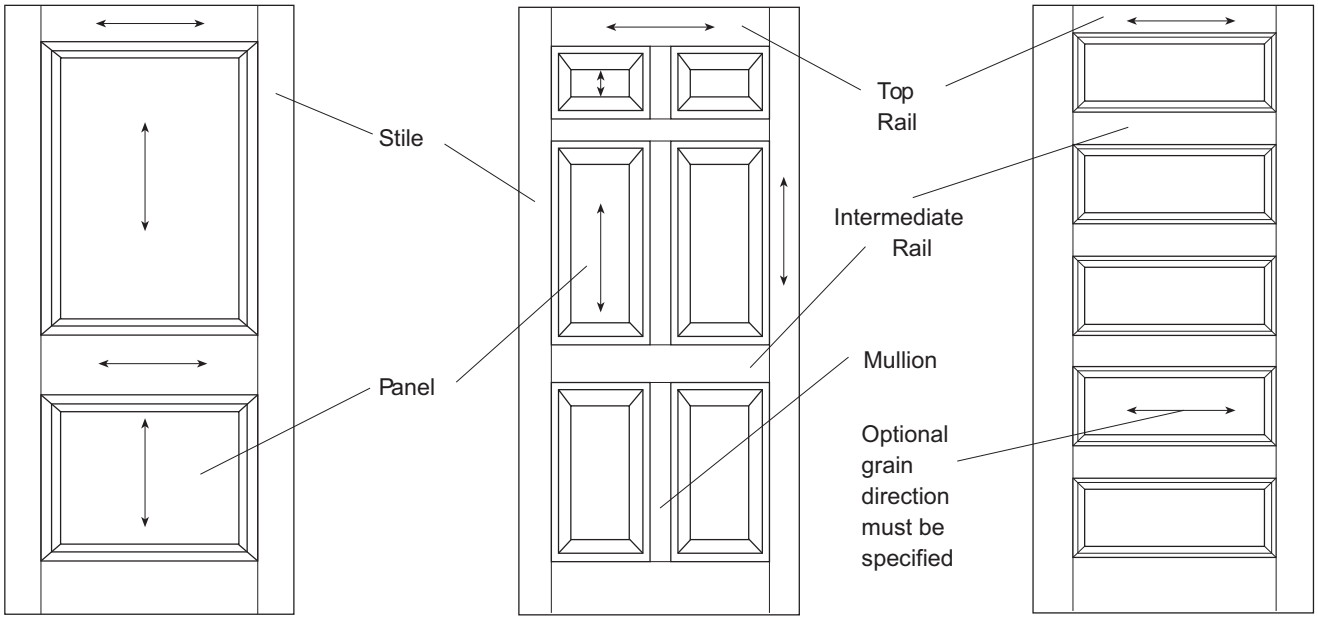
Custom-designed stile and rail doors offer many opportunities for creativity and choice. Some of the variables include:

- Panel layout
- Grain patterns and relationships
- Stile and rail construction
- Moulding details
- Panel construction
- Joinery techniques

Selection among these variables requires some knowledge of their relative performance characteristics. The following drawings illustrate some of the options. Many woodworkers feel veneered and laminated constructions offer the lowest risk of warp for most species of wood. Consult your woodworker early in the design process for assistance in making selections.

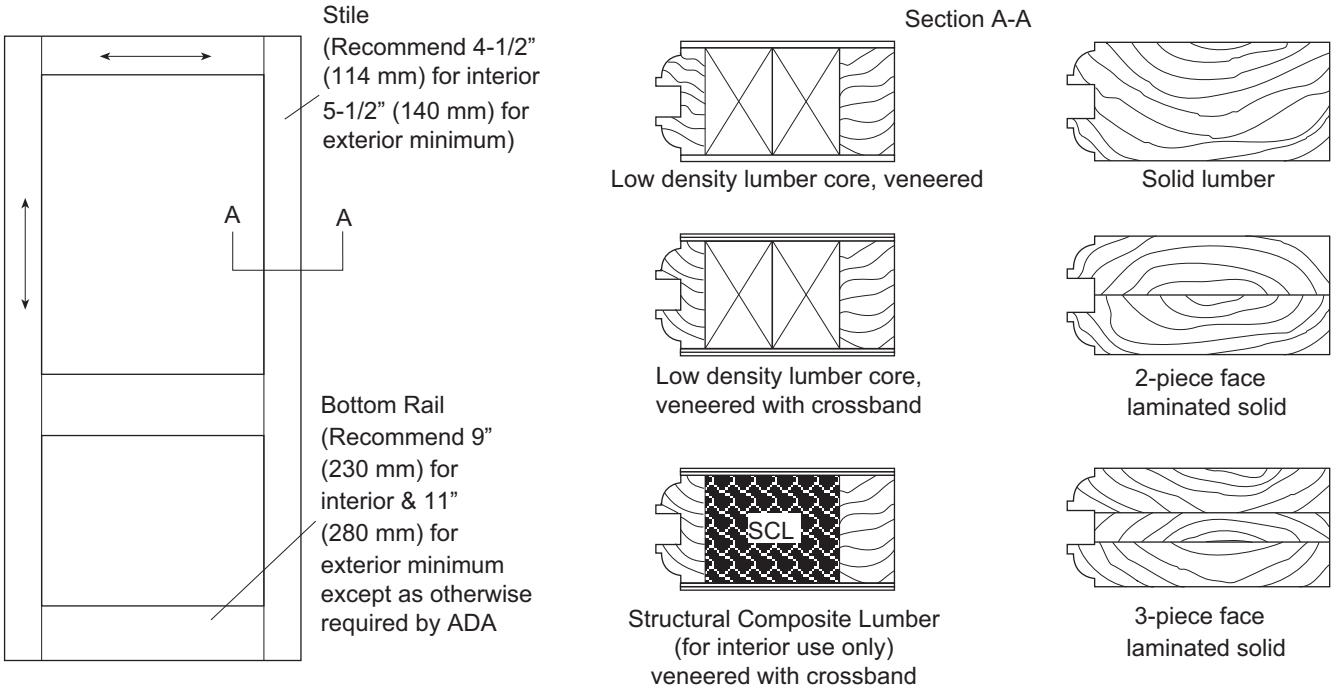
9 - Wood Doors

Door Thickness, Panel Layout, and Grain Patterns



Stile and rail doors are usually 44 mm [1-3/4"] thick. For doors over 1067 mm [3'-6"] in width or 2440 mm [8'-0"] in height, 57 mm [2-1/4"] minimum thickness is required. Doors over maximum width or height and required by specification to be less than 57 mm [2-1/4"] in thickness shall not be subject to the *AWS* test for warp. Traditionally, the grain direction flows with the longest dimension of the stile, rail, or panel. Panel grain direction can sometimes be altered for design purposes, and must be specified. If raised panels are to be rim-raised veneered construction, the grain of the rims will flow around the panel with the long dimension of the rim material.

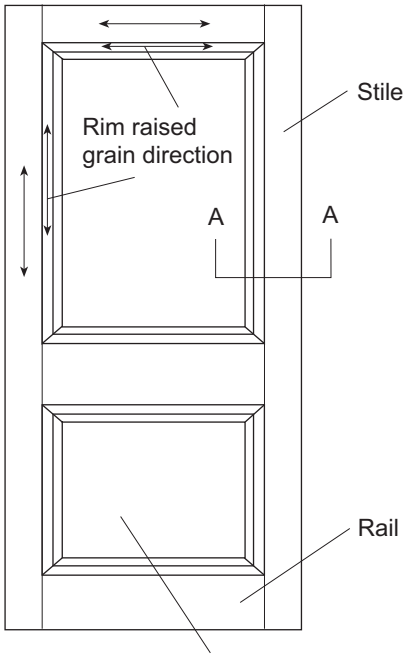
Stile and Rail Construction



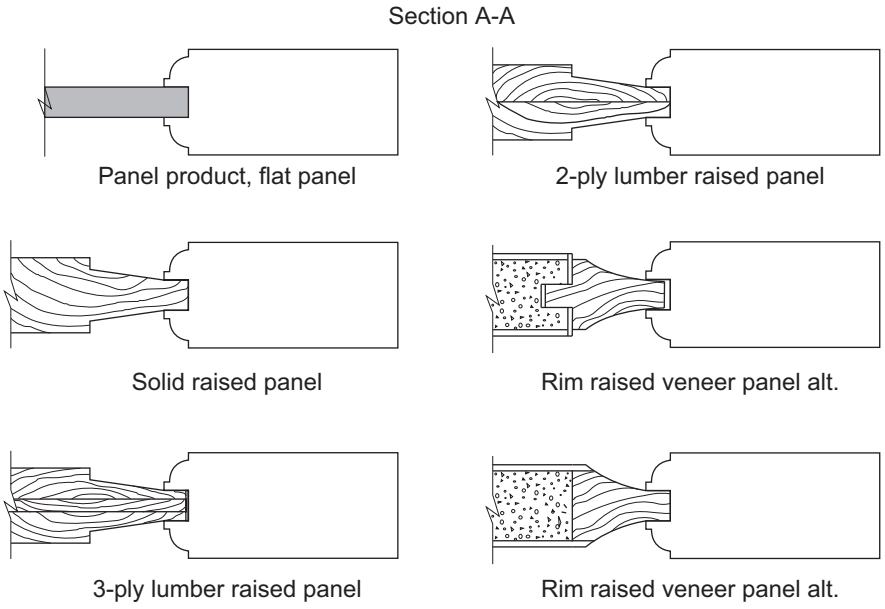
There are a variety of methods of stile and rail fabrication. It is possible to fabricate stile and rail doors that will perform within the tests established in this Standard using any of the illustrated techniques and others.

9 - Wood Doors

Panel Construction



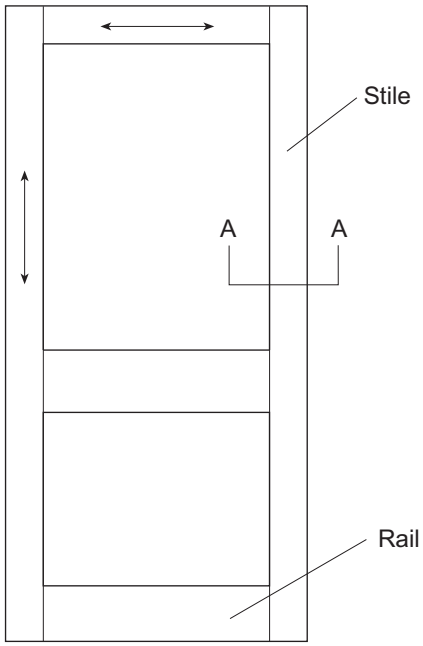
Flat or Raised panel

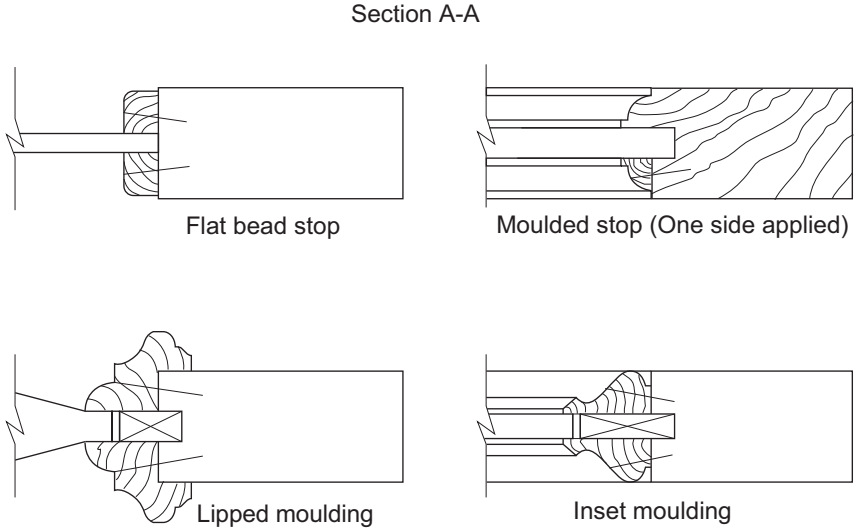


Other configurations may be available

There are a variety of methods of flat panel and raised panel fabrication. Review the *AWS* for maximum allowable widths in solid or edge-glued lumber. It is possible to fabricate stile and rail doors that will perform within the tests established in the compliance criteria of the *AWS* using any of the illustrated techniques and others.

Panel and Glass Retention





Other configurations may be available

A wide variety of design choices are available from woodworkers. The illustrations are intended as guidelines for the design professional and should not limit the potential for creative solutions. Glass cannot always be centered on stiles and rails, depending on the thickness. Mouldings and stop are usually applied with small brads or finish nails.

9 - Wood Doors

FREEDOM OF EXPRESSION

This section is a sample of design ideas. It makes no pretense of being complete. It's here for the reader to use as a starting point. The exercise of personal creativity is the essence of fine architectural woodworking.

Custom-designed woodwork gives you complete freedom of expression.

- Design flexibility: The use of custom-designed woodwork in a building allows the design professional freedom of expression, while meeting the functional needs of the client. A custom-designed building is enhanced by the use of custom-designed woodwork.
- Cost effective: Custom woodwork does compete favorably with mass-produced millwork, and offers practically limitless variations of design and material. Most woodwork lasts the life of the building – quality counts.
- Complete adaptability: By using custom woodwork, the architect or designer can readily conceal plumbing, electrical and other mechanical equipment without compromising the design criteria.
- No restrictions: Custom architectural woodwork permits complete freedom of selection of any of the numerous hardwoods and softwoods available for transparent or opaque finish. Other unique materials available from woodwork manufacturers require no further finishing at all, such as plastic laminates and decorative overlays. These materials can be fashioned into a wide variety of profiles, sizes, and configurations. The owner and design professional have the best of both worlds - high quality and freedom of choice.
- Dimensional flexibility: Since custom woodwork is normally produced by a specialty architectural woodwork firm, dimensions can easily be changed prior to actual fabrication, if required by job conditions. Special situations such as designing for the disabled can readily be accommodated by the custom architectural woodwork manufacturer.
- Quality assurance: Adherence to the *AWS* and specifications will provide the design professional a quality product at a competitive price. Use of a qualified industry member firm will help ensure the woodworker's understanding of the quality level required.

9 - Wood Doors

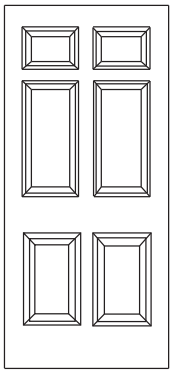


Fig. 1400-D-1

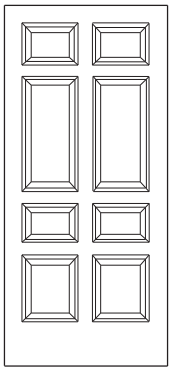


Fig. 1400-D-2

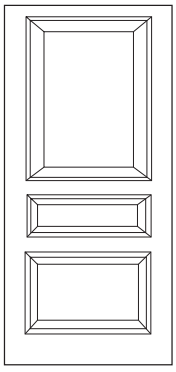


Fig. 1400-D-3

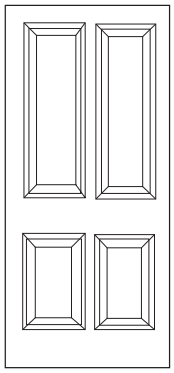


Fig. 1400-D-4

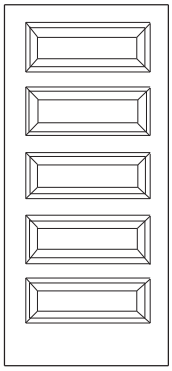


Fig. 1400-D-5

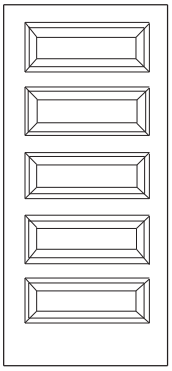


Fig. 1400-D-6

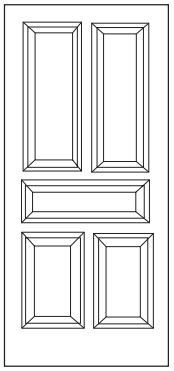


Fig. 1400-D-7

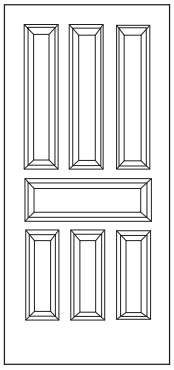
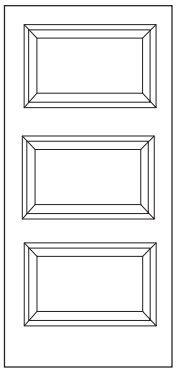


Fig. 1400-D-8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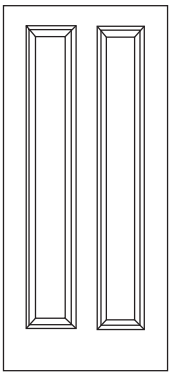
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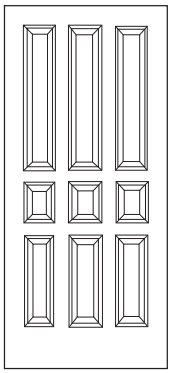
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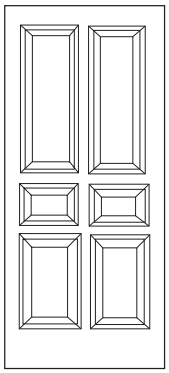
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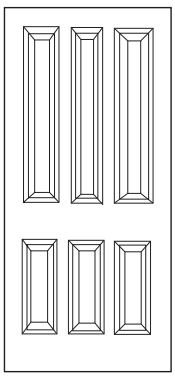
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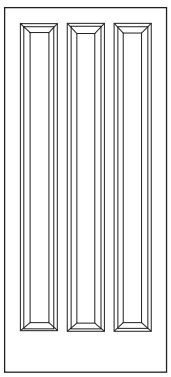
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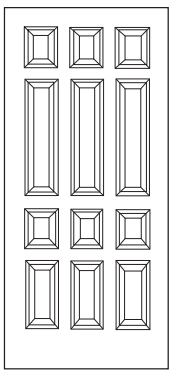
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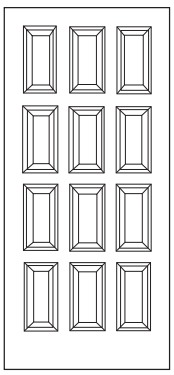
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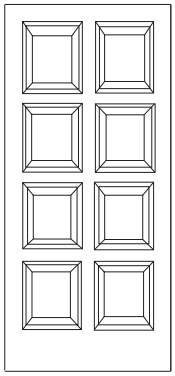
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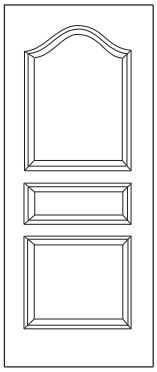
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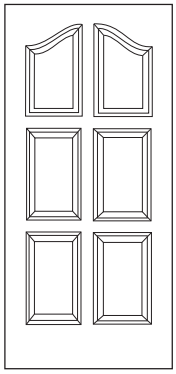
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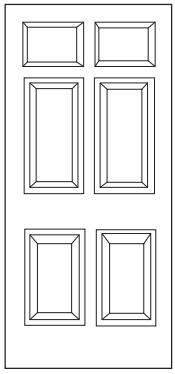
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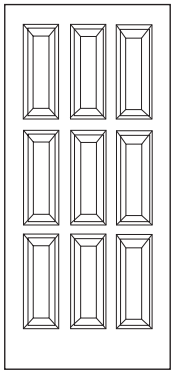
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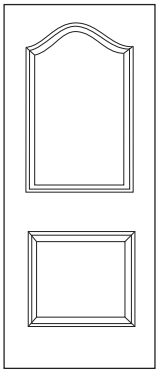
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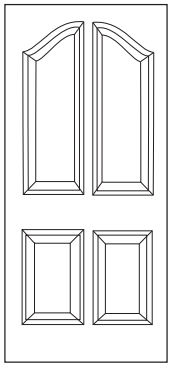
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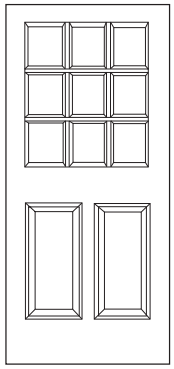
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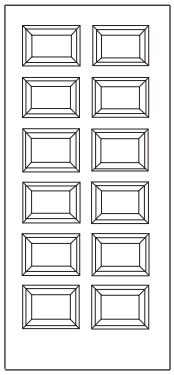
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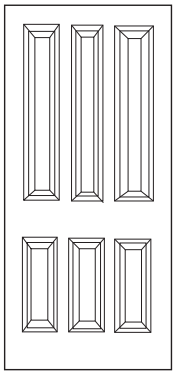
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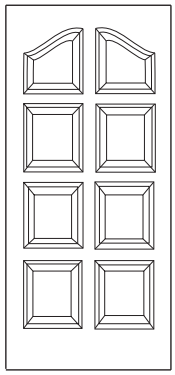
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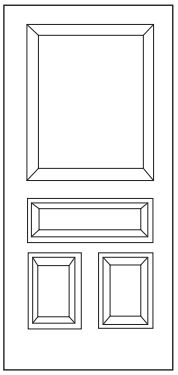
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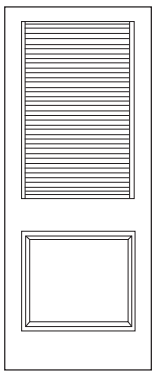
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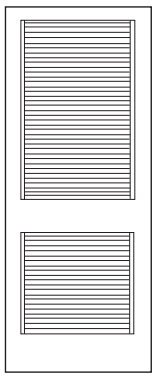
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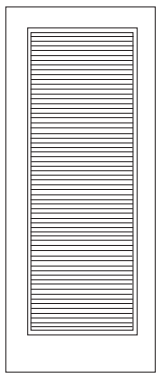
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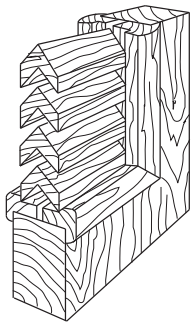
Fig. 1400-D-32

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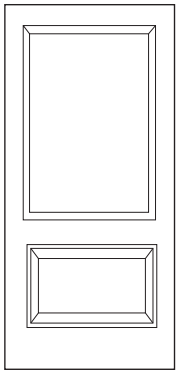
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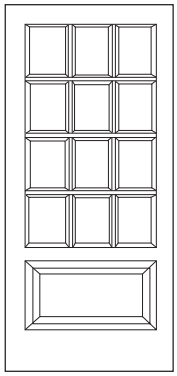
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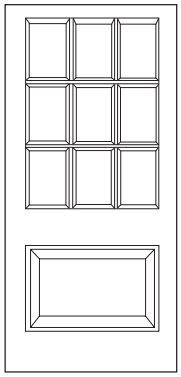
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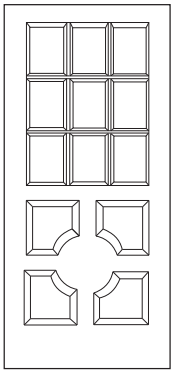
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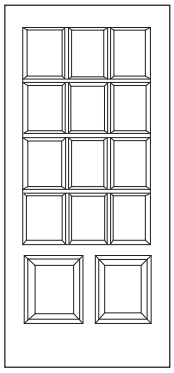
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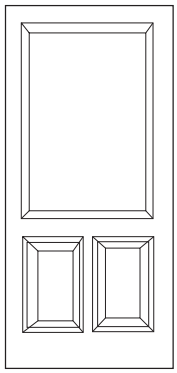
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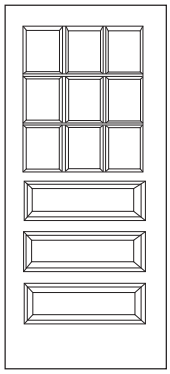
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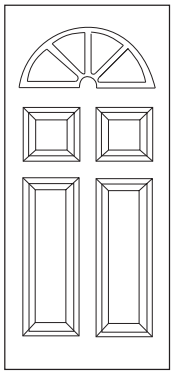
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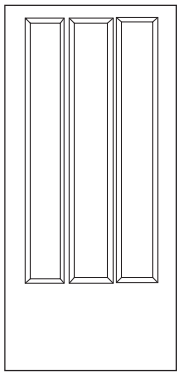
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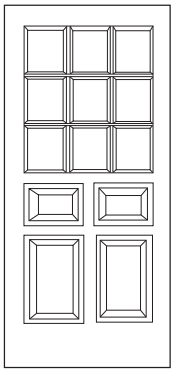
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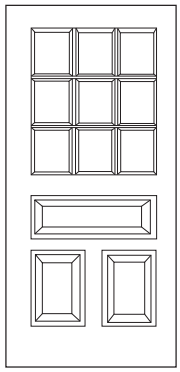
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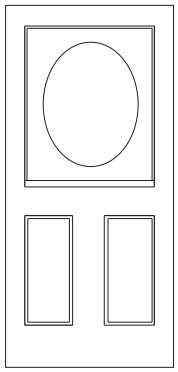
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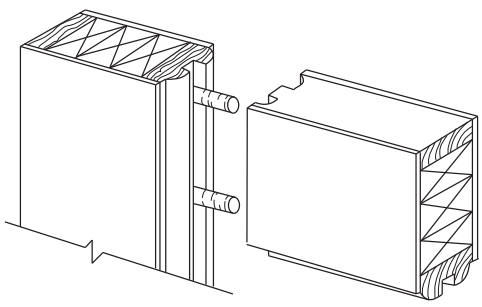
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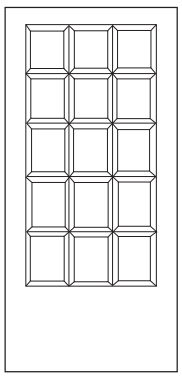
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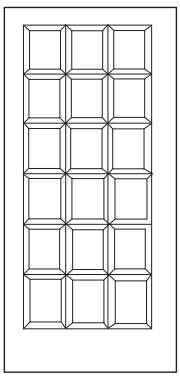


Fig. 1400-D-47

9 - Wood Doors

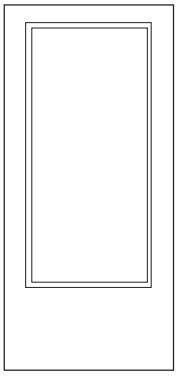


Fig. 1400-D-48

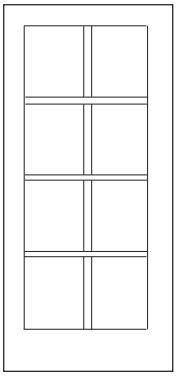


Fig. 1400-D-49

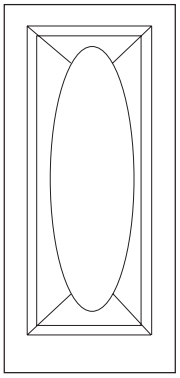


Fig. 1400-D-50

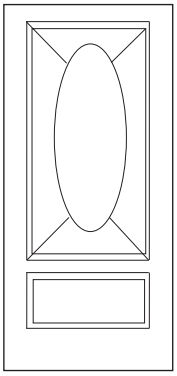
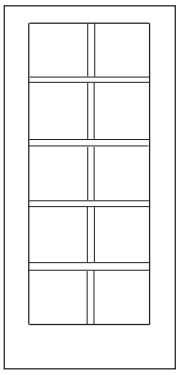


Fig. 1400-D-51



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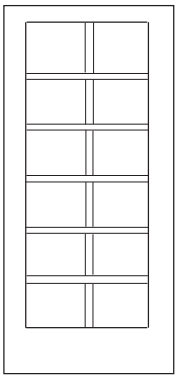

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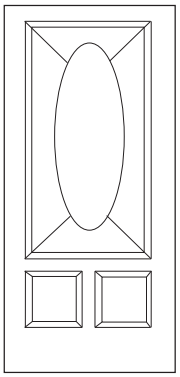


Fig. 1400-D-54

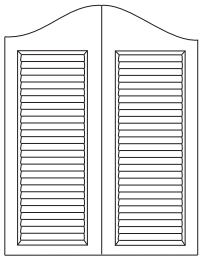


Fig. 1400-D-55

NOTES

10
Casework

10 - Casework

SHELF DEFLECTION INFORMATION

The Department of Wood Science in the Division of Forestry at West Virginia University, conducted a study for the Architectural Woodwork Institute regarding the deflection of wood shelving materials under various amount of stress. The following table represents their findings with the various products tested. The study was developed in the inch-pound method and is not converted to metric for this example.

