AWS
Additional Resources

Appendix B

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These additional resources are provided to assist in the use and understanding of the *Architectural Woodwork Standards*; however, none of what is included within this Appendix is to be interpreted as part of the *Architectural Woodwork Standards* for compliance purposes.

Quality Control Enforcement Options

Architectural Woodwork Institute
Quality Certification Program (QCP)

Your reputation depends on others when you specify architectural woodwork. The Quality Certification Program (QCP) provides the means to ensure that the quality you specify is the quality you get.

The AWI Quality Certification Corporation (AWI QCC) is a fully independent, international credentialing body and is the sole administrator of the QCP. To fulfill its mission, which is to Verify, inspect, report and enforce architectural woodwork standards compliance, the QCP:

- Performs more than 500 inspections annually;
- Inspects firms and projects throughout Asia, Africa, Europe, and North America.
- Is ISO 65 compliant;
- Retains a highly experienced team of inspectors, each of whom must possess a minimum of 15 years experience in the architectural woodwork industry; they must pass the 150 question written test, adhere to a strict conflict of interest policy, and undergo extensive training by the QCP.

Established in 1995, the QCP provides design professionals and owners a means of verifying the skills and competence of the architectural woodwork manufacturers on a project-specific basis. As a design professional or project owner, you are protected if the woodwork delivered to a QCP project does not meet specifications. One of the major benefits of the quality certification program is that it provides the resources to prevent noncompliant woodwork from being installed on the job site.

The QCP accredits eligible woodworking firms to certify that their work complies with the project specifications and the Architectural Woodwork Standards (*AWS*). QCP verifies compliance with the specifications and the standards through the inspection process. This includes all certified projects registered to new program participants, all projects for which it receives an inspection-request from the design professional and/or the owner, and dozens of randomly chosen projects each year.

Woodworking firms earn certification credentials through comprehensive testing, rigorous inspections, and the submittal of 10 trade references. Moreover, they must demonstrate the ability to fabricate, finish, and/or install work in accordance with the quality grade criteria set forth in the Architectural Woodwork Standards (*AWS*).

QCP suggested specification language 1 — Quality Standard: Unless otherwise indicated, comply with “Architectural Woodwork Standards” for grades of interior architectural woodwork, construction, finishes, and other requirements.
Provide AWI Quality Certification Program [labels] [certificates] indicating that woodwork [including installation] complies with requirements of grades specified. This project has been registered as AWI/QCP Number _____
OR, the contractor, upon award of the work, shall register the work under this Section with the AWI Quality Certification Program. (800-449-8811)

The QCP is endorsed by every leading organization that values quality, including the U.S. General Services Administration (GSA) and the American Subcontractors Association (ASA). Put the QCP to work for you. For more information, please visit our website www.awiqcp.org, or call (800) 449-8811.

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Architectural Woodwork Manufacturers Association of Canada
Guarantee and Inspection Service (GIS)

AWMAC regional chapters manage the GIS monitoring program, initiated in 1990. AWMAC GIS Certified Inspectors review, inspect and report on pretender specifications if requested, sample units when specified and shop drawings. Inspectors also perform a comprehensive final inspection of the architectural woodwork for the project owner. The AWMAC GIS program offers, through its members in good standing, a two year AWMAC Guarantee Certificate on projects which have the recommended GIS wording specified in the tender documents.

GIS MANDATE
In order to ensure that the quality of materials and workmanship of the architectural woodwork specified are in compliance with the current AWMAC Architectural Woodwork Standards (*AWS*), the AWMAC Guarantee and Inspection Service program (GIS) must be specified and be considered an integral component of the scope of work.

GIS OBJECTIVE
The objectives of the Guarantee and Inspection Service are:

1. To assist the design authority in achieving “good architectural woodwork”.
2. To offer the owner, customer, design authority, and woodwork contractor an assurance that strict monitoring of the architectural woodwork requirements on a given project will meet the specified AWMAC standards.

GIS WORDING FOR SPECIFICATIONS

Architectural woodwork shall be manufactured and/or installed to the current AWMAC Architectural Woodwork Standards and shall be sub¬ject to an inspection at the plant and/or site by an appointed AWMAC Certified Inspector. Inspection costs shall be included in the tender price for this project. (Contact your local AWMAC Chapter for details of inspec¬tion costs). Shop drawings shall be submitted to the AWMAC Chapter office for review before work commences. Work that does not meet the AWMAC Architectural Woodwork Standards, as specified, shall be replaced, reworked and/or refinished by the architectural woodwork contractor, to the approval of AWMAC, at no additional cost to the owner.

If the woodwork contractor is an AWMAC Manufacturer member in good standing, a two (2) year AWMAC Guarantee Certificate will be issued. The AWMAC Guarantee shall cover replacing, reworking and/or refinishing any deficient architectural woodwork due to faulty workmanship or defective materials supplied and/or installed by the woodwork contractor, which may appear during a two (2) year period following the date of issuance.

If the woodwork contractor is not an AWMAC Manufacturer member they shall provide the owner with a two (2) year maintenance bond, in lieu of the AWMAC Guarantee Certificate, to the full value of the architectural woodwork contract.

For more information about AWMAC and the GIS Program visit our website at www.awmac.com and contact your local AWMAC Chapter office or phone the GIS office at: 1-866-447-7732.

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Woodwork Institute

- Assurance Options -

Certified and Monitored Compliance Programs

One of the greatest joys of being a design/specification professional is seeing your ideas become reality. The Woodwork Institute (WI) has been sharing your vision since 1951.

Currently over 10,000 design/specification professionals use our *Architectural Woodwork Standards* (*AWS*). The *AWS* establishes a minimum standard of quality, while giving you the flexibility to pair your vision with your customer's desires. The *AWS* is offered free of charge to members of the design/specification community in our service area.

Our Directors of Architectural Services (DAS), are employed throughout our service area, and provide knowledge from significant years of first-hand experience in the millwork industry. Their primary focus is compliance verification (inspection service); however, as registered AIA/CES instructors, they also provide numerous hours of standards/quality assurance/industry-based education. Additionally, our DAS's are available as an unbiased, industry consultation service. Education, consultation, and inspection services (when specified through one of our quality assurance programs), are provided free of cost to the design/specification community.

In conjunction with the *AWS*, WI also offers two distinct quality assurance options:

CERTIFIED COMPLIANCE PROGRAM (CCP)

A discipline of quality control used in conjunction with the *AWS,* providing a non-biased means of confirming conformance to your plans and specifications. Requiring Certified Compliance informs others of the expected specifications, without bidder discrimination. When receiving certified shop drawings, you are assured they conform to your specifications and *AWS* requirements, leaving verification of your design intent as your primary concern. Evidence of Certification is provided primarily by issuance of a Certified Compliance Certificate, listing the items certified, the applicable Grade, and whether installation is included. Additionally, shop drawings and each elevation of casework and/or countertops shall bear an individually serial-numbered "Certified Compliance Label," if so specified. The CCP started in 1959, and now certifies over 1,700 projects annually.

MONITORED COMPLIANCE PROGRAM (MCP)

A discipline of quality affirmation used in conjunction with the *AWS,* providing non-biased reviews/inspections of your project from its beginning through completion with WI Certification, without bidder discrimination. Requiring Monitored Compliance informs others of the quality demanded in what you have designed and specified for your client. The Institute will issue written progress reports throughout the duration of the project. The shop drawings, millwork products, and installation (of all involved parties), will progressively be inspected for compliance to your specifications and the specified Grade per the *AWS*. Evidence of Monitored Compliance is provided by issuance of a Monitored Compliance Certificate, listing the items certified, the applicable Grade, and whether installation is included. Additionally, shop drawings and each elevation of casework and/or countertops shall bear an individually serial-numbered "Certified Compliance Label." The MCP started in 2001, and has now become the premier quality control option.

For more information, please visit our website at www.woodworkinstitute.com, or call 916-372-9943.

NOTES

CSI Guide Specification
Section 06 41 00
Wood & Laminate Casework

CSI Section 06 41 00
Wood and Plastic Laminate Casework

This guide specification covers the materials and methods you would want to specify for wood or laminated plastic casework. It is strongly recommended that you read the "Cabinet Section" of *Architectural Woodwork Standards* before using this guide spec. Many of the items you would ordinarily specify are governed by your choice of Grade.

In this guide spec, choices are [**bold, in brackets**]. Comments are shaded.

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. [**Wood Casework**] [**Plastic Laminate Casework**].
2. [**Plastic Laminate**] [**Solid Surface**] [**Wood**] countertops.
3. Hardware typically furnished by the casework manufacturer.
4. Shelving.
5. [**Decorative metalwork incorporated into wood casework.**]
6. Structural supports incorporated into wood casework.
7. [**Factory finishing.**]

Factory finishing is strongly recommended. It is extremely difficult to get a quality finish under job site conditions.

B. Excluding:
1. Metal support brackets and fittings that are part of the building structure.
2. Plumbing, electrical fixtures, and telephone equipment.

C. Related Sections:
1. Rough Carpentry: Wood blocking or grounds inside finished walls or above finished ceilings.
2. Plumbing: Fixtures and fittings installed in countertops.
3. Wood Doors.

1.02 REFERENCES

A. Minimum standards for work in this Section shall be in conformity with the *Architectural Woodwork Standards*.

All of the other standards are referenced within the *AWS*.

1.03 SUBMITTALS

A. Shop Drawings:
1. Submit shop drawings in conformance with the requirements of the *Architectural Woodwork Standards*.
2. Submit two copies, one of which will be returned with reviewed notations. Make corrections noted (if any), and distribute required copies prior to the start of work.

B. Samples:
1. Submit four [**finished**] samples of each species and cut of wood to be used. Lumber samples to be minimum 6" by 12", and plywood samples to be minimum 12" by 12". Samples shall represent the range of color and grain expected to be provided.

Include Item 1 if there is any factory finished wood or veneer included in this Section.

Include Item 2 if any wood is to be provided for job site finishing.

2. Submit a sample in the specified finish of each hardware item that will be visible at exposed surfaces when the job is complete.

CSI Section 06 41 00
Wood and Plastic Laminate Casework

C. [**Mockups:**

Mockups shouldn't be necessary for most projects. Include this item if full sized samples are desired.

1. **Provide mockups of one base cabinet, one wall hung cabinet, and one countertop. Base cabinet shall have at least one drawer. Mockup shall be of the material and finish to be provided. The Approved Mockup may be incorporated in the project.**]

1.04 QUALITY ASSURANCE

A. Work shall be in accordance with the Grade or Grades specified of the *Architectural Woodwork Standards*.

B. [**Association Quality Assurance Program.**]

Association quality assurance programs provide a pre qualification for the sub contractor. Bidders will be Association program participants or they will understand that their work will be inspected by an Association program representative. For better quality assurance, it's recommended that an Association assurance program is used.

C. Qualification:

1. Firm (woodwork manufacturer) with no less than 5 years of production experience similar to a specific project, whose qualifications indicate the ability to comply with the requirements of this Section.
2. The woodwork manufacturer must have at least one project in the past 5 years where the value of the woodwork was within 20 percent of the cost of woodwork for this Project.

D. Single Source Responsibility: A single manufacturer shall provide and install the work of described in this Section.

1.05 DELIVERY STORAGE AND HANDLING

A. Deliver materials only when the project is ready for installation and the general contractor has provided a clean storage area.

1. Delivery of architectural millwork shall be made only when the area of operation is enclosed, all plaster and concrete work is dry and the area broom clean.
2. Maintain indoor temperature and humidity within the range recommended by the *Architectural Woodwork Standards* for the location of the project.

1.06 SCHEDULING

A. Coordinate fabrication, delivery, and installation with the general contractor and other applicable trades.

PART 2 - PRODUCTS

2.01 COMPONENTS

A. Lumber shall be in accordance with the *Architectural Woodwork Standards* Grade specified for the product being fabricated. Moisture Content shall be 6% to 12% for boards up to 2" (50.8 mm) inch nominal thickness, and shall not exceed 19% for thicker pieces.

B. Veneers shall be in accordance with the *Architectural Woodwork Standards* requirements for its use and the Grades.

C. Core shall be [**MDF**] [**particleboard**] meeting the requirements of *Architectural Woodwork Standards*.

Particleboard or MDF are recommended as core materials.

D. Veneer core plywood shall be a non-telegraphing hardwood manufactured with exterior glue.

E. Plastic Laminate shall meet the requirements of the *Architectural Woodwork Standards* for its intended use.

CSI Section 06 41 00
Wood and Plastic Laminate Casework

F. [**Cabinet Liner shall be type CLS.**]

Include this Item if you intend to use cabinet liner at semi-exposed surfaces.

G Edgeband

1. Veneer of the same species and cut as the exposed surfaces.
2. [**PVC**] [**ABS**] [**high pressure decorative laminate**].

PVC and ABS edgeband are available to match many laminate patterns. PVC is more durable than laminate and it is less subject to glue failure. PVC is available in 3mm and 0.5mm thicknesses. 0.5mm is generally used at case bodies, and 3mm may be used at doors, drawer fronts, and false fronts. ABS is a new product that claims to have the positive qualities of PVC without the environmental down side.

H Adhesives used shall be [**type I**] [**type II**].

Type I glue is water proof; Type II is water resistant. Type II is satisfactory except in a very wet environment.

I Hardware:

1. Pulls: [_____].
2. Drawer Guides shall be [**full extension**] [**¾ extension**] *AWS* approved.

If you specify brand and model of drawer guides, specify for pencil drawers, box drawers, file drawers, and lateral file drawers, as applicable.

3. Hinges: [**five knuckle Grade 1 hinges**] [**concealed European style Grade II hinges minimum 120º opening**] Brand, Model. Hinges shall be *AWS* compliant.

The *AWS* requires Grade I hinges for schools, hospitals and recommends such for police and fire facilities, and other high usage applications.

4. Door Catches: [_____]

If self closing hinges are selected catches will not be required. Self closing Grade I hinges are not available.

5. Shelf Supports: Shelf supports for adjustable shelves in wall-hung cabinets and the upper half of tall cabinets shall be designed to prevent shelves from sliding forward in a seismic event.

Bored hole shelf support systems and metal shelf ladders have both been determined to provide satisfactory support.

6. Locks
   a. Door locks: [_____].
   b. Drawer locks: [_____].
   c. Glass door locks: [_____].
   d. [_____].
   e. Provide [_____] keys per lock.
   f. Elbow Catches: [_____].

Elbow catches will only be necessary at the inactive leaf of locking pairs of doors. If no door locks are required, elbow catches will not be necessary.

7. Sliding glass door hardware: [_____].

Sliding glass doors that are more than 1 ½ times as tall as they are wide should be installed using top hung hardware. Tall, thin glass doors on bottom roller systems will tip and bind.

8. Etc.

Other hardware items may include wire grommets, keyboard trays, and other specialty items.

2.02. FABRICATION

A. Wood Casework

1. Casework shall meet the requirements of the *Architectural Woodwork Standards* [**Premium Grade**] [**Custom Grade**] [**Grades shown on plans**].

The *AWS* allows the use of Economy Grade for custodian's closets and utility rooms regardless of the Grade specified for the project as a whole (unless otherwise specified). This is usually the only application for Economy Grade.

CSI Section 06 41 00
Wood and Plastic Laminate Casework

2. Casework shall be *Architectural Woodwork Standards* CONSTRUCTION TYPE [**A, frameless**] [**B, face frame**] and cabinet and door INTERFACE STYLE [**1, overlay**] [**2, flush inset**].

   Typically TYPE A and STYLE 1 go together while TYPE B goes with either STYLE 1 or 2. Almost all plastic laminate casework is TYPE A and STYLE 1.

3. Exposed Surfaces shall be [[**species**], [**cut**]], [[**book**][**slip**] **matched**] [**material suitable for opaque finish**]] meeting the requirements of the *AWS* for the Grade specified.

   The species is the species of tree, such as Oak or Maple. The cut used is the angle of the face of the board to the growth rings. Flat sawn or plain sliced is the most common cut. Quarter sawn or Rift cut lumber is cut with the face at right angles to the growth rings, giving a vertical grain appearance. Match refers to the way veneer leaves are matched within a panel. Book match is the most common.

   a. [**Blueprint Match: veneers at room(s)** [**_____**] **shall be blueprint matched.**

      This item is only necessary if there is an area where a blueprint match is desired. Similar language must be inserted in the Sections specifying wood paneling, wood trim, and wood doors.

      1. **All work in this/these area(s) shall be AWS Premium Grade.**
      2. **Casework, paneling, doors and wood trim shall be provided by the same manufacturer.**
      3. **Veneers shall be taken from the same flitch, to be selected by the architect.**
      4. **Faces at cabinet doors, drawer fronts and false fronts shall be sequence matched, shall run and match vertically, and shall be sequence matched with adjacent wall paneling and/or doors.**
      5. **Faces at exposed ends of cabinets shall be selected from the same flitch, and shall be well matched to the adjacent paneling and to the cabinet fronts.**
      6. **All components including casework, paneling, doors, and trim shall be factory finished at the same time in the same facility.**]

4. Exposed interior surfaces shall be [**per the requirements of the AWS**] [**veneer of the same species as the exposed faces**] [**low pressure melamine overlay**].

   The default choices in the *AWS* are very well thought out. It should only be necessary to call out a material here if you wish for something special.

5. Semi-exposed surfaces shall be [**per the requirements of the AWS**] [**veneer of the same species as the exposed faces**] [**low pressure melamine overlay**].

   The default choices in the *AWS* are very well thought out. It should only be necessary to call out a material here if you wish for something special.

6. Doors, drawer fronts, and false fronts shall be [**flush overlay**] [**reveal overlay**] [**lipped**] [**flush inset**].

   STYLE 1 flush overlay is the most common door style and usually goes with TYPE A construction. The other door styles are generally used with face frame construction.

B. Plastic Laminate Casework:

1. Shall be *Architectural Woodwork Standards* [**Custom**] [**Premium**] Grade.

   The *AWS* allows the use of Economy Grade for custodian's closets and utility rooms regardless of the Grade specified for the project as a whole (unless otherwise specified). This is usually the only application for Economy Grade.

2. Exposed interior surfaces shall be [**low pressure melamine overlay**] [**low pressure melamine overlay of a color and pattern compatible with exposed surfaces**] [**high pressure laminate matching exposed surfaces**].

   The *AWS* default choices for exposed interiors and semi exposed surfaces are well matched with the *AWS* Grades. The items above and below are not necessary unless you have specific desires.

3. Semi-exposed surfaces shall be [**low-pressure melamine overlay**] [**cabinet liner**] [**laminate matching exposed surfaces**].

4. Doors, drawer fronts, and false fronts shall be [**flush overlay**] [**reveal overlay**].

   STYLE 1 flush overlay is the most common door style and usually goes with TYPE A construction. The other door styles usually go with face frame construction. Plastic Laminate casework is not usually constructed with face frames.

   a. [**Edgeband at doors, drawer fronts, and false fronts shall be 3mm** [**PVC**] [**ABS**].]

      PVC and ABS edgeband come in 3mm and 0.5mm thicknesses. 3mm edgeband on doors and drawer fronts is more durable, but the thicker edge will be more noticeable if the laminate is a wood grain or other pattern rather than a solid color.

CSI Section 06 41 00
Wood and Plastic Laminate Casework

C. Drawers shall meet the requirements of the *AWS* for the Grade or Grades specified.

The *AWS* does an excellent job of matching drawer materials and construction methods to the casework Grade. If something special is desired, modify this Item.

D. Laminated Plastic Countertops:

1. Laminate shall be [**Manufacturer**] [**Pattern**].
2. Core material shall be [**particleboard**] [**MDF**] [**exterior grade hardwood plywood with a non-telegraphing grain**].

Particleboard and MDF are satisfactory in most environments. The *AWS* requires water resistant Particleboard or MDF at tops with sinks. Plywood is recommended only in the most abusive wet environments.

3. Back splashes shall be ASSEMBLY [**1-Wall mount, jobsite assembled**] [**2-Deck mount, manufacturer assembled**].

If a preference is desired it shall be so specified, otherwise the Assembly method shall be manufacturers option.

4. Back splashes shall be [**butt joint**] [**cove**] [**per drawings**] and shall be [_____] inches (millimeters) high.

If several backsplash details are used, label “per drawing”, and be sure all tops are clearly detailed in the plans.

5. Front edges shall be [**self edge**] [**no drip bullnose edge**] [**waterfall edge**] [**no drip tilt edge**] [**three millimeter PVC edge**] [**wood edge**].

As mentioned above, if several details are to be used, make sure they are clearly shown or labeled on the plans.

E. Solid Surface Countertops:

1. Solid surface shall be [**brand**] [**pattern**] [**color**].
2. Back splashes shall be [butt joint] [cove] [per details] and shall be [_____] inches (millimeters) high.

If several backsplash details are used call out “per details,’ and be sure all tops are clearly detailed in the plans.

F. Front edges shall be [self edge] [no drip bullnose edge] [waterfall edge] [no drip tilt edge].

As above, if several details are to be used make sure they are clearly shown or labeled on the plans.

G Factory Finishing

1. All products provided in this Section shall be factory finished using *Architectural Woodwork Standards* finish system [_____].
2. Finish shall be *AWS* [**Premium**] [**Custom**] Grade.

As noted above, Factory Finishing is strongly recommended. In addition to getting a better finish, you are moving the air quality problems off site where a proper spray booth will protect the environment and the health of the finishers. It is still worth while to select a low VOC finishing system, as some touch up will be required at the job site.

PART 3 - EXECUTION

3.01. EXAMINATION

A. Verify the adequacy and proper location of any required backing or support framing.

B. Verify that mechanical, electrical, plumbing, and other building components affecting work in this Section are in place and ready.

3.02. INSTALLATION

A. Install all work in conformance with the *Architectural Woodwork Standards,* latest edition.

1. Installation shall conform to the *AWS* Grade of the items being installed.

B. All work shall be secured in place, square, plumb, and level.

CSI Section 06 41 00
Wood and Plastic Laminate Casework

C. All work abutting other building components shall be properly scribed.

D. Mechanical fasteners used at exposed and semi-exposed surfaces, excluding installation attachment screws and those securing cabinets end to end, shall be countersunk.

E. Equipment cutouts shown on plans shall be cut by the installer.

3.03. ADJUSTING & TOUCH UP

A. Before completion of the installation, the installer shall adjust all moving and operating parts to function smoothly and correctly.

B. All nicks, chips, and scratches in the finish shall be filled and retouched. Damaged items that cannot be repaired shall be replaced.

3.04. CLEANUP

A. Upon completion of installation, the installer shall clean all installed items of pencil and ink marks and broom clean the area of operation, depositing debris in containers provided by the general contractor.

END OF SECTION

NOTES

CSI Guide Specification
Section 06 42 00
Paneling

CSI Section 06 42 00
Paneling

This guide specification covers the materials and methods you would want to specify for wood or laminated plastic casework. It is strongly recommended that you read the "Cabinet Section" of *Architectural Millwork Standards* before using this guide spec. Many of the items you would ordinarily specify are governed by your choice of Grade.

In this guide spec, choices are in [**bold, in brackets**]. Comments are in shaded background.

PART 1 - GENERAL

1.01. SUMMARY

A. Section Includes:

Select the applicable items from the list below

1. [**Solid or Veneered Wood Paneling.**]
2. [**High Pressure Decorative Laminate Wall Covering.**]
3. [**Solid Surface Wall Covering.**]
4. [**Solid Phenolic Wall Covering.**]
5. [**All furring, blocking, shims, and methods of attachment from the face of the wall out.**]

Include Item 5 if installation is included.

6. [**Factory finishing.**]

Factory finishing is strongly recommended. It is extremely difficult to get a quality finish under job site conditions.

B. Excluding:

1. Casework, Soffits or other Filler Panels.
2. Room, Closet, or Access Doors.
3. Any structural wood framing of plywood.
4. Exposed base.

C. Related Sections:

1. Rough Carpentry: Wood blocking or grounds inside finished walls or above finished ceilings.
2. Casework.
3. Wood Doors.
4. Wood Trim.

1.02. REFERENCES

A. Minimum standards for work in this Section shall be in conformity with the *Architectural Woodwork Standards*, latest edition, published jointly by the Architectural Woodwork Institute, the Architectural Woodwork Manufacturer Association of Canada, and the Woodwork Institute.

All of the other standards you would reference are within the *AWS*.

1.03. SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings in conformance with the requirements of the *Architectural Woodwork Standards.*
2. Submit two copies, one of which will be returned with reviewed notations. Make corrections noted (if any), and distribute required copies prior to the start of work.

B. Samples:

1. Submit four [**finished**] samples of each species and cut of wood to be used. Lumber samples to be minimum 6" by 12", plywood samples to be minimum 12" by 12". Samples shall represent the range of color and grain expected to be provided.

CSI Section 06 42 00
Paneling

2. [**Submit four additional samples of each material for the use of the paint trade.**]

Include this Item if materials are to be finished at the job site.

C. [**Mockups:**

Mockups shouldn't be necessary for most projects. Include this Item if full sized samples are desired.

1. Provide a mockup of one Section of paneling, including an outside and an inside corner. The mockup shall be of the material and finish to be provided.]