The table shows total uniformly distributed load requirements necessary to cause deflection of $^1/_4$ inch in shelves 8 and 12 inches wide with spans (i.e., unfixed, supported at each end) of 30, 36, 42, and 48 inches. Load required to deflect shelves more or less than $^1/_4$ inch may be estimated by direct proportion. For example, the uniformly distributed load required to cause a deflection of $^1/_8$ inch is one-half that of the value in the table. For widths different than 8 or 12 inches (the values used in the table), load required to cause a $^1/_4$ inch deflection may also be determined by direct proportion. A 6 inch wide shelf, for example, will deflect twice as much as a 12 inch wide shelf under the same load.

The following equation shows how deflection is related to shelf dimensions, width, thickness, span, load per inch of span and E-value, a material property which measures stiffness or resistance to deflection. The higher the E-value, the less the deflection. When a shelf is made with several materials, each with its own E-value, a composite E-value must be determined.

To compute deflection:

$$D=\frac{0.1563wl^4}{Ebh^3}$$

In which the values are:

D = deflection (in inches)

w = load per lineal inch of span

l = span (length)

E = modulus of elasticity

b = base (width)

h = depth (thickness)

Shelf Deflection of $^1/_4$" by Estimated Total Distributed Load in Pounds

Material	Thickness		Span	30"		36"		42"		48"	
			Width	8"	12"	8"	12"	8"	12"	8"	12"
Yellow-Poplar	lumber	3/4"		322 lbs.	483 lbs.	189 lbs.	284 lbs.	117 lbs.	175 lbs.	78 lbs.	117 lbs.
Red Gum											
Sweet Gum		1-1/16"		912	1368	528	790	332	498	221	332
Hard Maple	lumber	3/4"		356 lbs.	534 lbs.	209 lbs.	313 lbs.	133 lbs.	206 lbs.	88 lbs.	133 lbs.
Pecan											
Red Oak		1-1/16"		1021	1536	592	888	373	560	249	374
Birch	lumber	3/4"		400	600	232	348	146	219	98	146
Hickory		1-1/16"		1134	1701	660	990	414	621	277	415
Medium density particleboard (raw or covered with "melamine")		3/4"		78	117	46	69	29	43	19	28
		1"		185	277	109	164	69	102	45	66
Medium density fiberboard (raw or covered with "melamine")		3/4"		100	150	58	87	36	54	25	38
		1"		237	356	137	206	85	128	59	90
Birch faced plywood, veneer core		3/4"		145	218	86	129	54	81	36	54
Birch faced plywood, medium density particleboard core		3/4"		125	188	72	109	46	68	31	46
Medium density particleboard covered two sides and one edge with nominal 0.028" high pressure decorative laminate		3/4" (core)		174	261	100	139	64	96	42	63
Medium density particleboard covered two sides and one edge with nominal 0.050" high pressure decorative laminate		3/4" (core)		234	350	137	205	86	129	58	87
Medium density particleboard with 1/8" solid lumber edge		3/4"		89	139	53	79	33	50	22	33
Medium density particleboard with 3/4" solid lumber edge		3/4"		100	150	60	90	42	63	25	38
Medium density particleboard with 3/4" x 1-1/2" solid lumber dropped edge		3/4"		384	435	216	241	132	152	92	107

NOTE: All medium density particleboard is ANSI 208.1- (ltest edition), Type M-2
The information and ratings stated here pertain to material currently offered and represent results of tests believed to be reliable. However, due to variations in handling and in methods not known or under our control, no warantee or guarantee as to the end results can be made.

10 - Casework

DETAIL NOMENCLATURE

Familiarity with the labeled details on this page will facilitate communication between architects, designers, specifiers, and woodwork manufacturers by establishing common technical language.

Spline Joint: Used to strengthen and align faces when gluing panels in width or length, including items requiring site assembly.

Stub Tenon: Joinery method for assembling stile and rail type frames that are additionally supported, such as web or skeleton case frames.

Haunch Mortise and Tenon Joint: Joinery method for assembling paneled doors or stile and rail type paneling.

Conventional Mortise and Tenon Joint: Joinery method for assembling square-edged surfaces such as case face frames.

Dowel Joint: Alternative joinery method serving same function as Conventional Mortise and Tenon.

French Dovetail Joint: Method for joining drawer sides to fronts when fronts conceal metal extension slides or overlay the case faces.

Conventional Dovetail Joint: Traditional method for joining drawer sides to fronts or backs. Usually limited to flush or lipped type drawers.

Drawer Lock-Joint: Another joinery method for joining drawer sides to fronts. Usually used for flush type installation, but can be adapted to lip or overlay type drawers.

Exposed End Details: Illustrates attachment of finished end of case body to front frame using a butt joint and a lock mitered joint.

Through Dado: Conventional joint used for assembly of case body members. Dado not concealed by application of case face frame.

Blind Dado: Variation of Through Dado with applied edge "stopping" or concealing dado groove.

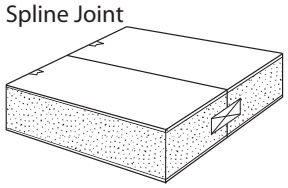
Stop Dado: Another method of concealing dado exposure. Applicable when veneer edging or solid lumber is used. Exposed End Detail illustrates attachment of finished end of case body to front frame using butt joint.

Dowel Joint: Fast becoming an industry standard assembly method, this versatile joinery technique is often based on 1-14" (32 mm) spacing of dowels.

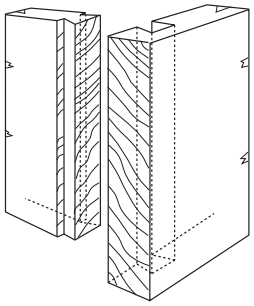
Edge Banding: Method of concealing plies or inner cores of plywood or particleboard when edges are exposed. Thickness or configuration will vary with manufacturers' practices.

Paneled Door Details: Joinery techniques when paneled effect is desired. Profiles are optional as is the use of flat or raised panels. Solid lumber raised panels may be used when width does not exceed the standard. Rim-raised panels recommended for Premium Grade or when widths exceed the *AWS* or when transparent finish is used.

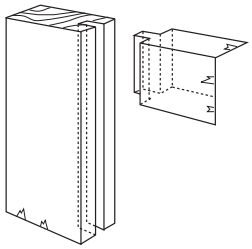
Spline Joint



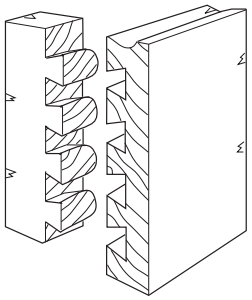
French Dovetail Joint



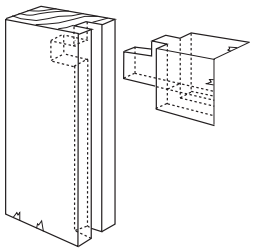
Stub Tenon



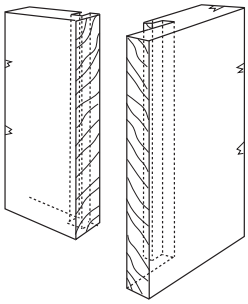
Conventional Dovetail Joint



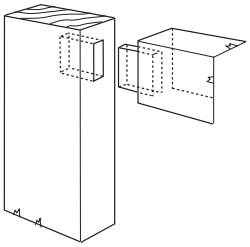
Haunch Mortise and Tenon Joint



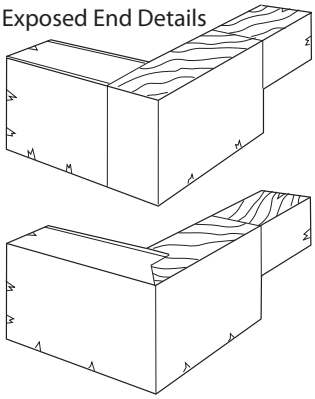
Drawer Lock-Joint



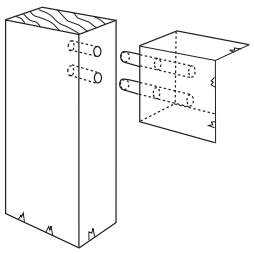
Conventional Mortise and Tenon Joint



Exposed End Details



Dowel Joint



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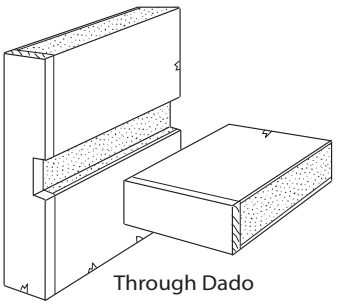
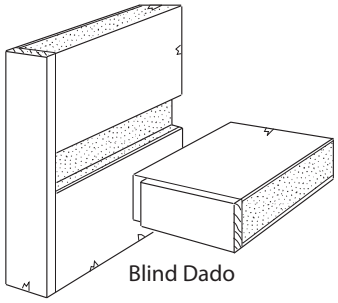
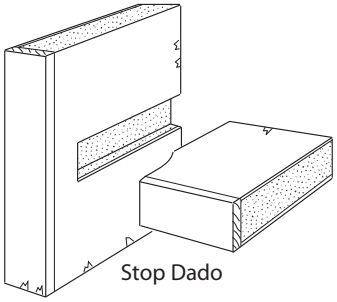


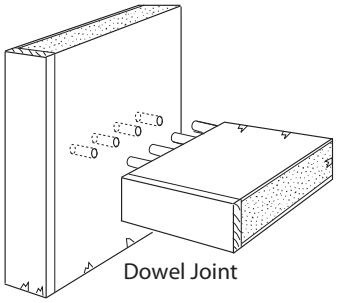
Through Dado



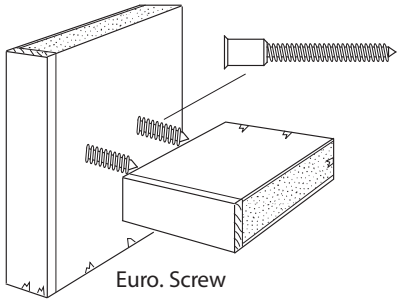
Blind Dado



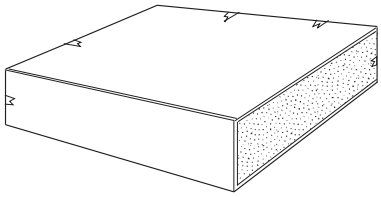
Stop Dado



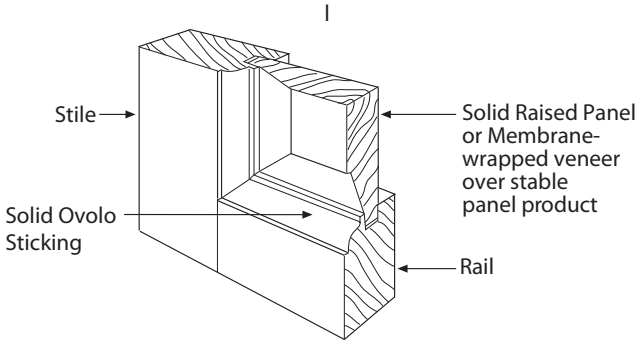
Dowel Joint



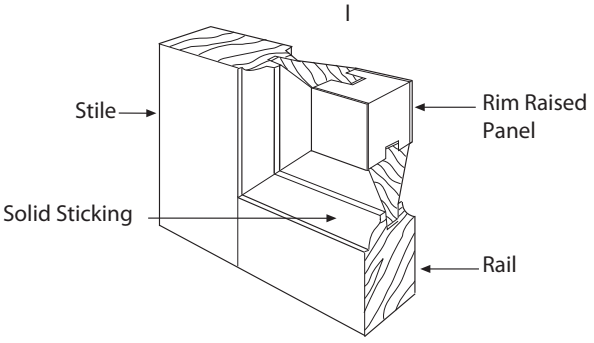
Euro. Screw



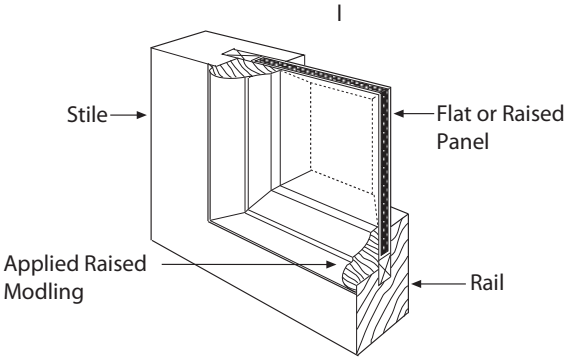
Edge Banding



Paneled Door Detai



Paneled Door Detai



Paneled Door Detai

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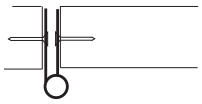
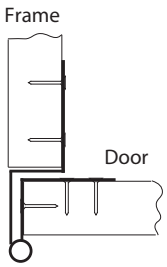
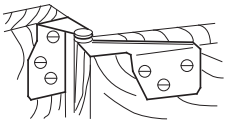
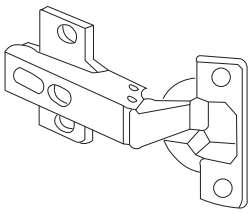
Hinge Selection Guide

Architectural cabinet hinges will usually be furnished from the manufacturer's stock unless otherwise specified. The four most common hinge types are illustrated below, along with a brief table to assist in selection.

European hinges with the screws set in synthetic inserts are fast becoming industry standard. These hinges have been found to be cost-effective alternatives to the more traditional hinges shown below. Follow hinge manufacturers' recommendations on number and spacing of hinges. There are conditions, however, in which the use of butt or wraparound hinges will continue to be the best solution. Pivot hinges often require a cut-in center hinge. Consult manufacturer's recommendations.

Hinge Type	Butt	Wraparound	Pivot	European Style
				
Applications	Conventional Flush with Face Frame	Conventional Reveal Overlay	Reveal Overlay Flush Overlay	Conventional Flush without Face Frame Reveal Overlay Flush Overlay
Strength	High	Very High	Moderate	Moderate
Concealed when closed	No	No	Semi	Yes
Requires mortising	Yes	Occasionally	Usually	Yes
Cost of hinge	Low	Moderate	Low	Moderate
Ease of installation	Moderate	Easy	Moderate	Very Easy
Easily adjusted after installation	No	No	No	Yes
Remarks	Door requires hardwood edge	Exposed knuckle and hinge body	Door requires hardwood edge	1. Specify degree of opening 2. No catch required on self-closing styles

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Drawer Slide Selection Guide

The following table serves as both a checklist and a starting point for the discussion of a wide variety of drawer slide systems. While by no means exhaustive, the characteristics described below are often considered the most important by the client, the design professional, and the woodwork manufacturer. The selection of the slide characteristics will affect the usefulness of the cabinets. Careful consideration should be given to avoid "over-specifying" for the purpose intended.

The owner and the design professional will be wise to involve a manufacturer in the design and selection process early in the project. Dimensions use the inch-pound convention.

Degree of Extension	☐ STANDARD EXTENSION—All but 4-6" of drawer body extends out of cabinet ☐ FULL EXTENSION—Entire drawer body extends out to face of cabinet ☐ FULL EXTENSION WITH OVERTRAVEL—Entire drawer body extends beyond the face of cabinet
Static Load Capacity	☐ 50 Pounds—Residential/Light Commercial ☐ 75 Pounds—Commercial ☐ 100 Pounds—Heavy Duty ☐ Over 100 Pounds—Special Conditions, Extra Heavy Duty
Dynamic Load Capacity	☐ 30 Pounds; 35,000 cycles—Residential/Light Commercial ☐ 50 Pounds; 50,000 cycles—Commercial ☐ 75 Pounds; 100,000 cycles—Heavy Duty
Removal Stop	☐ INTEGRAL STOP—Requires ten times the normal opening force to remove drawer ☐ POSITIVE STOP—Latch(es) which must be operated/opened to remove drawer
Closing	☐ SELF CLOSING/STAY CLOSED—Drawer slides will self-close with their related dynamic load when the drawer is 2" from the fully closed position and not bounce open when properly adjusted
Metal Sided Systems	In recent years several hardware manufacturers have developed "drawer systems" of one type or another, nearly all proprietary. In addition to the above criteria, the following should be considered for these systems prior to approval for use: ☐ POSITIVE STOP—Drawer must stop within itself and not rely on the drawer front to stop it ☐ PULLOUT STRENGTH—System must demonstrate sufficient strength of attachment of front to sides - design professional should evaluate and approve individually

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Ideas in Groups

The subdivisions of this Section are an ever-growing collection of design ideas with an additional level of detail. While these ideas are grouped by (admittedly somewhat arbitrary) classifications, the design professional should never hesitate to adopt and adapt from one group to another.

Most importantly, the *Architectural Woodwork Standards* presents these ideas as a *starting point* for creative design and fabrication. They are not intended as an illustration of the only way to accomplish a design solution, nor are they intended to establish firm recommendations on dimensions or fabrication techniques.

NOTE: There are projects, such as credenzas, which benefit from having the grain or pattern carried on to the toe space. Toe kicks with exposure to moisture are often specified to be solid hardwood, with the grain running horizontally. Such special considerations shall be clearly noted on the design drawings and in the specifications. Base/toe on cabinets shall be integral (constructed as an integral part of the cabinet body), or separate (constructed as a separate member), at the option of the manufacturer.

Stile and rail doors and drawer fronts, and face frames on some cabinets, require careful attention to details regarding material selection for compatibility of grain and color as well as grain direction.

When transparent finish is specified for exposed surfaces, semi-exposed surfaces are not required to be transparent finish.

The advice and suggestions of all the members of the construction team, from the customers through the designers through the contractors and subcontractors, can and should be evaluated.

The classifications to follow are:

Schools and Libraries

Banks and Courts

Corporate Woodwork

Furniture and Fixtures

Reception

Church Fittings

Basic Cabinetry

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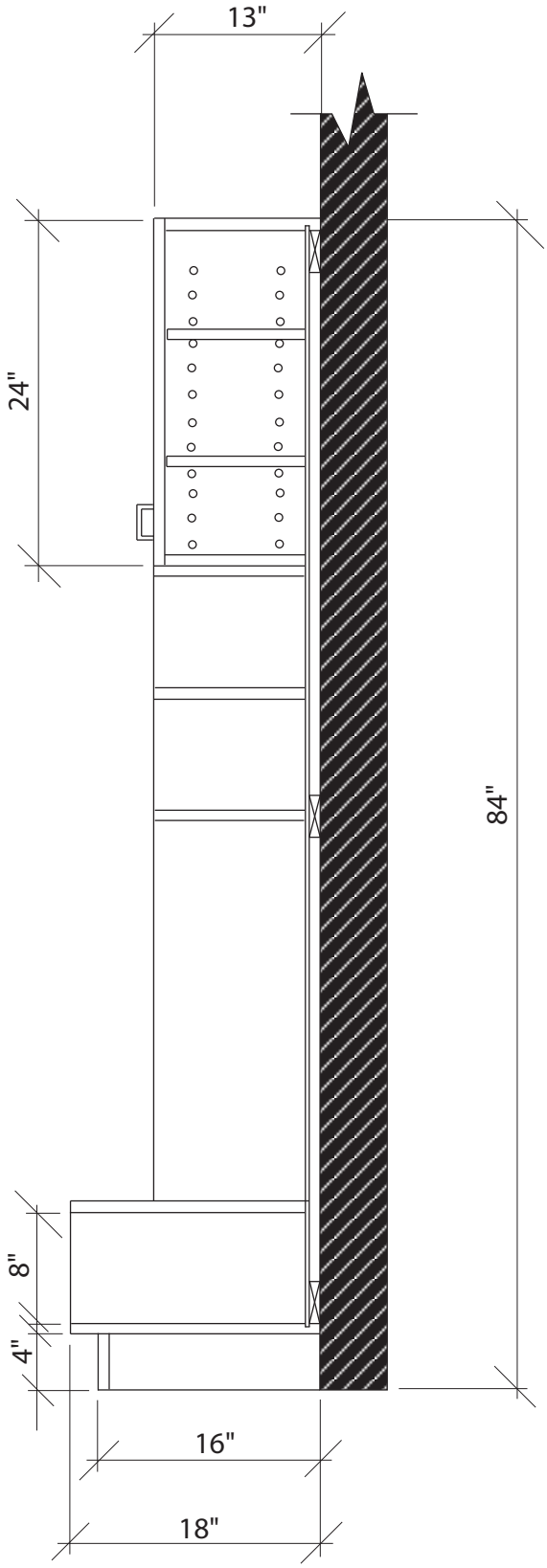
Schools and Libraries



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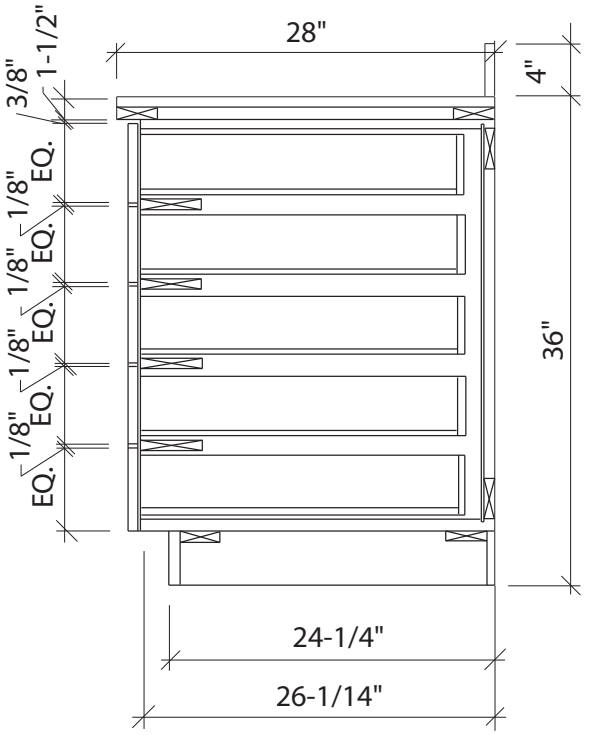
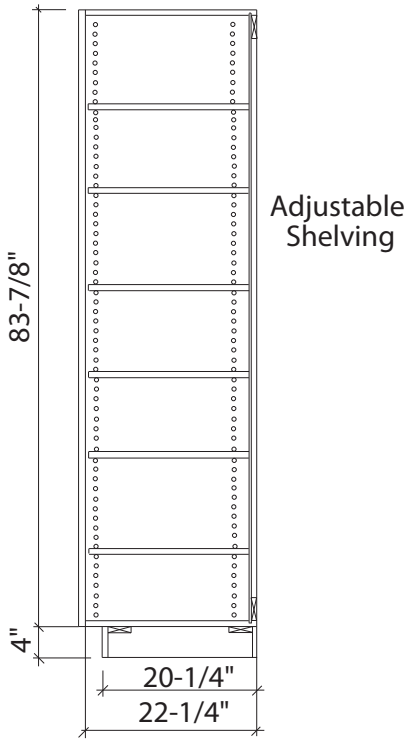
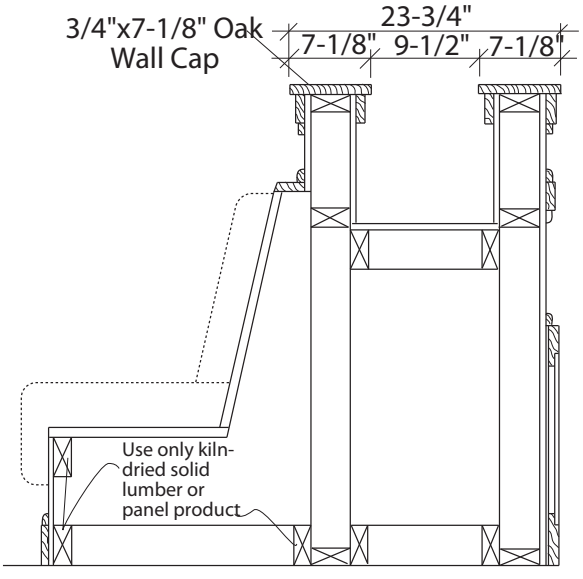
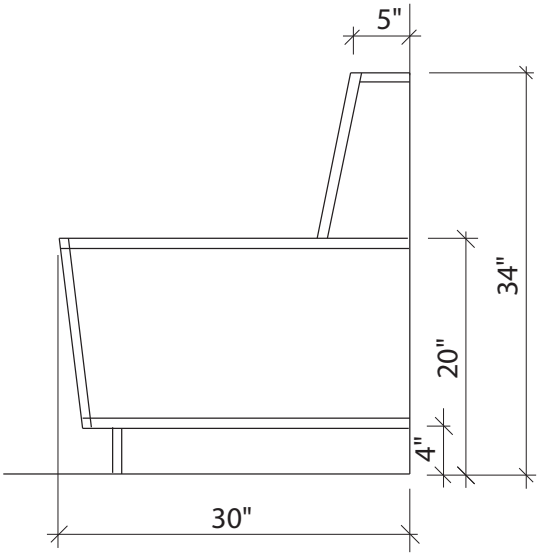
Schools and Libraries









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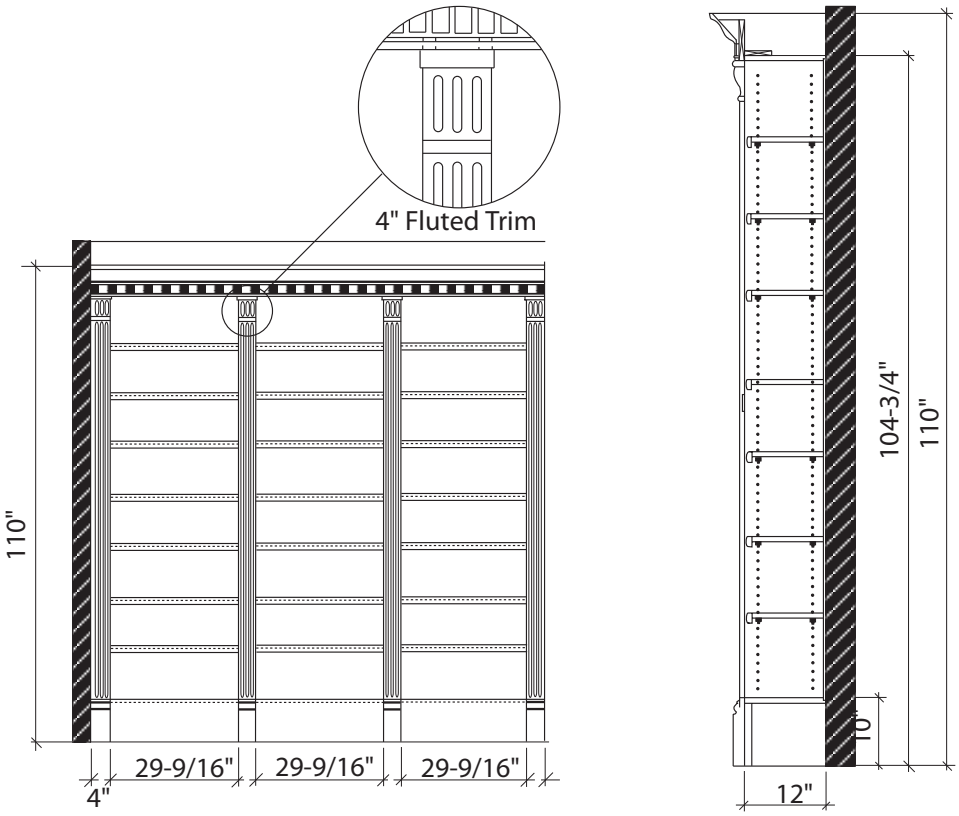
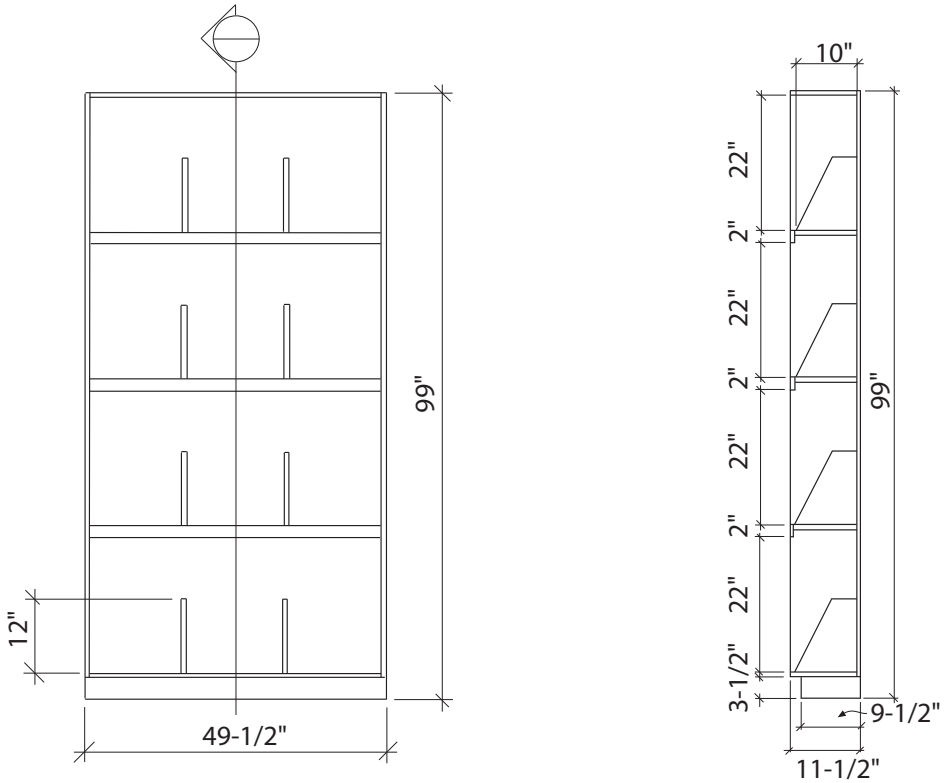
Schools and Libraries





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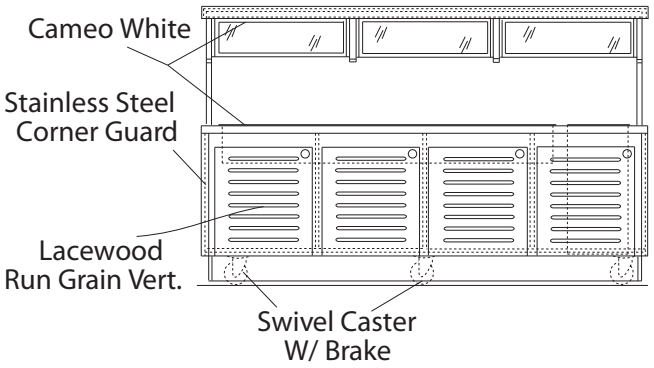
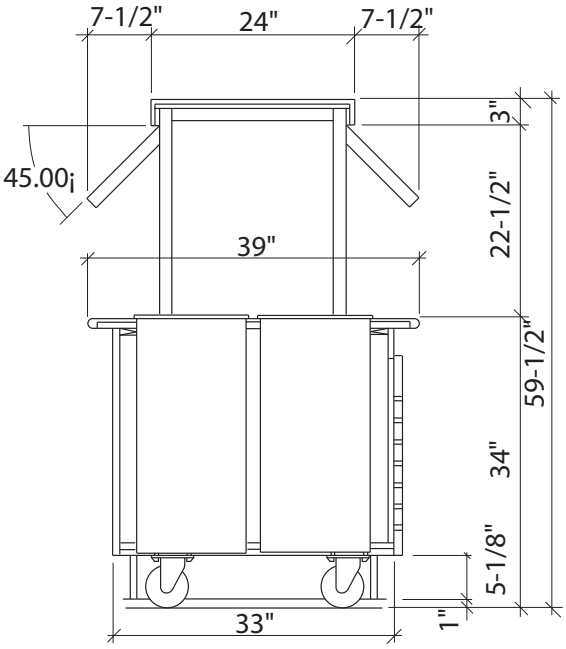
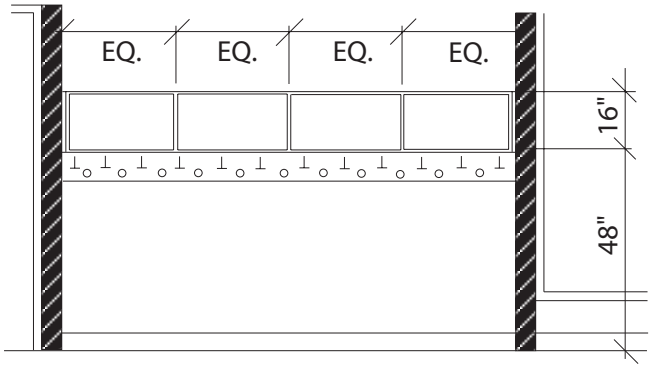
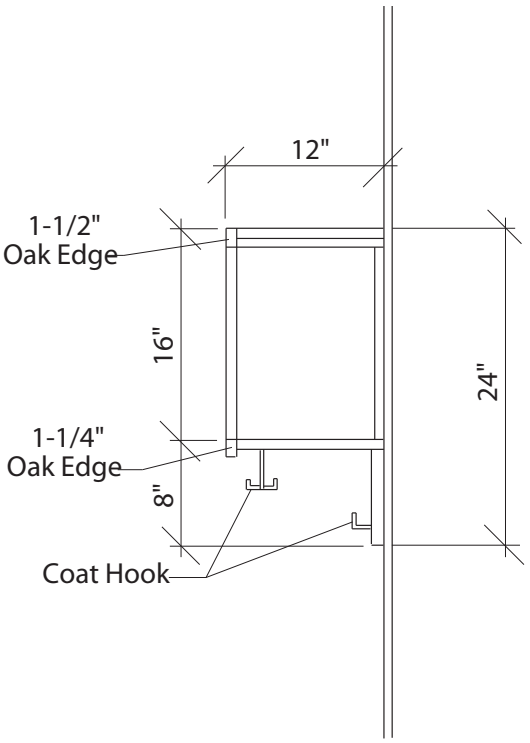
Schools and Libraries









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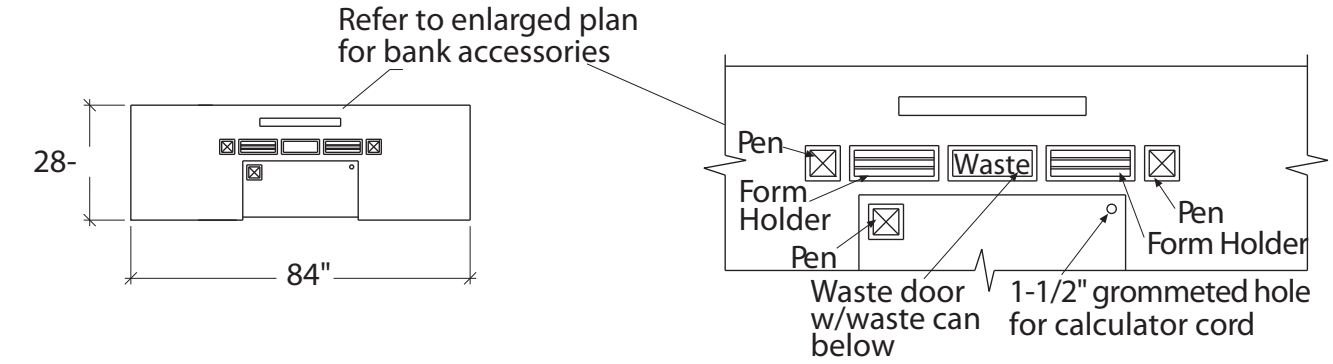
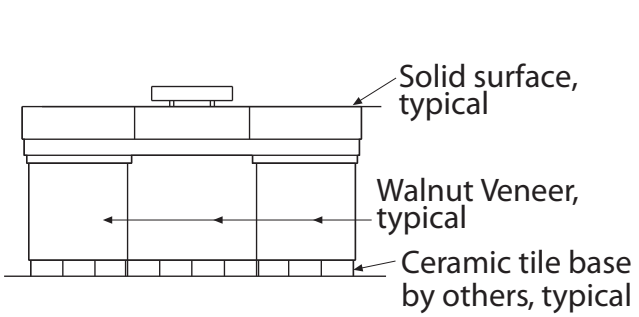
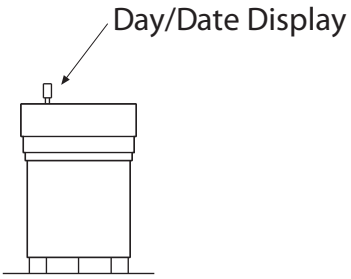
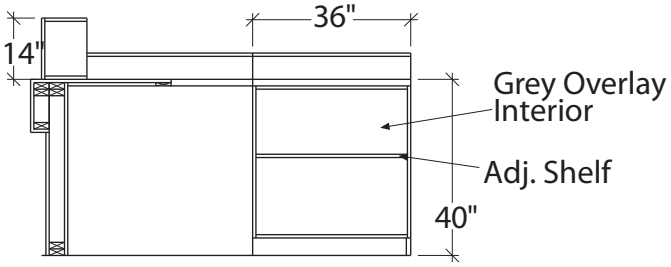
Banks and Courts

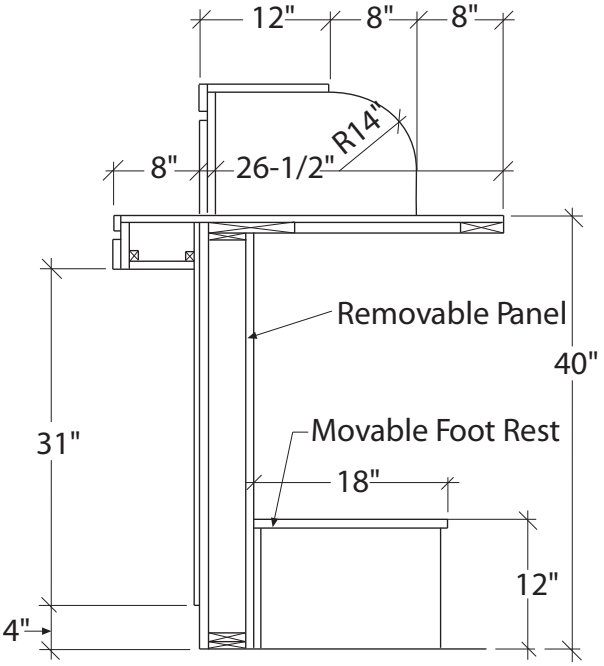








Typical Teller Counter Section



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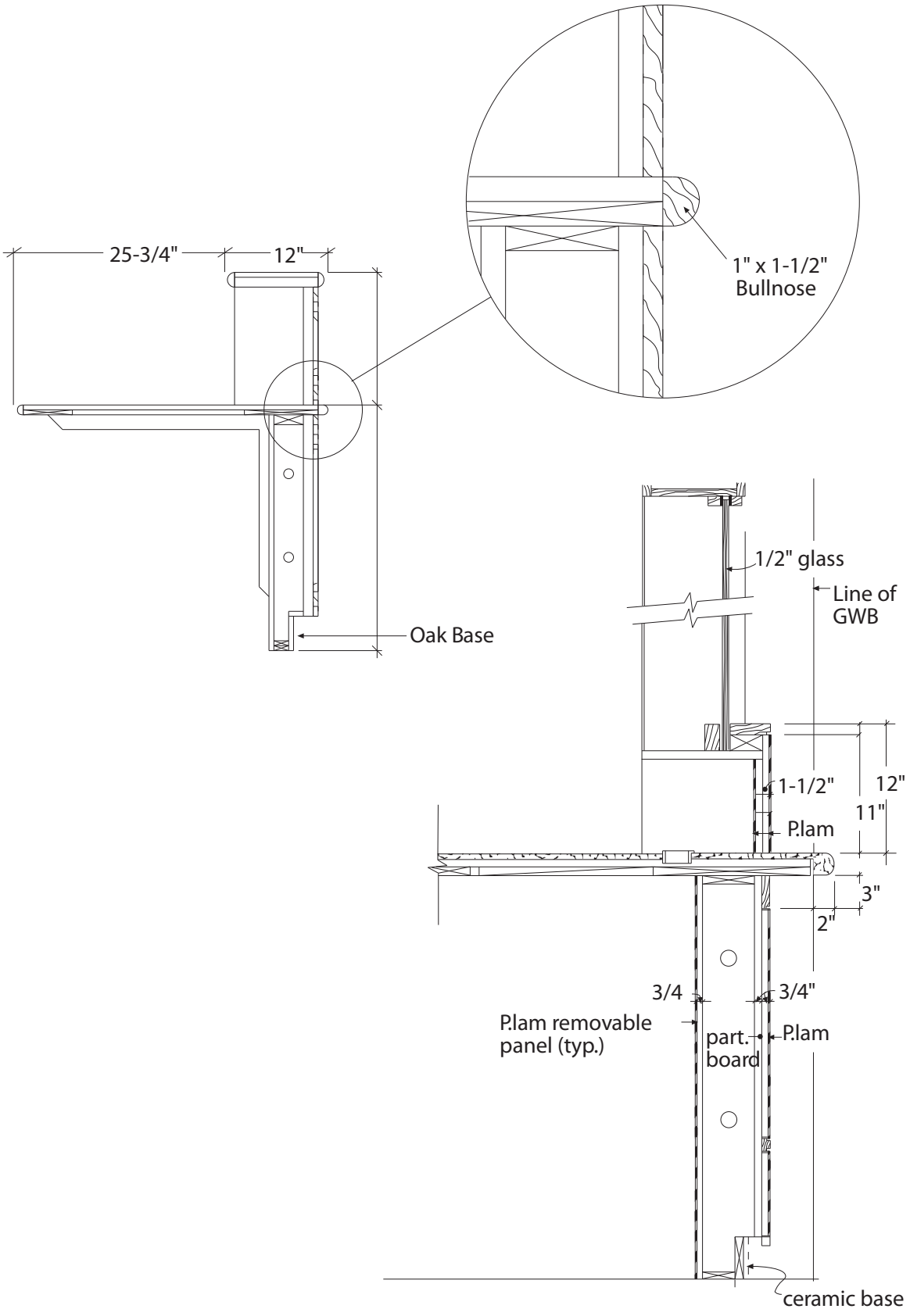
Banks and Courts



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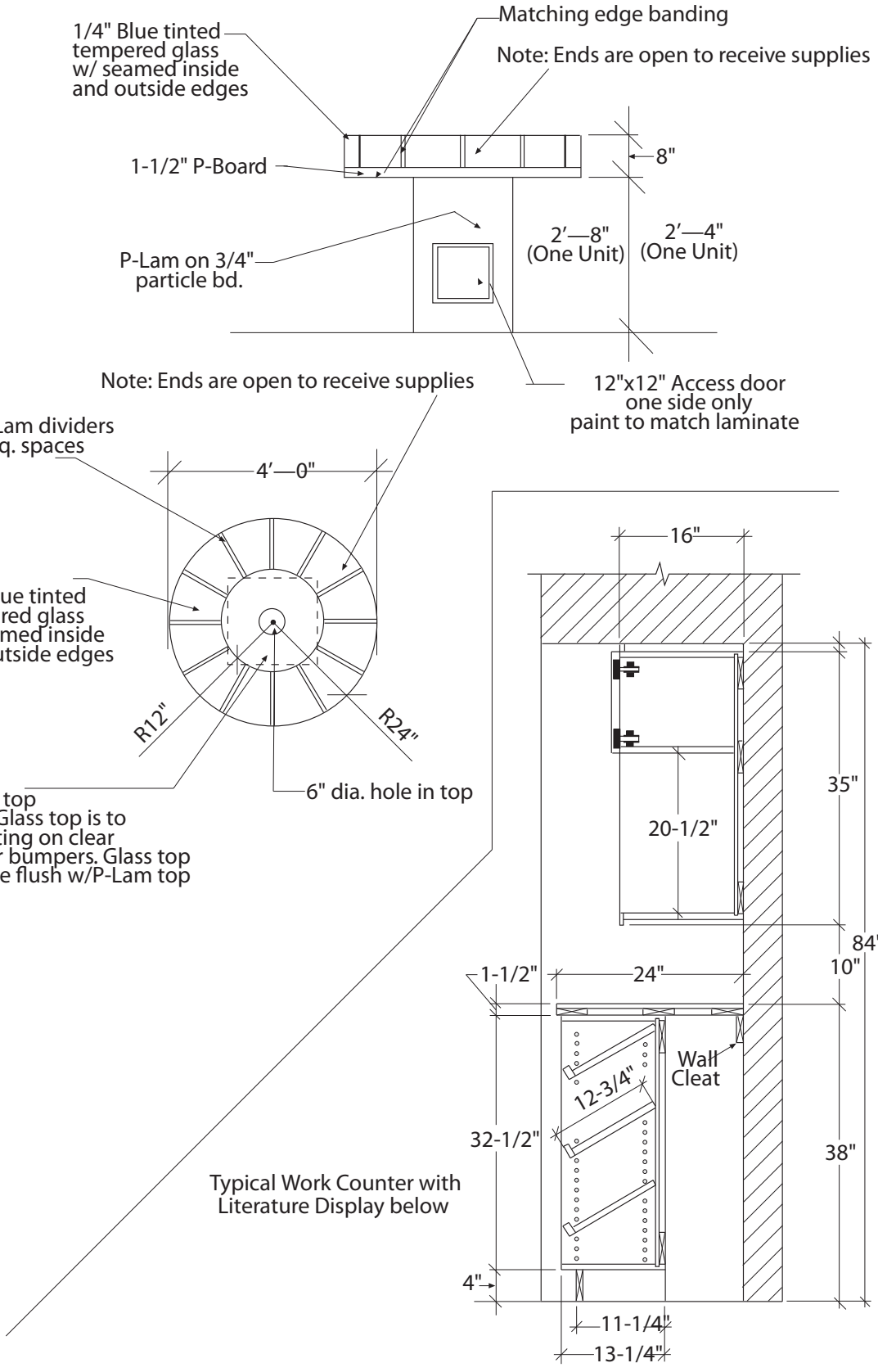
Banks and Courts



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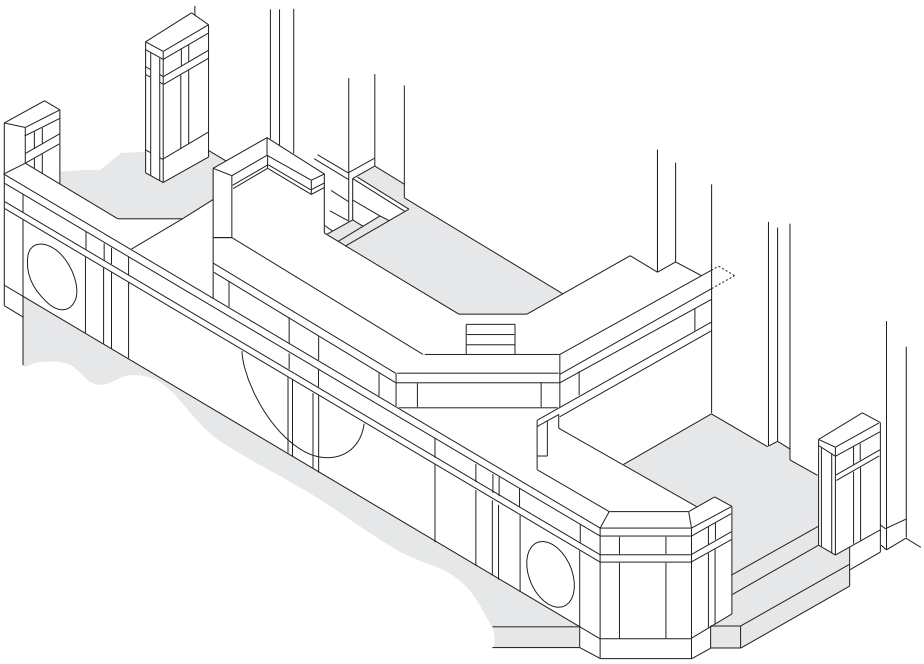
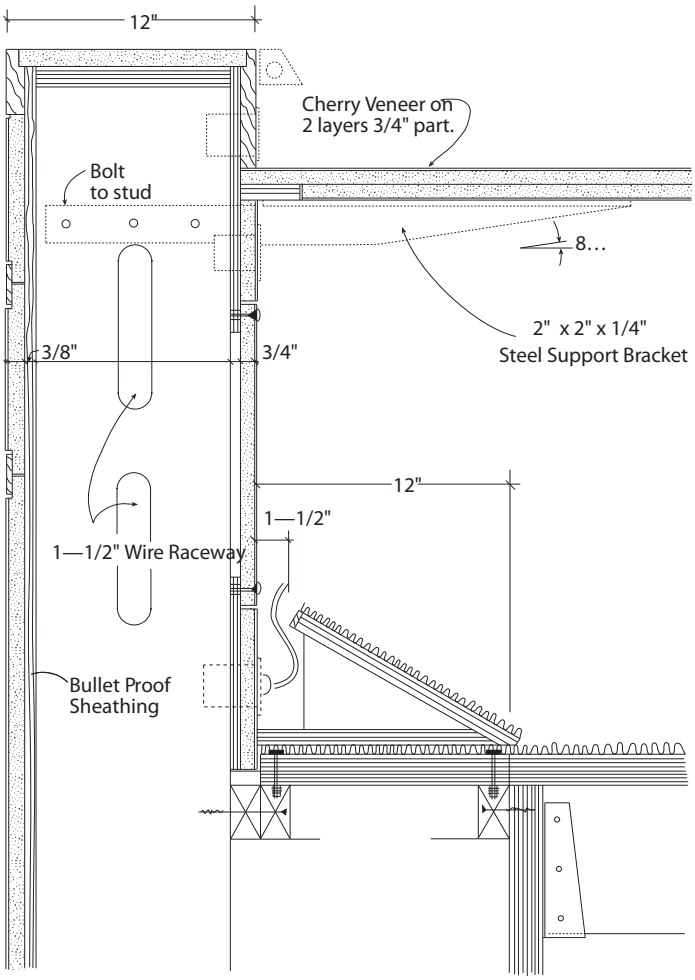
Judge's Bench





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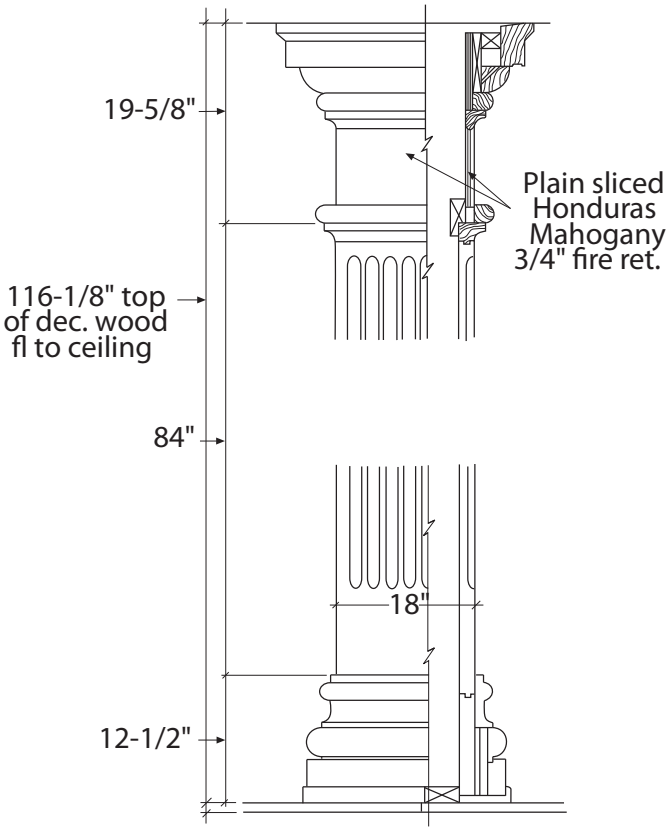
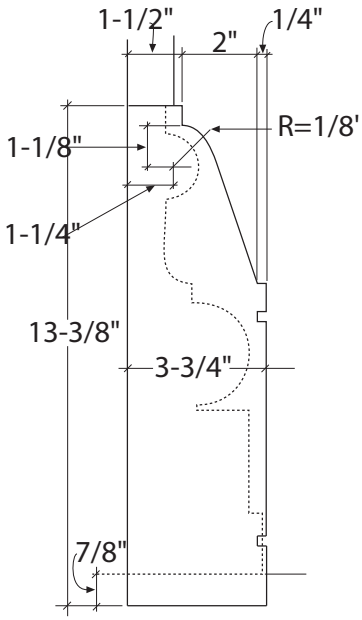
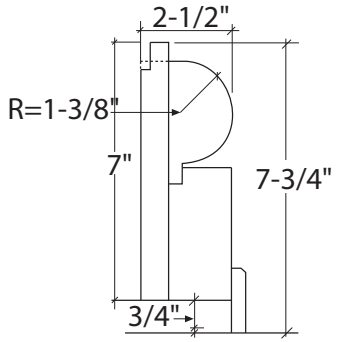
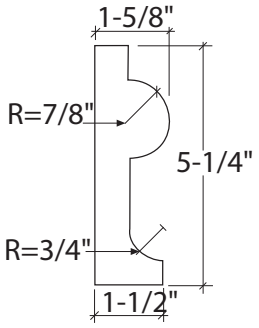
Corporate Woodwork