1.04. QUALITY ASSURANCE

A. Work shall be in accordance with the Grade or the Grades Specified of the *Architectural Woodwork Standards*.

B. [**Association Quality Assurance Program.**]

Association quality assurance programs provide a pre qualification for the sub contractor. Bidders will be Association program participants or they will understand that their work will be inspected by an Association program representative. For better quality assurance, it's recommended that an Association assurance program is used.

C. Qualification:

1. Firm (woodwork manufacturer) with no less than 5 years of production experience similar to this Project, whose qualifications indicate the ability to comply with the requirements of this Section.
2. The woodwork manufacturer must have had at least one project in the past 5 years where the value of the woodwork was within 20 percent of the cost of woodwork for this Project.
3. Single Source Responsibility: A single manufacturer shall provide and install the work of this Section.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Deliver materials only when the project is ready for installation and the general contractor has provided a clean storage area.

1. Delivery of architectural millwork shall be made only when the area of operation is enclosed, all plaster and concrete work is dry, and the area broom clean.
2. Maintain indoor temperature and humidity within the range recommended by the *Architectural Woodwork Standards* for the location of the project.

1.06. SCHEDULING

A. Coordinate fabrication, delivery, and installation with the general contractor and other applicable trades.

PART 2 - PRODUCTS

2.01. COMPONENTS

A. Meeting the requirements of the *Architectural Woodwork Standards*.

1. Lumber shall be sound and kiln dried.
   a. Exposed lumber shall be [[**species**], [**cut**]] [**closed grained hardwood**].

The species is the species of tree, such as birch or oak. The cut is the angle of the face to the grain, such as plain sliced or rift. Book match is the most common. Use closed grain hardwood for painted wood paneling.

2. Veneer shall be [**species**] [**cut**] [[**book**] [**slip**]] matched.

The match is the way the veneers are arranged on the panel. Book match is the most common.

3. Panels for opaque finish shall be [**MDO**] [**MDF**] [**closed grain hardwood veneer**].
4. Core material for laminated panels shall be [**MDF**] [**Particleboard**].
5. Laminate shall be [**manufacturer**] [**pattern**].

CSI Section 06 42 00
Paneling

6. Solid surface shall be [**manufacturer**] [**pattern**].
   a. All solid surface at any room or area shall be from the same batch to prevent color mismatch.
7. Solid Phenolic shall be [**manufacturer**] [**pattern**].

2.02 FABRICATION

Select the appropriate items below

A. Paneling shall be *Architectural Woodwork Standards* [**Economy**] [**Custom**] [**Premium**] Grade.

B. Stile and Rail Wood Paneling:
   1. Stiles and rails shall be [**3/4**] [**1**] inch thick.
   2. Joints at stiles and rails shall be securely fastened with dowels or biscuits.
   3. Panels shall be [**flat**] [**raised**].

C. Flat Veneered Paneling:
   1. Panels shall be [**full width**] [**selectively reduced**] [**balanced sequence matched panels**] [**blueprint matched**].
   2. Visible edges and reveals shall be [**filled and painted**] [**match faces**] [**per details**].
   3. Outside corners shall be [**lock mitered**] [**mitered and splined**] [**per detail**].
   4. [**Blueprint Match: Work at room(s)** [**_____] shall be blueprint matched.**

This item is only necessary if there is an area where a blueprint match is desired. This could apply if there is transparent finish flat wood paneling adjacent to Wood Doors and Wood Casework. Similar language must be inserted in the Sections specifying casework, wood trim, and wood doors.

   a. All work in this/these area(s) shall be AWS Premium Grade.
   b. Casework, paneling, doors and wood trim shall be provided by the same manufacturer.
   c. Veneers shall be taken from the same flitch, to be selected by the architect.
   d. Faces at cabinet doors, drawer fronts, and false fronts shall be sequence matched, shall run and match vertically, and shall be sequence matched with adjacent wall paneling and/or doors.
   e. Faces at exposed ends of cabinets shall be selected from the same flitch, and shall be well matched to the adjacent paneling and to the cabinet fronts.
   f. All components including casework, paneling, doors, and trim shall be factory finished at the same time in the same facility.]

D. High Pressure Decorative Laminate Paneling:
   1. Panels shall be [**full width -OR- selectively reduced**].
   2. Visible edges and reveals shall be [**filled and painted**] [**match faces**] [**per details**].
   3. Outside corners shall be [**lock mitered**] [**mitered and splined**] [**per detail**].

E. Solid Surface Paneling:
   1. Panels shall be [**manufacturer], [pattern**].
   2. Reveals shall be provided for expansion a maximum of 96” (2438 mm) on center.
   3. Reveals shall be [**butt jointed and caulked**] [**covered with a trim batten**] [**splined with a loose spline**].
   4. Outside corners shall be [**hard seamed**] [**per details**].

F. Solid Phenolic Core Paneling:
   1. Reveals or slip joints shall be provided for expansion a maximum of 96” (2438 mm) on center.
   2. Reveals shall be [**butt jointed and caulked**] [**be provided with a trim batten**].
   3. Outside corners shall be [**butt jointed**] [**trimmed with a metal corner mold**] [**per details**].

CSI Section 06 42 00
Paneling

G. [**Factory Finishing:**

This Item will not apply to HPDL, Solid Surface, or SPC paneling. As noted above, Factory Finishing is strongly recommended. In addition to getting a better finish, you are moving the air quality problems off site, where a proper spray booth will protect the environment and the health of the finishers.

1. **All products provided in this Section shall be factory finished using Architectural Woodwork Standards finishing system [_____].**
2. **Finish shall be AWS [Premium] [Custom] Grade.**]

PART 3 - EXECUTION

3.01. EXAMINATION

A. Verify the adequacy and proper location of blocking and support framing.

B. Verify that mechanical, electrical, plumbing, and other building components (supplied by others), affecting work in this Section are in place and ready.

3.02. INSTALLATION

A. Install all work in conformance with the *Architectural Woodwork Standards*, latest edition.
   1. Installation shall conform to the *AWS* Grade of the items being installed.

B. All work shall be secured in place, square, plumb, and level.

C. All work abutting other building components shall be properly scribed.

D. Mechanical fasteners at exposed and semi-exposed surfaces shall be countersunk and filled.

3.03. ADJUSTING & TOUCH UP

A. All nicks, chips, and scratches shall be [**sanded smooth**] [**filled and retouched**]. Damaged items that cannot be repaired shall be replaced.

Use “sanded smooth” if the work is to be finished at the job site. Use “filled and retouched” if the materials are to be factory finished.

3.04. CLEANUP

A. Upon completion of installation, the installer shall clean all installed items of pencil and ink marks, and broom clean the area of operation, depositing debris in containers provided by the general contractor.

END OF SECTION

NOTES

CSI Guide Specification
Section 06 46 00
Wood Trim

CSI Section 06 46 00
Wood Trim

This guide specification covers the materials and methods you would want to specify for wood or laminated plastic casework. It is strongly recommended that you read the "Cabinet Section" of *Architectural Millwork Standards* before using this guide spec. Many of the items you would ordinarily specify are governed by your choice of Grade.

In this guide spec, choices are in [**bold, in brackets**]. Comments are in shaded background.

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

Select the applicable items from the list below.

1. [**Interior Wood Door Frames.**]
2. [**Wood Door and Window Casings.**]
3. [**Wood Aprons.**]
4. [**Wood Base and Shoe Moldings.**]
5. [**Wood Chair Rails.**]
6. [**Wood Cornices.**]
7. [**Wood Fascia and Soffits.**]
8. [**Wood Stops, Stools, and Sills.**]
9. [**Factory finishing.**]

Factory finishing is strongly recommended. It is extremely difficult to get a quality finish under job site conditions.

B. Related Sections:

1. Rough Carpentry: Wood blocking or grounds inside finished walls or above finished ceilings.
2. Wood Paneling.
3. Wood and Plastic Laminate Casework.
4. Wood Doors.

1.02 REFERENCES

A. Minimum standards for work in this Section shall be in conformity with the *Architectural Woodwork Standards*, latest edition, published jointly by the Architectural Woodwork Institute, the Architectural Woodwork Manufacturer Association of Canada, and the Woodwork Institute.

All of the other standards you would reference are within the *AWS*.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings in conformance with the requirements of the *Architectural Woodwork Standards*.
2. [**Furnish a AWS Certified Compliance Label on the first page of the shop drawings.**]
3. Submit two copies, one of which will be returned with reviewed notations. Make corrections noted (if any), and distribute required copies prior to the start of work.

B. Samples:

1. Submit four [**finished**] samples of each species and cut of wood to be used. Lumber samples to be minimum 6" by 12", plywood samples to be minimum 12" by 12". Samples shall represent the range of color and grain expected to be provided.
2. [**Submit four additional samples of each material for the use of the paint trade.**]

Include this Item if materials are to be finished at the job site.

CSI Section 06 46 00
Wood Trim

1.04 QUALITY ASSURANCE

A. Work shall be in accordance with the Grade or the Grades Specified of the *Architectural Woodwork Standards*.

B. [**Association Quality Assurance Program.**]

Association quality assurance programs provide a pre qualification for the sub contractor. Bidders will be Association program participants or they will understand that their work will be inspected by an Association program representative. For better quality assurance, it's recommended that an Association assurance program is used.

C. Qualification:

1. Firm (woodwork manufacturer) with no less than 5 years of production experience similar to this Project, whose qualifications indicate the ability to comply with the requirements of this Section.
2. The woodwork manufacturer must have had at least one project in the past 5 years where the value of the woodwork was within 20 percent of the cost of woodwork for this Project.

D. Single Source Responsibility: A single manufacturer shall provide and install the work of this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials only when the project is ready for installation and the general contractor has provided a clean storage area.

1. Delivery of architectural millwork shall be made only when the area of operation is enclosed, all plaster and concrete work is dry and the area broom clean.
2. Maintain indoor temperature and humidity within the range recommended by the *Architectural Woodwork Standards* for the location of the project.

1.06 SCHEDULING

A. Coordinate fabrication, delivery, and installation with the general contractor and other applicable trades.

PART 2 - PRODUCTS

2.01 COMPONENTS

A. Lumber shall be sound, kiln dried, and in accordance with the *Architectural Woodwork Standards* requirements for its use and the Grade specified.

B. Particleboard, MDF, and Plywood shall meet the requirements of the *AWS* for the Grade specified and their intended use.

C. Veneered components shall be in accordance with the *Architectural Woodwork Standards* requirements for the Grade specified.

1. [**Core shall be** [**particleboard**] [**MDF**].]

If this item is not included, core is at the manufacturer's option, subject to requirements of the *AWS*. Particleboard or MDF are recommended as core materials.

2. Adhesives used shall be [**Type I**] [**Type II**].

Type I glue is water proof; Type II is water resistant. Type II is satisfactory except in a very wet environment.

2.02 FABRICATION

A. Interior Millwork shall be *Architectural Woodwork Standards* [**Custom**] [**Premium**] Grade.

B. Door Jambs shall be [**flat jamb with applied stop**] [**Plowed jamb with a T stop**] [**rabbeted**].

C. Wainscot height shall be [___] inches above finish floor.

CSI Section 06 46 00
Wood Trim

D. Trim for opaque finish.
   1. Moldings shall be [**MDF**] [**closed grain hardwood**].
   2. Flat trim items shall be [**MDF**] [**MDO**] [**closed grain hardwood veneer**].
      a. Exposed edges shall be [**sanded and filled if necessary**] [**edge banded with closed grain hardwood veneer**].

E. Trim for transparent finish:
   1. Moldings shall be [[**species**], [**cut**]] [**as indicated in the finish schedule**].
   2. Exposed faces of veneered items shall be [[**species**] [**cut**] [**match**]] [**as indicated in the finish schedule**].

F. [**Blueprint Match: Work at room(s) [_____] shall be blueprint matched:**

Include this Item if there is a room or area where a blueprint match is desired.

   1. All work in this/these area(s) shall be AWS Premium Grade.
   2. Casework, paneling, doors, and wood trim shall be provided by the same manufacturer.
   3. Veneers shall be taken from the same flitch, to be selected by the architect.
   4. Faces at cabinet doors, drawer fronts, and false fronts shall be sequence matched, shall run and match vertically, and shall be sequence matched with adjacent wall paneling and/or doors.
   5. Faces at exposed ends of cabinets shall be selected from the same flitch, and shall be well matched to the adjacent paneling and to the cabinet fronts.
   6. Solid wood elements such as base, casing, and frames shall be well matched for color and grain, and shall be compatible in color and grain with veneered elements.
   7. All components including casework, paneling, doors, and trim shall be factory finished at the same time in the same facility.]

G. [**Factory Finishing**
   1. [All products provided in this Section shall be factory finished using "Architectural Woodwork Standards" finish system [_____].]
   2. [Finish shall be AWS [Premium Grade] [Custom Grade] [the same Grade as the items being finished.]

As noted above, Factory Finishing is strongly recommended. In addition to getting a better finish, you are moving the air quality problems off site, where a proper spray booth will protect the environment and the health of the finishers. It is still worth while to select a low VOC finishing system, as some touch up will be required at the job site.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify the adequacy and proper location of any required backing or support framing.

B. Verify that mechanical, electrical, plumbing, and other building components effecting work in this Section are in place and ready.

3.02 INSTALLATION

A. Install all work in conformance with the *Architectural Woodwork Standards*, latest edition.
   1. Installation shall conform to the *AWS* Grade of the items being installed.

B. All work shall be secured in place, square, plumb, and level.

C. All work abutting other building components shall be properly scribed.

D. Mechanical fasteners used at exposed and semi-exposed surfaces shall be countersunk.

CSI Section 06 46 00
Wood Trim

3.03 ADJUSTING & TOUCH UP

A. All nicks, chips and scratches shall be [**sanded out**] [**filled and re-touched**]. Damaged items which cannot be repaired shall be replaced.

Use “sanded out” if material is to be finished at the job site. Use “filled and retouched” if the materials are factory finished.

3.04 CLEANUP

A. Upon completion of installation, the installer shall clean all installed items of pencil and ink marks, and broom clean the area of operation, depositing debris in containers provided by the general contractor.

END OF SECTION

NOTES

CSI Guide Specification
Section 08 14 00
Wood Doors

CSI Section 08 14 00
Wood Doors

This guide specification covers the materials and methods you would want to specify for wood or laminated plastic casework. It is strongly recommended that you read the "Cabinet Section" of *Architectural Millwork Standards* before using this guide spec. Many of the items you would ordinarily specify are governed by your choice of Grade.

In this guide spec, choices are in [**bold, in brackets**]. Comments are in shaded background.

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

Select the applicable Items from the list below.

1. [**Flush Wood Doors**] [**Transom Panels**]
2. [**Stile and Rail Wood Doors.**]
3. [**Fire-Rated Wood Doors.**]
4. [**Wood Doors with HPDL faces.**]
5. [**Sound Rated Wood Doors including gaskets and automatic door bottoms.**]
6. [**X-ray Resistant Wood Doors.**]
7. [**Bullet Resistant Wood Doors.**]
8. [**Wood Louvers, Glass Stops, and Astragals.**]
9. [**Glazing.**]

If glazing is included here, delete it below. If it is not included here, show it under "Excluding".

10. [**Factory finishing.**]

Factory finishing is strongly recommended. It is extremely difficult to get a quality finish under job site conditions.

B. Excluding:

1. Cabinet doors.
2. Metal or Vinyl doors with wood cores.
3. Garage, Metal, and Fiberglass doors.
4. Metal grills or Louvers.
5. [Glazing.]

C. Related Sections:

1. Rough Carpentry: Wood blocking or grounds inside finished walls or above finished ceilings.
2. Door Hardware.
3. Door Frames.

1.02 REFERENCES

A. *Architectural Woodwork Standards*, latest edition, published jointly by the Architectural Woodwork Institute, the Architectural Woodwork Manufacturer Association of Canada, and the Woodwork Institute.

The other standards you would reference are within the *AWS*.

B. ANSI/WDMA I.S. 1A, latest edition.

C. ANSI/WDMA I.S. 6A, latest edition.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit shop drawings in conformance to the requirements of the *Architectural Woodwork Standards*.
2. Submit two copies, one of which will be returned with reviewed notations. Make corrections noted (if any), and distribute required copies prior to the start of work.

CSI Section 08 14 00
Wood Doors

B. Samples:

1. Submit four [**finished**] samples of each species and cut of wood to be used. Veneer samples to be minimum 12” (305 mm) by 12” (305 mm) . Samples shall represent the range of color and grain expected to be provided.

Samples may not be necessary for painted or LP covered doors.

2. [**Submit four additional samples of each material for the use of the paint trade.**]

1.04 QUALITY ASSURANCE

A. Work shall be in accordance with the Grade or the Grades Specified of the *Architectural Woodwork Standards*.

B. [**Association Quality Assurance Program.**]

Association quality assurance programs provide a pre qualification for the sub contractor. Bidders will be Association program participants or they will understand that their work will be inspected by an Association program representative. For better quality assurance, it’s recommended that an Association assurance program is used.

C. Qualification:

1. Firm (woodwork manufacturer) with no less than 5 years of production experience similar to this Project, whose qualifications indicate the ability to comply with the requirements of this Section.
2. The woodwork manufacturer must have had at least one project in the past 5 years where the value of the woodwork was within 20 percent of the cost of woodwork for this Project.

D. Single Source Responsibility: A single manufacturer shall provide and install the work of this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials only when the project is ready for installation and the general contractor has provided a clean storage area.

1. Delivery of architectural millwork shall be made only when the area of operation is enclosed, all plaster and concrete work is dry and the area broom clean.
2. Maintain indoor temperature and humidity within the range recommended by the *Architectural Woodwork Standards* for the location of the project.

1.06 SCHEDULING

A. Coordinate fabrication, delivery, and installation with the general contractor and other applicable trades.

PART 2 - PRODUCTS

2.01 COMPONENTS

A. Flush Wood Doors:

Select below the types of doors that are required.

1. [**Doors shall meet the requirements of ANSI/WDMA Extra Heavy Duty performance level.**]

AWS requires ANSI/WDMA Heavy Duty performance level for all doors. Require Extra Heavy Duty for doors that will see frequent and heavy use such as classrooms, patient rooms, and public restrooms. See Section 9 of the *AWS* for more discussion of duty levels.

2. Faces of wood veneered doors intended for transparent finish shall be [**species**] [**cut**], with [**book**] [**slip**] veneer match.

Veneer may be plain sliced, quarter sliced, rift, or rotary cut. The match is the system of matching veneer leaves on the panel. Book matched is the most common system; slip match is also frequently used. Rotary cut veneers may be wide enough to make single leaf faces.

3. Faces at Plastic Laminate faced doors shall be [**manufacturer**] [**pattern**].
4. Faces at doors for opaque finish shall be [**closed grain hardwood -OR- MDO -OR- MDF**].

CSI Section 08 14 00
Wood Doors

5. Core shall be [**hollow grid**] [**Particleboard**] [**staved lumber**] [**structural composite lumber**] [**per door schedule**].

   Particleboard or SCL are recommended as core materials.

B. Stile and Rail Doors:

1. [**Doors shall meet the requirements of ANSI/WDMA Extra Heavy Duty performance standard.**]

   AWS requires ANSI/WDMA Heavy Duty performance level for all doors. Require Extra Heavy Duty for doors that will see frequent and heavy use such as classrooms, patient rooms, and public restrooms. See Section 9 of the *AWS* for more discussion of duty levels.

2. Lumber shall be [**species, cut**] [**closed grain hardwood**].

   Select closed grain hardwood for opaque finish.

3. Core material for panels shall be [**MDF**] [**water resistant MDF**] [**SCL**] [**exterior grade hardwood plywood**].

   Custom Grade allows solid lumber panels. Include this Item if Premium Grade is specified and you prefer one core material over another.

4. Core material for stiles and rails shall be [**MDF**] [**SCL**] [**stave core**].

   Custom Grade allows solid lumber stiles and rails. Include this Item if Premium Grade is specified and you prefer one core material over another.

5. Type I adhesives shall be used at exterior doors.

6. [**Lights shall be** [**tempered**] [**laminated**] safety glass.

   Include this Item if glazing is included in this Section.

   A. Lights at exterior doors shall be [_____].

   Insert your preferred insulated or low e glazing.

2.02 FABRICATION

A. Slab doors shall be *Architectural Woodwork Standards* [**Custom**] [**Premium**] Grade:

1. Doors shall be [**3**] [**5**] [**7**] ply construction.

   Three ply construction is only used for Laminate faced doors.

2. Exterior doors shall be assembled with Type 1 glue.

3. Size of doors; type, size, and location of lights and louvers; astragals, edging, flashing, and specialty hardware; X-ray and sound requirements, and transom panels shall be as indicated on the door schedule.

4. Fire-rated doors shall be of the construction standard of the manufacturer and conform with the requirements of all applicable labeling agencies.

5. Provide blocking as required for surface mounted hardware to prevent the need for through bolting.

   Specify a blueprint match if there is an area where casework, doors, and panels should all be sequence matched. Similar language must be inserted in the Sections specifying wood paneling, wood trim, and casework.

6. [**Blueprint Match: Work at room(s)** [**_____**] **shall be blueprint matched:**

   a. All work in this/these area(s) shall be AWS Premium Grade.

   b. Casework, paneling, doors and wood trim shall be provided by the same manufacturer.

   c. Veneers shall be taken from the same flitch, to be selected by the architect.

   d. Faces of cabinet doors, drawer fronts and false fronts shall be sequence matched, shall run and match vertically, and shall be sequence matched with adjacent wall paneling and/or doors.

   e. Faces at exposed ends of cabinets shall be selected from the same flitch, and shall be well matched to the adjacent paneling and to the cabinet fronts.

   f. All components including casework, paneling, doors and trim shall be factory finished at the same time in the same facility.]

B. Stile and Rail Doors shall be *Architectural Woodwork Standards* [**Custom**] [**Premium**] Grade.

1. Panels:

   A. Shall be [**1/2 (12.7 mm)**] [**3/4 (19 mm)**] [**1 3/8 (34.9)**] [**1 ¾ (44.5 mm)**] inches thick.

   Use ½" or ¾" panels for flat panel construction. Use thicker panels for raised panels.

CSI Section 08 14 00
Wood Doors

B. [**Veneered panels shall be** [**book**] [**slip**] **matched.**]

Use this item if Premium Grade is specified.

2. Sticking and panel edge details shall be [**per plans**] [**per manufacturer's standard details as selected by architect**].

C. Factory Finishing:

As noted above, Factory Finishing is strongly recommended. In addition to getting a better finish, you are moving the air quality problems off site, where a proper spray booth will protect the environment and the health of the finishers. It is still worth while to select a low VOC finishing system, as some touch up will be required at the job site.

1. All products provided in this Section shall be factory finished using *Architectural Woodwork Standards* finishing system [_____].
2. Finish shall be *AWS* [**Premium -OR- Custom**] Grade.

PART 3 - EXAMINATION

3.01 EXAMINATION

A. Verify that frames are set square, plumb, level, and in plane.
   1. Report openings that are not within tolerance to the General Contractor for correction before hanging doors.

3.02 INSTALLATION

A. Install all work in conformance with the Architectural Woodwork Standards, latest edition.
   1. Installation shall conform to the *AWS* Grade of the items being installed.

B. Doors shall be secured in place, square, plumb, and level.

C. Hardware shall be installed complete and as recommended by the manufacturer.

3.03 ADJUSTING & TOUCH UP

A. Before completion of the installation, the installer shall adjust all moving and operating parts to function smoothly and correctly.

B. All nicks, chips, and scratches in the finish shall be filled and retouched. Damaged items which cannot be repaired shall be replaced.

3.04 CLEANUP

A. Upon completion of installation, the installer shall clean all installed items of pencil and ink marks, and broom clean the area of operation, depositing debris in containers provided by the general contractor.

END OF SECTION

NOTES

1
Submittals

1 - Submittals

WHAT TO EXPECT

"The Woodworker shall submit shop drawings, samples, brochures, etc. on all items of architectural woodwork. Shop drawings shall be of sufficient detail in scale to determine compliance with the intent of the Quality Standard Grade specified." - from an office Master Specification

In commonly used Guide Specifications, the scale, level of detail and quantity of shop drawings actually required for custom architectural woodwork are described rather broadly. The key to achieving the most detailed and useful set of drawings is clear and continual communication between the architect/designer and the woodwork manufacturer, from the earliest stage of design.

PURPOSE

Shop drawings are the means by which the design intent is turned into reality, serving as the primary instructions for woodwork engineering and fabrication, and as a guide for other trades. As the primary communication among woodworker, general contractor and design professional, shop drawings serve a valuable coordinative function. Good shop drawings are the extension of the design into the area of engineering. They should indicate methods of construction, exact material selections, finishes, method of attachment and joinery, exact dimensions and should include the woodworker's technical suggestions.

LEVEL OF DETAIL

The level of detail required on shop drawings is established by the Quality Grade and complexity of the project. The specifier is at liberty to specify any level of detail as a requirement of the project and of the contract documents. It should be noted that requirements for local codes and utilization of fire retardant wood products are to be researched and directed by the design professional and are not the responsibility of the woodworker.