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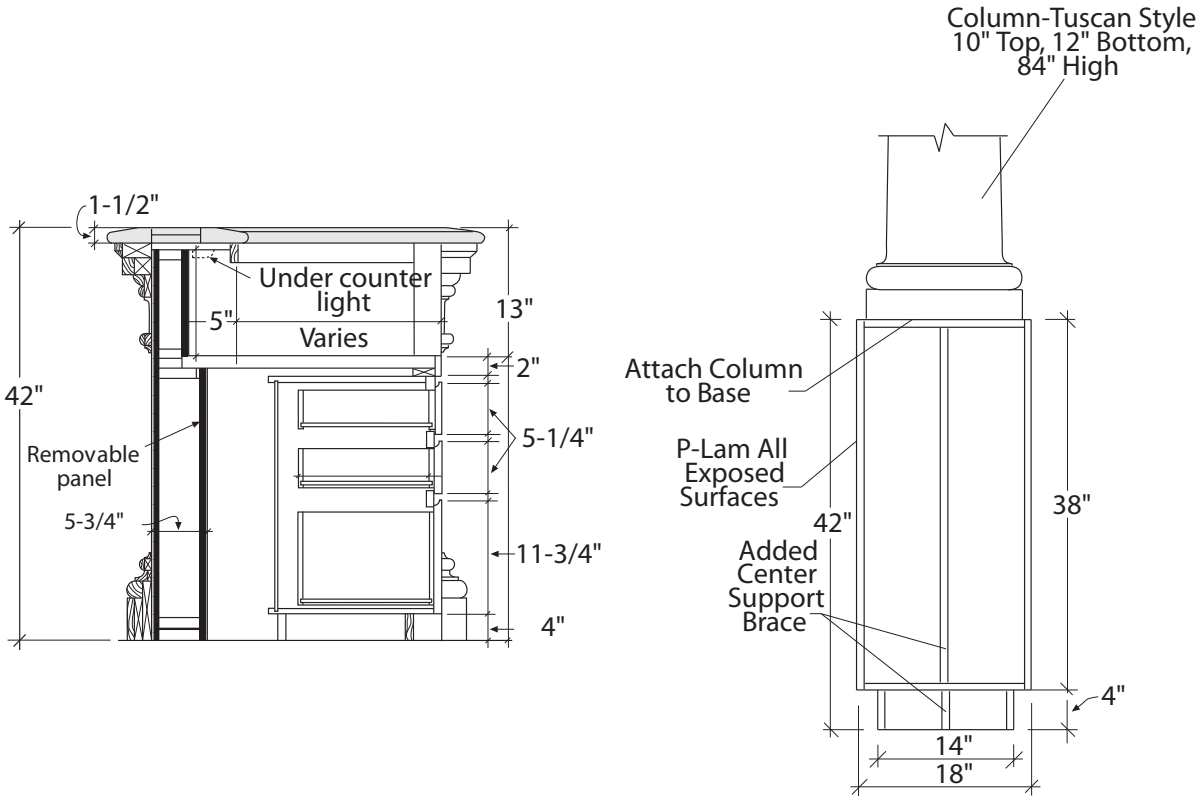
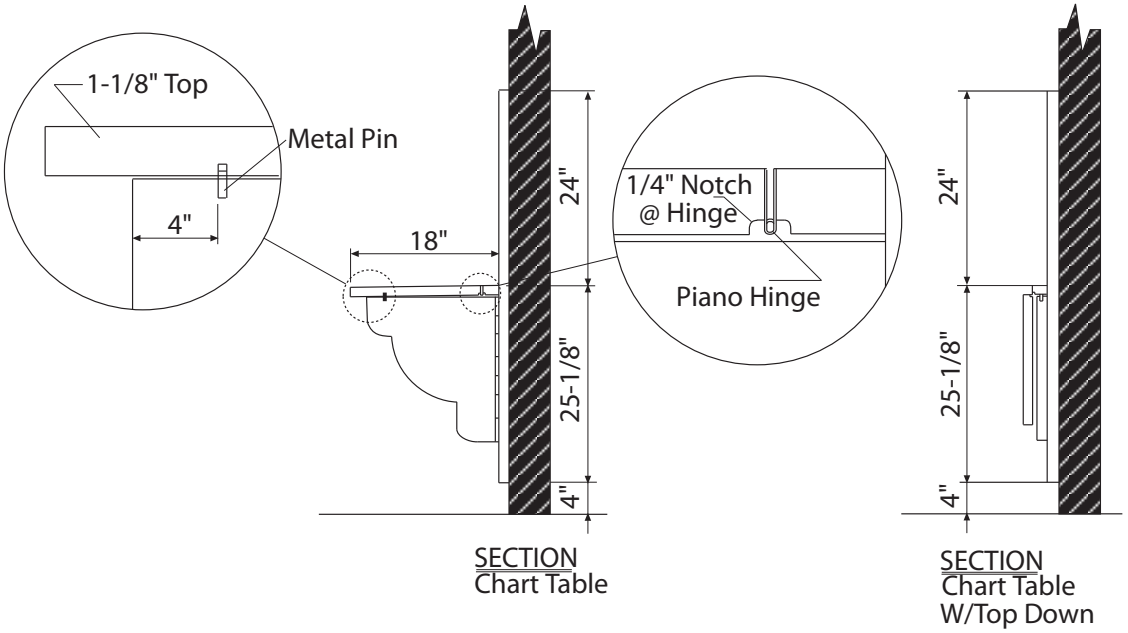
Corporate Woodwork





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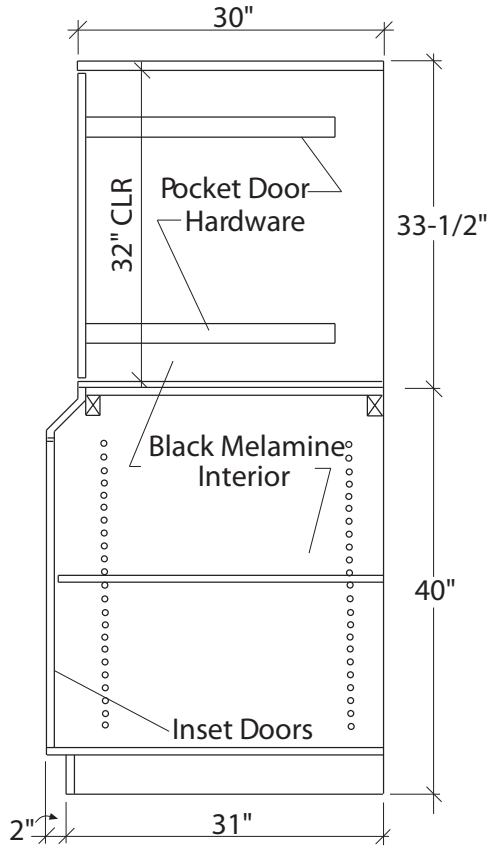
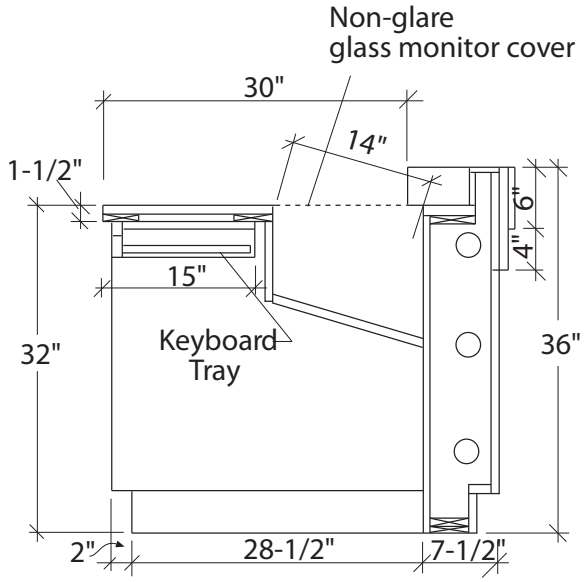
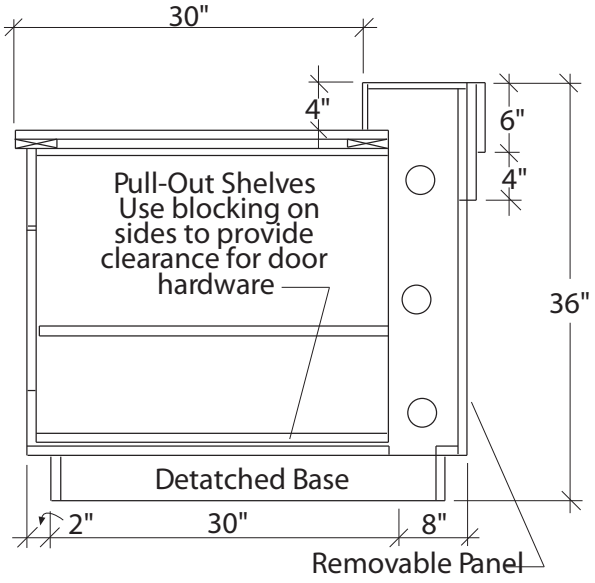
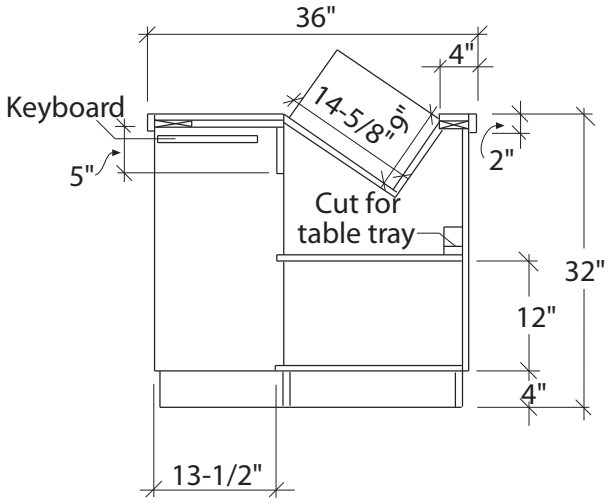
Corporate Woodwork



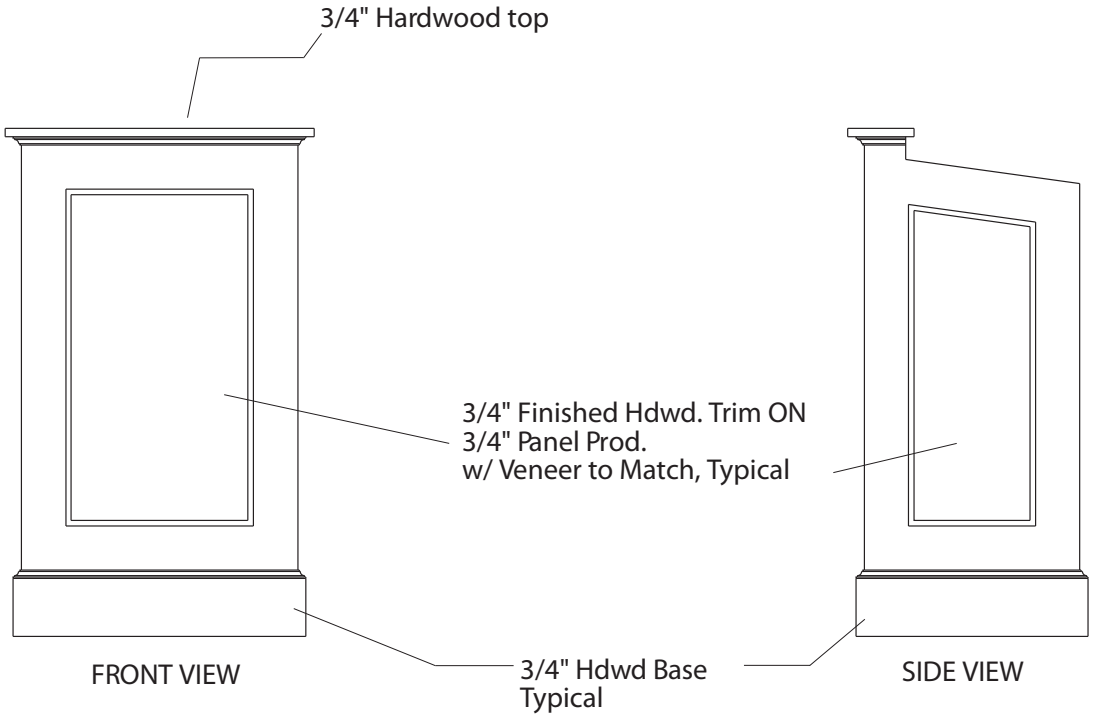


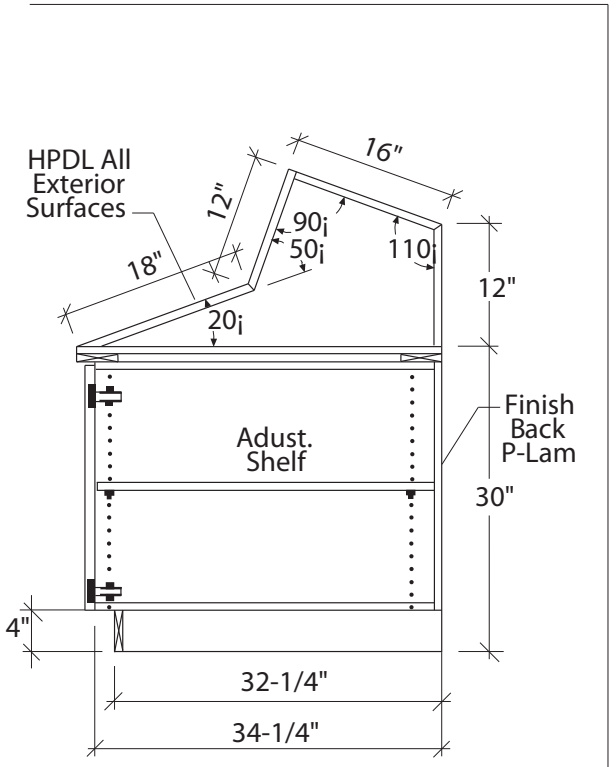


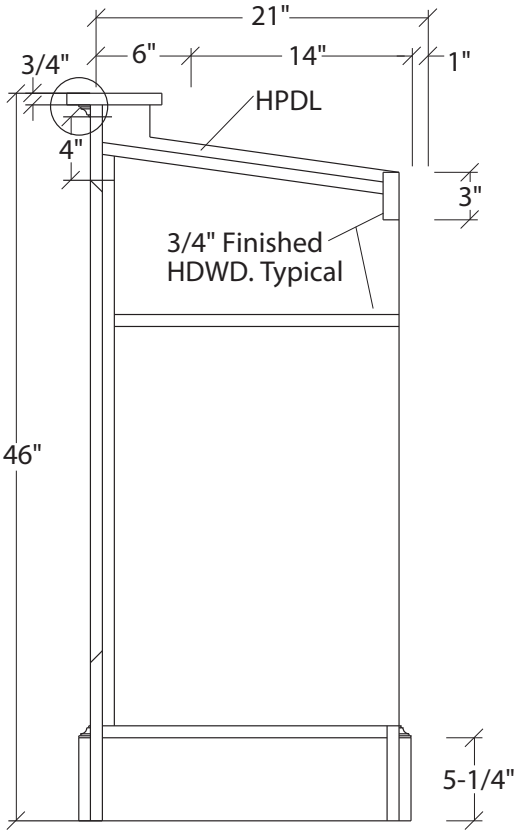


10 - Casework

Corporate Woodwork

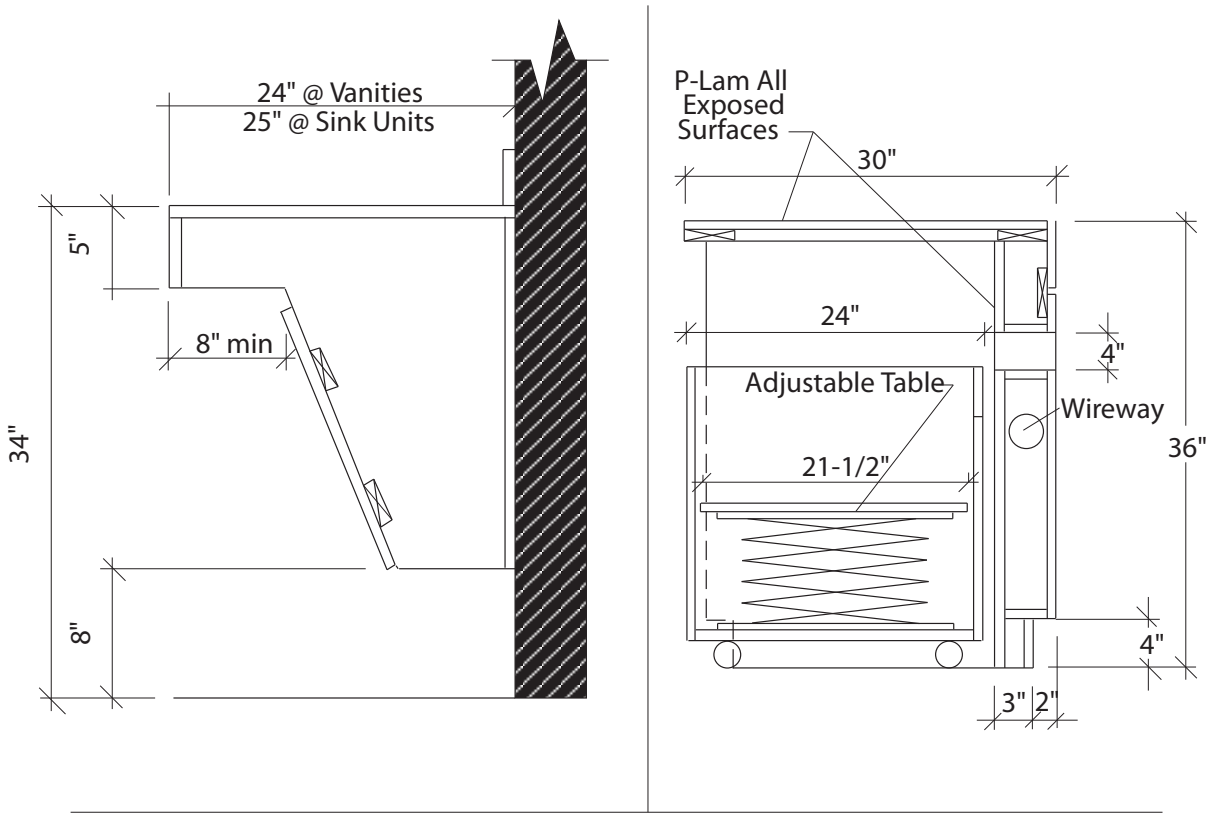


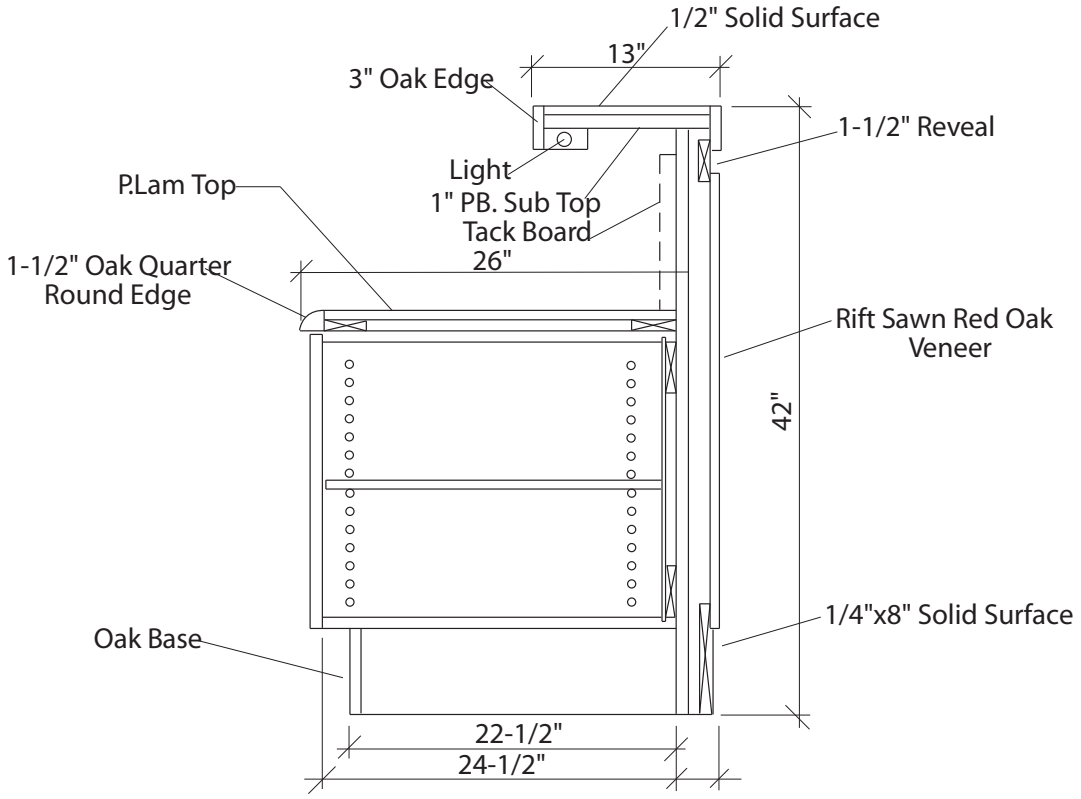




10 - Casework

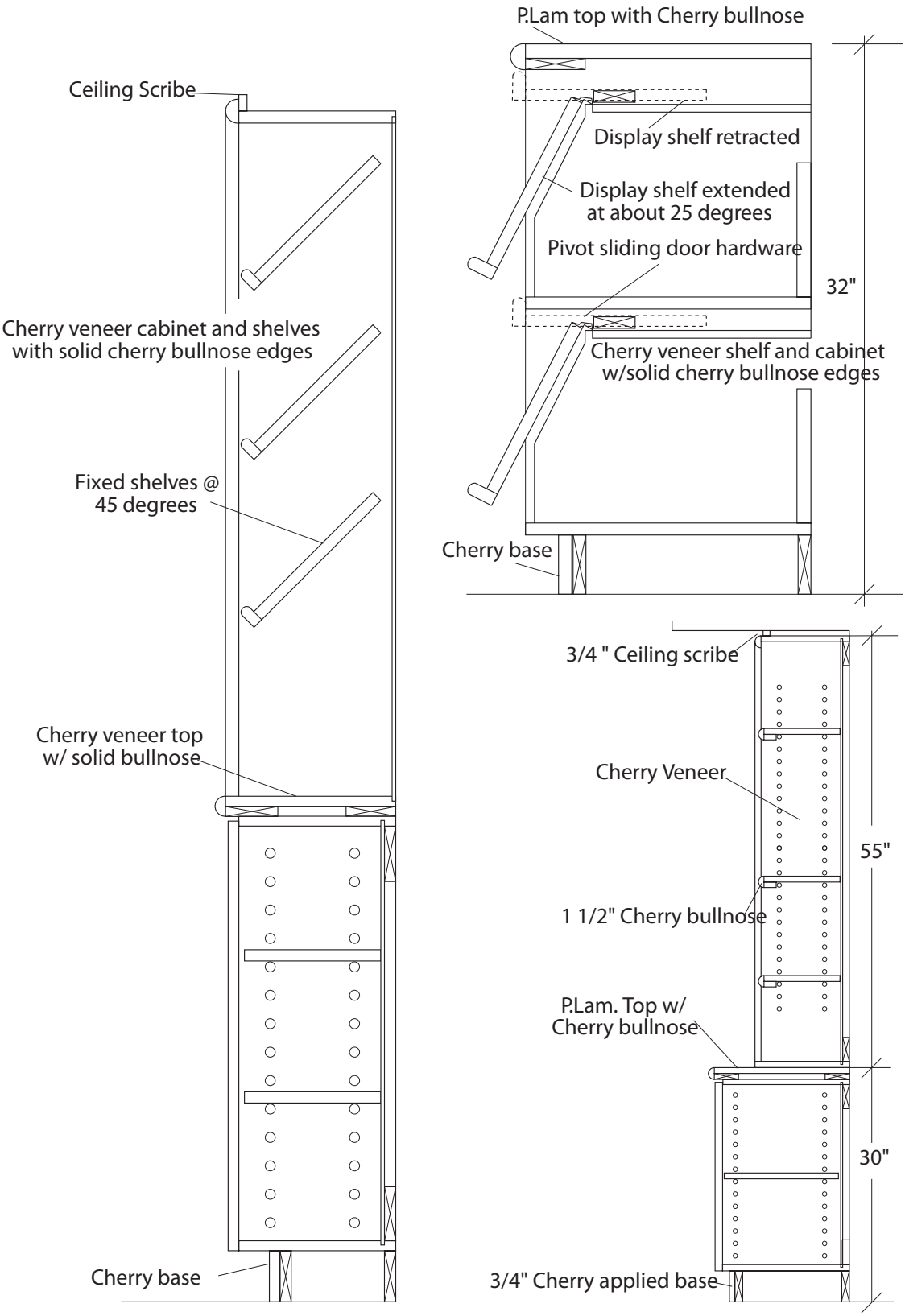
Corporate Woodwork





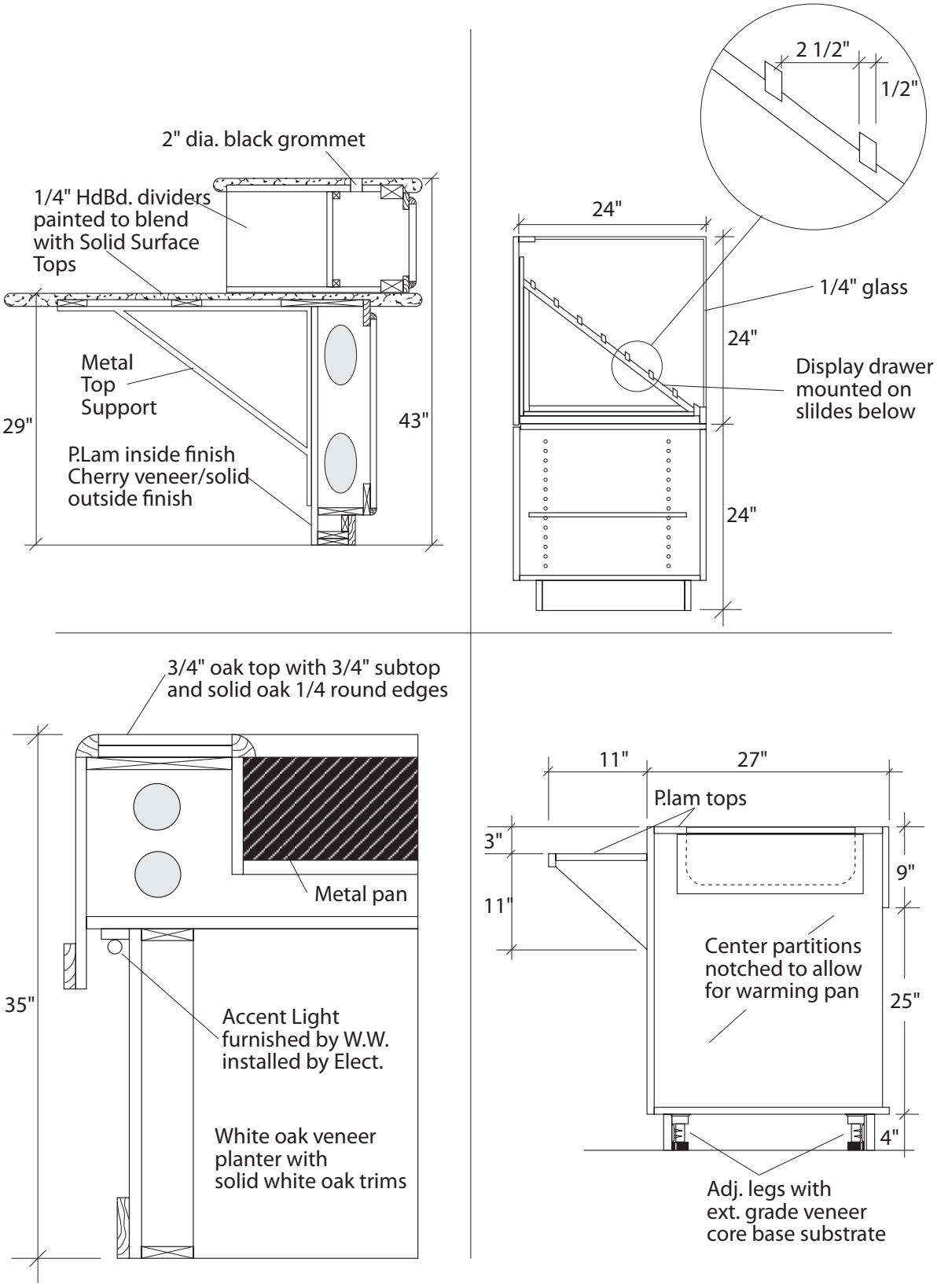
10 - Casework

Furniture and Fixtures



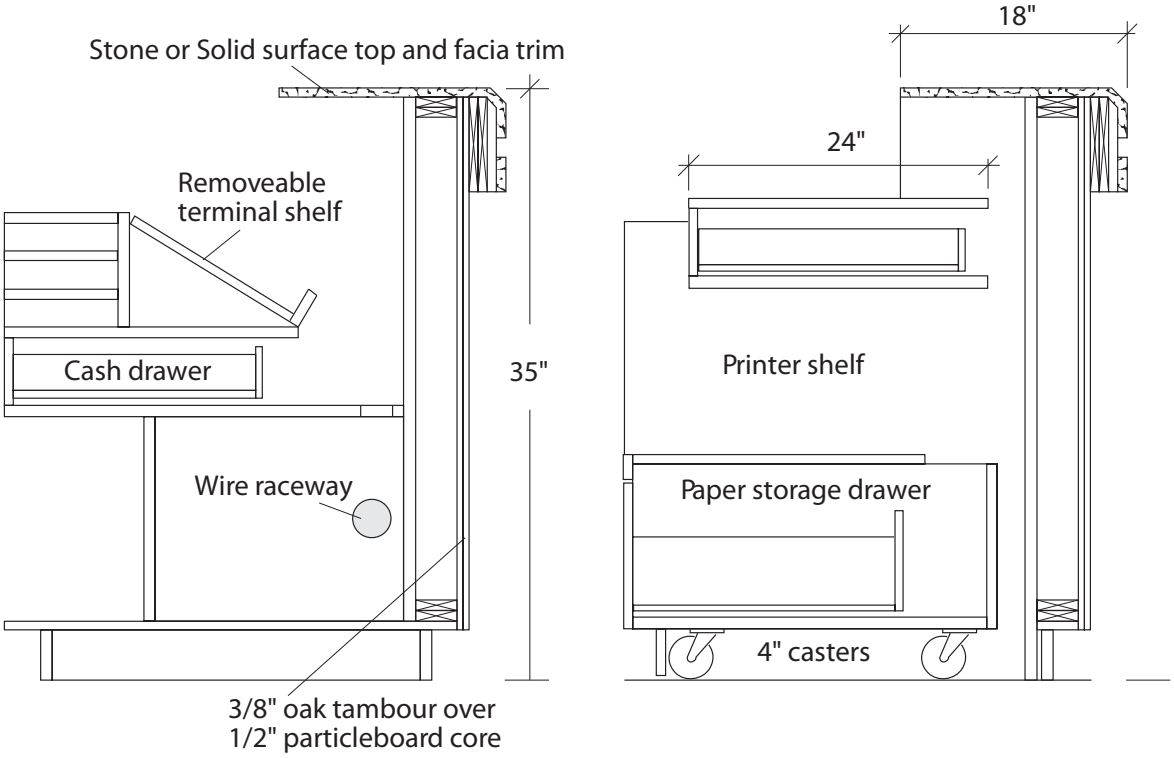
10 - Casework

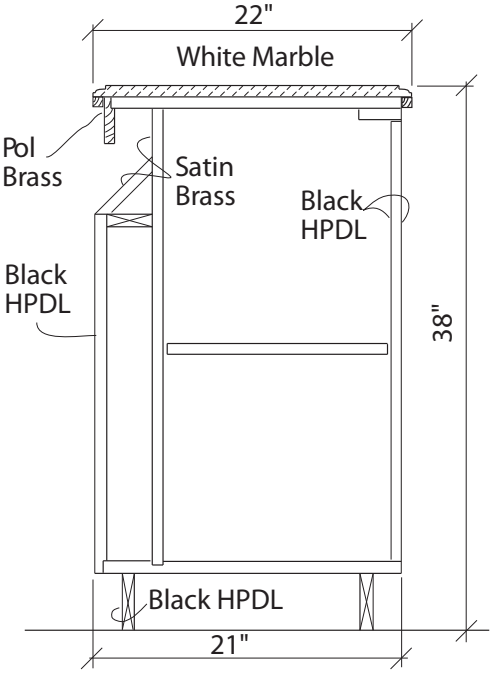
Furniture and Fixtures

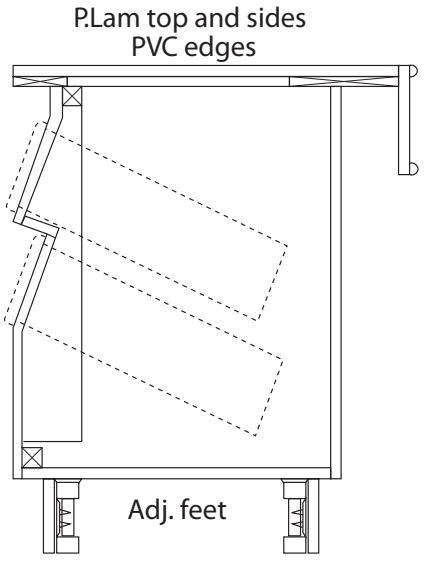


10 - Casework

Furniture and Fixtures



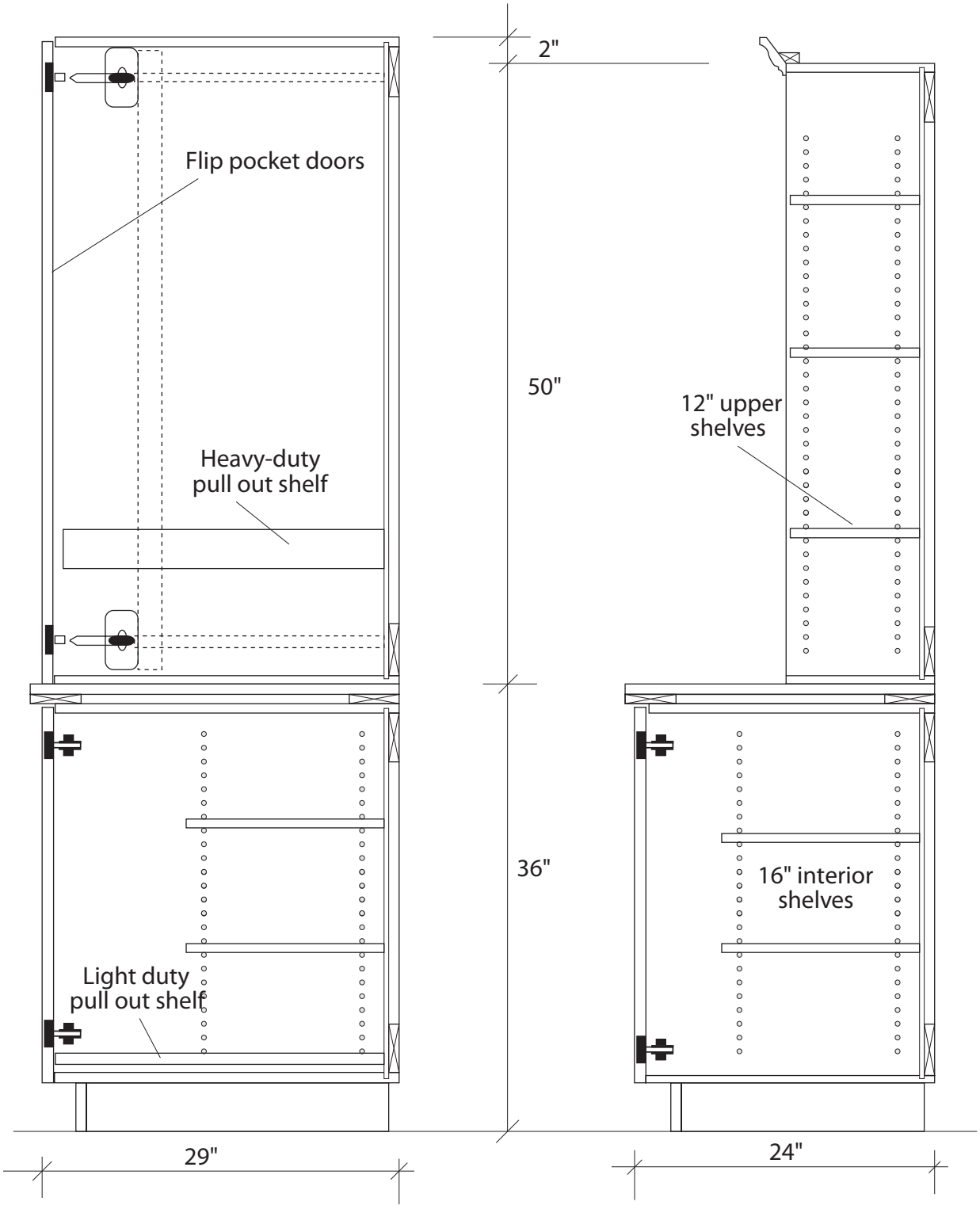




Cup dispenser inserts by owner

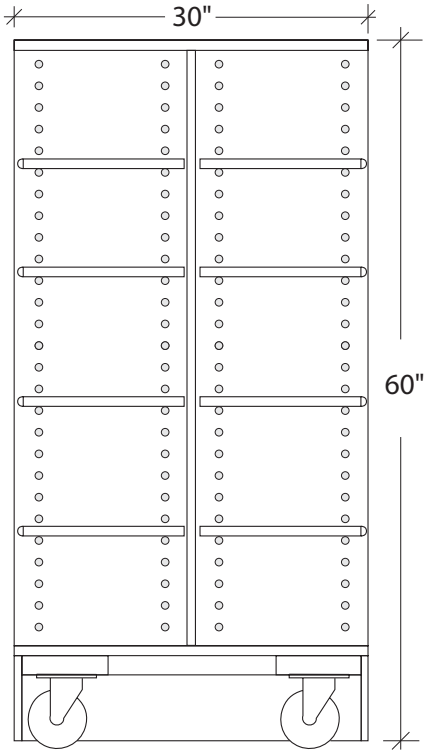
10 - Casework

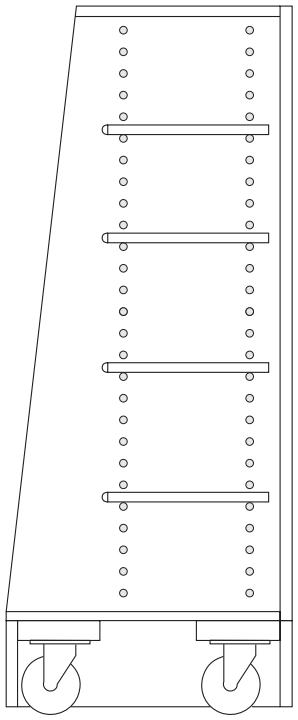
Furniture and Fixtures



10 - Casework

Furniture and Fixtures

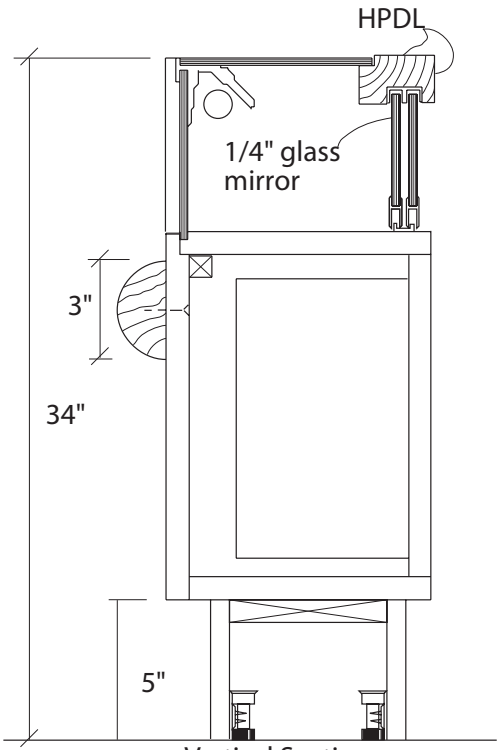




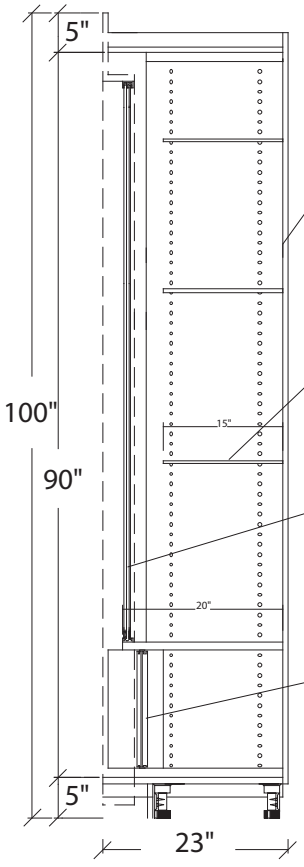
Single and Double-sided Units with bullnosed shelves

Finished back on single sided units

All exposed surfaces White Oak and White Oak veneer



Vertical Section
Jewelry Showcase



1/2" PtBd. wrapped w/ fabric

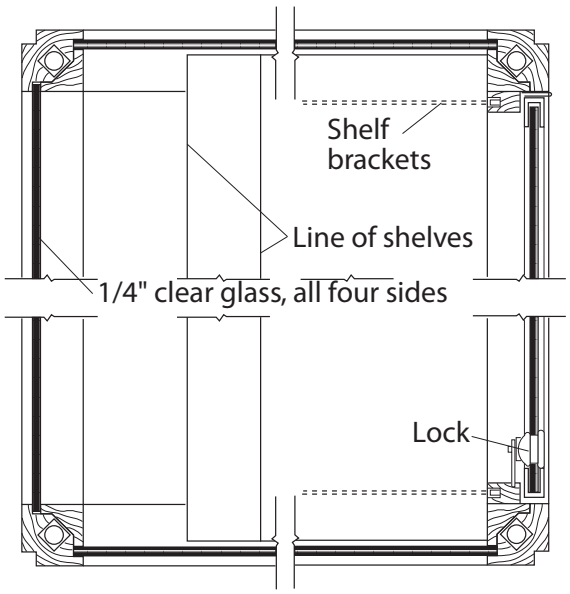
Glass shelves

1/4" clear glass sliding doors

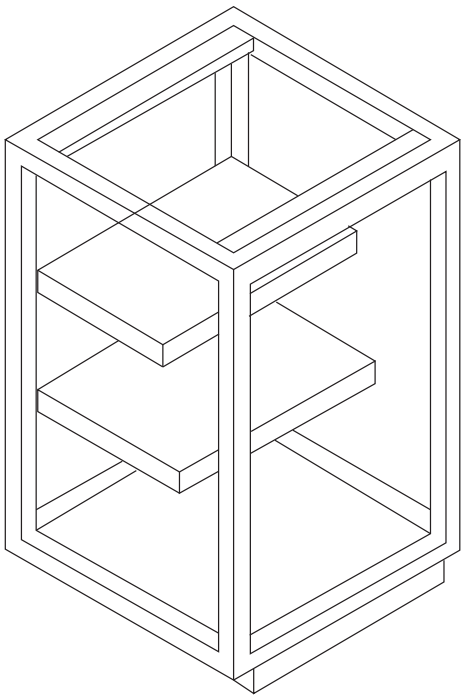
3/4" white oak veneer sliding doors

10 - Casework

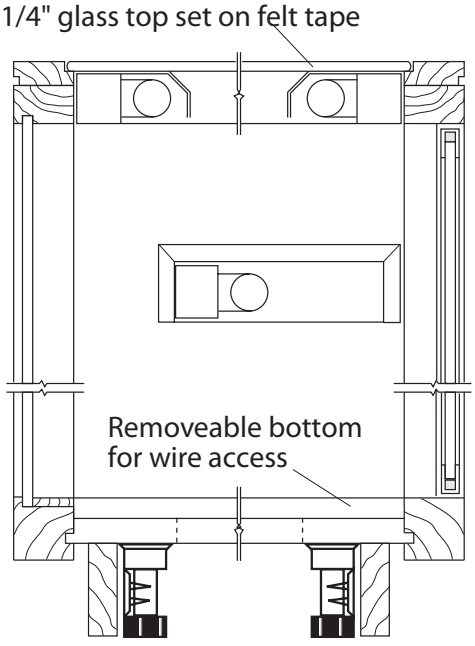
Furniture and Fixtures



Plan Section



Isometric



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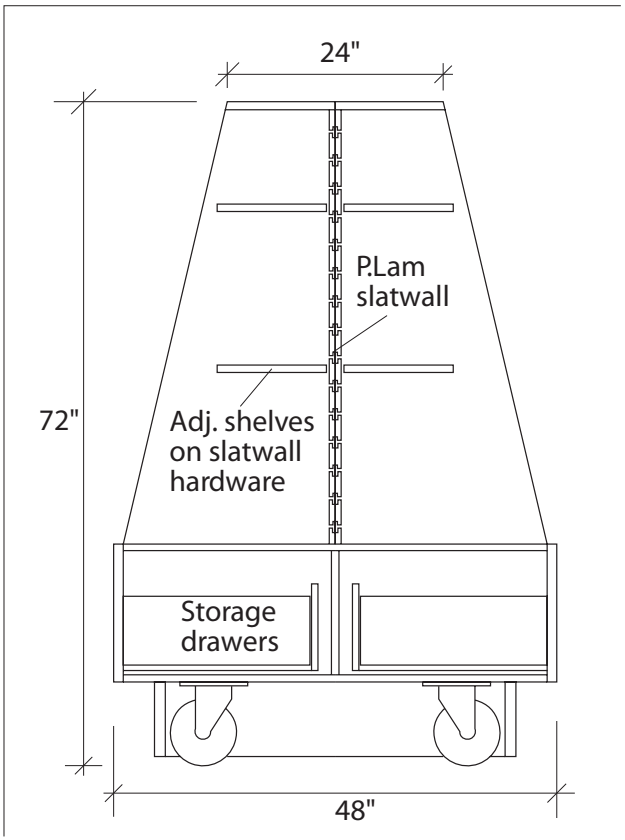
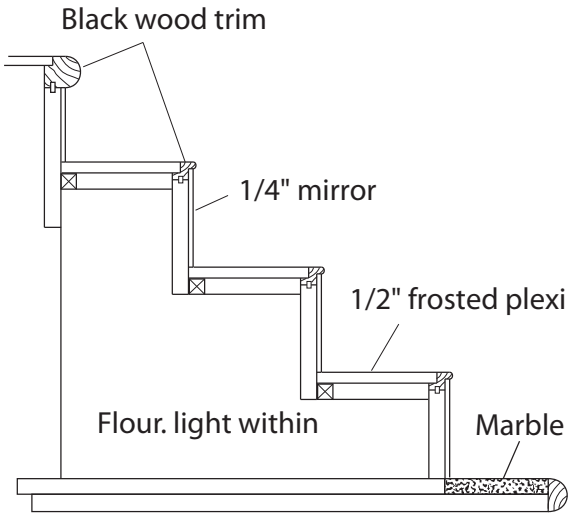
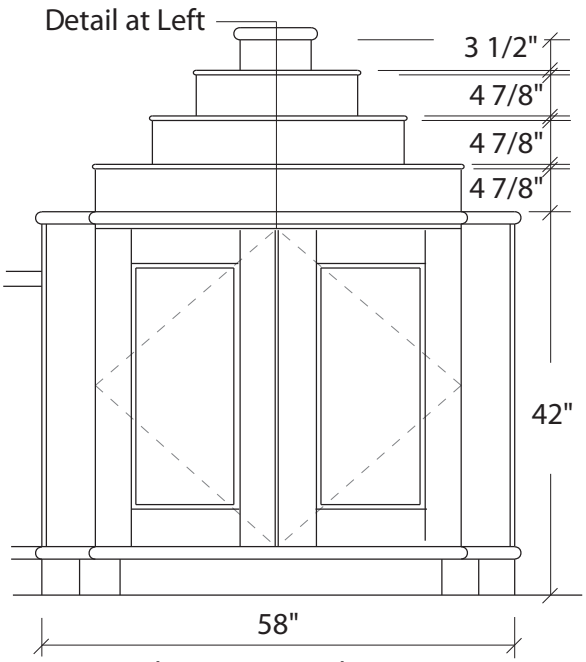