What constitutes the minimum expectation for a set of shop drawings? The answer is not simple, since there are many variables as to the complexity, quality and type of work being specified.

A suggested level of detail and scale of drawings has been established in tabular form and is provided on the following pages to be used as a guideline.

APPROVALS

The approval stage provides the architect/designer a final opportunity, prior to fabrication, to make changes or correct mistakes. Shop drawings, however, are not an extension of the design development process; therefore, changes of intent made during shop drawing review will in many cases involve an increase in cost and time.

During the review process the design professional should consider the following:

• Only two copies are necessary for checking purposes. After being reviewed, one marked copy should be returned to the woodworker with a request for the required number of prints or a sepia from which the owner's representative may make prints.

• Those charged with review of shop drawings should be completely familiar with woodwork fabrication, and be responsible for insuring compliance with referenced Standards as well as design intent.

• Deviations from the original plans are often recommendations for improvement, and not necessarily a "flying in the face" of instructions. It is as wrong for a checker to arbitrarily stamp "Redraw and Resubmit" on a shop drawing that proposes a change as it is wrong to automatically accept a folio of drawings because they contain duplicates of the original plans.

The four common levels of approval are:

- Approved
- Approved As Noted
- Redraw and Resubmit
- Disapproved

Approvals are generally indicated by a stamp on each of the drawings. When selecting "Approved As Noted" rather than "Redraw and Resubmit," the design professional can often save weeks of production time provided the intent and all changes are clearly marked on the drawings.

SCHEDULING

Most projects are encumbered by a tight production schedule, especially for the finish trades such as woodworking, painting, carpeting and wall coverings. Prompt review of shop drawings and accurate coordination of multiple trades can save weeks of time and eliminate problems before construction begins.

We recommend the design professional work with the woodwork manufacturer to determine the maximum "approval-to-fabrication" timeline needed to keep the job on schedule (e.g., "Shop drawings must be returned approved to fabricate seven (7) days after submittal.")

SCHEDULES VS. DRAWINGS

In some cases shop drawings are not required to communicate the necessary quality, type, quantity and details of an item. Tabular schedules are used instead, generally for such items as doors, frames, stock factory cabinets, closet shelves, and furniture items.

THE PROCESS

It is the role of the design professional and the contractor to coordinate the woodworker's shop drawings with work of all other trades and to insure the "hold" dimensions are actually held. It is also the responsibility of the architect or contractor to give field changes to all parties so that if dimensions are changed, each subcontractor and material supplier can be held responsible for his work.

2
Care and Storage

2 - Care and Storage

PERMANENT FURNITURE

Architectural woodwork should be treated like fine furniture, particularly that which is constructed of wood finished with a transparent finish system.

Fine architectural work is finished with a commercial finish which is durable and resistant to moisture. Allowing moisture to accumulate on, or stay in contact with, any wood surface, no matter how well finished, will cause damage. Prevent direct contact with moisture, and wipe dry immediately should any occur.

TREATMENT

With the exception of true oil-rubbed surfaces, modern finishes do not need to be polished, oiled, or waxed. In fact, applying some polishing oils, cleaning waxes, or products containing silicone may impede the effectiveness of touch-up or refinishing procedures in the future.

CLEANING

No abrasives or chemical or ammonia cleaners should be used to clean fine woodwork surfaces.

Routine cleaning is best accomplished with a soft, lint-free cloth lightly dampened with water or an inert household dust attractant. Allowing airborne dust, which is somewhat abrasive, to build up will tend to dull a finish over time.

Remove oil or grease deposits with a mild flax soap, following the directions for dilution on the container.

IMPACT

Avoid excessive or repetitive impact, however lightly applied. The cellular structure of the wood will compact under pressure. Many modern finishes are flexible, and will show evidence of impact and pressure applied to them.

HEAT

Avoid localized high heat, such as a hot pan or plate, or a hot light source, close to or in contact with the finished surface. Exposure to direct sunlight will alter the appearance of fine woodwork over time.

HUMIDITY

Maintain the relative humidity around the woodwork in accordance with the guidelines published in this standard, every hour of every day, to minimize wood movement.

ABUSE

Use the trims, cabinets and fixtures, paneling, shelving, ornamental work, stairs, frames, windows, and doors as they were intended. Abuse of cabinet doors and drawers, for example, may result in damage to them as well as to the cabinet parts to which they are joined.

REPAIR AND REFINISHING

Contact a local woodworking firm, or the offices of the associations, to explore the options for repair or refinishing. It is often cost effective to replace damaged woodwork elements rather than attempting large scale, on site refinishing.

3
Lumber

3 - Lumber

LUMBER used in architectural woodwork is divided into two groups:

HARDWOODS: Lumber obtained from angiosperms, usually deciduous trees (broadleaf trees). There are more angio sperms on Earth than any other plant group, over 200,000 species. About 900 of those species are commonly available for lumber or veneer throughout the world.

SOFTWOODS: Lumber obtained from gymnosperms, about 600 of which are coniferous trees such as pine, spruce, and fir. The gymnosperms are among the largest and oldest living plants.

NOTE: The above groups have **NO** relationship to the density or "hardness" within or between various species. Some softwoods are harder than some hardwoods, and hardness varies greatly between species within each group.

AWS lumber grades will always be referenced when specifying architectural woodwork. Selection of the ***AWS*** Grade for the finished product (Premium, Custom, or Economy) will define both materials and workmanship for that product. Lumber grades defined by the lumber manufacturers' associations allow some defects which the architectural woodworker must remove (cut out), or otherwise work around (by gluing, etc.).

The selection of the proper wood species for an architectural design can be the end result of a number of contributing factors and conditions. Intended use, costs, hardness, and relative stability are among many important considerations.

The architect and designer may make his selection from a large variety of foreign and domestic species, now commercially available. The unique quality that wood imparts to design is that each species has its own distinguishing characteristics. Once the species is chosen, its effectiveness may vary according to the manner in which it is sawn, sliced as veneer, treated, and finished.

This Section is designed to counsel the architect and designer in the comparisons, considerations, and species which should be evaluated before decisions are made and specifications are written. This Section will help you correlate and tabulate the information needed. An informed choice will reward the owner with the best possible performance by a natural building material.

WOOD AS A PLANT

The trunk and its branches: The cross section of a tree shows the following well-defined features in succession from the outside to the center: (1) bark and cambium layer; (2) wood, which in most species is clearly differentiated into sapwood and heartwood; and (3) pith, the small central core. The pith and bark, of course, are excluded from finished lumber.

Most branches originate at the pith, and their bases are intergrown with the wood of the trunk as long as they are alive. These living branch bases constitute intergrown or tight knots. After the branches die, their bases continue to be surrounded by the wood of the growing trunk and therefore loose or encased knots are formed. After the dead branches fall off, the stubs become overgrown, and subsequently clear wood is formed.

All growth in thickness takes place in the cambium layer by cell division. No growth in either diameter or length takes place in wood already formed; new growth is purely the addition of new cells, not the further development of existing cells.

ANNUAL RINGS

Most species grown in temperate climates produce well-defined annual growth rings, which are formed by the difference in density and color between wood formed early and late in the growing season. The inner part of the growth ring formed first is called "spring wood," and the outer part formed later in the growing season is called "summer wood."

Spring wood is characterized by cells having relatively large cavities and thin walls. Summer wood cells have smaller cavities and thicker walls, and consequently are more dense than spring wood. The growth rings, when exposed by conventional methods of sawing, provide the grain or characteristic pattern of the wood. The distinguishing features of the various species are thereby enhanced by the differences in growth ring formation.

Some tropical species, on the other hand, experience year long even growth which may result in less obvious growth rings.

SOFTWOODS AND HARDWOODS

Native species of trees and the wood produced by these trees are divided into two botanical classes: hardwoods, which have broad leaves; and softwoods, which have needle-like or scale-like leaves. This botanical classification is sometimes confusing, because there is no direct correlation between calling a species a hardwood or softwood and the hardness or softness of the wood itself. Generally, hardwoods are more dense than softwoods, but some hardwoods are softer than many softwoods. If hardness is a desired characteristic, refer to the Comparative Table of Wood Species later in this section.

HEARTWOOD

Heartwood consists of inactive cells formed by changes in the living cells of the inner sapwood rings, presumably after their use for sap conduction and other life processes of the tree have largely ceased. The cell cavities of heartwood may also contain deposits of various materials that frequently provide a much darker color. Not all heartwood, however, is darker. The infiltrations of material deposited in the cells of heartwood usually make lumber cut therefrom more durable when exposed to weather. All wood, with the possible exception of the heartwood of Redwood and Western Red Cedar, should be preservative-treated when used for exterior applications.

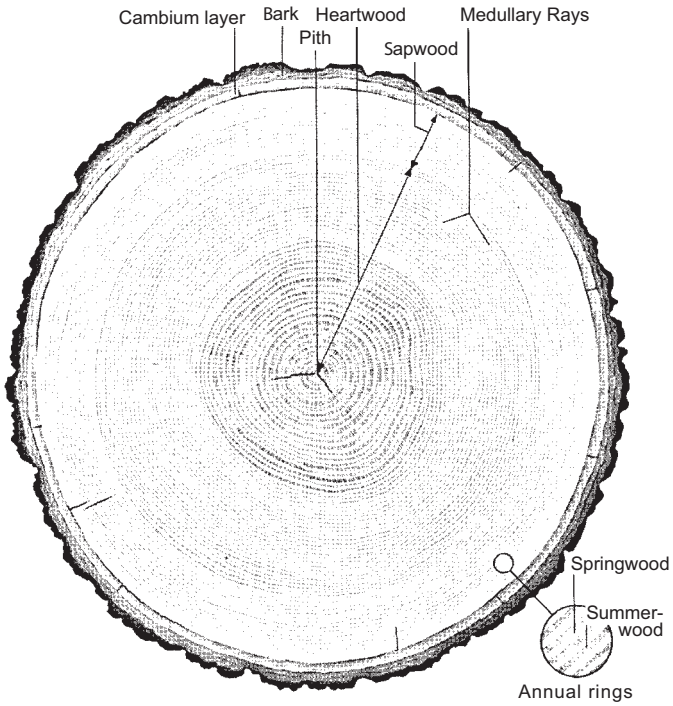
SAPWOOD

Sapwood contains living cells and performs an active role in the life processes of the tree. It is located next to the cambium and functions in sap conduction and storage of food. Sapwood commonly ranges from 1" to 2" (25-50 mm) in thickness. The Maples, Hickories, Ashes, and some of the Southern Yellow Pines and Ponderosa Pine may have sapwood 3" to 6" (76-152 mm) in thickness, especially in second growth trees.

3 - Lumber

MEDULLARY RAYS

Medullary rays extend radially from the pith of the log toward the circumference. The rays serve primarily to store food and transport it horizontally. They vary in height from a few cells in some species to four or more inches in the oaks, and produce the fleck (sometimes called flake) effect common to the quarter-sawn lumber in these species.



COMPARATIVE TABLE OF WOOD SPECIES

In order to simplify species selection, the Comparative Table of Wood Species (pg. 436) has been prepared showing pertinent characteristics of some species of domestic and foreign woods used by the architectural woodwork industry. The table can quickly confirm or deny the wisdom of a species selection by the architect or designer or conversely lead to a proper selection after studying the characteristics.

COST has been broken into both Lumber and Plywood headings, with data divided into Low, Moderate, High, and Very High [V. High]. (Important: Market conditions cause these relationships to vary. Current ratios are likely to be different.) The reason for cost variations in the two products is obvious when we consider the physical differences. Generally, the prices of veneered products reflect the relatively high labor and equipment cost and relatively low material cost in their manufacture. On the other hand, the price of lumber in most species reflects cost factors that are exactly the opposite. In spite of their physical differences, the two products are always compatible, and both are essential to complete design freedom in contemporary buildings.

End use determines the importance of Hardness in selecting a species for each particular type of application. Counters, door frames, wall treatments in high-traffic areas, etc., are obvious uses of wood products where hardness and resistance to abrasion must be considered. In many other applications these factors, relatively speaking, are not of great importance.

The **DIMENSIONAL STABILITY** column is helpful in selecting woods for use where humidity conditions may vary widely and where design or fabrication of a wood product does not allow free movement or the use of plywood. The column figures indicate extreme conditions and show the maximum amount of movement possible in a 12” (305 mm) wide piece of unfinished wood where its moisture content increases or decreases from 10% to 5%. The possible change in dimension demonstrates that unfinished interior woodwork must be carefully protected prior to finishing by keeping it in rooms where relative humidity is between 25% and 55%. The column also shows the variation between species, and between flat grain and edge grain where such cuts are available commercially.

Careful analysis of the table will make it possible for an architect, designer or specification writers (who may have only a limited knowledge of architectural wood species) to make an informed selection. It is our intent that this tool will enhance understanding between the manufacturer of the woodwork you have designed and your profession, thereby enabling the building industry to better service the client.

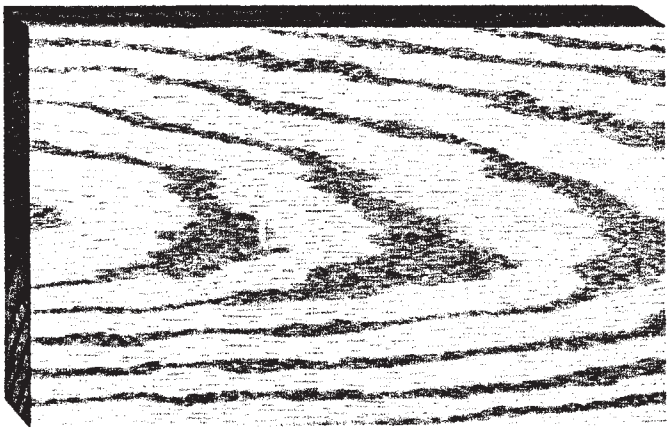
3 - Lumber

COMPARATIVE TABLE OF WOOD SPECIES

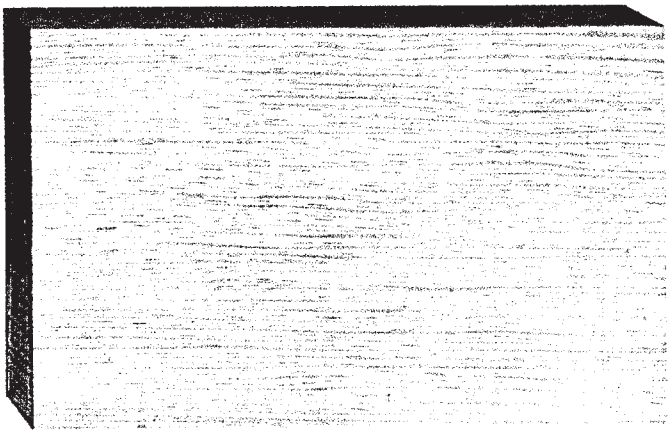
Species	Costs (1)		Practical Size Limits (2)			Hardness	Dimensional Stability (3)
	Lumber	Plywood	Thick-ness	Width	Length		
Ash	Moderate	Moderate	2-1/2"	5-1/2"	12'	Hard	10/64"
Basswood	Low	No data	2-1/2"	5-1/2"	10'	Soft	10/64"
Beech	Low	No data	1-1/2"	5-1/2"	12'	Hard	14/64"
Birch, Yellow - natural	Moderate	Moderate	1-1/2"	5-1/2"	12'	Hard	12/64"
Birch, Yellow - select red	Moderate	Moderate	1-1/2"	4-1/2"	11'	Hard	12/64"
Birch, Yellow - select white	Moderate	Moderate	1-1/2"	4"	11'	Hard	12/64"
Butternut	High	V. High	1-1/2"	4-1/2"	8'	Soft	8/64"
Cedar, Western Red	High	Moderate	3-1/4"	11"	16'	Soft	10/64"
Cherry, American Black	High	High	2-1/2"	4"	7'	Hard	9/64"
Chestnut - wormy	High	No data	3/4"	5-1/2"	10'	Medium	9/64"
Cypress, Yellow	Low	No data	2-1/2"	7-1/2"	16'	Medium	8/64"
Fir, Douglas - flat grain	High	Moderate	3-1/4"	11"	16'	Medium	10/64"
Fir, Douglas - vertical grain	High	No data	1-1/2"	11"	16'	Medium	6/64"
Hickory	Low	Moderate	1-1/2"	4-1/2"	12'	Very Hard	11/64"
Mahogany, African - plain sawn	High	High	2-1/2"	9"	15'	Medium	7/64"
Mahogany, African - quarter sawn	V. High	V. High	2-1/2"	5-1/2"	15'	Medium	5/64"
Mahogany, Genuine (American)	High	V. High	2-1/2"	11"	15'	Medium	6/64"
Maple, Hard - natural	Moderate	Moderate	3-1/2"	7-1/2"	12'	Very Hard	12/64"
Maple, Hard - select white	Moderate	High	2-1/2"	5-1/2"	12'	Very Hard	12/64"
Maple, Soft - natural	Moderate	No data	3-1/2"	7-1/2"	12'	Medium	9/64"
Oak, English Brown	V. High	V. High	1-1/2"	4-1/2"	8'	Hard	No data
Oak, Red - plain sawn	Moderate	Moderate	2-1/2"	7-1/4"	12'	Hard	11/64"
Oak, Red - rift sawn	High	High	1-1/16"	3-1/2"	8'	Hard	7/64"
Oak, Red - quarter sawn	High	High	1-1/16"	5-1/2"	8'	Hard	7/64"
Oak, White - plain sawn	Low	High	1-1/2"	5-1/2"	10'	Hard	11/64"
Oak, White - rift sawn	High	High	3/4"	3"	8'	Hard	7/64"
Oak, White - quarter sawn	High	High	3/4"	4"	8'	Hard	7/64"
Pecan	Low	Moderate	1-1/2"	4-1/2"	12'	Hard	11/64"
Pine, Eastern or Northern White	Moderate	No data	1-1/2"	9-1/2"	14'	Soft	8/64"
Pine, Idaho	Moderate	No data	1-1/2"	9-1/2"	16'	Soft	8/64"
Pine, Ponderosa	Moderate	Moderate	1-1/2"	9-1/2"	16'	Soft	8/64"
Pine, Sugar	Moderate	No data	3-1/4"	11"	16'	Soft	7/64"
Pine, Southern Yellow	Low	No data	1-1/2"	7-1/2"	16'	Medium	10/64"
Poplar, Yellow	Low	No data	2-1/2"	7-1/2"	12'	Medium	9/64"
Redwood, flat grain heartwood	Moderate	No data	2-1/2"	11"	16'	Soft	6/64"
Redwood, vert. grain heartwood	Moderate	No data	2-1/2"	11"	16'	Soft	3/64"
Teak	V. High	V. High	1-1/2"	5-1/2"	8'	Hard	6/64"
Walnut, American Black	Moderate	High	2-1/2"	4"	6'	Hard	10/64"
Walnut, Nogal	Moderate	No data	3/4"	9-1/2"	9'	Medium	12/64"
Zebrawood, African - quarter sawn	V. High	V. High	1-1/2""	7"	14'	Hard	7/64"

(1) Market conditions will cause these relationships to vary. These are raw costs without consideration of labor.
(2) Maximum practical sizes without lamination/gluing. Only 10% of any order is required to be at maximum sizes.
(3) These figures represent possible width change in a 12" (304.8 mm) board when moisture content is reduced from 10% to 5%. Figures taken are for plain sawn unless indicated otherwise in the species column.

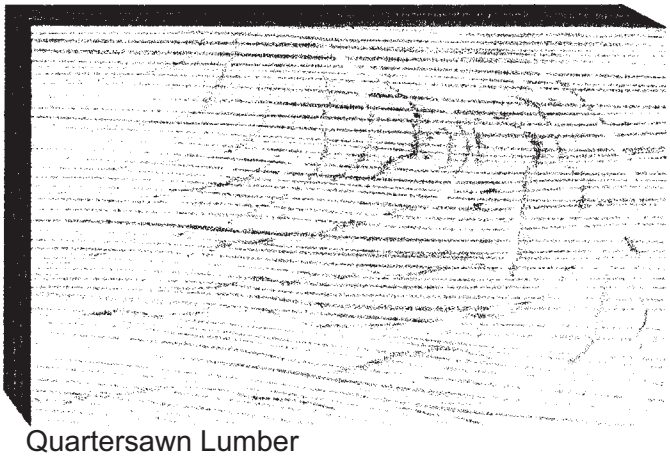
3 - Lumber



Plainsawn Lumber



Riftsawn Lumber



Quartersawn Lumber

ASH, WHITE (Fraxinus americana)

While White Ash has always enjoyed widespread use for industrial products where hardness, shock resistance, stability and strength were important, its acceptance for architectural woodwork is increasing. It is open grained and has a strong and pronounced grain pattern. The heartwood is light tan or brown and its sapwood creamy white. Color contrast between the two is minor and its blond effect makes it particularly appealing when a light or near natural finish is desired. Finished with darker tones it presents a very forthright, honest, and virile effect. Its cost is moderate and it is readily available in lumber form. In veneered form some size limitation may be experienced but it can be easily produced on special order.

BIRCH, YELLOW - "Natural" (Betula alleghaniensis)

BIRCH, YELLOW - "Select Red" (heartwood) (Betula alleghaniensis)

BIRCH, YELLOW - "Select White" (sapwood) (Betula alleghaniensis)

Yellow Birch has been and continues to be one of the prominent wood species used for architectural woodwork. This is due not only to its attractive appearance but also to its general availability both as lumber and as veneered products, its adaptability to either paint or transparent finish, and its abrasion resistance. The heartwood of the tree varies in color from medium to dark brown or reddish brown while its sapwood, which comprises a better than average portion of the tree, is near white. Despite its wide usage some confusion exists as to the common terms used to describe Birch lumber and/or veneer. Virtually all commercially used Birch is cut from the Yellow Birch tree, not from the White Birch tree, which botanically is a distinct species. The term "Natural" or "Unselected" Birch means that the lumber or veneer may contain both the sapwood, or white portion, as well as the heartwood, or dark portion, of the tree in unrestricted amounts. The term "Select Red" Birch describes the lumber or veneer produced from the heartwood portion of the tree, and the term "Select White" Birch describes the lumber or veneer produced from the sapwood portion of the tree. To obtain "Red" or "White" Birch exclusively requires selective cutting with corresponding cost premium as well as considerable restriction on the width and length availability in lumber form. Birch, in veneer form, is readily available in all "selections" and is usually rotary cut. While some sliced veneer is produced which simulates the same grain effect as lumber, its availability and cost reflect the same cutting restrictions that are incurred in producing the "select" forms of Birch lumber.

CHERRY, AMERICAN BLACK (Prunus serotina)

Wild Black American Cherry is a fine and especially stable close grained cabinet and veneer wood. Its heartwood color ranges from light to medium reddish brown. Its sapwood, which is a light creamy color, is usually selectively eliminated from the veneer and lumber. In some respects it resembles Red Birch, but has a more uniform grain and is further characterized by the presence of small dark gum spots which, when sound, are not considered as defects but add to its interest. Cherry is available in moderate supply as lumber and architectural paneling and is usually plain sawn or sliced. Exceptionally rich appearance is achieved with transparent finishes which, together with its fine machining characteristics, justifies its identity with Early American cabinetry and furniture manufacturing, thus adding to its prestige as one of our most desirable native woods.

3 - Lumber

CYPRESS, YELLOW (Taxodium distichum)

While Cypress is still prevalent throughout the south, distinction should be made between the type now generally available and what was once known as "Tidewater Red Cypress." The latter, once the "premium" wood for exterior applications, is now virtually extinct and subject to limited usage. The currently available Cypress lumber, while similar in appearance, does not contain the heartwood of inherently high decay resistance once associated with the species, and in lumber form contains a high percentage of sapwood. Thus, like most softwoods, preservative treatment is imperative if used on the exterior. While this does not preclude its exterior application, it is perhaps more generally utilized for paneling where its strong, bold grain is best displayed.

FIR, DOUGLAS (Flat Grain) (Pseudotsuga taxifolla)

Douglas Fir is a large, fast-growing species and is native to the northwest. It accounts for much of the lumber produced in North America. While the preponderance of its production is developed for structural and construction type products, some of its upper grades are used for stock millwork and specialized woodwork. Its heartwood is reddish tan while its sapwood is creamy yellow. Since its growth rings are conspicuous, a rather bold grain pattern develops when either plain sawn for lumber or rotary cut as is common in plywood. Some lumber and veneer is cut edge or vertical grain, producing a superior form of the product since the tendency to "grain-raise" is greatly reduced.

MAHOGANY, AFRICAN (plain sawn) (Khaya ivorensis)

This, one of the true Mahoganies, is perhaps the most widely used of the several Mahogany species. This is due to its excellent cutting and working characteristics and versatility. While its use has been largely for interior purposes, its innate stability and moderate decay resistance justifies its consideration for selected and demanding exterior applications. It has a very pleasing open grain, with its heartwood ranging in color from light to medium dark reddish brown. In lumber form it is more readily available as plain sawn and selectively so as quartersawn. In veneer form the quarter or "ribbon striped" cut predominates, but plain sliced, as well as many of the exotic "figure" cuts, can be produced on special order.

MAHOGANY, GENUINE OR AMERICAN (Swietenia macrophylla)

This Mahogany species is commonly known as "Honduras Mahogany," but actually encompasses all of this species that grow throughout Mexico, Brazil, Peru, and Central America. Its traditional identity with fine cabinetry and furniture justifies its position as one of the finest woods for this purpose. Its stability, workability, warm appearance, and firm grain make it a favorite of all woodworking craftsmen. It is a semi-open grain wood, with its heartwood color ranging from light tan to a rich golden brown depending to some extent on the country of its origin. Its outstanding stability and decay resistance expands its potential to include exterior applications for "monumental" projects. It is most generally available as plain sawn lumber and plain sliced veneer with different veneer cuts available on special order.

MAPLE, HARD - "Natural" (Acer saccharum)

MAPLE, HARD - "Select White" (Sapwood) (Acer saccharum)

Hard Maple is very similar in general characteristics to Yellow Birch. It is heavy, hard, strong, and resistant to shock and abrasion. The heartwood of the tree is reddish brown and its sapwood is near white with a slight reddish-brown tinge. Another natural characteristic is the prevalence of dark mineral streaks (predominantly in the heartwood), which can be minimized in the sapwood by selective cutting. Like Birch, common usage of descriptive terms does occasion some confusion. The term "Natural" or "Unselected" Maple indicates that the lumber or veneer may contain both the white sapwood and the darker heartwood. The term "White" Maple means that the lumber or veneer is selected and separated from the pieces containing the dark heartwood. Unlike Birch, the heartwood is so low in content that no comparable selection is available. Maple's close identity with furniture and specialized industrial use overshadows its potential for architectural woodwork. Its modest cost, and pleasing, mild grain pattern warrants its consideration, especially on items subject to hard usage.

ENGLISH BROWN OAK (Quercus robur)

The English Brown Oak, or Pollard Oak is a tree which varies in height from 18-40 m [60'-130'] depending on soil conditions. It varies in color from a light tan to a deep brown with occasional black spots. It produces burls and swirls which are very brittle and fragile, but beautiful work can be obtained with their use. English Brown Oak is considered one of the finest woods in use today.

English Brown Oak is obtained from trees which have had their tops cut out before reaching maturity. This pruning leads to the production of a number of new branches around the cut, and if these are subsequently lopped off, more new branches are formed.

This wood is difficult to season and to work, tending to warp and twist in drying and to tear in working. The best figure is obtained from trees which have been cut over regularly every few years, the branches never being left sufficiently long for the production of large knots. The constant exposure of freshly cut surfaces promotes attack from parasites, the result being that a considerable portion of these trees become decayed sooner or later. This has made the timber relatively scarce and costly.

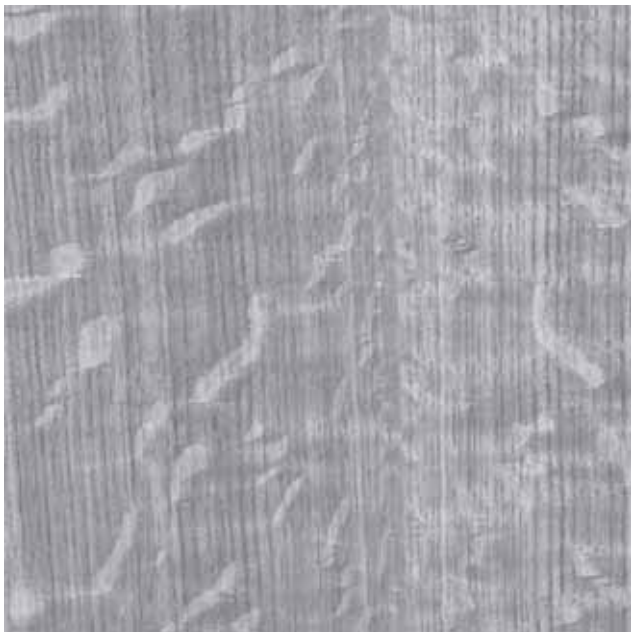
OAK, RED (plain sawn) (Quercus rubra)

OAK, RED (rift sawn) (Quercus rubra)

Red Oak is one of the most abundant of our domestic hardwoods. Its moderate cost, strength, wearability, and appealing grain characteristics make its use widespread. It is open grained and in its plain sawn or sliced form expresses a very strong "cathedral" type grain pattern. The heartwood is reddish tan to brown and very uniform in color. Its sapwood is lighter in color and minimal in volume, making its elimination by selective cutting very easy. Red Oak is also available in rift sawn or sliced form, which produces a very uniform straight-grained effect. Less frequently it is quarter sawn or sliced, still producing a straight grain but with the fleck (sometimes called flake) of the medullary ray accented. Some sacrifice in width and length availability occurs when producing either rift or quarter sawn lumber.

3 - Lumber

OAK, WHITE (plain sawn) (Quercus alba)



OAK, WHITE (quarter sawn) (Quercus alba)

White Oak, like Red Oak, is perhaps one of the best-known hardwoods in the world, and its use for architectural woodwork is widespread. It is hard and strong. Its heartwood has good weathering characteristics, making its use for selected exterior applications appropriate. It is open grained and in its plain sawn form is highly figured. The heartwood varies considerably in color from light grayish tan to brown, making the maintenance of color consistency difficult. Its sapwood is much lighter in color, is fairly prevalent, and its elimination is accomplished by selective ripping. White Oak is often rift sawn or sliced, producing a very straight-grained effect or frequently quarter sawn or sliced, producing straight grain, but with the fleck (sometimes called flake) of the medullary ray greatly pronounced. The special cuts mentioned are more readily attained in veneer form since the solid lumber cutting techniques greatly restrict its width and length potential.

PINE, PONDEROSA (Pinus ponderosa)

Ponderosa Pine is said to be the softwood species most commonly used for exterior and interior woodwork components. Its heartwood is tannish pink, while its sapwood is a lighter creamy pink. Its supply is extensive; found in commercial quantities in every state west of the Great Plains. Ponderosa Pine grows in pure stands and is abundant in mixed stands. Also, like most Pines, the proportion of sapwood is high and its heartwood has only a moderate natural decay resistance. Fortunately, its receptivity to preservative treatment is high, and since all Pines should be so treated when used on the exterior, it can be used interchangeably with them.

PINE, SOUTHERN YELLOW (Short Leaf) (Pinus echinata)

Southern Yellow Pine, commonly called Short Leaf Pine, is commercially important in Arkansas, Virginia, Missouri, Louisiana, Mississippi, Texas, and South and North Carolina, and is found in varying abundance from New York and south central Pennsylvania, south and westerly to eastern Texas and Oklahoma.

The yellowish wood is noticeably grained, moderately hard, strong, and stiff. A cubic foot of air-dried Southern Yellow Pine weighs 36 to 39 pounds. It is used extensively in house building, including framing, ceiling, weather boarding, panels, window and door frames, casing, and carved work. The grain shows well in natural finish or when stained. Frames of overstuffed furniture, chairs, desks, agricultural machinery, wood pulp, mine props, barrels, and crates are also made of this Pine.

POPLAR, YELLOW (Liriodendron tulipfera)

Yellow Poplar, sometimes incorrectly called “Whitewood,” is an extremely versatile and moderately priced hardwood that is well adapted to general interior woodwork usage. It is even textured, close grained, stable, of medium hardness, and has an inconspicuous grain pattern. The heartwood is pale greenish yellow while the sapwood is white. Occasional dark purple streaks also occur. The tight, close grain results in outstanding paintability, while its modest figure and even texture permits staining to simulate more expensive hardwood. Due to its indistinct grain figure, Poplar is seldom used for decorative veneered products. Its white sapwood is not appropriate for use in exterior applications.

REDWOOD, FLAT GRAIN (Heartwood) (Sequoia sempervirens)

Redwood is the product of one of nature’s most impressive accomplishments. The enormous size and unique inherent characteristics of this tree produce a material ideally suited for exterior applications. Its heartwood color is a fairly uniform brownish red, while its very limited sapwood is lemon colored. In its plain sawn form medium “cathedral” type figure develops, while in the vertical grain a longitudinal striped figure results. Its availability in “all heartwood” form with its outstanding natural resistance to decay accounts for its wide usage for exterior purposes. It is considered a very stable wood and its paint retention qualities are excellent. Redwood’s principal identity with painted exterior application should not preclude its consideration for either exterior or interior use with transparent finish. Its pleasing and uniform color lends itself to a variety of such finishes suggesting the warmth and honesty of wood in its natural state. The enormous size of the trees yields lumber of unusually character-free widths and lengths.

TEAK (Tectona grandis)

Teak is one of the most versatile and valuable woods and has attained great prestige value. The figure variations are extensive and it is available in both lumber and veneered products. Adding to its appeal is its distinctive tawny yellow to green to dark brown color, often with light and dark accent streaks. It is perhaps most appealing in plain sawn or sliced cuts. While it has unique stability and weathering properties, making it ideal for exterior applications, its high cost usually limits its use to decorative interior woodwork, most often in veneer form. Its great beauty and interest dictate it being finished in its near “natural state.”

3 - Lumber

AMERICAN BLACK WALNUT (Juglans nigra)

American Black Walnut is perhaps our most highly prized domestic wood species. Its grain pattern variations are extensive and in veneered form produces, in addition to its normal plain sliced cut, quartered or "pencil striped" as well as specialty cuts such as crotches, swirls, burls, and others. Its heartwood color varies from gray brown to dark purplish brown. The sapwood, which is very prevalent in solid lumber, is cream colored and its complete elimination by selective cutting is very costly. Fortunately, if this natural effect is felt to be undesirable, its appearance can be neutralized by sap staining in the finishing process. The growth conditions of Walnut result in significant width and length limitations in its lumber form. Its potential is best expressed in veneered products.

ZEBRAWOOD, AFRICAN (quarter sawn) (Brachystegea fleuryana)

The Zebrawood tree is an equatorial tree of medium size, obtaining a height of about 65' (20 m) with a diameter of about 3' (1 m). The sapwood is pale in color and distinct from the heartwood, which is of a creamy yellow color veined or striped with very dark brown or black. The striped effect is seen at its best when the wood is quarter sawn.

The wood is reported to be easy to saw but somewhat difficult to work with other tools. It is claimed that there is little tendency for the wood to "work" after seasoning. It has been used for a number of years for cabinet work, fine joinery, fancy turnings, and veneers. By careful selection of veneered material, the skilled craftsman can obtain very beautiful effects in paneled work. In large panels, a very striking and attractive result may be obtained when using Zebrawood.

OTHER SPECIES

There are many other species, both domestic and imported, used in fine woodworking. Nearly all are ecologically sound and appropriate for use. Using fine hardwoods for architecture gives value to the species, encouraging improved forest management techniques and the continuation of the species. As of March 2001, there are only four tree species listed on the Convention on International Trade in Endangered Species (CITES) Appendix I restricted table: Brazilian Rosewood, Monkey Puzzle Tree, Guatemalan Fir, and Alerce. Contact your local woodwork manufacturer for up-to-date information or visit www.cites.org.

USE OF RECLAIMED TIMBER

Interest in timber salvaged or reclaimed from old logs cut from old growth forests has increased recently.

Logs harvested over 100 years ago and transported by water often sank en-route to mills. The resulting "lost underwater forest" lay on the bottoms of rivers and lakes until recently as proper environmental and mechanical procedures for retrieving them have been developed.

Reclaimed submerged materials are utilized in all aspects of construction of fine furniture, architectural woodwork and musical instruments. Submerged lumber is generally processed in both solid lumber, plain sliced and rotary veneer.

The uniqueness of the harvesting procedures, the high quality of the material and unusual aesthetic qualities are a few of desirable traits associated with this special material.

Some of the characteristics unique only to reclaimed submerged timber are:

- Greater density due to tighter growth rings than currently harvested stock;
- Beautiful variance of color gained from the transfer of mineral absorption found naturally in bottom sediments and water;
- Substantial increase of ease in milling due to sap replacement;
- Superior tonal qualities;
- A more pristine appearance;
- Aspects of Historical importance as well as environmental consciousness is added to any project;
- Complete use of the harvested resource.

Check availability and differences in aesthetic qualities before selecting.

ENGINEERED PRODUCTS

Structural Composite Lumber (SCL) — A man-made composite that utilizes grain oriented wood strands from a variety of tree species, providing an alternative to dimension lumber. The material is engineered for strength and stability. While SCL is not really "lumber," it is marketed as a lumber substitute. SCL can be specified as core, stile backers, and core for stiles and rails, so long as all other criteria of the AWS are met in relation to its use.

ÆSTHETIC CHARACTERISTICS

One of the qualities which contributes to the widespread use of wood is the option offered for æsthetic selection. It varies between species, between two logs of the same species, and between two boards from the same log. Æsthetic considerations in specifying wood are influenced by the following characteristics:

COLOR - The basic hue of the species, which may be further enhanced by the finishing process employed.

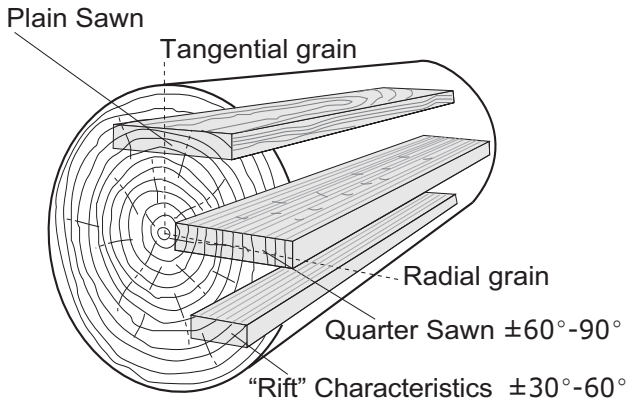
Sapwood and heartwood - The color of wood within a tree varies between the "sapwood" (the outer layers of the tree that continue to transport sap), which is usually lighter in color than the "heartwood" (the inner layers in which the cells have become filled with natural deposits). If desired, sapwood may be stained in the finishing process to blend with the heartwood. This difference in color is so pronounced in certain species that the sapwood is marketed under a different nomenclature from the heartwood. Some examples are:

- Select White Birch - sapwood of Yellow or Paper Birch
- Select Red Birch - heartwood of Yellow Birch
- Natural Birch - both sapwood and heartwood of any Birch
- Select White Ash - sapwood of White or Green Ash
- Select Brown Ash - heartwood of Black Ash
- Natural Ash - both sapwood and heartwood of any Ash
- Select White Maple - sapwood of the Sugar Maple

3 - Lumber

GRAIN

The appearance produced by the arrangement of wood fibers and pores of the species. Open grain woods are said to be ring-porous and usually show a distinct grain pattern. Close grain woods are said to be diffuse-porous with even grain.



OPEN GRAIN AND CLOSE GRAIN

The size and distribution of the cellular structure of the wood influences the appearance and uniformity. Open grain hardwoods, such as Elm, Oak, Ash, and Chestnut are ring-porous species. These species have distinct figure and grain patterns. Close grain hardwoods, such as Cherry, Maple, Birch, and Yellow Poplar, are diffuse-porous species. Most North American diffuse-porous woods have small, dense pores resulting in less distinct figure and grain. Some tropical diffuse-porous species (e.g., Mahogany) have rather large pores.

FIGURE

Various species produce different grain patterns (figures), which influence the selection process. There will be variations of grain patterns within any selected species. The architectural woodworker cannot select solid lumber cuttings within a species by grain and color in the same manner in which veneers may be selected.

METHODS OF SAWING

The sawing method, and the selection of boards after sawing the log will produce the following types of lumber:

PLAIN SAWN

Plain sawing, the most common type of lumber sawing, yields broad grain, the widest boards and least waste. The annular rings are typically 30 degrees or less to the face of the board.

QUARTER SAWN

Most often cut as Rift-and-Quartered, and then sorted for appearance, quarter sawn lumber is available in certain species, yields a straight grain, narrow boards, and fleck (sometimes called flake) or figure which runs across the grain in some species (notably the oaks). Dimensional stability across the grain is the best. The annular rings run approximately 60 to 90 degrees to the face of the board, with the optimum being 90 degrees. Quartered lumber is generally more expensive than plain sawn.

RIFT SAWN

Rift sawing produces small flecks caused by cutting through the wood rays. Only certain species produce these flecks, primarily Red and White Oak. Rift cutting reduces yield and increases cost. The annular rings run about 30 to 60 degrees to the face of the board, with the optimum being 45 degrees.

FINISHING CHARACTERISTICS

The many species of wood vary considerably in their receptivity to the multitude of finishing processes on the market. Some woods, because of their open pores, will accept fillers while tighter grained woods will not. Some will show greater contrast between the "early wood" and the "late wood" when stained than others. Design professionals should take into consideration the finish that will be applied when selecting a particular species. Consult with a woodworker about finishing prior to selection or specification. Providing large samples of the desired finish to woodworkers during the design phase and bidding process will assure the designer of obtaining an acceptable final product, while enabling the woodworker to be aware of exactly what is required.

AVAILABILITY

The supply of lumber is in constant flux throughout the world. It is affected by many factors such as current demand, export regulations of the country of origin, natural forces of weather, fire, disease, political situations, etc. Consult a woodworker before specifying uncommon species, as well as large quantities of a species, thickness, width, or long length.

SIZE LIMITATIONS

Certain trees (species) naturally grow larger, thus producing longer and wider lumber. Other trees are smaller and produce narrow and shorter boards. The architectural woodworker must work with the available lumber, which must be considered when selecting any species.

COST

The cost of lumber, as with other commodities, is influenced by supply and demand, both of which are constantly changing. For current comparative costs consult a woodworker.

STRENGTH, HARDNESS, DENSITY

Always a consideration is the ability of the selected lumber species to sustain stress; resist indentation, abuse, and wear; and to carry its anticipated load in applications such as shelving and structural members. *The Wood Handbook*, published by the U.S. Forest Products Society, contains comprehensive data on the mechanical properties of wood.

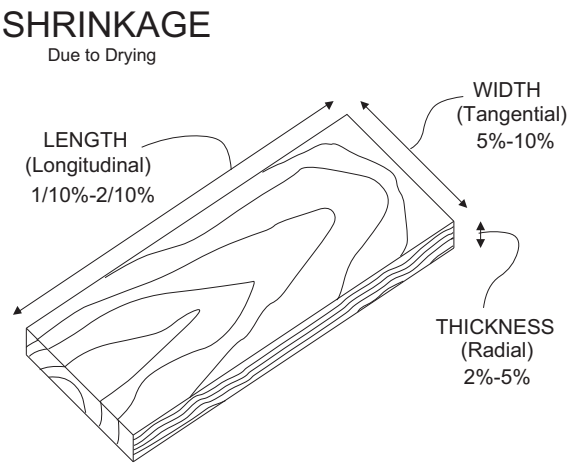
3 - Lumber

DIMENSIONAL STABILITY, RELATIVE HUMIDITY, AND MOISTURE CONTENT

All woods are affected significantly by moisture and to a lesser degree by heat. Lumber swells and shrinks primarily in two directions: thickness and width. There is insignificant change in length. The changes in dimension due to moisture vary with different species, thus influencing the selection of lumber to use and the design elements.

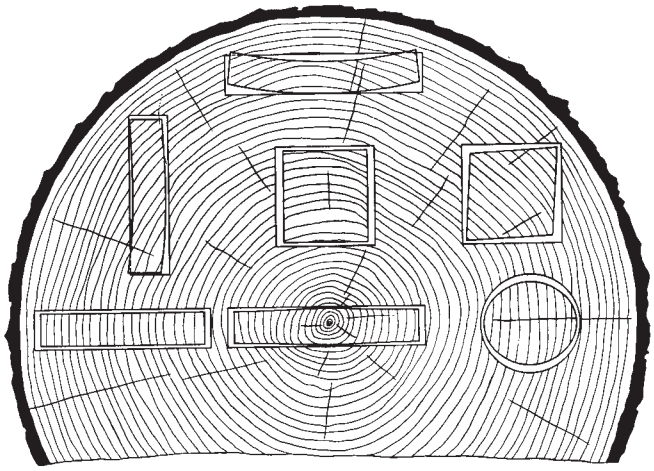
Prevention of dimensional problems in architectural woodwork products as a result of uncontrolled relative humidity is possible. Wood products perform, as they have for centuries, with complete satisfaction when correctly designed and used. Problems directly or indirectly attributed to dimensional change of the wood are usually, in fact, the result of faulty design or improper humidity conditions during site storage, installation, or use.

Wood is a hygroscopic material, and under normal conditions all wood products contain some moisture. Wood readily exchanges this moisture with the water vapor in the surrounding atmosphere according to the relative humidity. In high humidity, wood picks up moisture and swells. In low humidity, wood releases moisture and shrinks. As normal minor changes in humidity occur, the resulting dimensional response in properly designed construction will be insignificant. To avoid problems, it is recommended that relative humidity be maintained within the range of 25% and 55%. Uncontrolled extremes - below 20% or above 80% relative humidity - are likely to cause problems. Together with proper design, fabrication, and installation, humidity control is the important factor in preventing dimensional change problems. The book *Understanding Wood* by Bruce Hoadley contains excellent data of wood and moisture.

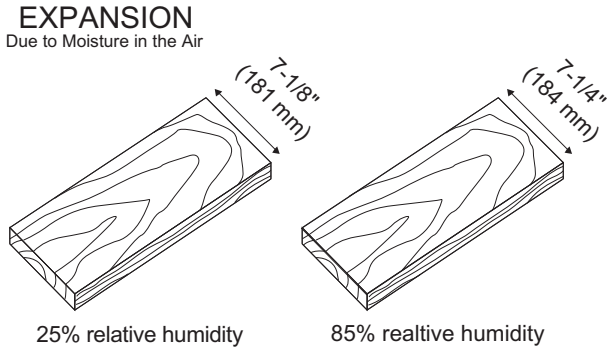


TS=2RS
Tangential Shrinkage
Approximates Twice
the Radial Shrinkage

Shrinkage of 1" x 8" x 10'
Dried from Green to Oven Dry
Approximates: 3/64" in thickness
3/4" in width
1/8" in length



Wood is anisotropic in its shrinkage characteristics. It shrinks most in the direction of the annual rings when it loses moisture from the cell walls. This illustration from the USDA *Wood Handbook* shows the typical distortion of cuts from various parts of a log.



25% relative humidity

85% realtive humidity

Expansion of 1" x 8" x 10' when relativity
Humidity increases from 25% to 85%

Moisture can also cause iron stain (oxidation) in wood, also referred to as blue/black stain. Iron stain is a natural reaction of acids with iron, oxygen, and moisture (either high relative humidity or direct moisture) in wood. Control of moisture is a simple way to protect wood products from iron stain.

ADAPTABILITY FOR EXTERIOR USE

Years of performance have shown certain species to be more durable for exterior applications. Heartwood shall be furnished when these species are designated for external use, excluding the sapwood. The following is a list of species generally considered acceptable for exterior use, from the *Wood Handbook* (USDA):

Eastern and Western Red Cedar
Cherry, black
Douglas, Fir
Mahogany, Genuine
Chestnut
Oak, white
Teak, old growth
Redwood, heartwood
Locust, black
Spanish Cedar

3 - Lumber

BALDCYPRESS (Taxodium distichum) has a long tradition as a species resistant to decay, but beware! There are at least nine other species of four different genus which are marketed under the common name cypress. Only the heartwood of T. distichum, often marketed as Tidewater or Red Cypress, is decay resistant. Sinker Cypress, that is old trees which have been brought up from below water in which they have been submerged for some time and properly cured and dried, is also resistant. None of this Cypress will come from new cutting, but as salvaged wood.

FIRE-RETARDANT WOOD

The natural fire-retardant qualities and acceptability of treatments vary among the species. Where items of architectural woodwork are required to have a flame spread classification to meet applicable building and safety codes, the choice of lumber species must be a consideration. Most treated species are structural softwoods. Following are some references to assist in making these choices. Additional data on various species may be available from the U.S. Department of Agriculture Forest Service, Fire Safety of Wood Products Work Unit — (608) 231-9269.

Flame Spread Classification: This is the generally accepted measurement for fire rating of materials. It compares the rate of flame spread on a particular species with the rate of flame spread on untreated Oak. Most authorities accept the following classes for flame spread:

Class I or A.	0-25
Class II or B.	26-75
Class III or C.	76-200

Built-up Construction to Improve Fire Rating: In lieu of solid lumber, it is often advisable, where a fire rating is required, to build up members by using treated cores clad with untreated veneers not thicker than 1 mm [1/28”]. Some existing building codes, except where locally amended, provide that facing materials 1 mm [1/28”] or thinner finished dimension are not considered in determining the flame spread rating of the woodwork.

In localities where basic model building codes have been amended, it is the responsibility of the specifier to determine whether the application of the facing material specified will meet the code.