10 - Casework

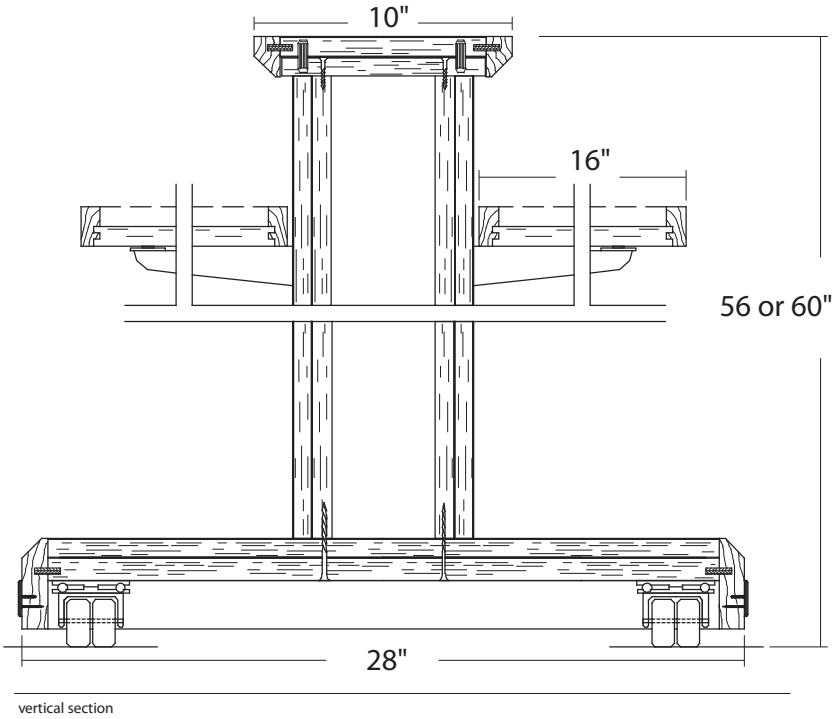
Furniture and Fixtures



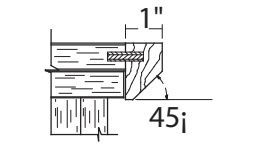
Detail at Top of Back Bar

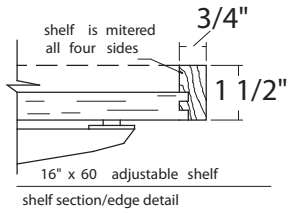


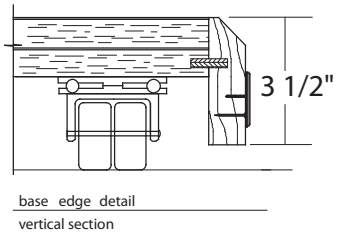
Elevation at Back Bar



Rolling Display Store Fixture

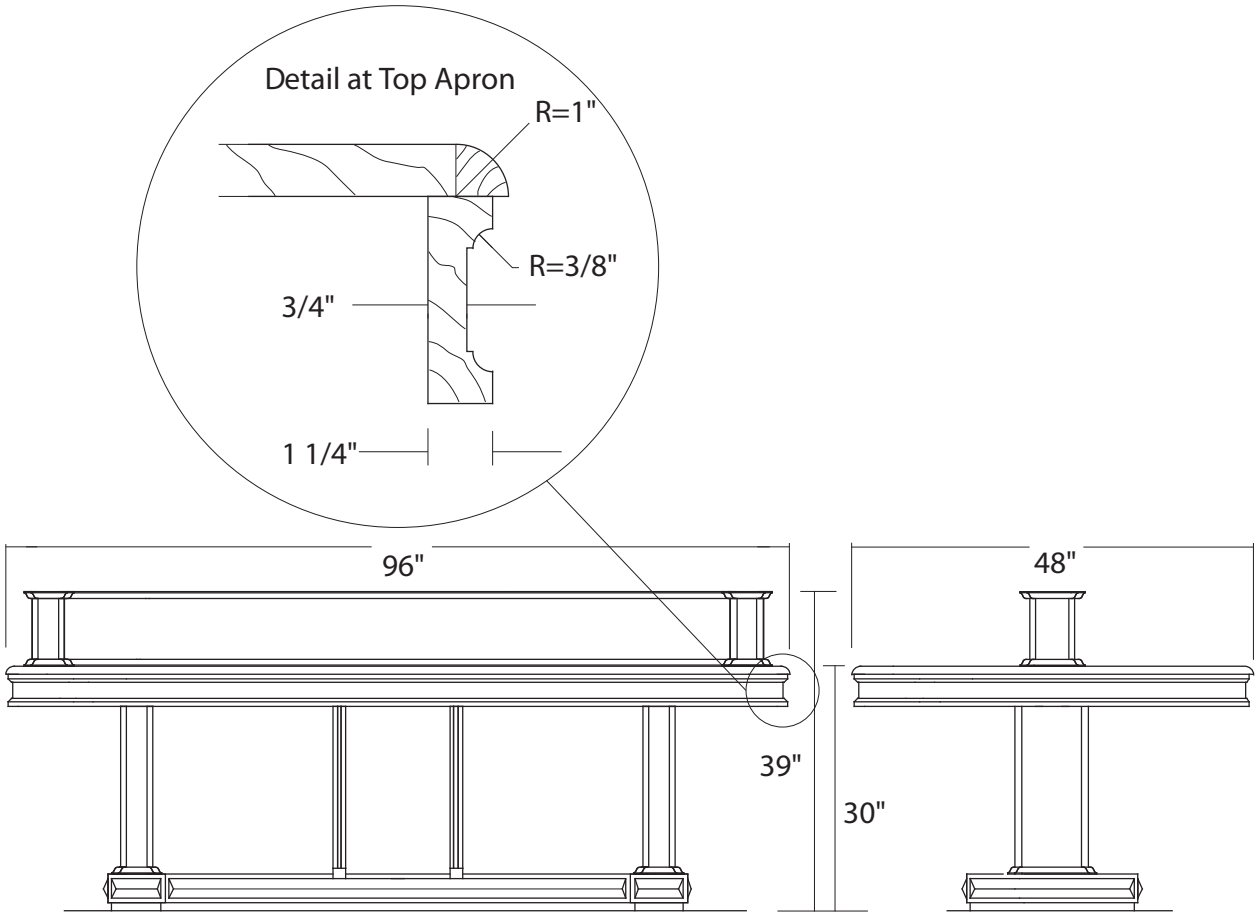






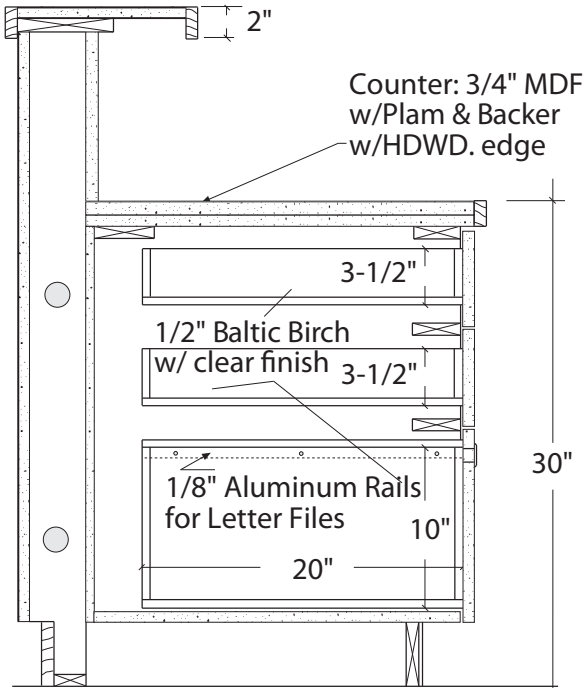
10 - Casework

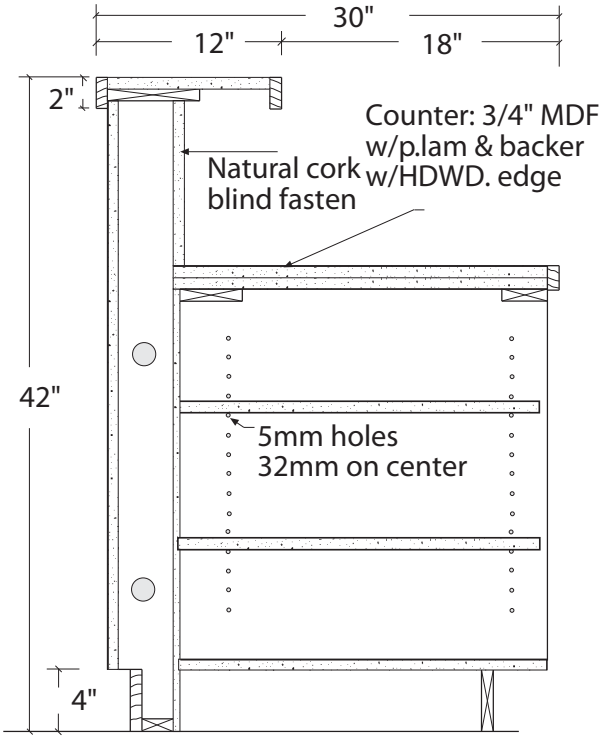
Furniture and Fixtures

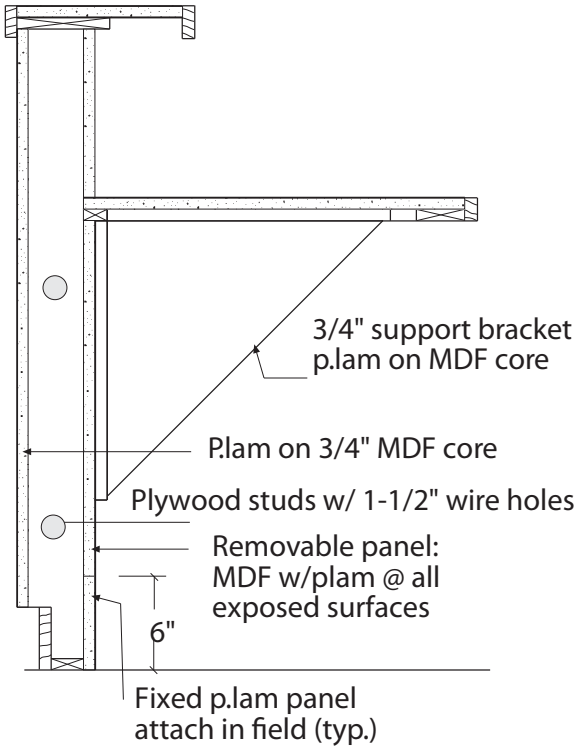


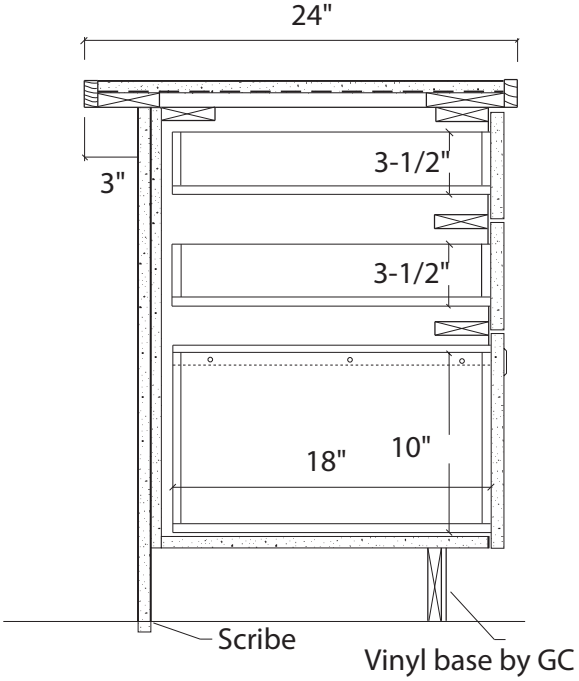
10 - Casework

Reception



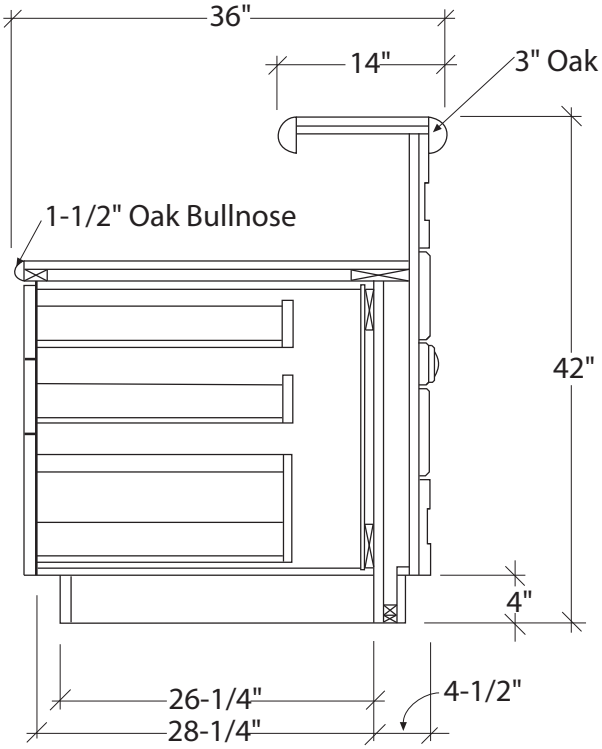


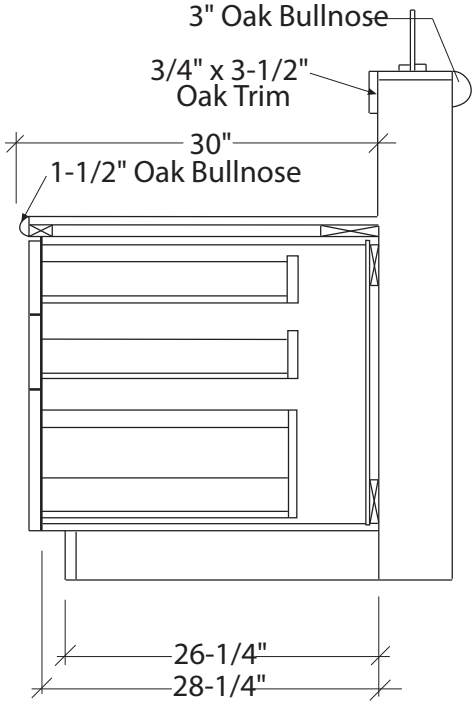


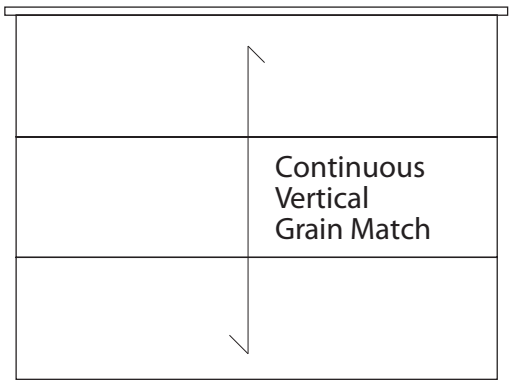


10 - Casework

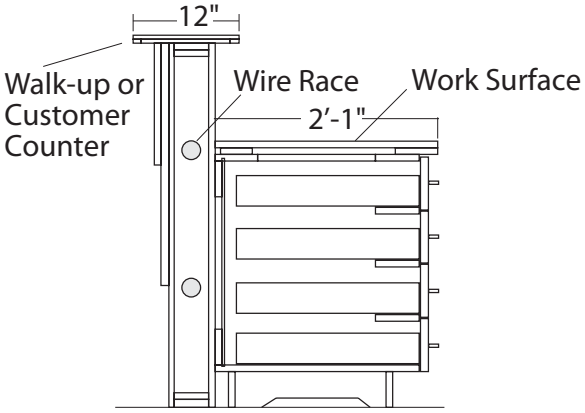
Reception







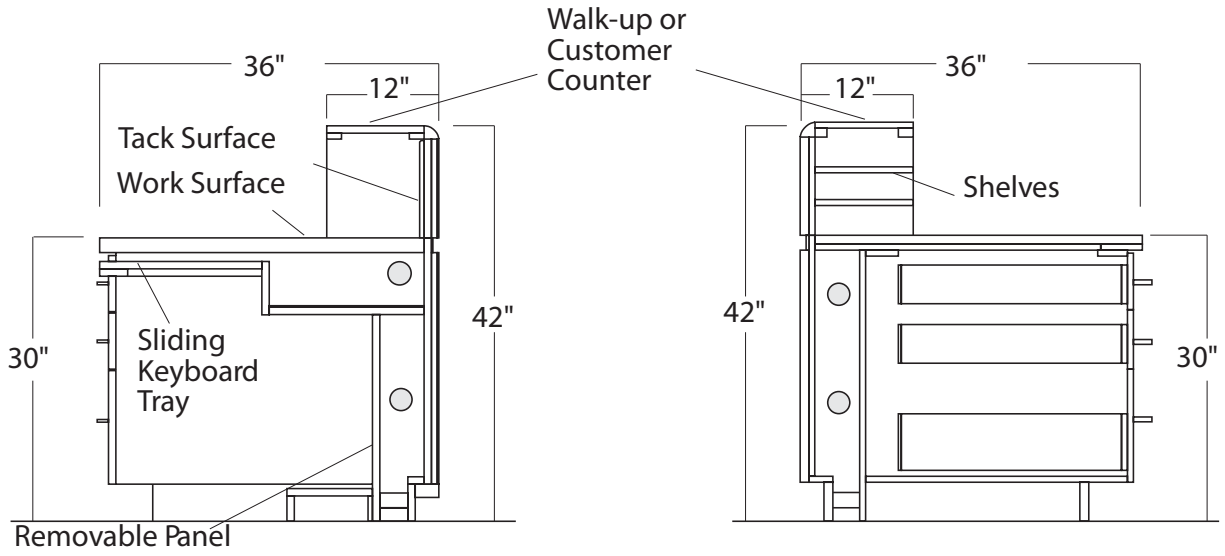
Front Elev. - Small Reception Desk w/ Drawers