Fire-Retardant Treatments (FRT): Some species may be treated with chemicals to reduce flammability and retard the spread of flame over the surface. This usually involves impregnating the wood, under pressure, with salts suspended in a liquid. The treated wood must be redried prior to fabrication. FRT wood may exude chemicals in relative humidity above 85%, damaging finishes and corroding metals in contact with the FRT surface. Consult with a woodworker about the resulting appearance and availability of treated woods prior to specification.

Hardwoods currently being treated (Flame spread less than 25) include 4/4 Red Oak, and 4/4 to 8/4 Poplar. These woods can be machined after treatment, although machining may void the label classification. Fire retardant treatment does affect the color and finishing characteristics of the wood.

According to the traditional model codes in the USA and subject to local code modifications, untreated wood and wood products can usually be used in up to 10% of the combined surface area of the walls and ceiling. Cabinetry, furniture, and fixtures are rarely fire rated, and can be built of combustible materials.

The National Building Code of Canada (1995), states:
3.1.5.7.1 - Combustible millwork including interior trim, doors and door frames, aprons, and backing, handrails, shelves, cabinets and counters is permitted in a building required to be of noncombustible construction.

Code requirements are reviewed and updated regularly. The design authority shall check document publication dates and local amendments to national codes, and shall inform the woodworker of requirements.

Face veneers are not fire-retardant treated, and combining untreated veneers with treated lumber will usually result in color and finishing contrasts.

Finishing of Fire-Retardant Treated Lumber: Fire-retardant treatments may affect the finishes intended to be used on the wood, particularly if transparent finishes are planned. The compatibility of any finishes should be tested before they are applied.

Intumescent Coatings for Wood: It is possible to reduce flammability by using intumescent coatings in either opaque or transparent finishes. These are formulated to expand or foam when exposed to high heat, and create an insulating effect, which reduces the speed of flame spread. Improvements are continually being made on these coatings. Consequently, the specifier must ascertain whether they will be permitted under the code governing the project. The relative durability of the finish and the effect of the coating on the desired color of the finished product vary from manufacturer to manufacturer. In general, the coatings are less durable, softer, and more hygroscopic than standard finishes.

3 - Lumber

Wood Species (a)	Flame Spread Index (b)	Smoke Developed Index (b)	Source (c)
ASTM E 84 flame-spread indexes for various wood species of 19 mm thick [3/4"] solid lumber as reported in the literature.			
Birch, Yellow	105-110	no data	UL
Cedar, Western Red	70	213	HPVA
Cedar, Alaska (Pacific Coast yellow)	78	90	CWC
Cottonwood	115	no data	UL
Baldcypress (Cypress)	145-150	no data	UL
Fir, Douglas	70-100	no data	UL
Fir, Pacific silver	69	58	CWC
Sweetgum (Gum, red)	140-155	no data	UL
Hemlock. western (West Coast)	60-75	no data	UL
Maple, Sugar (maple flooring)	104	no data	CWC
Oak, Red	100	100	UL
Oak, White	100	100	UL
Pine, red	142	229	CWC
Pine, Eastern White	85	122	CWC
Pine, Western White	75	no data	UL
Pine, Northern White	120-215	no data	UL
Pine, Ponderosa	105-230	no data	UL
Pine, Southern Yellow	130-195	no data	UL
Pine, Lodgepole	93	210	CWC
Poplar, Yellow	170-185	no data	UL
Redwood	70	no data	UL
Spruce, Eastern (Northern, White)	65	no data	UL, CWC
Spruce, Sitka (Western, Sitka)	100, 74	no data, 74	UL, CWC
Walnut, Black	130-140	no data	UL
No reliable data is available on other species at the time of this printing.			
(a)-In cases where the name given in the source did not conform to the official nomenclature of the Forest Service, the probable official nomenclature name is given and the name given by the source is given in parentheses. (b)-Data area as reported in the literature (dash where data do not exist). (c)-CWC, Canadian Wood Council (CWC 1996); HPVA, Hardwood Plywood & Veneer Association (Tests); UL, Underwriters Laboratories, Inc. (UL 527, 1971) from the Wood Handbook, Forest Products Society, 1999 - FPS catalog no. 7269			

PRESERVATIVE TREATMENTS

Modern technology has developed methods of treating certain species to extend their life when exposed to the elements. Some lumber species used for exterior architectural woodwork may be treated with an industry tested and accepted formulation. One such formulation is a liquid containing 3-iodo-2-propynyl butyl carbamate (IPBC) as its active ingredient, which must be used according to manufacturer's directions.

The Window & Door Manufacturers Association (WDMA), through the treatments and coatings committee, has reviewed information from third party testing laboratories which indicates that the number of formulations at the stated in-use concentration meet the requirements of WDMA I.S.4, latest edition. The formulations are acceptable for use under the WDMA Hallmark Water-Repellent Non-Pressure Preservative Treatment Certification Program and are adopted to meet all requirements.

3 - Lumber

IMPORTANT PRODUCT ADVISORY REGARDING DIMENSIONAL CHANGE PROBLEMS IN ARCHITECTURAL WOODWORK

This advisory concerns prevention of dimensional problems in architectural woodwork products as the result of uncontrolled relative humidity. It is further intended as a reminder of the natural dimensional properties of wood and wood-based products such as plywood, particleboard, and high pressure decorative laminate (HPDL) and of the routine and necessary care—and responsibilities—which must be assumed by those involved.

For centuries, wood has served as a successful material for architectural woodwork, and as history has shown wood products perform with complete satisfaction when correctly designed and used. Problems directly or indirectly attributed to dimensional change of the wood are usually, in fact, the result of faulty design, or improper humidity conditions during site storage, installation, or use.

Wood is a hygroscopic material, and under normal use and conditions all wood products contain some moisture. Wood readily exchanges this molecular moisture with the water vapor in the surrounding atmosphere according to the existing relative humidity. In high humidity, wood picks up moisture and swells. In low humidity, wood releases moisture and shrinks. As normal minor fluctuations in humidity occur, the resulting dimensional response in properly designed construction will be insignificant. To avoid problems, it is recommended that relative humidity be maintained within the range of 25-55%. Uncontrolled extremes—below 20% or above 80% relative humidity—can likely cause problems.

Oxidation is a reaction of acids in wood (e.g., tannic acid), with iron, oxygen, and moisture, whether this be relative humidity or direct moisture. Control of moisture is a simple way to protect wood products from stains as a result of oxidation.

Together with proper design, fabrication, and installation, humidity control is obviously the important factor in preventing dimensional change problems.

Architectural woodwork products are manufactured as designed from wood that has been kiln dried to an appropriate average moisture content and maintained at this condition up to the time of delivery. Subsequent dimensional change in wood is and always has been an inherent natural property of wood. These changes cannot be the responsibility of the manufacturer or products made from it. Specifically:

- Responsibility for dimensional change problems in wood products resulting from improper design rests with the designer/architect/specifier.
- Responsibility for dimensional change problems in wood products resulting from improper relative humidity exposure during site storage and installation rests with the general contractor.
- Responsibility for dimensional change problems in wood products resulting from humidity extremes after occupancy rests with engineering and maintenance.

NOTES

4
Sheet Products

4 - Sheet Products

There are a great variety of panels manufactured with differences in core materials, adhesives or binders, forming techniques, surface treatments, etc., which affect characteristics of the panels.

In addition, constant research gives rise to the production of new panel products. These new products are usually accompanied by data on test results of important characteristics for end-use purposes. In selecting new panel products for architectural woodworking, such data should be considered with reference to the AWS.

Many prefinished wood panels and decorative overlays have aesthetic and performance characteristics that meet or exceed the AWS, and should be evaluated, approved, and specified by the design professional when desired.

TYPES OF PANEL CORES

There are a wide range of core materials available for the fabrication of architectural woodwork. The primary core materials are covered in the AWS as follows:

INDUSTRIAL GRADE PARTICLEBOARD CORE - wood particles of various sizes that are bonded together with a synthetic resin or binder under heat and pressure.

Medium Density Industrial Particleboard is used in the broadest applications of architectural woodwork. It is especially well suited as a substrate for high quality veneers and decorative laminates.

When used as panels without any surface plies, the product is referred to as particleboard. *When used as an inner core with outer wood veneers, the panel is referred to as particle core plywood.* Industrial particleboard is commercially classified by "density," which is measured by the weight per cubic foot of the panel product.

• Low Density [LD series] = generally less than 640 kg per m^3 (40 pounds per ft^3).

• Medium Density [M series] = generally between 640-800 kg per m^3 (40-50 pounds per ft^3).

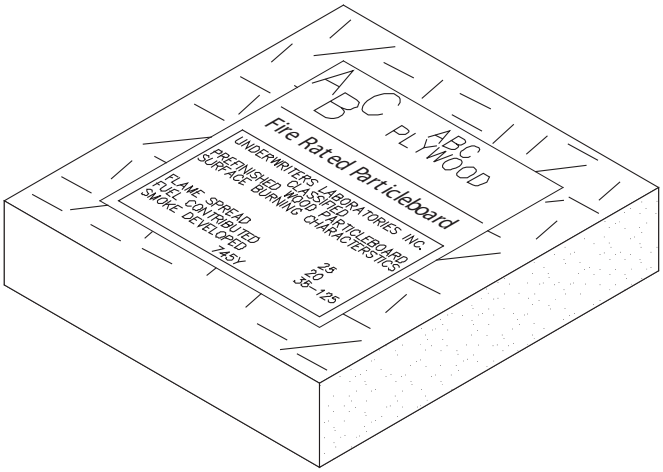
• High Density [H series] = generally above 800 kg per m^3 (50 pounds per ft^3). Rarely used for woodwork.

MOISTURE RESISTANT PARTICLEBOARD CORE

Some Medium Density Industrial Particleboard is bonded with resins more resistant to swelling when exposed to moisture. The most common grades are ANSI 208.1-1999 Type M-2-Exterior Glue and M-3-Exterior Glue. Availability to the architectural woodworker is limited in some markets.

FIRE-RETARDANT PARTICLEBOARD CORE

Some Medium Density Industrial Particleboard has been treated during manufacture to carry a UL stamp for Class I fire rating (Flame spread 20, Smoke developed 450). This material is often used as a substrate for paneling requiring a Class I rating. Fire-retardant Medium Density Fiberboard is also available in some markets.

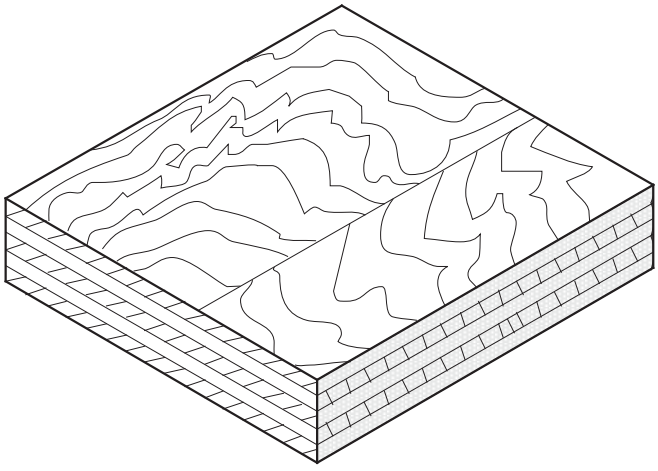


MEDIUM DENSITY FIBERBOARD (MDF) CORE - wood particles reduced to fibers in a moderate pressure steam vessel, combined with a resin, and bonded together under heat and pressure.

Due to the finer texture of the fibers used in manufacturing Medium Density Fiberboard (MDF) it is smoother than Medium Density Particleboard. The uniform texture and density of the fibers create a homogenous panel that is very useful as a substrate for paint, thin overlay materials, veneers and decorative laminates. MDF is among the most stable of the mat-formed panel products. When used as an inner core with outer wood veneers, the panel is referred to as MDF core plywood.

Some MDF is made to meet the ANSI 208.2-2002 reduced thickness swell criteria. Availability to the architectural woodworker is limited in some markets.

VENEER CORE - three or more layers (plies) of wood veneers pressed and glued into a single sheet.



What many think of as traditional "plywood," a panel made up of alternating layers of thin veneers, is called veneer core. Adhesive is placed between the veneer layers, and the panels are assembled under heat and pressure until the adhesive is set. The two outside layers of veneer are often selected for species, grain, and appearance; and are called the "face veneers."

4 - Sheet Products

COMBINATION CORE - A balanced blend of particleboard or fiberboard with veneer layers.

A combination of veneer core and particleboard/fiberboard core technologies, utilizing some of the advantages of each. This material should be evaluated and approved by the customer. Many products will meet the AWS.

HARDBOARD CORE - Hardboard is defined as inter-felted fibers consolidated under heat and pressure to a density of 500 kg per m^3 (31 pounds per cubic foot) or greater.

Often used for casework backs, drawer bottoms, and divider panels, hardboard is available with either one side (S1S) or two sides (S2S) smooth. There are typically two types of hardboard core used by architectural woodworkers: Standard (untempered) and Tempered, which is standard hardboard subjected to a curing treatment increasing its stiffness, hardness, and weight.

AGRIFIBER/AGROFIBER CORE - Panel products made from straw and similar fiber are appearing in the marketplace. Boards which meet the ANSI 208.1 or 208.2 standards for Medium Density are acceptable for use under the AWS.

The characteristics of agrifiber/agrofiber core material performance vary by manufacturer, and are not included in the following table.

CHARACTERISTICS OF CORE MATERIAL PERFORMANCE

NOTE: It is important for the reader to understand the difference between “flatness” and “dimensional stability” characteristics. Particleboard and MDF are the recommended substrates for high pressure decorative laminate and wood veneer work because of their excellent flatness. Fair dimensional stability (expansion/contraction in panel size) is acceptable unless the product is exposed to wide swings in relative humidity, generally below 20% or above 80% with swings of more than 30 points.

Panel Core Type	Flatness	Visual Edge Quality	Surface Uniformity	Dimensional Stability	Screw Holding	Bending Strength	Availability
Industrial Particleboard (Medium)	Excellent	Good	Excellent	Fair	Fair	Good	Readily
Medium Density Fiberboard (MDF)	Excellent	Excellent	Excellent	Fair	Good	Good	Readily
Veneer	Fair	Good	Fair	Excellent	Excellent	Excellent	Readily
Lumber	Good	Good	Good	Good	Excellent	Excellent	Limited
Combination Core with composite crossbands	Excellent	Good	Excellent	Good	Excellent	Excellent	Limited
Combination Core with composite inner ply	Good	Fair	Good	Good	Good	Good	Limited
Moisture Resistant Particleboard	Excellent	Good	Good	Fair	Fair	Good	Limited
Moisture Resistant MDF	Excellent	Excellent	Excellent	Fair	Good	Good	Limited
Fire Rated Particleboard	Excellent	Fair	Good	Fair	Fair	Good	Limited

Notes: Various characteristics above are influenced by the grade and thickness of the core and specific gravity of the core species. Visual Edge Quality is rated before treatment with edge bands or fillers and Visual Edge Quality of lumber core assumes the use of “clear edge” grade. Surface Uniformity has a direct relationship to the performance of fine veneers placed over the surface. Dimensional Stability is usually related to exposure to wide swings in relative humidity. Screwholding and Bending Strength are influenced by proper design and engineering.

4 - Sheet Products

PLYWOOD

The term "plywood" is defined as a panel manufactured of three or more layers (plies) of wood or wood products (veneers or overlays and/or core materials), generally laminated into a single sheet (panel). Plywood is separated into two groups according to materials and manufacturing:

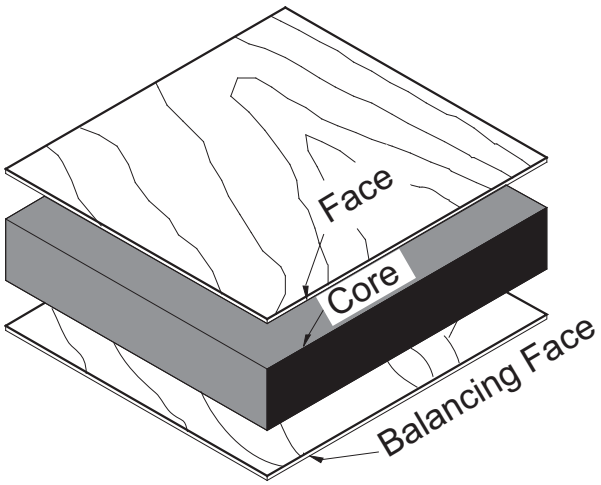
HARDWOOD PLYWOOD - manufactured of hardwood or decorative softwood veneers over a core material, such as medium density particleboard, medium density fiberboard, low density lumber, and/or other veneers.

SOFTWOOD PLYWOOD - Panels manufactured with softwood face veneers are described in standards published by the APA - The Engineered Wood Association. Softwood plywood is seldom incorporated into finished architectural woodworking projects, except to achieve specific design aesthetics. Softwood (construction) plywood is not recommended for use as a core material due to poor stability and core voids.

PANEL CONSTRUCTION BALANCE

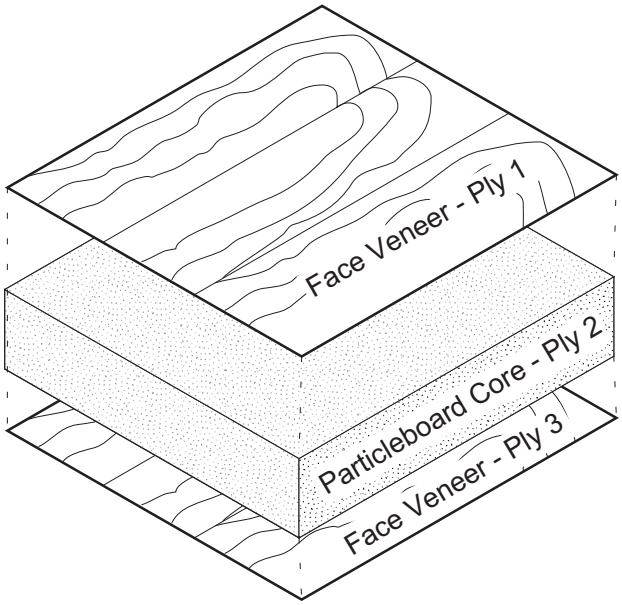
To achieve balanced construction, panels must be an odd number of layers (plies) symmetrical from the center line; e.g., all inner plies, except the innermost ply, should occur in pairs, using materials and adhesives on both sides that contract and expand, or are moisture permeable, at the same rate. A ply may consist of a single veneer, particleboard, medium density fiberboard, or hardboard. Each pair of inner plies should be of the same thickness and direction of grain. Each ply of each pair is placed on opposite sides of the innermost ply or layer, alternating grain directions from the center out. (Particleboard and MDF do not have a specific grain orientation.)

Balanced Construction

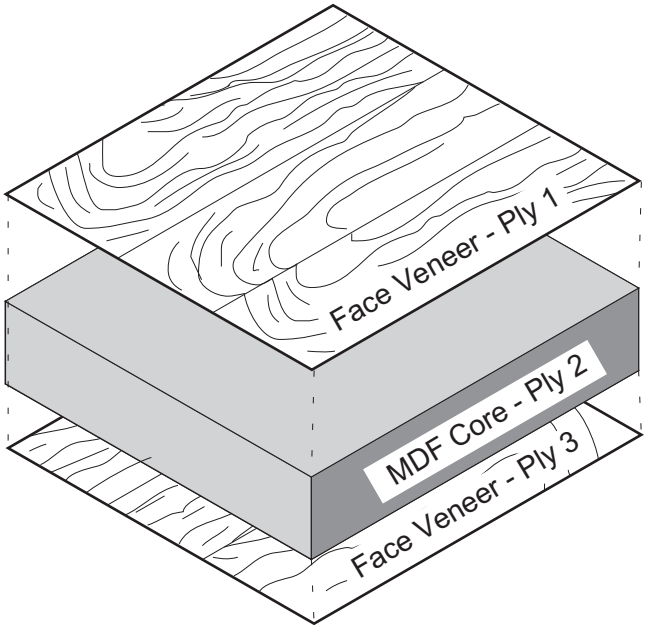


GENERAL RULES: The thinner the facing material, the less force it can generate to cause warping. The thicker the substrate, the more it can resist a warping movement or force.

TYPES OF PLYWOOD

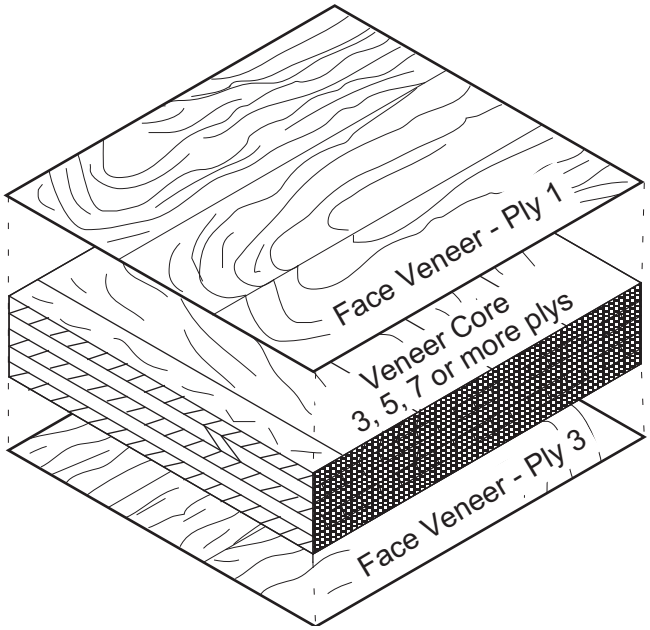


Particleboard Core Plywood

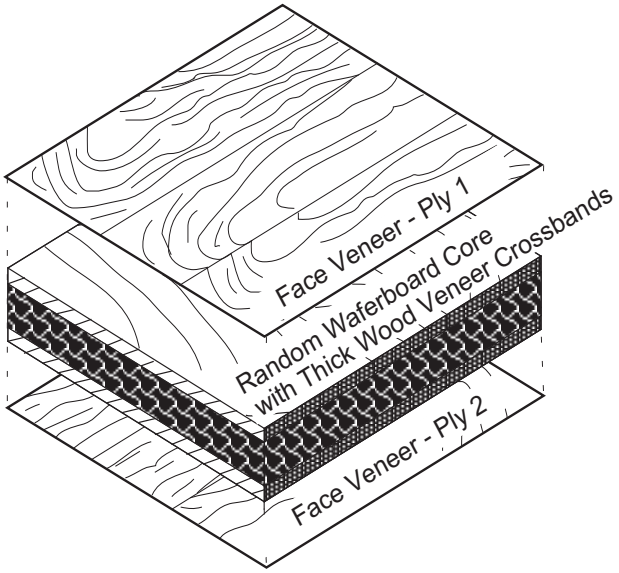


Medium Density Fiberboard Core Plywood

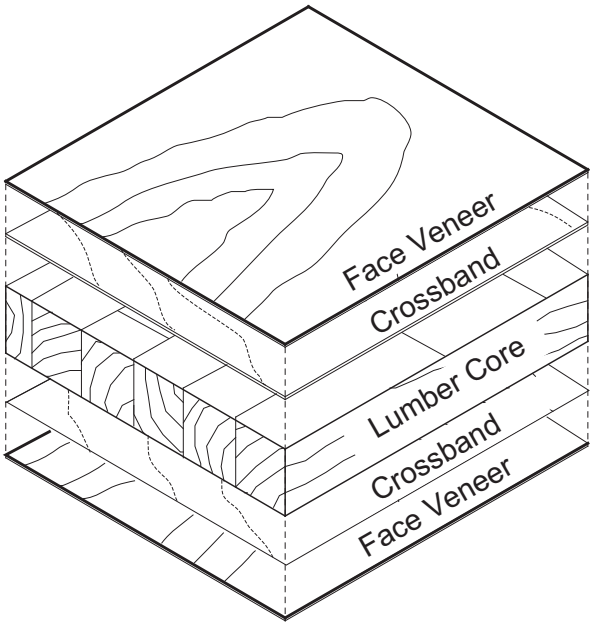
4 - Sheet Products



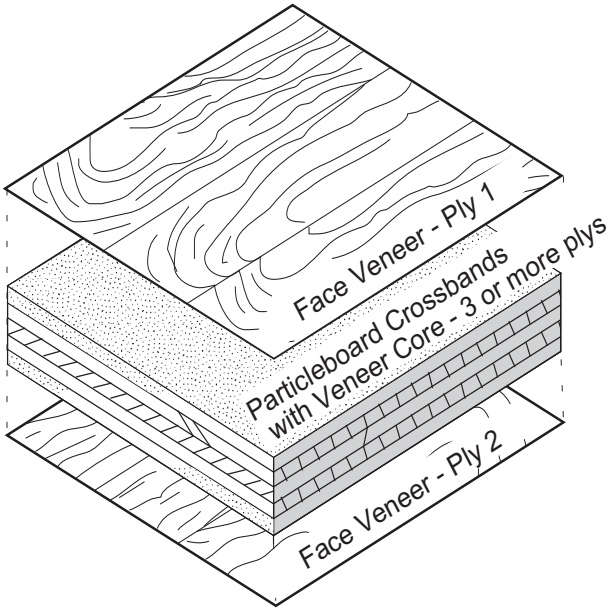
Veneer Core Plywood



Combination Core Plywood



Lumber Core Plywood



Combination Core Plywood

4 - Sheet Products

TYPES OF FACING MATERIALS

WOOD VENEERS

Wood veneer is produced by veneer manufacturers in a variety of "industry standard" thicknesses. The slicing process is controlled by a number of variables. The thickness of the raw veneer has little bearing on the ultimate quality of the end product so long as show-through and sand-through is avoided.

HARDWOOD VENEER - Species: Available in many domestic and imported wood species.

Cut: Normally cut as plain sliced. Rift sliced and quarter sliced available in certain species at additional cost. Some species available as rotary cut.

SOFTWOOD VENEER - Species: Most common is Douglas fir; Pines are available; other softwoods in limited supply.

Cut: Most softwood veneer is Rotary cut. Plain sliced softwood veneer and "vertical grain" (quarter sliced) softwood veneer are limited in availability with the long lead times and higher prices associated with special orders.

DECORATIVE LAMINATES, OVERLAYS, AND PREFINISHED PANEL PRODUCTS

Decorative surfacing materials are often applied to wood product substrates such as industrial particleboard, fiberboard, hardboard, etc. Terminology and definitions of these overlay products follow, broadly grouped as:

THERMOSET DECORATIVE OVERLAY

Decorative thermally fused panels flat pressed from a thermoset polyester or melamine resin-impregnated web. Most products are pre-laminated to Industrial Particleboard or Medium Density Fiberboard substrates when they arrive at the woodwork fabricator. Performance characteristics are similar to High Pressure Decorative Laminate.

MEDIUM DENSITY OVERLAYS

Pressed resin-impregnated paper overlays, highly resistant to moisture, applied to suitable cores for both interior and exterior uses. The seamless panel face and uniform density furnishes a sound base for opaque finishes and paint.

THERMOPLASTIC SHEET

Semirigid sheet or roll stock extruded from a nonporous acrylic/polyvinyl chloride (PVC) alloy solid color throughout. Withstands high impact. Minor scratches and gouges are less conspicuous due to the solid color. Thickness ranges from 0.7 mm [.028"] to 6.4 mm [.250"]. Not recommended for horizontal surfaces where hot items may be placed and in areas near heat sources.

FOILS

These papers are generally referred to as "finished foils" in Europe. In the United States they have been called melamine papers, intermediate weight foils and impregnated foils. Not all foils are finished, nor are they all impregnated. Therefore foils vary in bond strength, porosity, cutting qualities and machinability. (Of limited use in custom architectural woodworking.)

VINYL FILMS

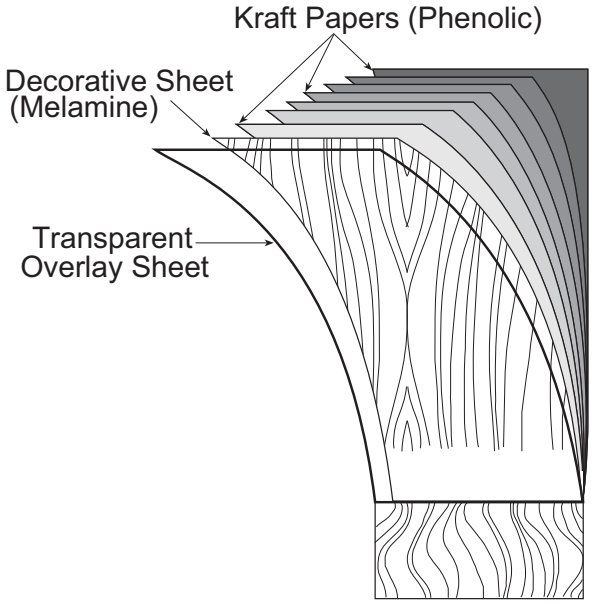
Polyvinyl chloride (PVC) film, either clear or solid color, used extensively for decorative vertical surfaces in mobile homes, recreational vehicles, commercial panels and movable walls. Product thicknesses range from0.02" to .03 (0.5 mm to 0.8 mm). Some films are available with scuff-resistant top coatings. (Of limited use in custom architectural woodworking.)

BASIS WEIGHT PAPERS

Sometimes referred to as "micro-papers" or "rice papers," these overlays are printed paper coated with polyurethane, urea, polyester, acrylic, or melamine resins. They offer an economical alternative for low-wear surfaces. (Of limited use in custom architectural woodworking.)

H PRESSURE DECORATIVE LAMINATES

Resin-impregnated kraft paper substrates with decorative plastic face materials and a clear protective top sheet, formed under heat and pressure. The assembly offers resistance to wear and many common stains and chemicals. Common uses include casework exteriors, countertops, and wall paneling.



HPDL Elements

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HPDL TYPES MOST COMMONLY USED

BASIC TYPES

Five basic types form the majority of applications of high pressure decorative laminate in North America: They are General Purpose, Vertical, Postforming, Cabinet Liner and Balancing Sheet laminates.

General Purpose (HGS and HGL) Used for most horizontal applications, such as desk tops and self-edged kitchen countertops, "HG" laminates offer durability, resistance to stains, and resistance to heat.

Vertical (VGS and VGL) A slightly thinner material, "VG" laminates are produced for areas which will receive less wear and impact than typical horizontal materials. They are an excellent choice for cabinet doors, the sides of casework, primarily decorative display shelves and vertical panels.

Postforming (HGP and VGP) Specifically for applications where a radiused surface is desirable, "P" laminates offer strong performance in both horizontal and vertical applications. A major advantage of formed surfaces on the exposed corners of casework and service counters is the edge's resistance to chipping damage. Most chip damage occurs at sharp 90° corners. Surfaces are thermoformed under controlled temperature and pressure. Not all manufacturers have post-forming machinery.

Flame Retardant (SGF, HGF, and VGF) These laminates are capable of providing flame retardant characteristics as determined by test methods required by the authority having jurisdiction. HGF is the most common type used.

Cabinet Liner (CLS) A thin vertical sheet, this type is designed for areas where the surface must be decorative, but will need to withstand little wear, such as the inside surfaces of cabinets and closets.

Backing Sheet (BKL) Backing materials are essential in the fabrication of most HPDL clad surfaces to prevent warping and to protect against dimensional instability of both laminate and substrate in conditions of changing temperature and humidity. Backing sheets are non-decorative, and both economical and effective in the creation of a successful application.

In summary, these types have the limitations of all high pressure decorative laminate:

• They are for interior use only, and may not be successfully used outdoors or under heavy exposure to the ultraviolet rays of the sun.

• They should not be used as cutting surfaces, because knives and other sharp tools will readily deface the surface and lower its other performance capabilities.

• They should not be exposed to caustic chemicals, such as drain and toilet bowl cleaners, which can permanently etch the surface.

• While they offer outstanding heat resistance, exposure to constant heat - from a curling iron, an electric skillet or coffee pot, for example - can harm the surface and may cause it to discolor or blister.

• Finally, basic HPDL types are veneering, and not structural materials. They must be adhered to satisfactory substrates for successful use.

SPECIALTY TYPES

The technological development of new high pressure decorative laminate products has multiple application opportunities for designers in every area from residential to contract, institutional, light industrial and custom commercial planning.

Variations in manufacturing technique, as well as in materials used, have created many new high pressure decorative laminate products. Some of these products offer enhancement of a basic characteristic; for example, heightened resistance to wear, impact or staining, or static dissipation.

Since these special materials in every case represent significant value added to basic HPDL, their cost is usually higher. Actual cost varies by material chosen, quantity specified, and manufacturer; you should work closely with your woodworker for material's cost on individual projects.

Specialty types available from several producers are summarized here. New types, and those offered by only one producer, appear constantly. Professional publications and manufacturers' literature will help keep you abreast of these new developments.

COLOR-THROUGH DECORATIVE LAMINATES. The interest in specifying solid color decorative laminates and the resurgence of interest in very pale pastels and neutral shades have caused increasing concern with the brown line visible at glued HPDL edges.

Color-through decorative laminates were formulated specifically to provide light colors without this brown line.

Color-through HPDL is produced in thicknesses of 0.050" to 0.060" (1.3 to 1.5 mm) and may be applied to substrates in three basic ways:

• As sheets, to form a decorative face with a true monolithic look;

• As edge trims, to match a face of conventional HPDL or to accent a natural material such as wood or leather;

• As decorative inlays.

Color-through HPDL may also be layered, in the same or several different colors, then sliced, routed or sandblasted for decorative dimensional and sculptural effects.

Color-through HPDL is produced with multiple layers of decorative papers, rather than the decorative-plus-kraft composition of conventional laminate. As a result, this material is slightly stiffer and slightly more brittle when flexed.

Selection of adhesive must take into consideration that a visible glue line will detract from the beauty of a fabricated piece. Adhesive should be untinted.

The bond created must be strong, too. Colorthrough HPDL contains a high level of melamine resin, and can generate considerable force when temperature and humidity fluctuate.

4 - Sheet Products

The substrate choice must be appropriate to resist this dimensional movement. Also, the substrate must sustain all anticipated tensile and flexural load, and must supply all needed screw-holding properties.

STATIC-DISSIPATIVE LAMINATES. High pressure decorative laminate is a good electrical insulator—in fact, it was for the specific purpose of electrical insulation that the product was originally developed.

HPDL does not store static electricity, and it is therefore a suitable material for use in hospital operating rooms, X-ray rooms, and computer room controlled environments where the accumulation and retention of static electricity must be avoided.

However, the growing need for work surfaces in areas such as electronic clean rooms, where electrostatic charges must be actively, continuously channeled away, has triggered the development of specifically conductive (static-dissipative) laminates.

These HPDL sheets have a conductive layer enclosed in, or backing, the sheet. Connected to suitable grounding, they create a decorative, sturdy, practical work surface. Applications include electronic workbench tops and work areas around instrument monitoring devices, in lab testing environments, around photo equipment and on computer desktops.

Antistatic laminates are produced in a number of compositions, thicknesses, colors and patterns. Consult manufacturers' literature for details.

CHEMICAL-RESISTANT DECORATIVE LAMINATES. For intermediate laboratories, the need for a work surface impervious to strong chemicals (acids and bases; dental, medical and photographic supplies), has long been met by drab industrial materials such as stainless steel, slate and soapstone.

There is a growing need for alternatives. High costs, both of materials and, in the case of stones, of support structures, are serious concerns, especially in construction and remodeling of schools and hospitals.

Chemical-resistant decorative laminates offer the familiar advantages of HPDL: resistance to wear, conductive and radiant heat, and impact; as well as ease in cleaning, color fastness, and relatively light weight.

These laminates may be applied on vertical as well as horizontal surfaces, to extend protection to cabinet doors and sides. And they may be postformed for seamless edges.

They may be specified in both vertical and forming thicknesses, and in a number of colors and patterns.

Adhesives should be specified carefully. Edges which may be exposed to chemical attack should be glued with chemical-resistant adhesives.

Formulation of chemical-resistant HPDL differs from producer to producer. Consult product literature to make sure the material you specify meets the needs of your projects.

FIRE-RATED DECORATIVE LAMINATES. Safer interiors are a primary concern for commercial, contract and institutional designers across North America. The threat of fire—and its concomitant hazard of smoke—has created a critical need for interior materials that address this concern without aesthetic sacrifice.

Every major manufacturer of HPDL materials offers fire- and smoke-retardant grades for interior application. The addition of fire retardant does not affect the performance characteristics of HPDL; wear and stain resistance, ease of maintenance, and color stability remain very strong.

Fire-rated high pressure decorative laminates are evaluated and certified according to ASTM-E-84 test procedures (cataloged as ASTM-E-84 Tunnel Test; and as Test No. 723 by Underwriters Laboratories, Inc. Similar Canadian testing is cataloged as CAN4-512-79).

With appropriate choices of substrate and adhesive, panels clad with fire-rated HPDL may be produced to comply with Class 1, I, or A, fire codes. Finished panels, already certified, may also be specified from some HPDL manufacturers.

Major applications of fire-rated HPDL include door, wall, and wainscot cladding in corridors, stairwells, entries, and elevators; as well as surfacing on fixtures and cabinetry. These materials are supplied in both horizontal and vertical types, in a wide range of colors and patterns.

They may not be postformed; the special formulation that produces fire retardant is not compatible with heat forming.

Adhesive choice for fire-rated HPDL is important. As with many types of FR particleboard, some PVA adhesives are incompatible with the fire-retardant chemical composition of the HPDL material. Resorcinol adhesives are best for both chemical compatibility and fire rating of the end product. Contact adhesives do surprisingly well in some cases. Verify test ratings with your HPDL manufacturer.

THICK LAMINATES. High pressure decorative laminate is produced by several manufacturers in thicknesses adequate to preclude the use of a substrate.

These HPDL products range in thickness from $^{1}/_{10}$" to 1" (2.5 mm - 25.4 mm), and have decorative faces on both sides for balance. Unlike conventional sheets, thick laminates may be drilled and tapped, and offer significant screw-holding capacity. Screw holes must be centered at least 1-$^{1}/_{2}$ times the diameter of the screw in from any edge, horizontal or vertical.

Depending on thickness, these laminates may be used for many flat applications, such as toilet and dressing room partitions, workbenches, shelving, and table tops. Thick laminates are also used in cladding interior doors, where their special properties can eliminate the need for cross banding.

Durability and impact resistance of thick laminates exceed these same properties in comparably thick panels fabricated with an HPDL + medium density fiberboard + HPDL assembly.

Dimensional stability is slightly less predictable, because of the time required for humidity changes to affect movement through the many plies.

4 - Sheet Products

Panels are heavy for their size—an asset in sturdiness of the end application, but a factor which must be considered when planning for time and cost of labor and transportation as well as for support structures.

DIMENSIONAL LAMINATES are conventional high pressure decorative laminates with deeply embossed finishes. These laminates are manufactured in a very broad range of colors and patterns, and add to the visual and tactile appeal of HPDL in both horizontal and vertical applications. Some dimensional laminates may be successfully postformed.

Typical embossed finishes include versions of leather, slate, woven fabric and reed. Selection and individual texture vary from one producer's line to another—these finishes are proprietary. Manufacturers can provide actual product samples.

Dimensional laminates are frequently specified for bar and restaurant tabletops, for retail fixtures and display walls, and for countertops.

Dimensional laminates offer the æsthetic and performance characteristics of conventional laminates; low points require a bit more attention in cleaning. Deeply embossed finishes are not recommended for high wear areas, because the highest points receive all the wearing force and may show wear more rapidly than matte-finish laminates.

HPDL-CLAD DECORATIVE TAMBOURS extend the wide choice of color and finish, as well as the long wear and easy care attributes, of high pressure decorative laminate to flexible tambours for both architectural cladding and functional closure systems.

These tambours are produced by several major HPDL manufacturers; actual configurations vary from traditional flat slats and half-rounds to flexible grids, horizontal rectangles, and triangular slats. They may be specified in literally hundreds of color or pattern and finish combinations. Each producer's line should be carefully examined to give you a full grasp of the options open to you.

Tambours clad with high pressure decorative laminate are perhaps most important because of their capability for exact coordination with HPDL sheets. Thus, one color scheme can be effectively continued throughout the surfaces of a cabinet, a piece of furniture, even a room.

HPDL clad tambours provide visually appealing surfaces for walls and wainscoting, vertical areas of reception desks and bank counters, and flexible wraps around table pedestals and columns. They create exciting graphic effects on cabinet doors and drawer panels, as well as on full-size interior doors.

Tambours are relatively light in weight and may be easily installed with construction mastic; but, like conventional high pressure decorative laminate sheets, they are not structural materials, and must be adhered to an appropriate substrate.

Functional tambours, which slide along tracks or grooves, extend the color, finish and wear benefits of HPDL to roll-top desks, appliance garages and other storage areas.

NATURAL WOOD LAMINATES are one excellent example of the ongoing evolution of the high pressure decorative laminate process. Presently, natural wood laminates may be specified in two formats; both feature thin veneers of fine woods bonded under high pressure and heat to a core of kraft papers and phenolic resins. One process leaves the face of the wood untreated, and ready to finish. The other adds a protective face of melamine resin.

Performance characteristics vary with the presence or absence of the melamine resin.

In both cases, the ease of cutting and bonding, as well as the wear resistance, improve in comparison to raw wood veneer. With the melamine face, the natural wood assumes all the easy care and long wear properties of conventional high pressure decorative laminate.

Applications of these products involve public spaces, such as banks and reception areas of hotels, where the full beauty of fine wood is an important aesthetic asset.

METAL-FACED LAMINATES. Several manufacturers of high pressure decorative laminates now produce metal veneers with a backer of kraft paper and phenolic resin, and at least one product with a thermoplastic core between two metal sheets is presently available.

The material used for most metal laminates is interior-type anodized aluminum. Other materials, including copper and nickel alloys, may be specified in various formats.

The primary advantage of metal-clad laminates lies in their relative ease of fabrication, as compared to conventional metals. Such sheets may be cut, formed and machined with standard woodworking equipment. And the laminate backer makes for ease in gluing; the adhesives and techniques used for HPDL are appropriate. Metal laminates add light and visual drama for interior vertical surfaces. Walls, wainscoting, stairwells, columns and accent trims around ceilings are appropriate for their application. Inset trims, reveals and base moldings around furniture and casework can be very effectively accented with metal laminates. Freestanding panels faced with metal laminates should have similar veneer on their reverse sides, to control warping.

Metal faced laminates are recommended for vertical surfaces where resistance to abuse is not a major concern. These materials have largely replaced metallic foil-faced laminates, because of the greater beauty, increased durability, and generally higher quality of sheets with solid metal surfacing. Note: metal laminates will conduct electricity.

FLOORING LAMINATES are formulated specifically for surfacing panels used for access, or raised, floors. These laminates, available from several major producers of high pressure decorative laminate, combine the good looks and easy maintenance of conventional HPDL with greatly enhanced wear resistance, and feature the capability for permanent static dissipation.

Such flooring offers outstanding performance in areas such as hospitals, for cardiac and intensive care areas; electronic clean rooms and computer facilities; and high traffic areas, where heavy wear from both pedestrian and wheeled traffic is predictable.

4 - Sheet Products

These laminates can be maintained with regular damp mopping, using water and a mild, nonflammable, organic cleaner. They do not require sealing, varnishing, buffing or waxing.

Stock selection of patterns is limited to frequently specified neutral colors and patterns; custom colors and patterns can be made available.

ENGRAVING STOCK for indoor signs and nameplates is available from some HPDL producers. It offers the resistance to stain, wear and impact of conventional laminates, and makes up easily into attractive, easy to clean, long lasting signage.

This material may be specified with a black, white, or red core, with two decorative faces, in many colors, patterns, and finishes.

CUSTOM LAMINATE PRODUCTS. Many architectural designers are unaware of the custom capabilities of high pressure decorative laminate manufacturers.

These capabilities extend from production of specially developed colors and patterns to individual layups of surfaces to custom silk screening.

Typical uses include horizontal and vertical surfaces for games and sports from backgammon to bowling; custom lamination of maps, menus and charts; table tops and wall panels with logotypes or special graphics; hand inlaid patterns; laminated textiles; and special matches for corporate colors.

Your HPDL manufacturer will be happy to consult with you when custom services are needed for effective realization of a design.

Your woodworker will be an excellent partner for your design team when your designs call for custom treatments.

VOLUNTARY STANDARDS

Voluntary standards for the production of these overlay products are available from: National Electrical Manufacturers Association (NEMA), Rosslyn, VA; Laminating Materials Association (LMA), Oradell, NJ.

SPECIAL PRODUCTS

Included in this classification are special panel products such as lead-lined panels for X-ray areas; bullet-resistant panels for armor protected areas; honeycomb-core panels when light weight is a consideration, etc.

LEAD-LINED PANELS

Usually a sheet of lead of a specified thickness, to meet X-ray shield requirements, is laminated between 2 layers of core material. A decorative overlay and balancing sheet can then be applied as required.

PROJECTILE RESISTANT ARMOR (BULLET PROOFING)

Available as steel plate-, glass-, polycarbonate-, acrylic- or fiberglass-reinforced material which can offer protection against most available small-arms fire, depending upon the thickness specified. These panels are usually built into the interior of the structure of the counter, teller's lines, judge's benches, etc. Standards and tests for bullet resistance are set by both Underwriters Laboratories (UL. 752) and the National Institute of Justice (N.I.J.-0108.01).

SOLID SURFACING MATERIALS

Solid surfacing materials are available and can be fabricated and/or supplied by many woodworkers. The products (and manufacturer's warranties) vary and must be fabricated according to manufacturer's recommendations, including the use of unique fasteners and adhesives. Many decorative inlays are available. Consult your woodworker about performance issues, materials, colors, and patterns.

COMPOSITE VENEERS

Composite veneers are slices of blocks or "flitches" made from pre-dyed veneer which has been laminated, and in some cases deformed, to produce a special grain and color characteristic.

Composite veneer has both advantages and limitations. The woodworker and the design professional may choose to use composite veneers for economical and/or æsthetic reasons.

Composite veneers are not meant as a substitute for real wood veneer. Each has its own place and proper application. The design professional, in consultation with a woodwork manufacturer, will determine which product to use on a specific project.

ACRYLIC AND METHACRYLATE SHEETS

Overlay materials typically 3.2 mm [$^{1}/_{8}$"] thick with a high-gloss finish. Individual products should be evaluated and specified or approved by the design professional when desired. Manufacturer's performance test data is available for review.

SOLID PHENOLIC

A composite of solid phenolic resins molded with a homogeneous core of organic fiber reinforced phenolic and one or more integrally cured surfaces of compatible thermoset nonabsorbent resins. SPC has seen some use in recent years as wall surfacing, casework parts, and countertops.

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THERMOSET DECORATIVE OVERLAY SUMMARY TABLE

Tests for Resistance to:	Test Description [1]	Minimum Requirements		NEMA LD3-2000 VGL [2]
		Solid Colors	Wood Grains	
Wear	A measure of the ability of a decorative overlaid surface to maintain its design or color when subjected to abrasive wear.	400 cycles	125 cycles	400 cycles
Scuff	A measure of the ability of a decorative overlaid surface to maintain its original appearance when exposed to scuffing.	No effect		<---Same
Stain	A measure of the ability of a decorative overlaid surface to resist staining or discoloration from contact with 29 common household substances.	No effect 1-10 Moderate 11-15		<---Same
Clean-ability	A measure of the ability of a decorative overlaid surface to be cleaned using a sponge.	No effect. Surface cleaned in 20 or fewer strokes		<---Same
Light [3]	A measure of the ability of a decorative overlaid surface to retain its color after exposure to a light source having a frequency range approximating sunlight.	Slight		<---Same
High temperature	A measure of the ability of a decorative overlaid surface to maintain its color and surface texture when subjected to a high temperature [180˚ C (356˚ F)].	Slight		<---Same
Radiant heat	A measure of the ability of a decorative overlaid surface to resist spot damage when subjected to a radiant heat source.	No effect up to 60 seconds		<---Same
Boiling water [4]	A measure of the ability of a decorative overlaid surface to maintain its color and surface texture when subjected to boiling water.	No effect		<---Same
Impact	A measure of the ability of a decorative overlaid surface to resist fracture due to spot impact by a steel ball dropped from a measured height.	380 mm [15”] without fracture		<---Same

[1] These test procedures are identical to those used by the National Electrical Manufacturers Association (NEMA) for testing high pressure decorative laminates. The minimum requirements to comply for SOLID COLORS meet or exceed NEMA Standard LD3- (latest edition for high pressure decorative laminates).
[2] This standard applies to decorative panel faces only.
[3] Environmental regulations have caused certain colors to be subject to changes in appearance and the manufacturer should be consulted.
[4] Melamine panels, when produced under conditions for optimum panel performance, may show slight effect.
A shipment meeting 95% of the minimum requirements of the performance standard is in conformance.