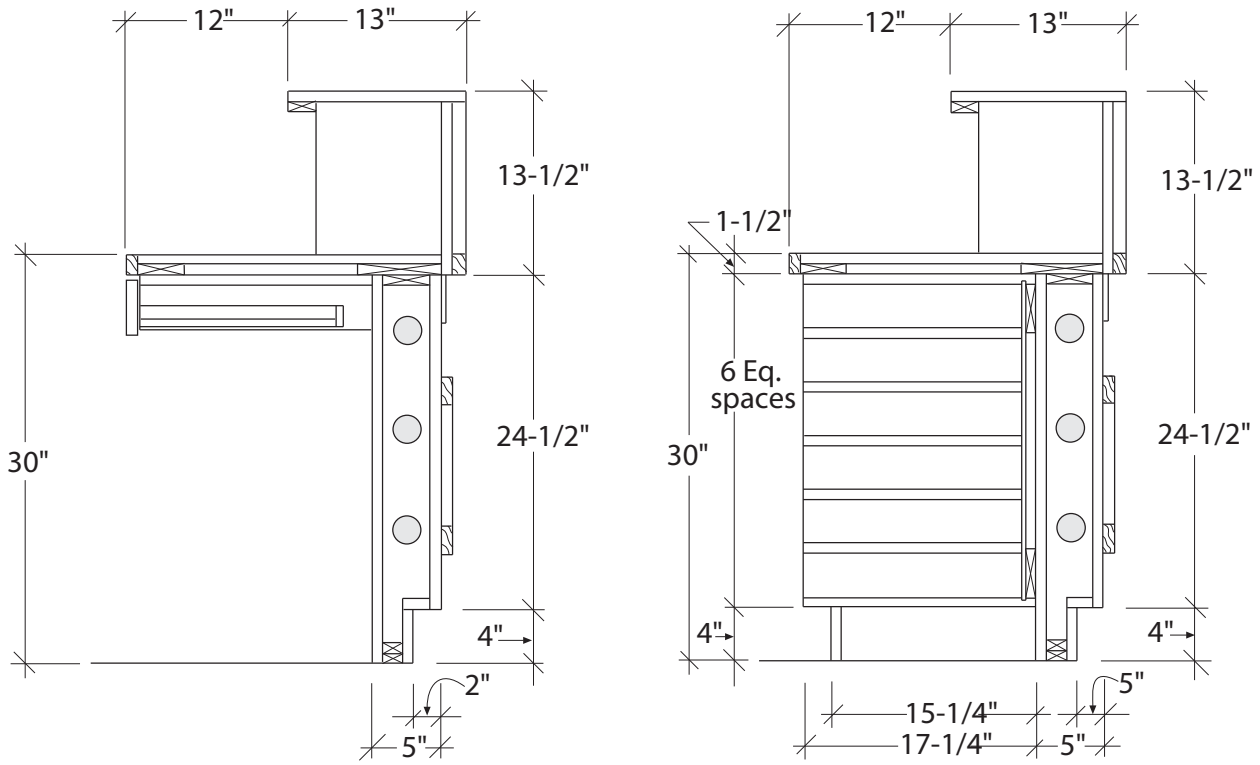


Sect. thru Typ. Drawer
Stack/Reception

10 - Casework

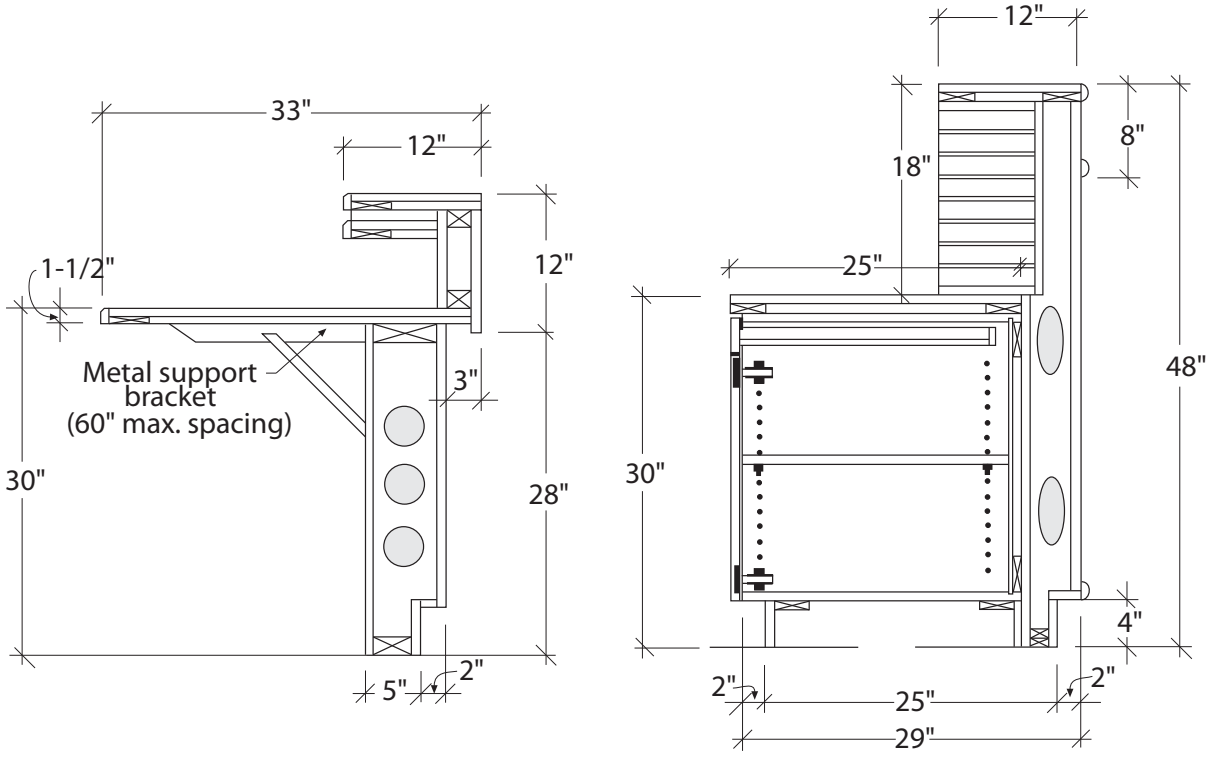
Reception

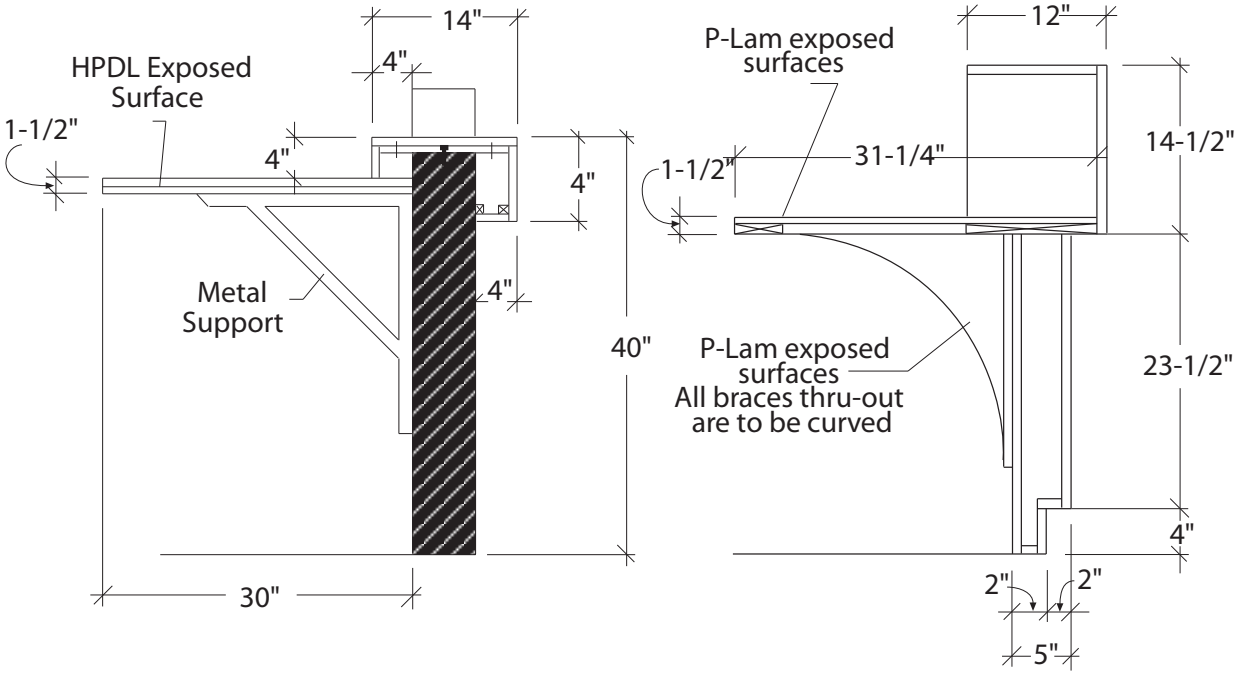




10 - Casework

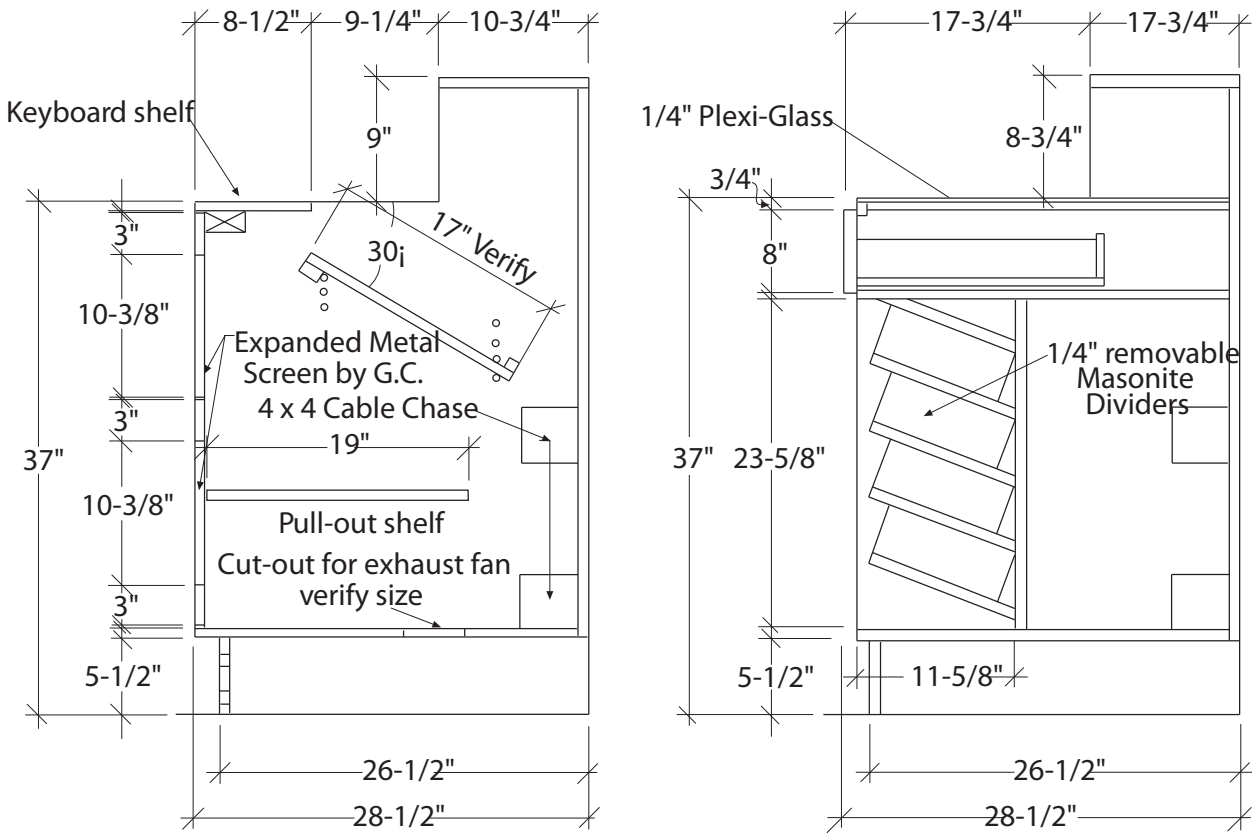
Reception

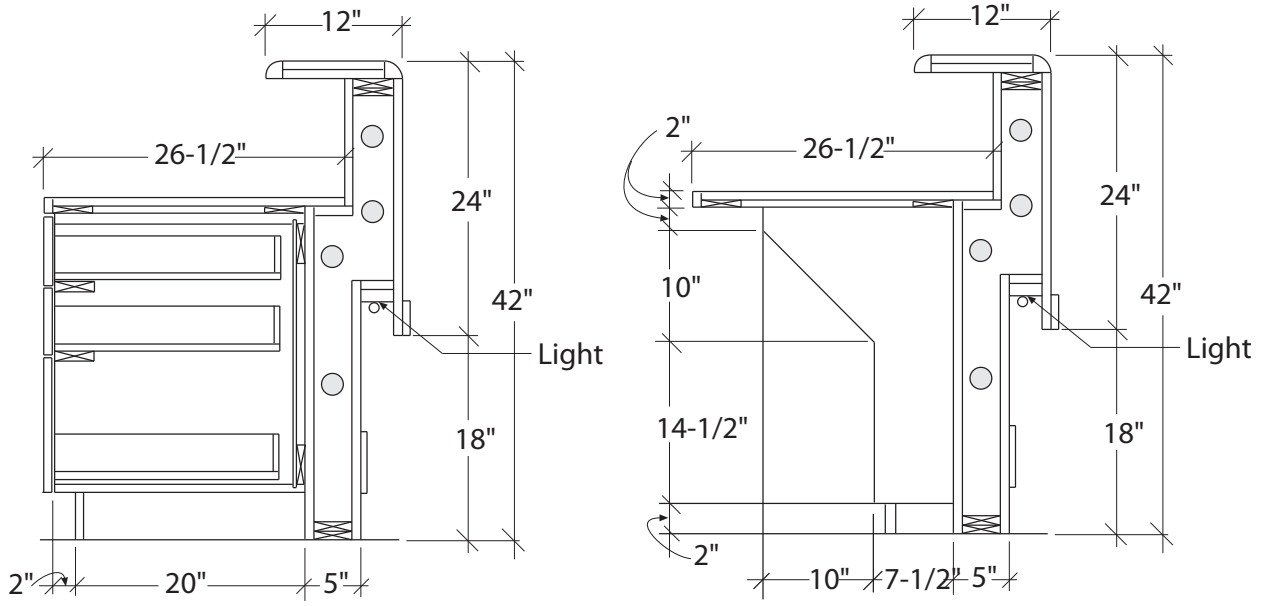




10 - Casework

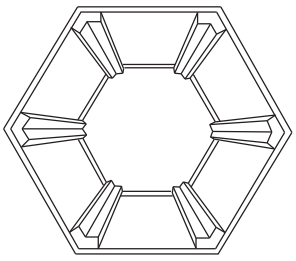
Reception





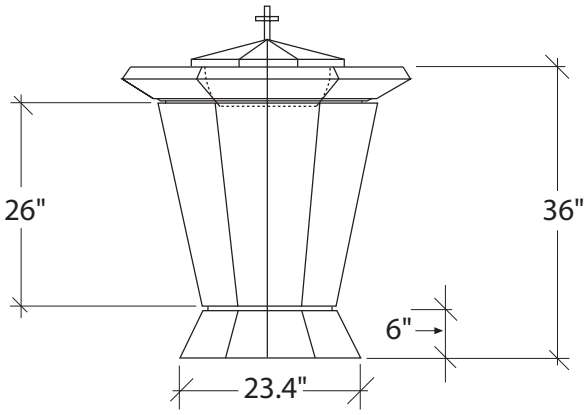
10 - Casework

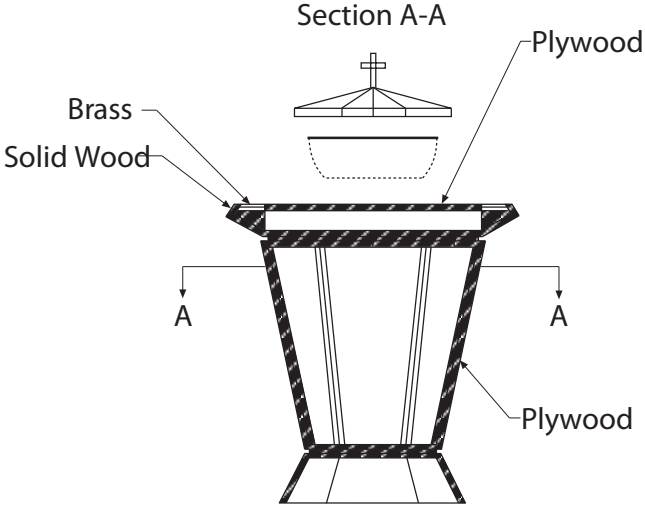
Church Fittings



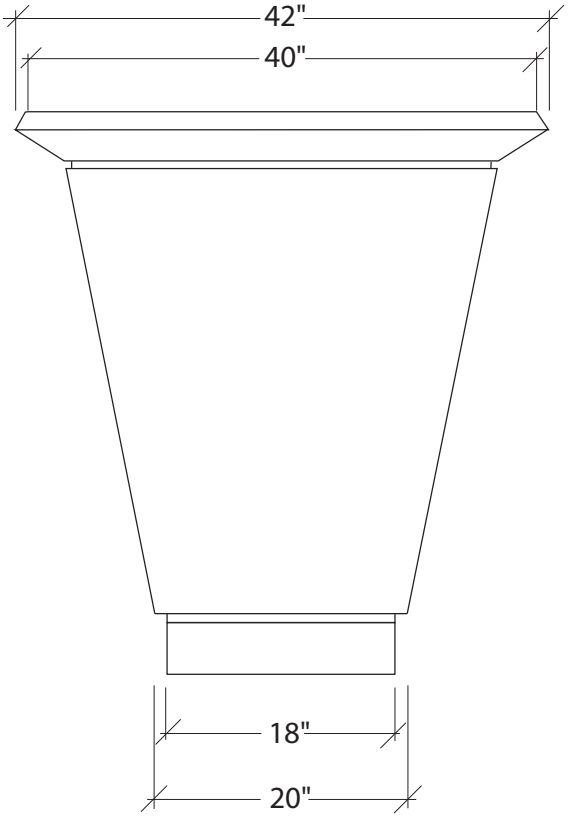
Section A-A

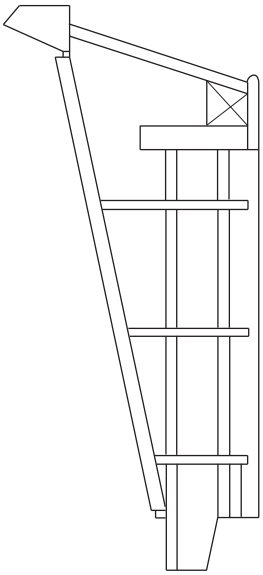
Baptismal Font





Vertical Section

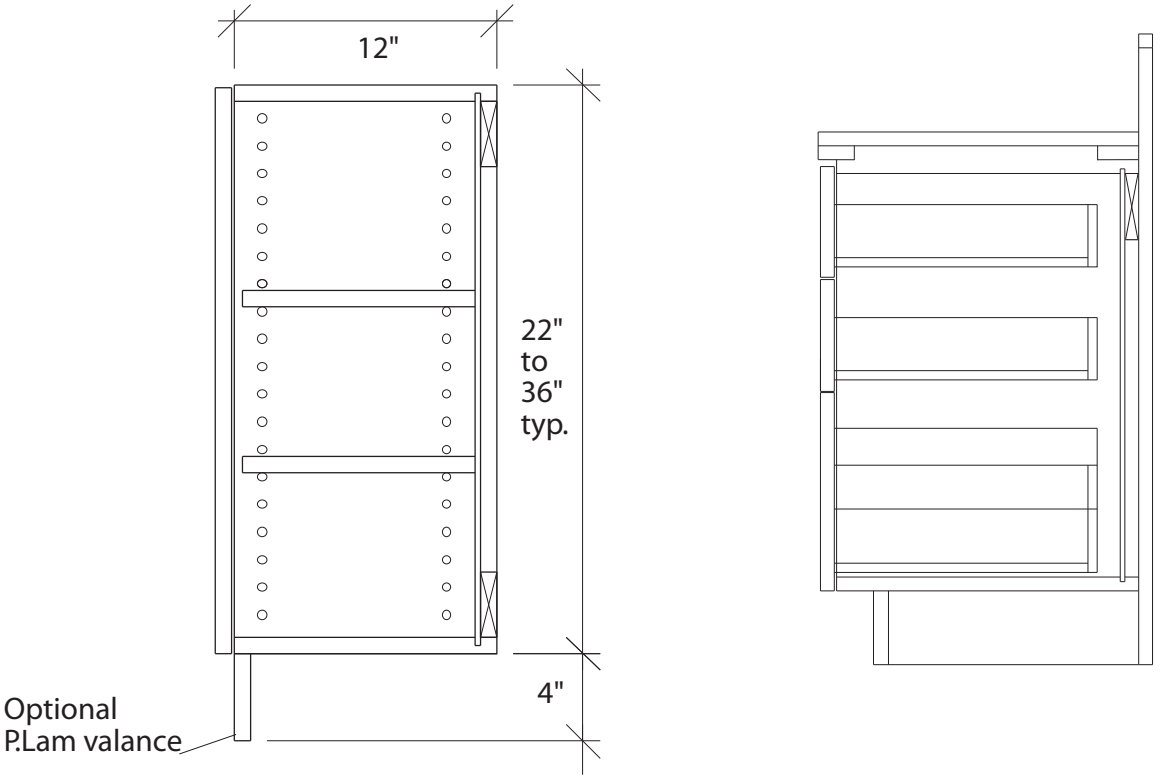


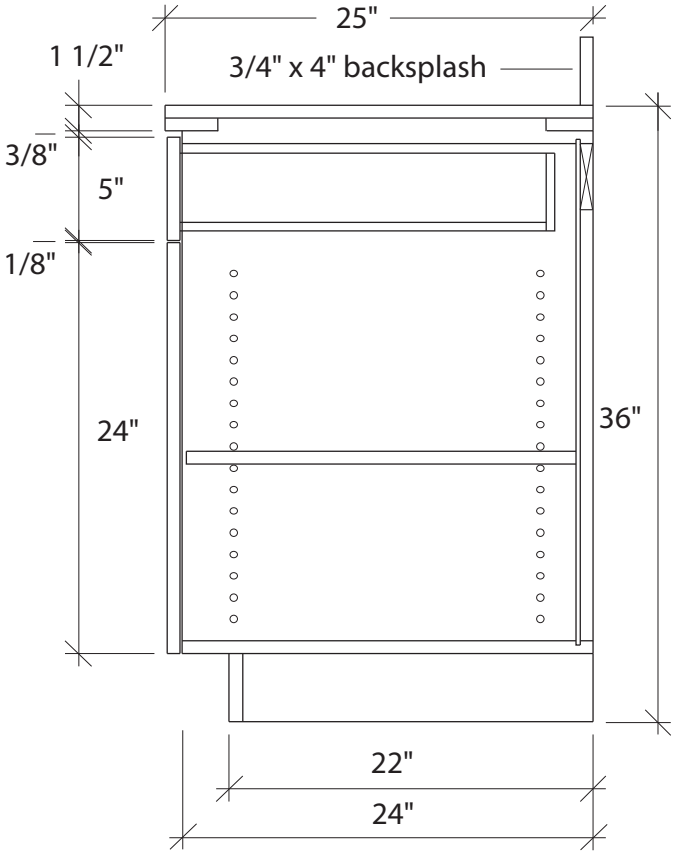


Lectern

10 - Casework

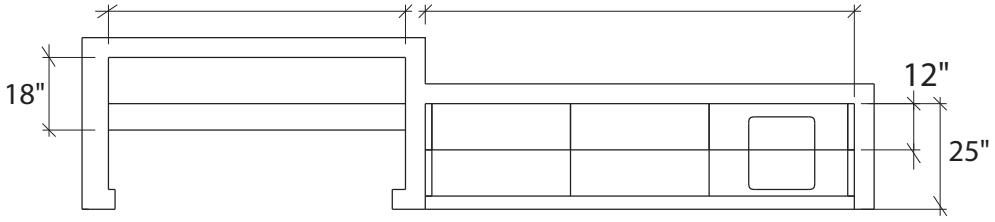
Basic Cabinetry

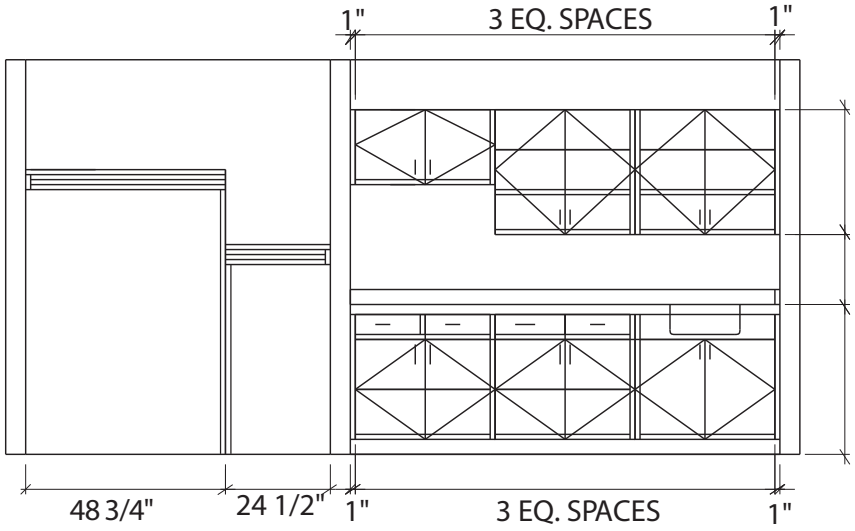


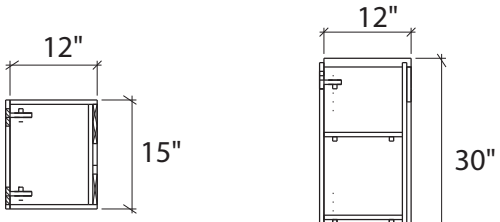


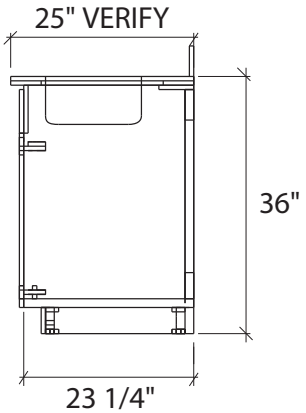
10 - Casework

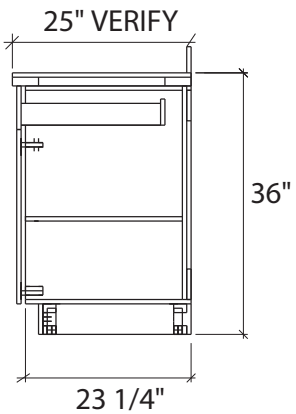
Basic Cabinetry









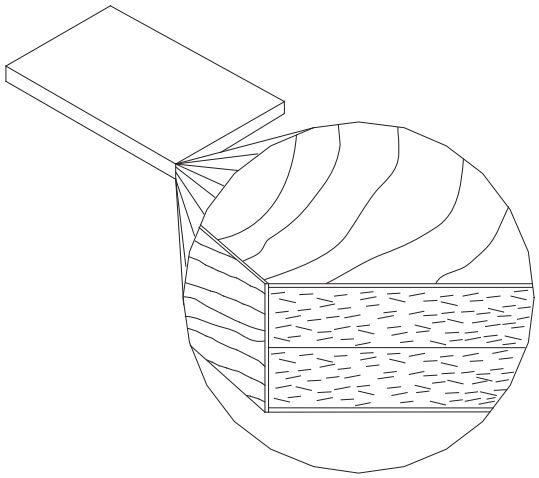


11
Countertops

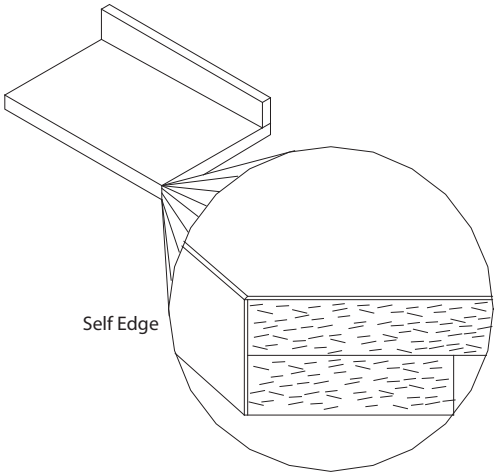
11 - Countertops

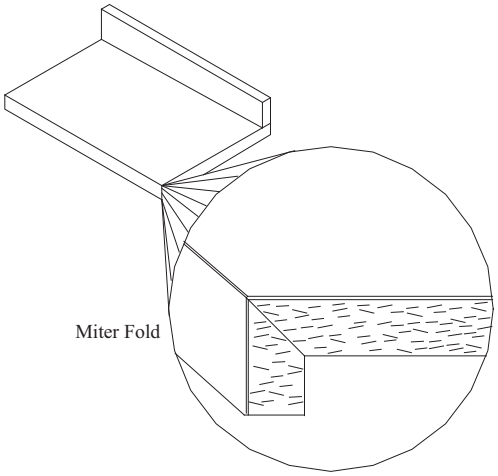
Typical Countertop Configurations:

A. Panel Product Tops - This type of top consists of wood veneer over a stable substrate, veneer edge banded or with an applied decorative edge of another material as specified.

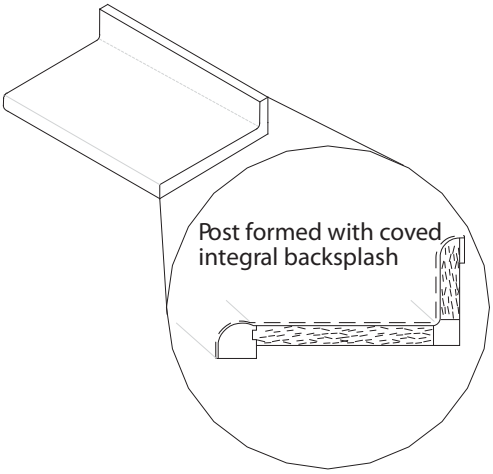


B. High Pressure Decorative Laminate (HPDL) Tops - This type of top consists of plastic laminate over a stable substrate, self edge banded or with an applied decorative edge of another material as specified.

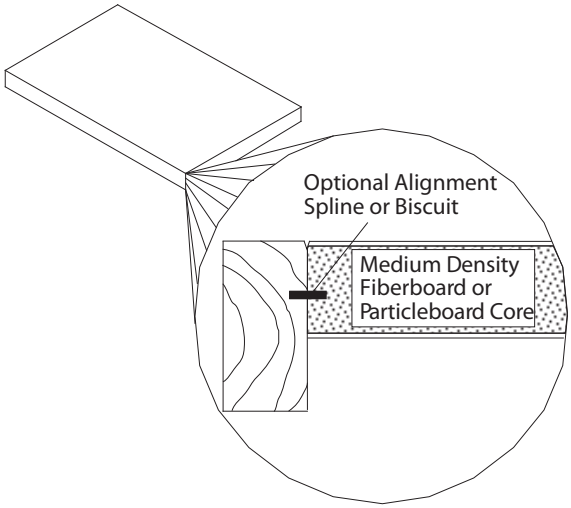




C. Post-formed High Pressure Decorative Laminated Tops - This type of top consists of plastic laminate formed with heat and pressure over a stable substrate and must be specified.

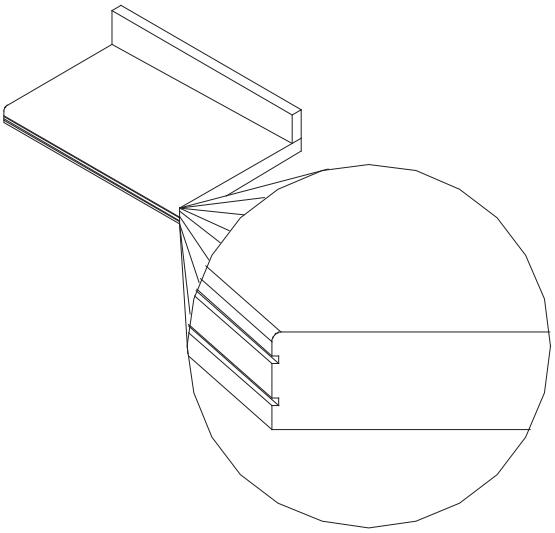


D. Combination Material Tops - This type of top may consist of a mixture of materials, such as wood, high pressure decorative laminate, inlays, etc.

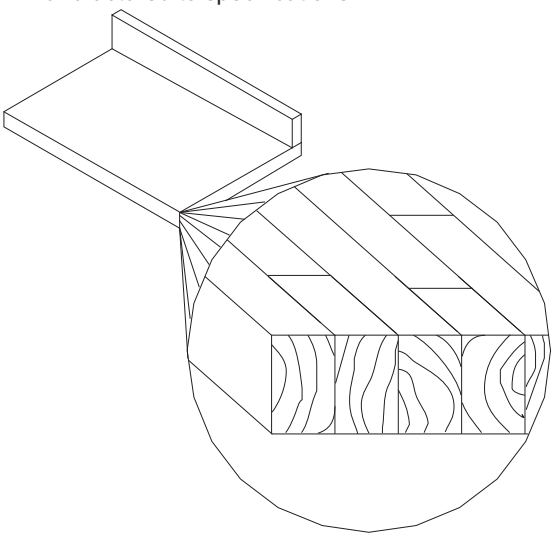


11 - Countertops

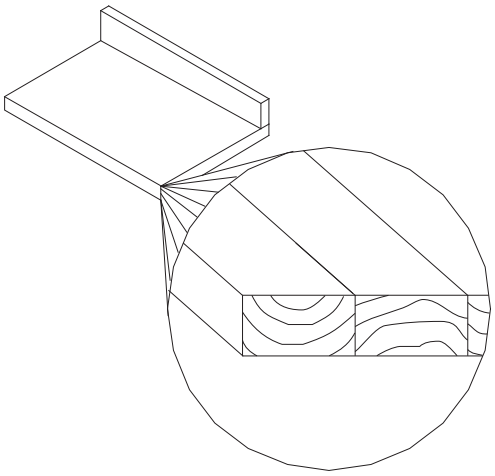
E. Solid Surfacing Materials - This type of top requires special fabrication techniques, depending upon the composition of the product. Many woodworkers fabricate and install the products. Must be specified by brand name and manufacturer.



F. Solid Laminated Tops - This type of top consists of narrow strips of wood, face glued together, similar to “butcher block,” but custom manufactured to specifications.



G. Solid Wood Tops - This type of top consists of boards edge glued to a desired width. In this kind of top there is no assurance of matching grain or color at the edges or individual ends of the boards.



H. Epoxy Resin Laboratory Tops and Splashes - Specially formulated resin tops designed to resist harsh chemicals. Must be specified by brand name and manufacturer.

11 - Countertops

General Guidelines for Fabrication and Installation for HPDL

Data was taken in part from the National Electrical Manufacturers Association (NEMA), and is used with permission.

When making any cutout (as for electrical receptacles, ranges, sinks, grills, windows, chopping blocks, L-shaped counter tops, and so forth), all inside corners should be smoothly rounded using a minimum comer radius of $^{1}/_{8}$" [3 mm]. A router is an ideal tool for making cutouts. (1)

When removing large areas from a sheet of laminate (e.g., a sink cutout), the connecting strips between the remaining areas should be left as wide as possible. (2)

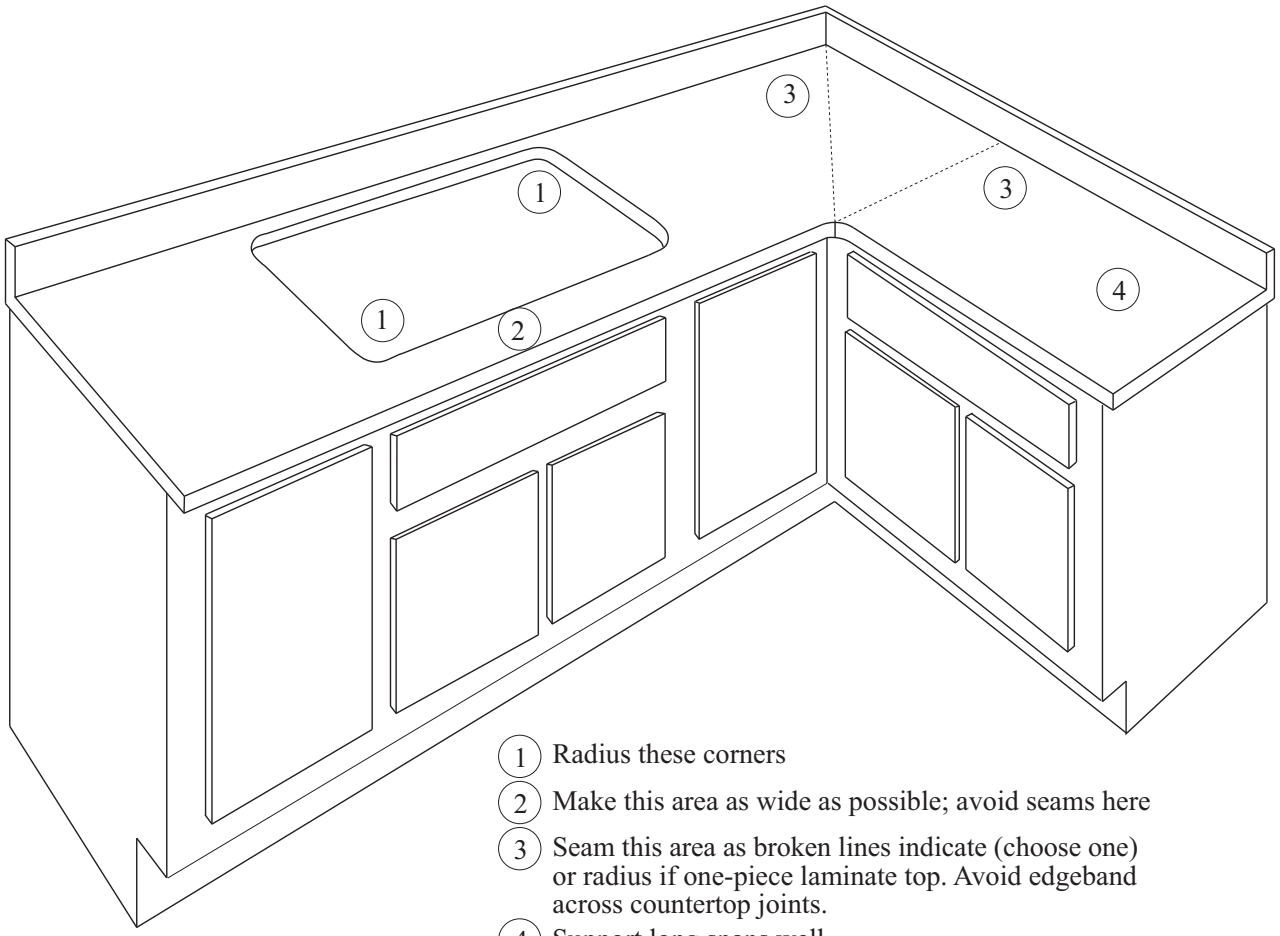
Factory-trimmed sheet edges and saw-cut edges should be routed or filed. Original edges on factory-cut laminates are not finished edges since oversized laminates are supplied to allow for proper fabrication.

All chips, saw marks, and hairline cracks should be removed from cuts by filing, sanding, or routing.

Backsplash seam areas on countertops which are exposed to spilled water or other fluids should be *sealed with caulking* to ensure a tight seal.

When laminate is bonded to a substrate, precaution should be taken to prevent warping of the assembly. Laminates used on shelves or in long unsupported spans should make use of a backer. A thick backer (approximately the same thickness as the face sheet), can provide more stability than a thin backer. Thicker laminates can offer better dimensional stability and resistance to stress (corner) cracking. Paint, varnish, vinyl film, and fiber backers will not balance HPDL.

Before using nails or screws, oversized holes should be drilled through the laminate with a sharp drill bit.



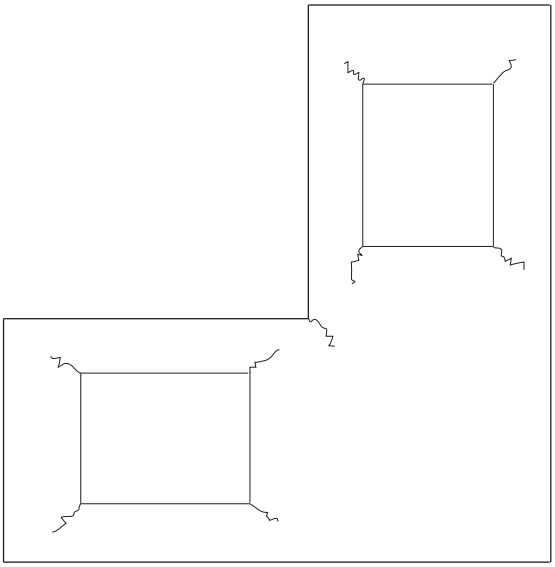
1. Radius these corners
2. Make this area as wide as possible; avoid seams here
3. Seam this area as broken lines indicate (choose one) or radius if one-piece laminate top. Avoid edgeband across countertop joints.
4. Support long spans well

11 - Countertops

Typical Problems - Causes and Prevention

Some of the problems that may arise after laminates have been fabricated and installed are the following:

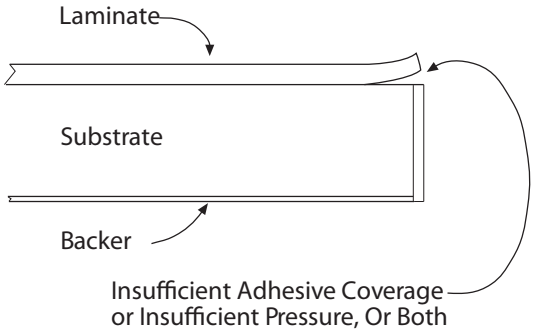
CRACKING of the laminate at corners and around cutouts may be caused by improper conditioning, improper bonding and, sometimes, poor planning, or any combination of these reasons. Cracking may be caused by shrinkage; conditioning helps to prevent it. Rough edges, inside corners that have not been rounded, binding and/or forced fits can contribute to cracking.



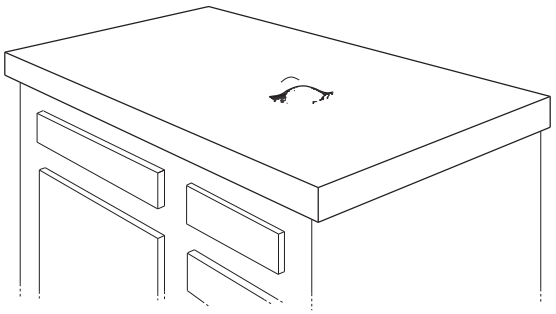
If the seams are properly placed in the layout of the laminate, stresses can be minimized.

SEPARATION of the laminate from the substrate may generally be caused by a poor adhesive bond. The bonding procedure should be reviewed with close attention to uniform glue line, uniform pressure and cleanliness of mating surfaces. If the edges fail to bond, extra adhesive may be applied and the product reclamped. Contact adhesives can often be reactivated by heat and rebonded by adequate pressure if the glue line is not starved.

NOTE: Some cleaning agents, excess heat, and moisture can contribute to bond failure at joints and edges.

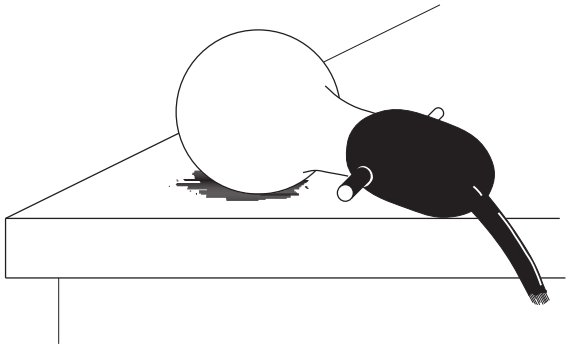


BLISTERING or **BUBBLING** of the laminate surface away from the substrate can be caused by excessive heat, starved glue line, improper conditioning, and inadequate pressure or drying. When contact adhesive is used, the condition can sometimes be corrected by applying heat and pressure. But uniform glue lines and pressure over clean conditioned laminates and substrate might have prevented the problem.

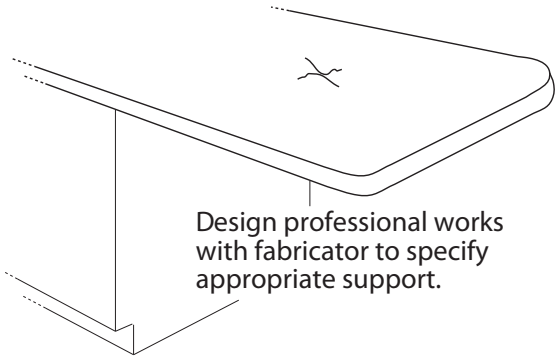


The forming of a blister or bubble over a small area, often accompanied by a darkening of the laminate can be caused by continual exposure to a source of heat. Electrical appliances which produce heat and light bulbs should not be placed in contact with or close proximity to laminate surfaces.

REPEATED HEATING may cause the laminate and adhesive to react and finally deteriorate after continual exposure to temperatures above 66° C [150˚ F].



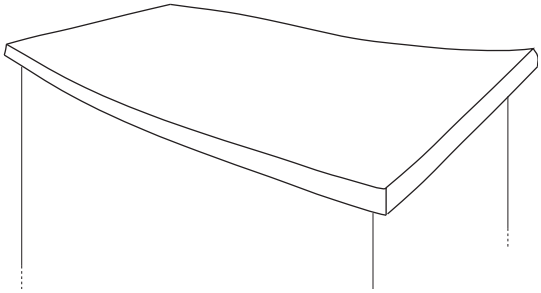
CRACKING of the laminate in the center of the sheet may be caused by flexing of the substrate when it covers a wide span or by spot gluing. Wide spans call for sturdy framework, and special attention should be given to the uniformity of glue lines and gluing pressures. Also, care should be taken to avoid trapping foreign objects between the laminate and the substrate.



11 - Countertops

LONG, UNSUPPORTED SPANS are generally avoided. Most manufacturers limit spans to between 760 to 915 mm [30 to 36"] before the addition of a support of some type. A wide variety of engineering solutions are available.