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WOOD VENEER SPECIES - General characteristics of selected species:

Species	Cut and Details	Width to	Length	Flitch Size	Cost (1)	Availability
Mahogany	Plain Sliced Honduras Mahogany	457 mm [18"]	3658 mm [12']	Large	Moderate	Good
	Quartered Honduras Mahogany	305 mm [12"]	3658 mm [12']	Large	High	Moderate
	Plain Sliced African Mahogany	457 mm [18"]	3658 mm [12']	Large	Moderate	Moderate
	Quartered African Mahogany	305 mm [12"]	3658 mm [12']	Large	High	Good
Ash	Plain Sliced American White Ash	305 mm [12"]	3048 mm [10']	Medium	Moderate	Good
	Quartered American White Ash	203 mm [8"]	3658 mm [12']	Small	High	Good
	Quartered or Plain Sliced European Ash	254 mm [10"]	3048 mm [10']	Medium	High	Limited
Anegre	Quartered or Plain Sliced Anegre	305 mm [12"]	3658 mm [12']	Large	High	Good
Avodire	Quartered Avodire	254 mm [10"]	3048 mm [10']	Large	High	Limited
Cherry	Plain Sliced American Cherry	305 mm [12"]	3353 mm [11']	Medium	Moderate	Good
	Quartered American Cherry	102 mm [4"]	3048 mm [10']	V. Small	High	Moderate
Birch	Rotary Cut Birch (Natural)	1220 mm [48"]	3048 mm [10']	Large	Low	Good
	Rotary Cut Birch (Select Red or White)	914 mm [36"]	3048 mm [10']	Medium	Moderate	Moderate
	Plain Sliced Birch (Natural)	254 mm [10"]	3048 mm [10']	Small	Moderate	Limited
	Plain Sliced Birch (Select Red or White)	127 mm [5"]	3048 mm [10']	Small	High	Limited
Butternut	Plain Sliced Butternut	305 mm [12"]	3048 mm [10']	Medium	High	Limited
Makore	Quartered or Plain Sliced Makore	305 mm [12"]	3658 mm [12']	Large	High	Good
Maple	Pl. Sl. (Half Round) American Maple	305 mm [12"]	3048 mm [10']	Medium	Moderate	Good (2)
	Rotary Birdseye Maple	6096 mm [20"]	3048 mm [10']	Medium	V. High	Good
Oak	Plain Sliced English Brown Oak	305 mm [12"]	3048 mm [10']	Medium	V. High	Limited
	Quartered English Brown Oak	254 mm [10"]	3048 mm [10']	Medium	V. High	Limited
	Plain Sliced American Red Oak	4877 mm [16"]	3658 mm [12']	Large	Moderate	Good
	Quartered American Red Oak	203 mm [8"]	3048 mm [10']	Small	Moderate	Good
	Rift Sliced American Red Oak	254 mm [10"]	3048 mm [10']	Medium	Moderate	Good
	Comb Grain Rift American Red Oak	203 mm [8"]	3048 mm [10']	Small	V. High	Limited
	Plain Sliced American White Oak	305 mm [12"]	3658 mm [12']	Medium	Moderate	Good
	Quartered American White Oak	203 mm [8"]	3048 mm [10']	Small	Moderate	Good
	Rift Sliced American White Oak	203 mm [8"]	3048 mm [10']	Medium	High	Good
	Comb Grain Rift American White Oak	203 mm [8"]	3048 mm [10']	Small	V. High	Limited
Hickory or Pecan	Plain Sliced American Hickory or Pecan	305 mm [12"]	3048 mm [10']	Small	Moderate	Good
Sapele	Quartered or Plain Sliced Sapele	305 mm [12"]	3658 mm [12']	Large	High	Good
Sycamore	Plain Sliced English Sycamore	254 mm [10"]	3048 mm [10']	Medium	V. High	Limited
	Quartered English Sycamore	152 mm [6"]	3048 mm [10']	Medium	V. High	Limited
Teak	Plain Sliced Teak	305 mm [12"]	3658 mm [12']	Large	V. High	Limited (3)
	Quartered Teak	305 mm [12"]	3658 mm [12']	Medium	V. High	Limited (3)
Walnut	Plain Sliced American Walnut	305 mm [12"]	3658 mm [12']	Medium	Moderate	Good
	Quarter Sliced American Walnut	152 mm [6"]	3048 mm [10']	V. Small	High	Rare

(1) Cost reflects raw veneer costs weighted for waste or yield characteristics and degree of labor difficulty.
(2) Seasonal factors may affect availability.
(3) Availability of blond Teak is very rare.
When Quartered or Plain Sliced (Pl. Sl.) are listed on the same line, the width dimensions are Plain Sliced; Quartered is narrower.

4 - Sheet Products

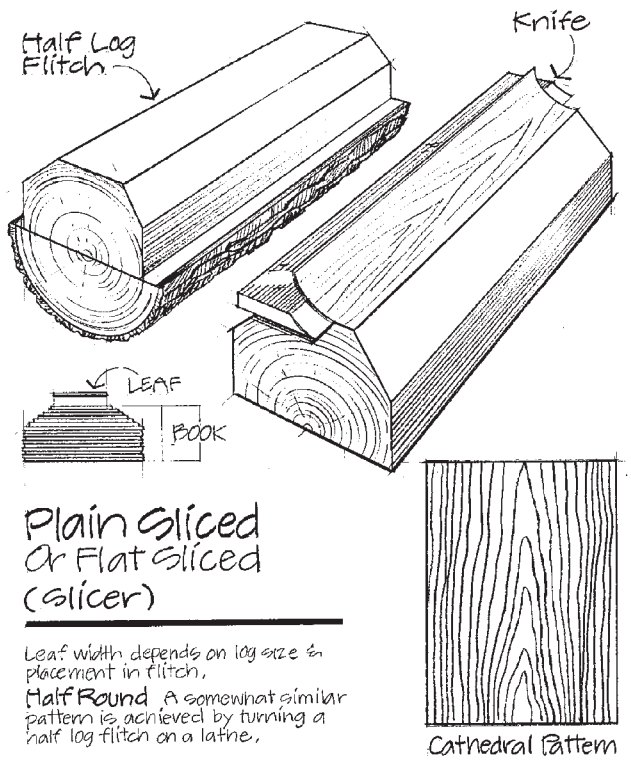
TYPES OF VENEER CUTS

The manner in which a log segment is cut with relation to the annual rings will determine the appearance of the veneer. When sliced, the individual pieces of veneer, referred to as leaves, are kept in the order in which they are sliced, thus permitting a natural grain progression when assembled as veneer faces. The group of leaves from one slicing is called a flitch and is usually identified by a flitch number and the number of gross square feet of veneer it contains. The faces of the leaves with relation to their position in the log are identified as the tight face (toward the outside of the log) and the loose face (toward the inside or heart of the log). During slicing the leaf is stressed on the loose face and compressed on the tight face. When this stress is combined with the natural variation in light refraction caused by the pores of the wood, the result is a difference in the human perception of color and tone between tight and loose faces.

The principal methods of slicing veneers and the general visual characteristics of the grain are:

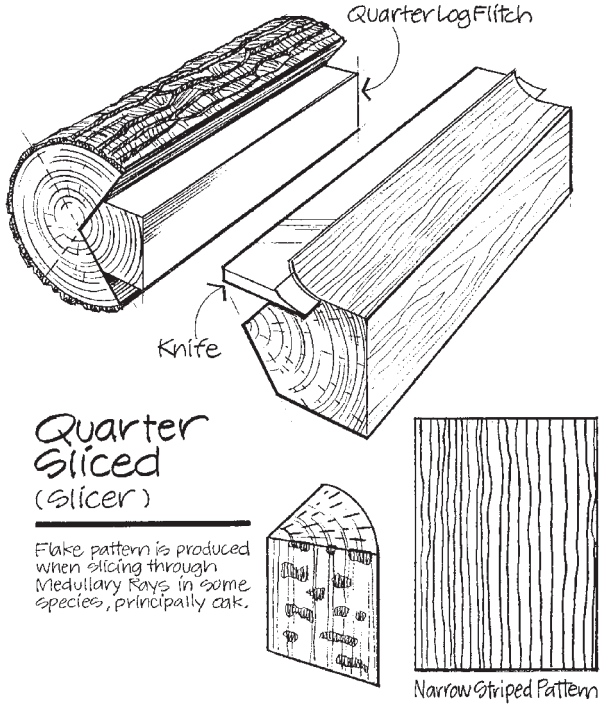
PLAIN SLICING (OR FLAT SLICING)

This is the slicing method most often used to produce veneers for high quality architectural woodworking. Slicing is done parallel to a line through the center of the log. A combination of cathedral and straight grain patterns results, with a natural progression of pattern from leaf to leaf.



QUARTER SLICING (OR QUARTER CUT)

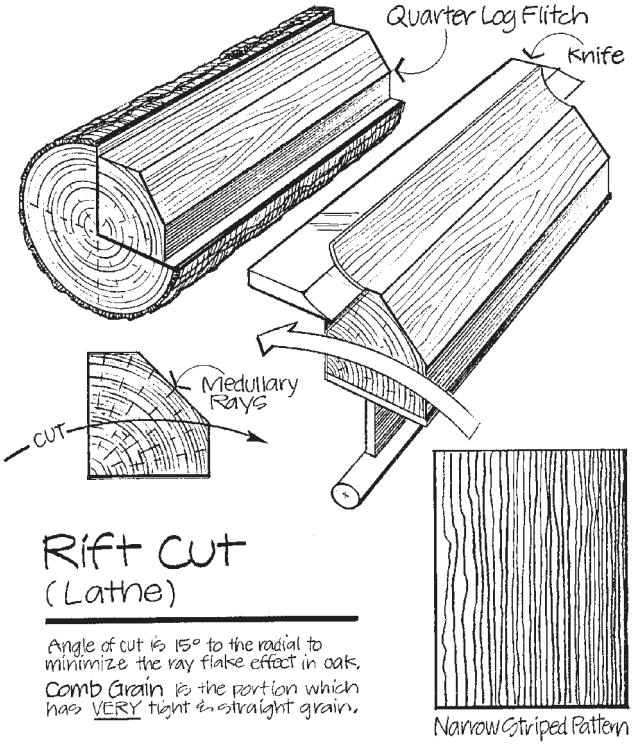
Quarter slicing simulates the quarter sawing process of solid lumber, roughly parallel to a radius line through the log segment. In many species the individual leaves are narrow as a result. A series of stripes is produced, varying in density and thickness from species to species. “Fleck” (sometimes called flake) is a characteristic of this slicing method in Red and White Oak.



4 - Sheet Products

RIFT SLICING (OR RIFT CUT)

Rift veneers are produced most often in Red and White Oak, rarely in other species. Note that rift veneers and rift sawn solid lumber are produced so differently that a "match" between rift veneers and rift sawn solid lumber is highly unlikely. In both cases the cutting is done slightly off the radius lines minimizing the "fleck" (sometimes called flake) associated with quarter slicing.



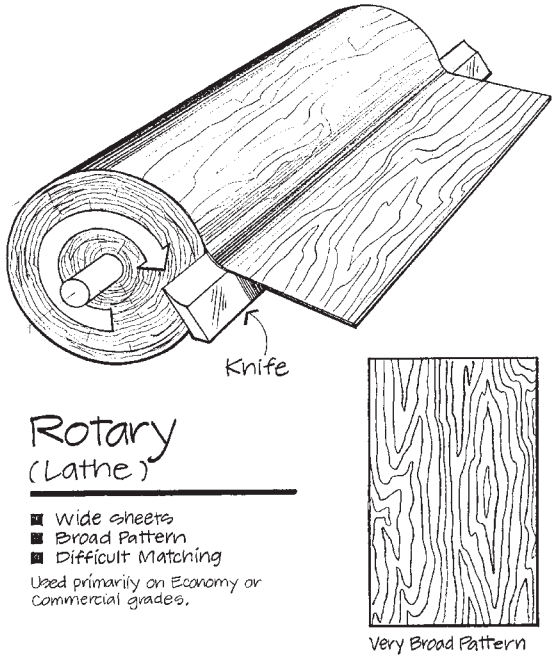
COMB GRAIN

Limited in availability, comb grain is a select product of the Rift process distinguished by tight, straight grain along the entire length of the veneer. Slight angle in the grain is allowed. Comb grain is restricted to Red and White Oak veneers.

ROTARY

The log is center mounted on a lathe and "peeled" along the general path of the growth rings like unwinding a roll of paper, providing a generally bold random appearance. Rotary cut veneers may vary in width and matching at veneer joints is extremely difficult. Almost all softwood veneers are cut this way. Except for a specific design effect, rotary veneers are the least useful in fine architectural woodwork.

Rotary sliced fine hardwood veneers are used in a limited way, and usually for special figure and cut, in the manufacture of Premium Grade woodwork. Careful consideration, specification, and communication are recommended when rotary cut is contemplated.



COMPOSITE VENEERS

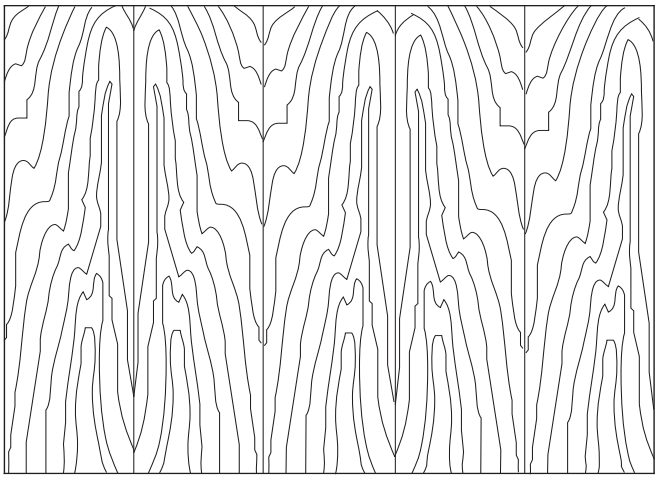
Sliced from fast-growing trees, these veneers are dyed and then reglued in molds to create "grain" patterns. The color is established during manufacture because the high percentage of glue lines resist staining by the woodworker. Must be specified by brand name and manufacturer's designation. "Matching" between components may not be possible.

4 - Sheet Products

MATCHING ADJACENT VENEER LEAVES

It is possible to achieve certain visual effects by the manner in which the leaves are arranged. As noted, rotary cut veneers are difficult to match; therefore most matching is done with sliced veneers. The matching of adjacent veneer leaves must be specified. Special arrangements of leaves such as “diamond” and “box” matching are available. Consult your woodworker for choices. The more common types are:

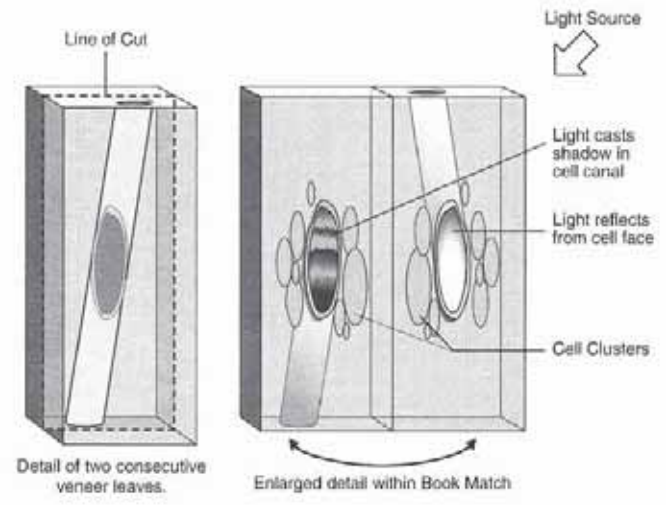
BOOK MATCHING



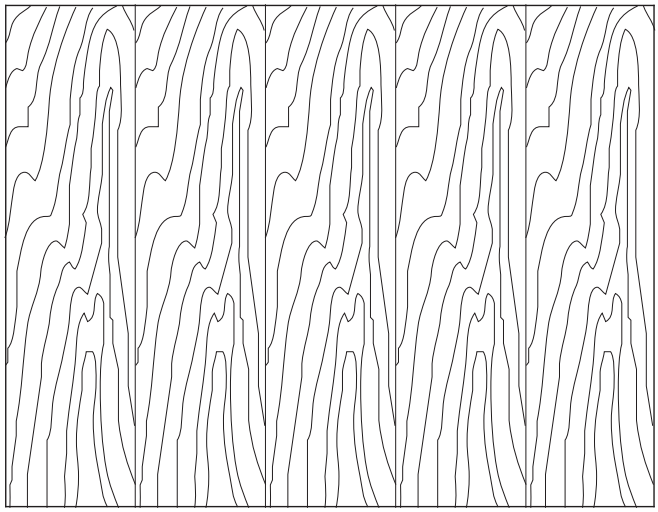
The most commonly used match in the industry. Every other piece of veneer is turned over so adjacent pieces (leaves) are opened like the pages of a book.

Visual Effect - Veneer joints match, creating a symmetrical pattern. Yields maximum continuity of grain. When sequenced panels are specified, prominent characteristics will ascend or descend across the match as the leaves progress from panel to panel.

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.



SLIP MATCHING

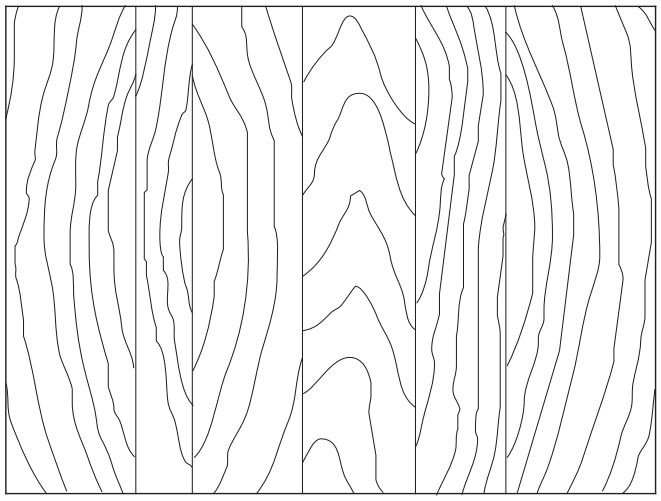


Often used with quarter sliced and rift sliced veneers. Adjoining leaves are placed (slipped out) in sequence without turning, resulting in all the same face sides being exposed.

Visual Effect - Grain figure repeats; but joints do not show visual grain match.

Note: The lack of grain match at the joints can be desirable. The relatively straight grain patterns of quartered and rift veneers generally produce pleasing results and a uniformity of color because all faces have the same light refraction.

RANDOM MATCHING



Veneer leaves are placed next to each other in a random order and orientation, producing a “board-by-board” effect in many species.

Visual Effect - Casual or rustic appearance, as though individual boards from a random pile were applied to the product. Conscious effort is made to mismatch grain at joints.

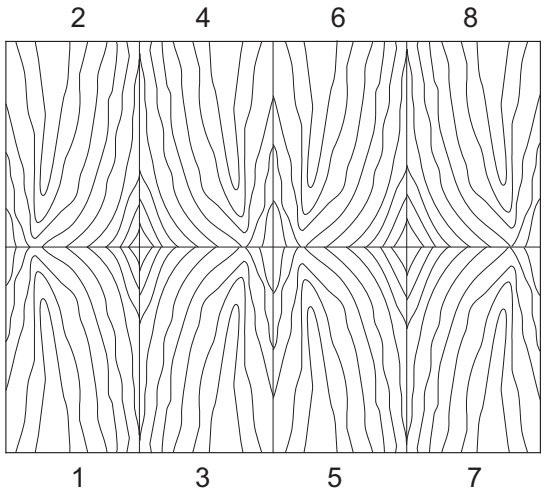
Degrees of contrast and variation may change from panel to panel. This match is more difficult to obtain than book or slip match, and must be clearly specified and detailed.

4 - Sheet Products

END MATCHING

Often used to extend the apparent length of available veneers for high wall panels and long conference tables. End matching occurs in three types:

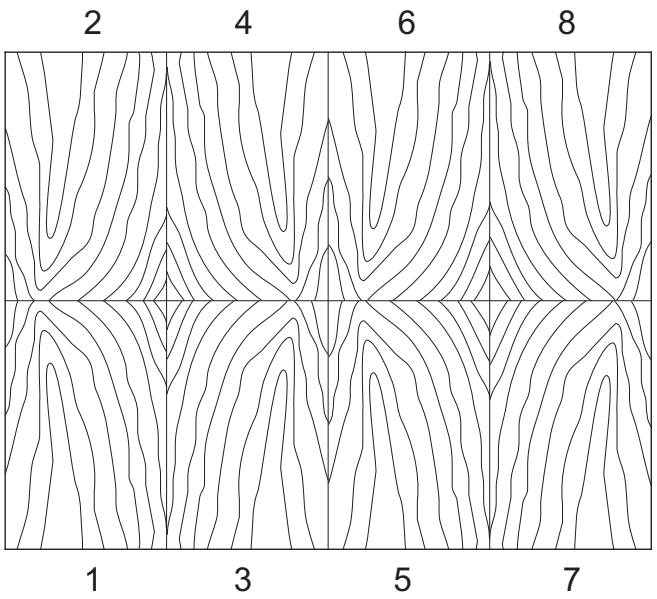
ARCHITECTURAL END MATCH



Leaves are individually book (or slip) matched, first end-to-end and then side-to-side, alternating end and side.

Visual Effect - Yields best continuous grain patterns for length as well as width. Minimizes misalignment of grain pattern.

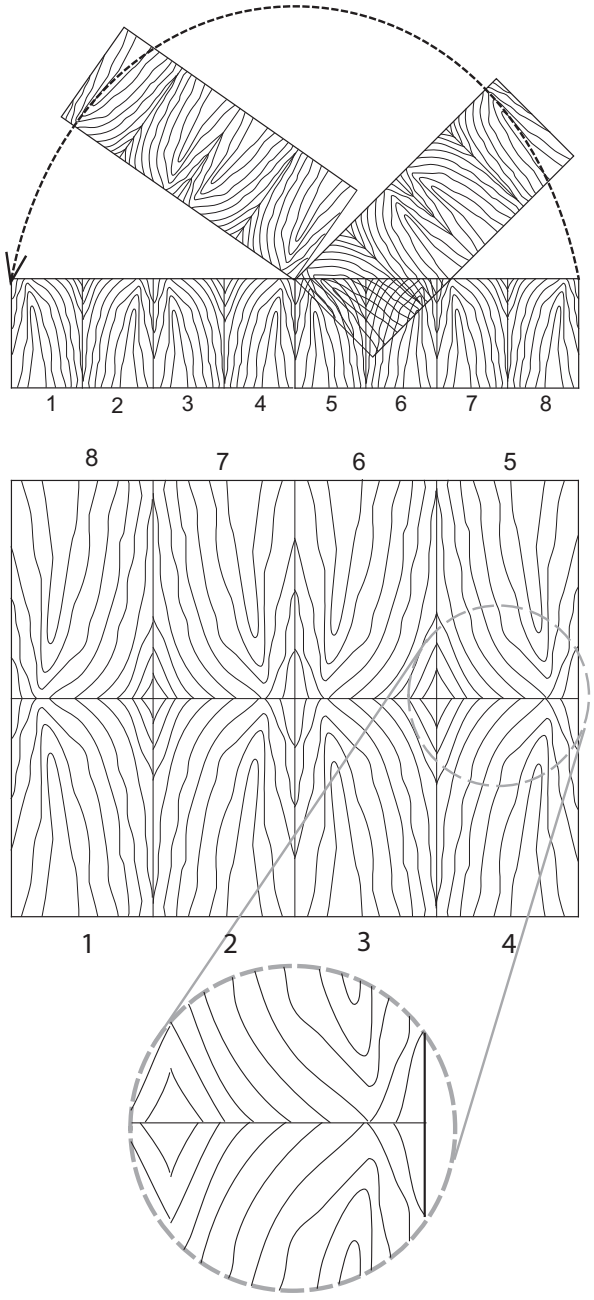
CONTINUOUS END MATCH



Leaves are individually book (or slip) matched, separate panels are stacked in sequenced order, either horizontally or vertically in the elevation. (Horizontal sequence illustrated.)

Visual Effect - Yields sequenced grain patterns for elevations, with pleasing blend of figure horizontally or vertically.

PANEL END MATCH



Natural Grain Pattern Mismatch Occurs

Leaves are book (or slip) matched on panel subassemblies, with sequenced subassemblies end matched, resulting in some modest cost savings on projects where applicable.

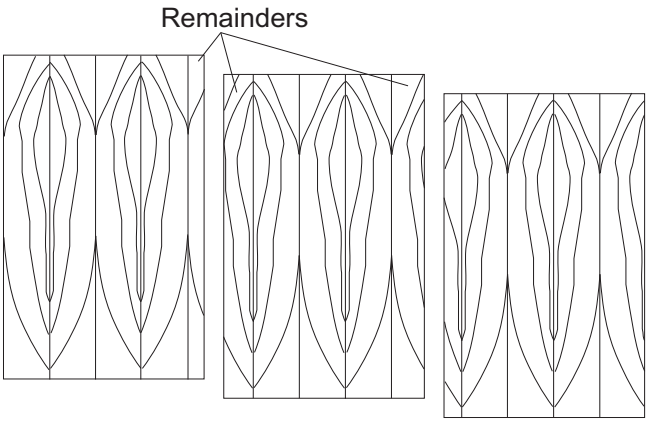
Visual Effect - For most species, yields pleasing, blended appearance and grain continuity. Some misalignment of grain pattern will occur, and is not a defect.