WARPING of the assembly may be generally caused by unbalanced construction or unbalanced glue lines. Proper HPDL backer sheets should be chosen and aligned so that their grain direction is parallel to that of the face laminate. Proper gluing is also important. If the substrate is secured to a framework, the framework should be designed to hold the assembly to a flat plane. Conditioning is also helpful.



FREEDOM OF EXPRESSION

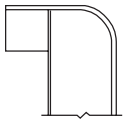
This Section is a sample of design ideas. It makes no pretense of being complete. It's here for the reader to use as a starting place. The exercise of personal creativity is the essence of fine architectural woodworking.

Custom-designed woodwork gives you complete freedom of expression.

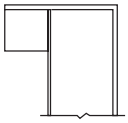
- Design flexibility: The use of custom-designed woodwork in a building allows the design professional freedom of expression while meeting the functional needs of the client. A custom-designed building is enhanced by the use of custom-designed woodwork.
- Cost effective: Custom woodwork does compete favorably with mass-produced millwork, and offers practically limitless variations of design and material. Most woodwork lasts the life of the building - quality counts.
- Complete adaptability: By using custom woodwork, the architect or designer can readily conceal plumbing, electrical and other mechanical equipment without compromising the design criteria.
- No restrictions: Custom architectural woodwork permits complete freedom of selection of any of the numerous hardwoods and softwoods available for transparent or opaque finish. Other unique materials available from woodwork manufacturers require no further finishing at all, such as plastic laminates and decorative overlays. These materials can be fashioned into a wide variety of profiles, sizes, and configurations. The owner and design professional have the best of both worlds - high quality and freedom of choice.
- Dimensional flexibility: Since custom woodwork is normally produced by a specialty architectural woodwork firm, dimensions can easily be changed prior to actual fabrication, if required by job conditions. Special situations such as designing for the disabled can readily be accommodated by the custom architectural woodwork manufacturer.
- Quality assurance: Adherence to the *AWS* and specifications will provide the design professional a quality product at a competitive price. Use of a qualified industry member firm will help ensure the woodworker's understanding of the quality level required.

11 - Countertops

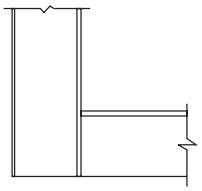
These illlustrations are not intended to be all inclusive. Other engineering solutions may be acceptable. In the absence of specifications, fabrication methods are at the option of the woodwork manufacturer.



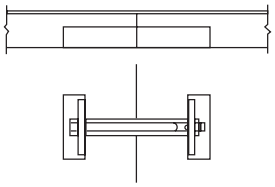
Radiused Top



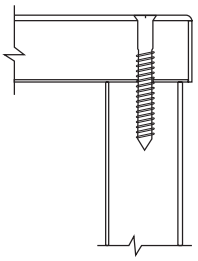
Square Top



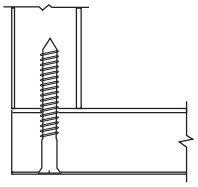
End Splash Joint



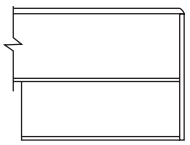
Tight Joint Fastener



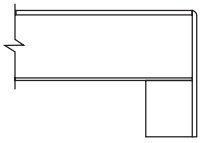
Removable Ledge



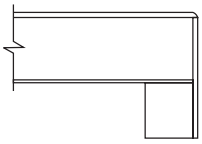
Square Splash Joint



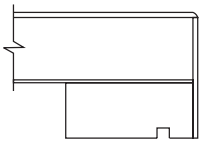
Self Edge w/ Wide Build Up



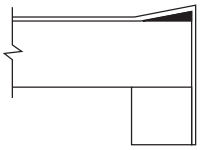
Self Edge Economy



Self Edge Premium/Custom

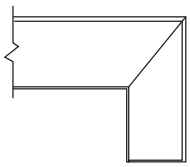


Self Edge w/ Drip Groove Laboratory

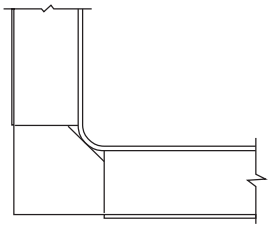


No Drip Self Edge

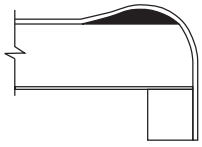
The details below cannot be made on radiused counter tops:



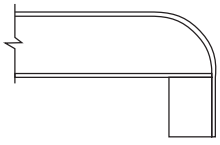
Miter Fold



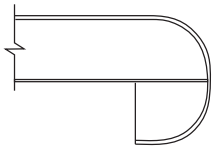
Coved Splash Joint



No-Drip Edge



Waterfall Edge



Full Round Edge

Details courtesy of The Woodwork Institute of California
Used with permission.

NOTES

12
Installation

12 - Installation

Site Conditions, Materials, and Preparation

It is the responsibility of the general contractor to insure the following site conditions which are required for the installation to meet the *AWS*.

A. Walls, ceilings, floors, and openings must be level, plumb, straight, in-line, and square.

NOTE: In the absence of floor tolerances in the contract documents, variance of a cabinet's toe base height due to floor variations is not a defect. Casework is required to be installed level. Shimming of toe base, not to exceed 12.5 mm [$^1/_2$"], is acceptable. Floor variations exceeding 12.5 mm [$^1/_2$"] shall be corrected before cabinets are installed. Wall panel installations are subject to the same tolerances at wall or ceiling. Correction is not the responsibility of the manufacturer or installer.

B. Prior to delivery and installation of architectural woodwork, casework and related woodwork, to the job site, the building environment shall be stabilized to provide condition that will maintain a relative humidity of not less than 25%, nor more than 55%.

NOTE: These parameters apply for most of North America. In any event, relative humidity during the time of installation shall remain within the range to be maintained during occupancy.

All woods are affected by humidity, which is the water/moisture, in vapor form, in the atmosphere, but not appreciably by heat. Lumber swells and shrinks, primarily in two directions only, thickness and width, and insignificantly in length. These changes in dimension, due to effects of humidity, vary with different species. Providing and maintaining a stable environment, from the time of delivery, through installation, and on through building occupancy, is the key to minimizing the effects of humidity.

C. Areas to receive architectural woodwork must be fully enclosed with windows installed and glazed, exterior doors in place, HVAC systems operational, and temporary openings closed. All plaster, wet grinding, and concrete work shall be fully dry.

D. A secure storage area must be provided within the building that is flat and level, clean, dry, well ventilated, protected from direct sunlight, and broom clean.

E. Unless specified as part of the installer's contract, it is the responsibility of the general contractor to furnish and install structure, grounds, and blocking, or other anchorage which become part of the walls, floors, or ceilings, required for architectural woodwork installation.

F. All metal backing strips welded to steel studs shall be as specified and/or detailed on architectural/design drawings to show locations and gauge of thickness of these items.

G. Should the architect, designer, or engineer omit details calling for the general contractor to supply necessary blocking or backing strips in the wall, either through inadvertence or otherwise, the architectural woodwork installer shall not proceed with the installation until such time as the blocking is installed by others. The owner or owner's general contractor is responsible for placing blocking acceptable to the woodwork installer prior to installation, with no penalty to the woodwork manufacturer or installer.

H. All preparatory work done by others shall be subject to inspection by the architectural woodwork installer, and may be accepted or rejected prior to commencing installation.

I. Rough openings which are installed by others prior to commencement of installation shall be built square, in plane, and to the proper dimensions.

Architectural woodwork is a "finish" trade, and should be installed after ceilings, plumbing, flooring, etc. The fabricator of the work shall not be held responsible for any damage that might develop by others not adhering to the above procedures.

Delivery and Storage Requirement

Architectural woodwork shall be delivered to the jobsite only after all painting, wet work, grinding, and similar operations are completed. For most areas of North America, the ambient relative humidity at the site, including both the storage and the installation areas, should be maintained between 25% and 55% prior to delivery and through the life of the installation. In any event, the range of relative humidity change should not exceed 30 percentage points. Relative humidity below 20% and above 80% is particularly harmful to wood and wood products, not to mention fabrics, ceiling materials, and flooring, wall coverings and the human inhabitants.

Installation (when specified)

The methods and skill involved in the installation of woodwork in large measure determine the final appearance of the project. Architectural woodwork shall be allowed to come to equilibrium on site prior to installation. A minimum of 72 hours shall be allowed for best results. Factory finished woodwork will require a week or more to acclimatize. The design, detailing and fabrication should be directed toward achieving installation with a minimum of exposed face fastening. The use of interlocking wood cleats or metal hanging clips combined with accurate furring and shimming will accomplish this. Such hanging of woodwork has the additional advantage of permitting movement that results from humidity changes or building movement.

Finishing (when specified)

This Section does not cover finishing. However, site conditions for finishing are rarely conducive to good results. Poor lighting, dust-laden air, and available techniques are limiting factors. In many areas woodworkers will factory finish, yielding better results than can be achieved from field finishing.

Priming and back priming are the responsibility of the general contractor unless specified otherwise.

When projects are factory finished under Section 9, field touch-up is the responsibility of the installing contractor, and includes the filling and touch-up of exposed job-made nail or screw holes, refinishing of raw surfaces resulting from job fitting, repair of job-inflicted scratches and mars, and final cleaning of the finished surfaces. The prefinisher may be contracted to supply touch-up materials by special arrangement and agreement between the finisher and the general contractor.

12 - Installation

Fire-Retardant Ratings

(when specified)

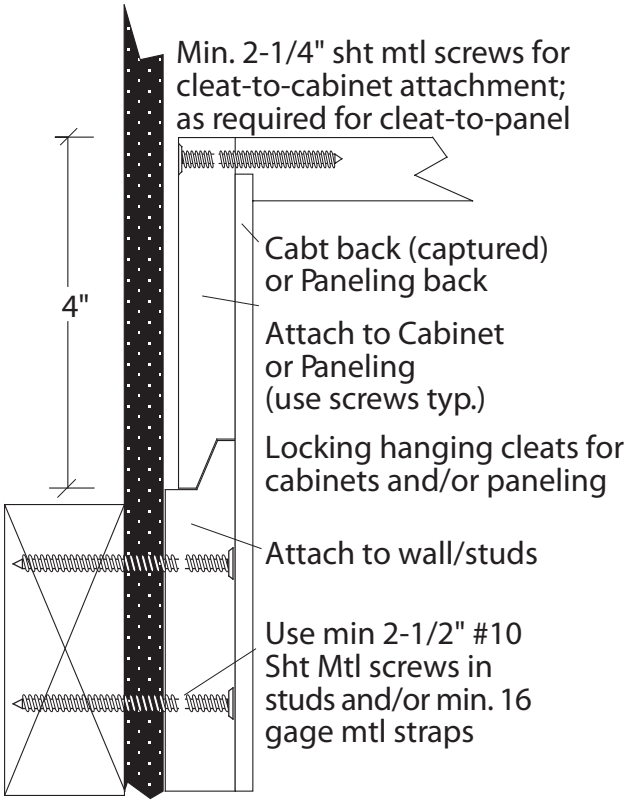
It is the responsibility of the specifier to research local codes and to indicate what fire-retardant rating, if any, is required for the specific items and classifications of the woodwork.

In the absence of such a specified rating, the woodworker shall supply, and the installer shall install unrated woodwork.

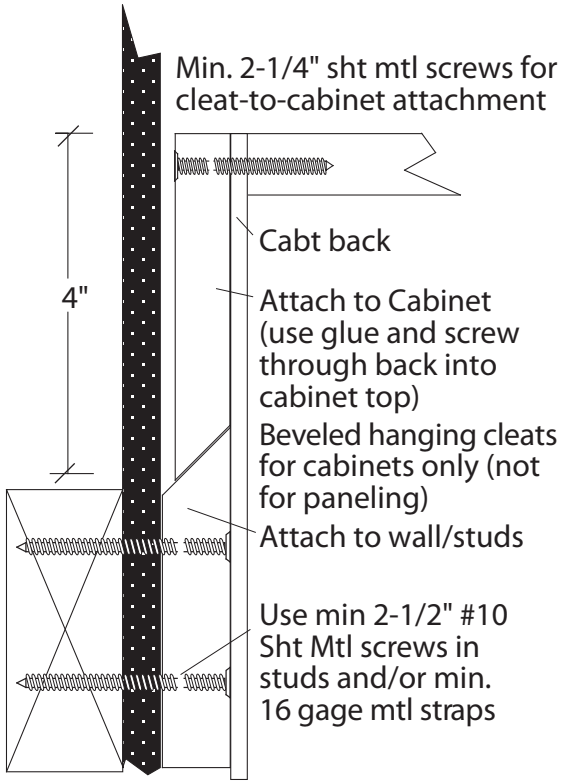
Recommendations which follow

Illustrations do not represent the only possible, practical, or appropriate engineering solutions for the issues shown. Design professionals and woodworking professionals often work together to create innovative solutions for installation. Solutions proposed by responsible parties shall not be deemed inappropriate merely because they are not shown herein. Variance from compliance with the *AWS* can be, and often is, granted by the design authority or owner.

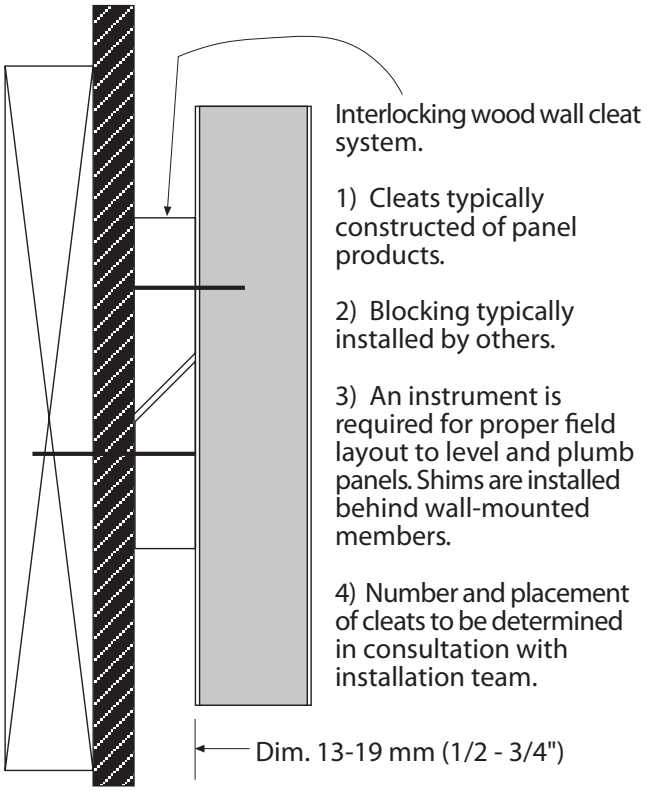
Hanging Cleat Recommendations



CABINET OR PANEL HANGING

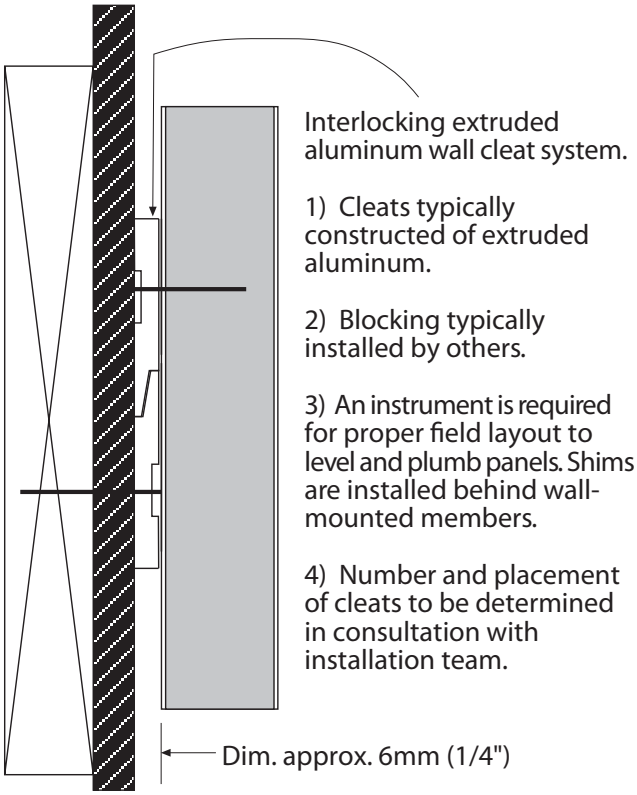


CABINET HANGING



WOOD INTERLOCK

12 - Installation

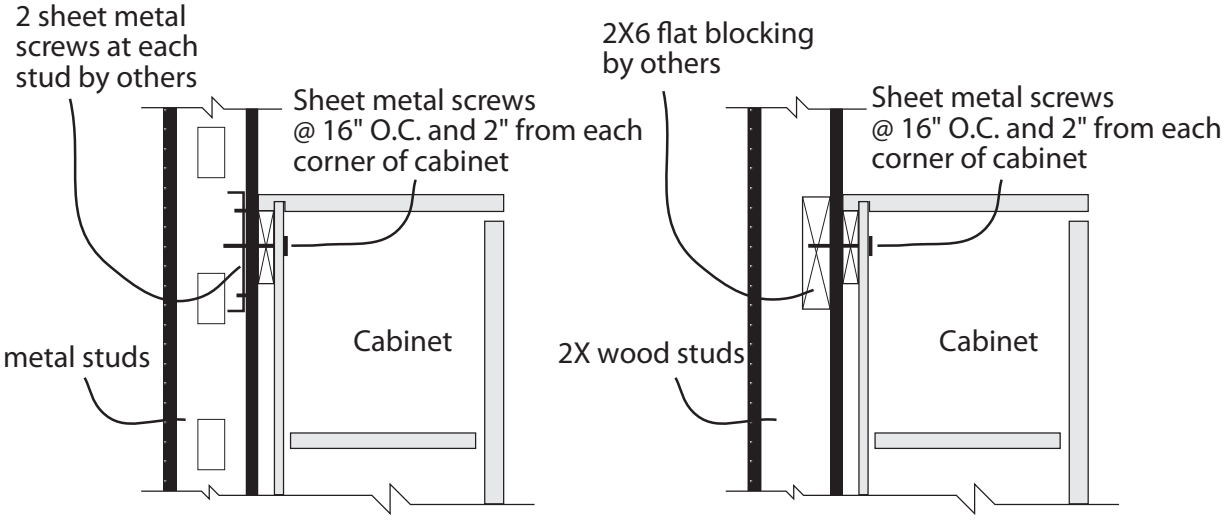


ALUMINUM INTERLOCK

12 - Installation

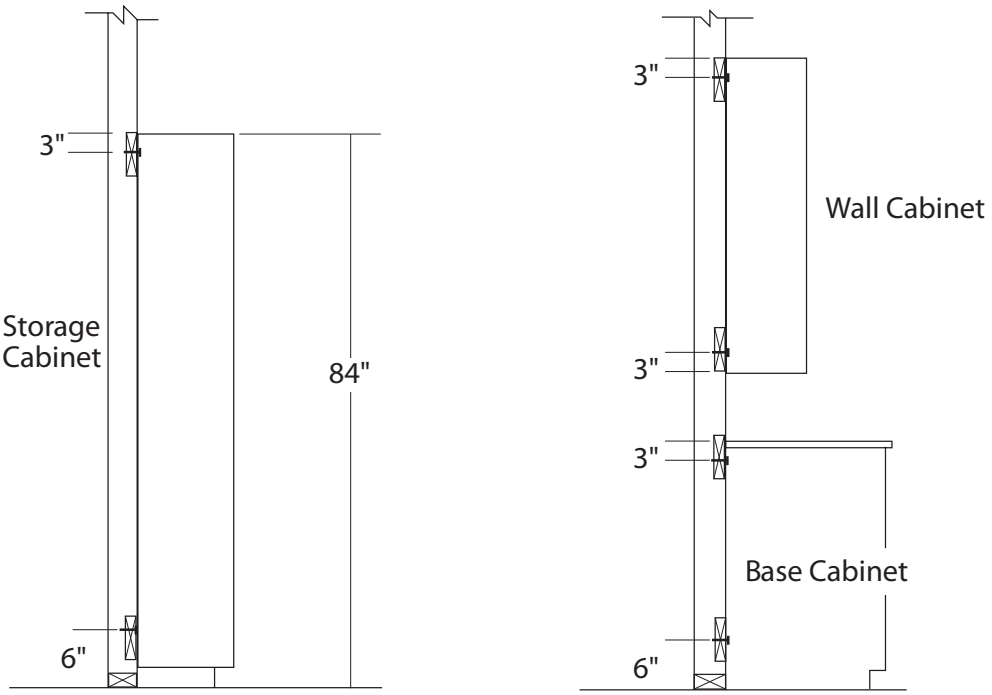
Cabinet Fastening Recommendations

NOTE: These techniques are not approved for seismic areas.



Typical at Metal Stud Walls

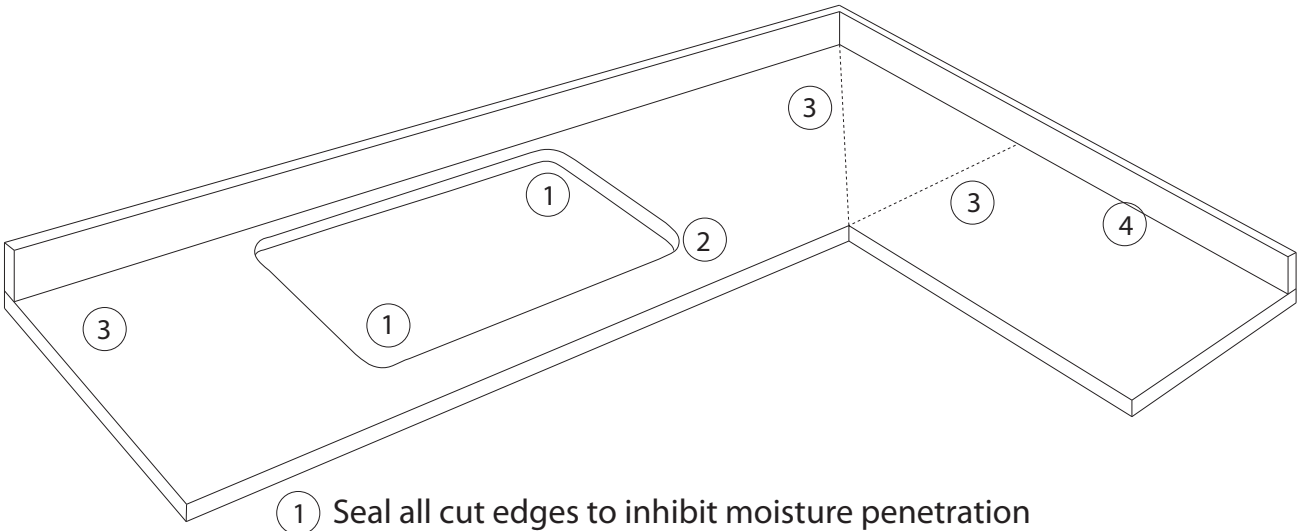
Typical at Wood Stud Walls



Typical Cabinet Fastening Details - In-wall Blocking usually by General Contractor

12 - Installation

HPDL Countertop Requirements



(1) Seal all cut edges to inhibit moisture penetration
NOTE: Use of pigment in the sealant will facilitate confirmation.

(2) Radius cut outs to minimize stress fractures

(3) Locate joints in HPDL and substrate at least 18″ (460 mm) from sink, unless design criteria locates sink within this dimension of corner joint or change of direction of top. Seal joints watertight when within 48″ (1220 mm) of sink cut outs for any Grade of work.

(4) Seal backsplash to top with caulk or silicone:
Required at fabrication when factory assembled Premium Grade
Required at installation for Premium and Custom Grade
Mill/Installer's option for Economy Grade

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Adhesive Summary

Adhesive Summary

Adhesives

Adhesives have been used to bond wood for centuries, but until about 1930, the choice was limited to a relatively few resinous substances with adhesive properties derived from plants and animals.

The following table describes some of the characteristics of modern adhesives. Most adhesives will adhere to wood, but satisfactory performance depends on careful consideration of these factors:

1. Physical and chemical compatibility of the glue and the wood;
2. Processing requirements (open time/closed time, etc.);
3. Mechanical properties; durability in the expected service conditions;
4. Ease of use;
5. Color and cost.

Plastics and metals are generally more difficult to bond successfully than wood. When they are bonded to wood, it is necessary to choose an adhesive capable of bonding the more difficult material.

Adhesive Summary

Class	ANSI/HPVA WDMA Type	Form	Properties	Typical uses for wood bonding
Urea resin	Type II	Dry powders or liquids; may be blended with melamine or other resins	High in both wet and dry strength; moderately durable under damp conditions; moderate to low resistance to temperatures in excess of 120° F; white or tan	Hardwood plywood for interior use and furniture; interior particleboard; flush doors; furniture core stock
Phenol resin*	Type I	Dry powders or liquids	High in both wet and dry strength; very resistant to moisture and damp conditions; dark red in color	Primary adhesive for exterior softwood plywood and flakeboard
Resorcinol resin and phenol-resorc-inol resins	Type I	Liquid; hardener supplied separately	High in both wet and dry strength; very resistant to moisture and damp conditions; dark red	Primary adhesive for laminated timbers and assembly joints to withstand severe service conditions
Polyvinyl acetate resin emulsions	Slight moisture resistance	Liquid; ready to use	Generally high in dry strength; low resistance to moisture and elevated temperatures; joints tend to yield under continued stress; white or yellow	Furniture assembly, flush doors, bonding of plastic laminates, architectural woodworking
Crosslinkable polyvinyl acetate resin emulsions	Type I	Similar to polyvinyl acetate resin emulsions but includes a resin capable of forming linkage (catalyzed)	Improved resistance to moisture and elevated temperatures; improved long-term performance in moist or wet environments; color varies	Interior and exterior doors, moulding and architectural woodworking
Contact adhesives	Type II	Typically an elastomer base in organic solvents or water emulsion	Initial joint strength develops immediately upon pressing, increases slowly over a period of weeks; dry strengths generally lower than those of conventional woodworking glues; water resistance and resistance to severe conditions variable; color varies	For some nonstructural bonds; high pressure decorative laminates to substrates. Useful for low strength metal and some plastic bonding.
Mastics (elastomeric construction adhesives)	Type II	Puttylike consistency, synthetic or natural elastomer base, usually in organic solvents	Gap filling; develop strength slowly over several weeks; water resistance and resistance for severe conditions variable; color varies	Lumber and plywood to joists and studs; gypsum board; styrene and urethane foams
Thermoplastic synthetic resins (hot melts)	Not tested for moisture resistance	Solid chunks, pellets, ribbons, rods, or films; solvent-free	Rapid bonding; gap filling; lower strength than conventional woodworking adhesives; minimal penetration; moisture resistant; white to tan	Edge banding of panels; films and paper overlays
Epoxy resins	Type I	Chemical polymers, usually in two parts, both liquid; completely reactive, no solvents	Good adhesion to metals, glass, certain plastics, and wood products; permanence in wood joints not adequately established; gap-filling	Used in combination with other resins for bonding metals, plastics, and materials other than wood; fabrication of cold molded wood panels

*Most types used in the United States are alkaline-catalyzed. The general statements refer to this type.
Above data summarized from Table 9-2, Wood Handbook, U.S. Dept. of Agriculture, Forest Service, Agriculture Handbook 72, 1987

Generic Name	ANSI/HPVA WDMA Type	Form	Properties	Typical uses for wood bonding
Aliphatic (Carpenter's Glue)	Type II	Liquid; ready to use	Non-toxic; non-flammable; non-staining Highly water resistant for interior use	Furniture assembly, flush doors, bonding of plastic laminates, architectural woodworking
Casein	Type II	Dry powder form, or prepared from raw materials	Highly water resistant, not waterproof	Doors for interior use, laminated timber, some architectural woodworking

Type data similar to ANSI/HPVA/WDMA testing as follows (no testing done by the Architectural Woodwork Institute):
-- Type I: Fully waterproof (exterior) 2 Cycle Boil/Shear test
-- Type II: Water resistant (interior) 3 Cycle Soak test

NOTES