4 - Sheet Products

MATCHING WITHIN INDIVIDUAL PANEL FACES

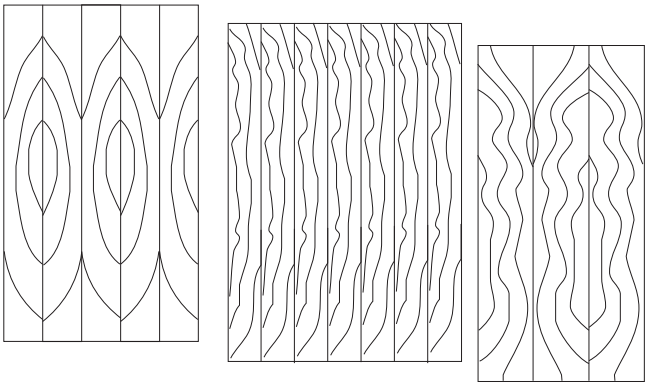
The individual leaves of veneer in a sliced flitch increase or decrease in width as the slicing progresses. Thus, if a number of panels are manufactured from a particular flitch, the number of veneer leaves per panel face will change as the flitch is utilized. The manner in which these leaves are "laid up" within the panel requires specification, and is classified as follows:

RUNNING MATCH



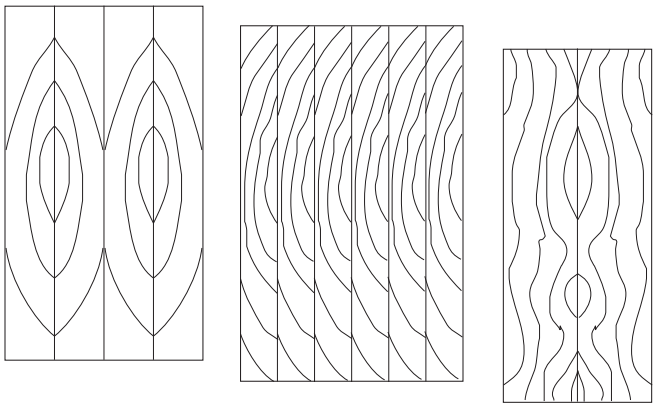
Each panel face is assembled from as many veneer leaves as necessary. This often results in a non-symmetrical appearance, with some veneer leaves of unequal width. Often the most economical method at the expense of æsthetics, it is the standard for Custom Grade and must be specified for other Grades. Running matches are seldom "sequenced and numbered" for use as adjacent panels. Horizontal grain "match" or sequence cannot be expected.

BALANCE MATCH



Each panel face is assembled from veneer leaves of uniform width before edge trimming. Panels may contain an even or odd number of leaves, and distribution may change from panel to panel within a sequenced set. While this method is the standard for Premium Grade, it must be specified for other Grades, and it is the most common assembly method at moderate cost.

BALANCE AND CENTER MATCH



Each panel face is assembled of an even number from veneer leaves of uniform width before edge trimming. Thus, there is a veneer joint in the center of the panel, producing horizontal symmetry. A small amount of figure is lost in the process. Considered by some to be the most pleasing assembly at a modest increase in cost over Balance Match.

FIRE-RETARDANT PANELS

FLAME SPREAD CLASSIFICATION

The various codes utilize flame spread classifications for wood and other materials. It is the responsibility of the specifier to determine which elements, if any, of the woodwork require special treatment to meet local codes. In most codes, the panel products used to fabricate casework and furniture are not regulated.

FLAME SPREAD FACTORS

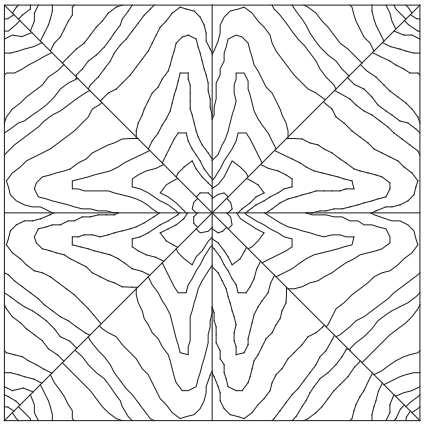
CORE - The fire rating of the core material determines the rating of the assembled panel. Fire-retardant veneered panels must have a fire-retardant core. Particleboard core is available with a Class I (Class A) rating and can be used successfully with veneer or rated high pressure decorative laminate faces. MDF (Medium Density Fiberboard) is available with a fire rating in some markets.

FACE - Some existing building codes, except where locally amended, provide that facing materials $^{1}/_{28}$" (0.9 mm)or thinner are not considered in determining the flame spread rating of the panel. If state and local codes move toward adoption of the International Building Code provisions, it is possible that the $^{1}/_{28}$" (0.9 mm) exemption may not be available. In localities where basic panel building codes have been amended it is the responsibility of the specifier to determine whether the application of the facing material specified will meet the code. Traditionally, face veneers are not required to be fire-retardant treated, and such treatment will adversely affect the finishing process.

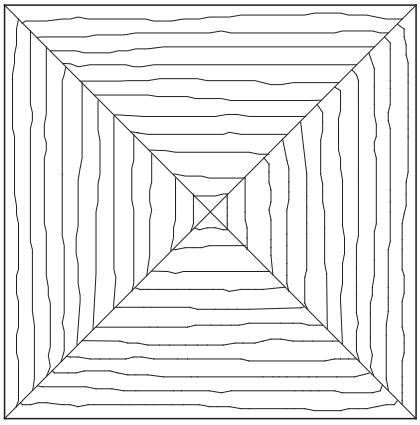
4 - Sheet Products

SPECIAL MATCHES

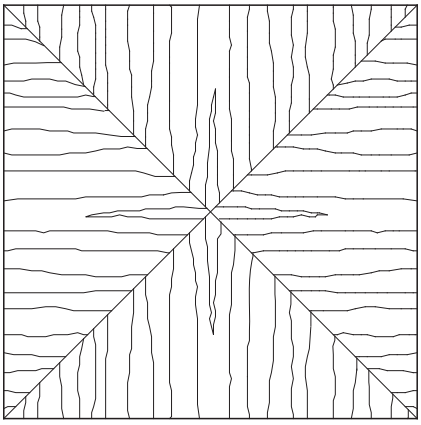
There are regional variations in the “names” of the following veneer leaf matching techniques. It is strongly recommended the design professional use both names and drawings to define the effect desired.



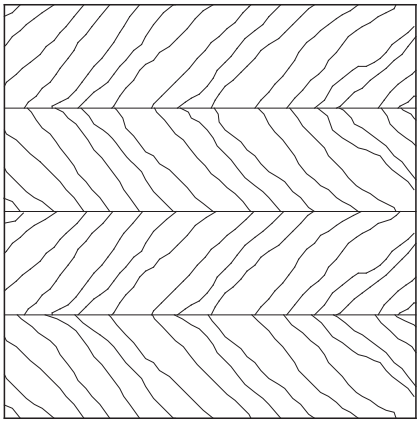
8 Piece Sunburst



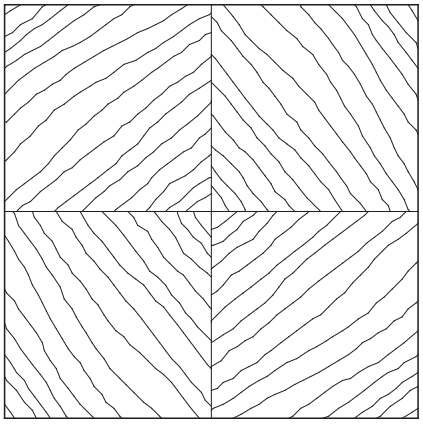
Box Match



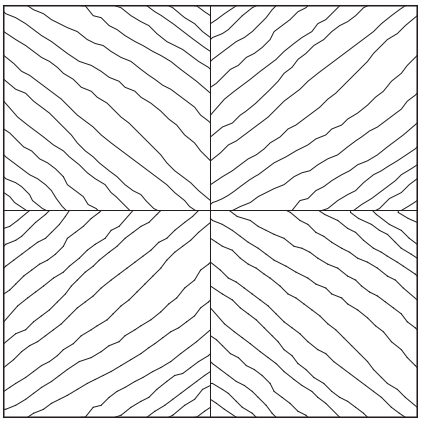
Reverse or End Grain Box



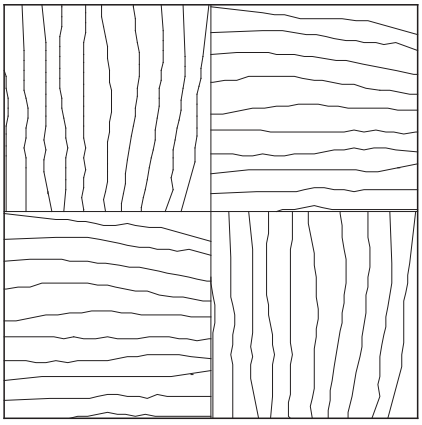
Herringbone or V-Book Match



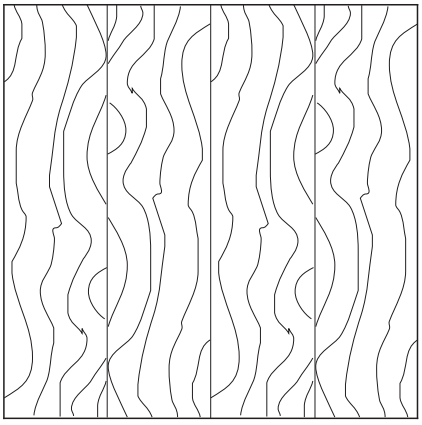
Diamond Match



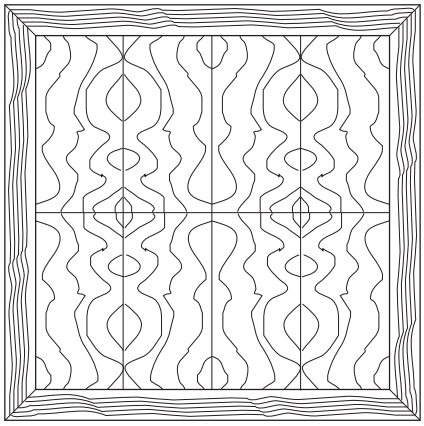
Reverse Diamond Match



Parquet Match



Swing Match



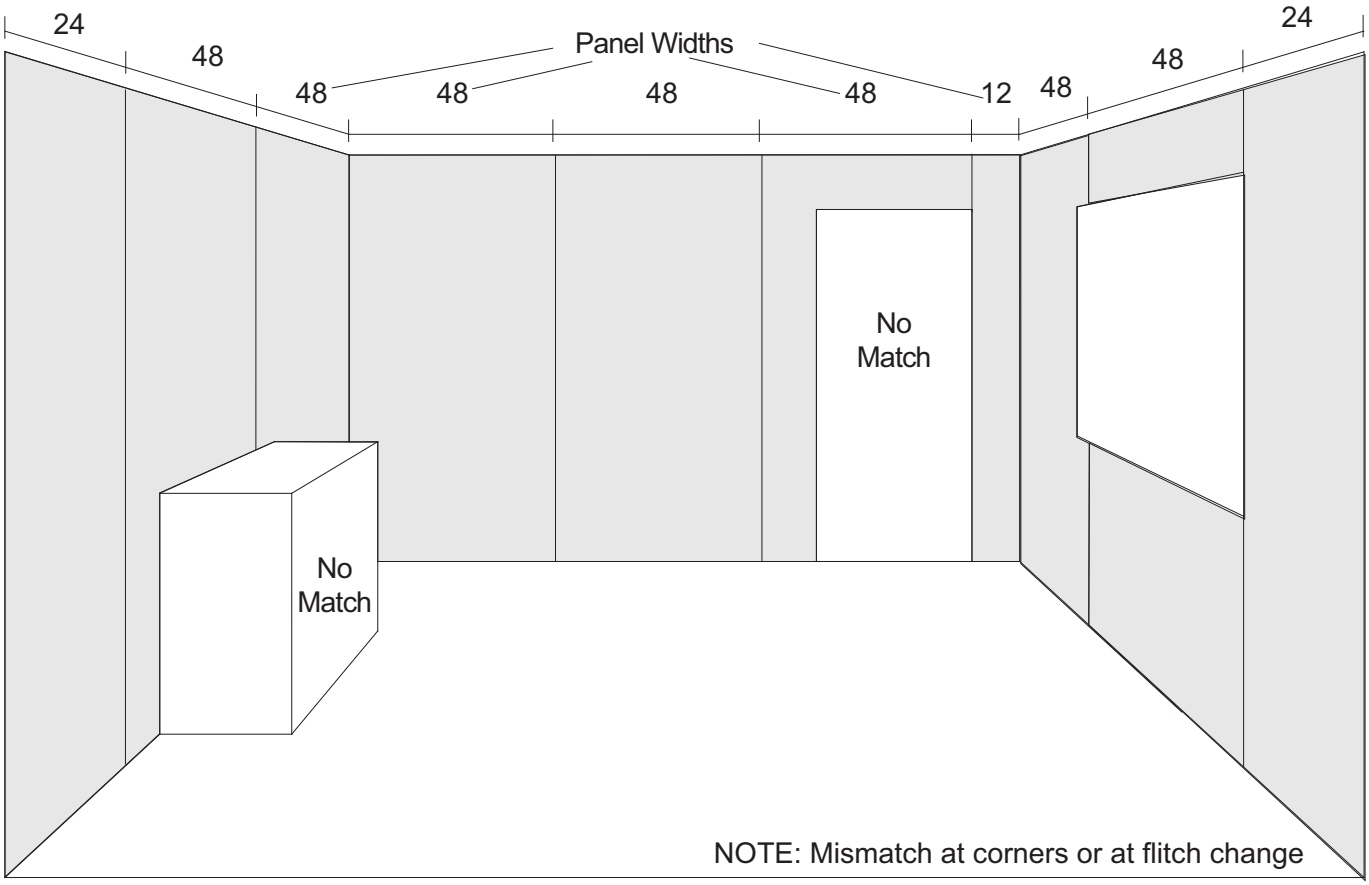
Book & Butt Match w/ Border

4 - Sheet Products

METHODS OF MATCHING PANELS

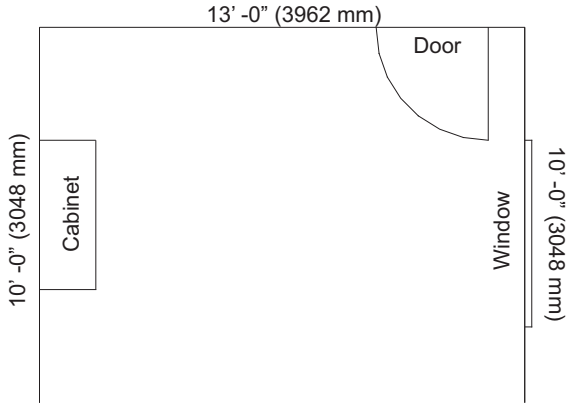
Veneered panels used in casework or paneling in the same area may be matched to each other. This important component of the project must be carefully detailed and specified. The natural growth patterns of the tree will cause the figure on the sequential panels to ascend, descend, or show a “grain progression” as the eye moves from panel to panel. These illustrations were developed in Imperial measure and have not been converted for this edition. The four common methods are:

PRE-MANUFACTURED SETS - FULL WIDTH



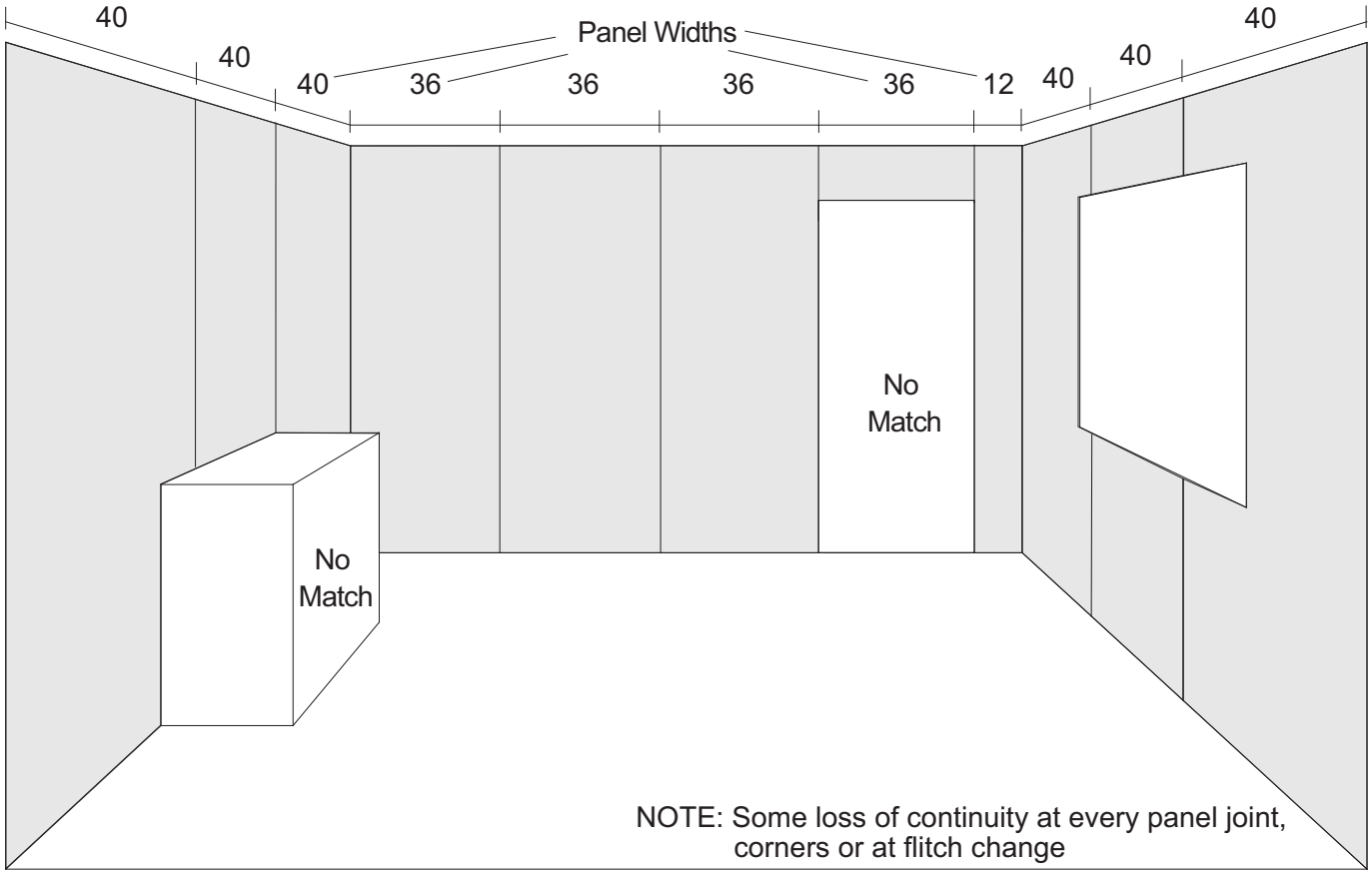
These are one step above stock plywood panels, usually made and warehoused in 4’ x 8’ or 4’ x 10’ sheets in sequenced sets. They may be produced from a single flitch or a part of a flitch, usually varying in number from 6 to 12 panels. If more than one set is required, matching between the sets cannot be expected. Similarly, doors or components often cannot be fabricated from the same flitch materials, resulting in noticeable mismatch. This is often the most economical type of special panel products.

FLOOR PLAN KEY



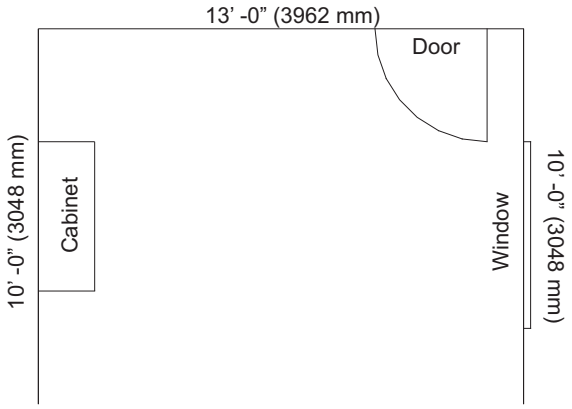
4 - Sheet Products

PRE-MANUFACTURED SETS - SELECTIVELY REDUCED IN WIDTH



These are panels just like those in the previous illustration, usually made and warehoused in 4' x 8' or 4' x 10' sheets in sequenced sets. They are often selected for continuity, recut into modular widths, and numbered to achieve the appearance of greater symmetry. If more than one set is required, matching between the sets cannot be expected. Similarly, doors or components often cannot be fabricated from the same flitch materials, resulting in noticeable mismatch.

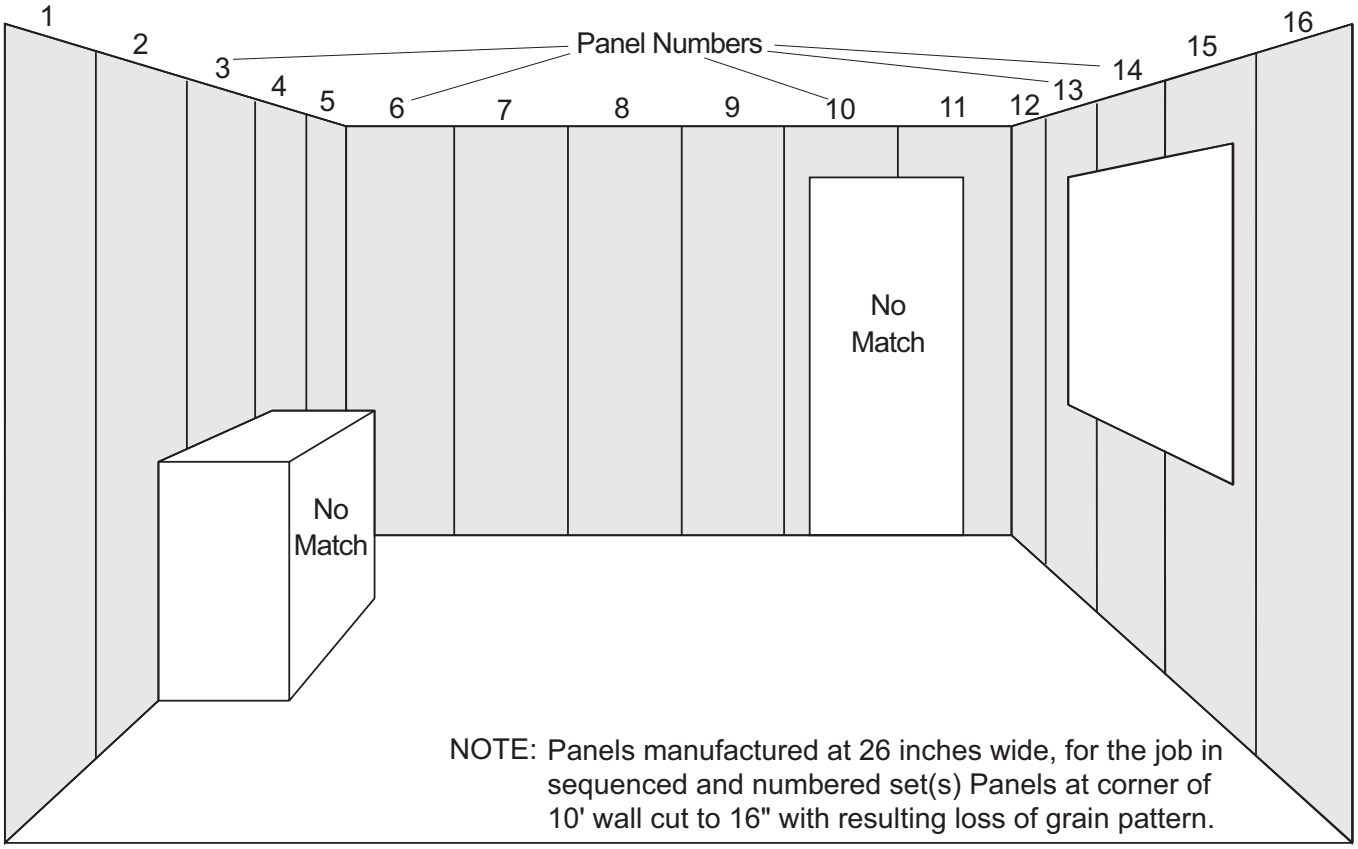
FLOOR PLAN KEY



SE-

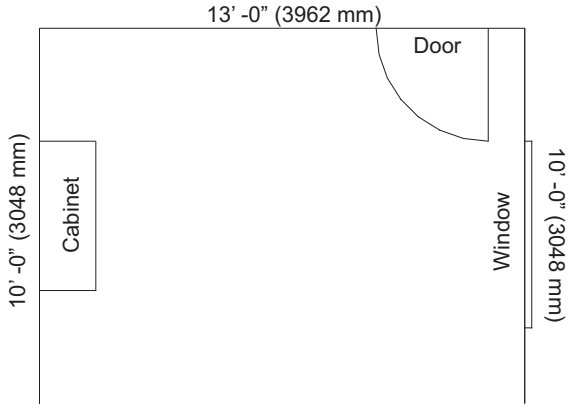
4 - Sheet Products

QUENCE-MATCHED UNIFORM SIZE SET



These sets are manufactured for a specific installation to a uniform panel width and height. If more than one flitch is required to produce the required number of panels, similar flitches will be used. This type of panel matching is best used when panel layout is uninterrupted, and when the design permits the use of equal-width panels. Some sequence will be lost if trimming is required to meet field conditions. Doors and components within the wall cannot usually be matched to the panels. Moderate in cost, sequenced uniform panels offer a good compromise between price and æsthetics.

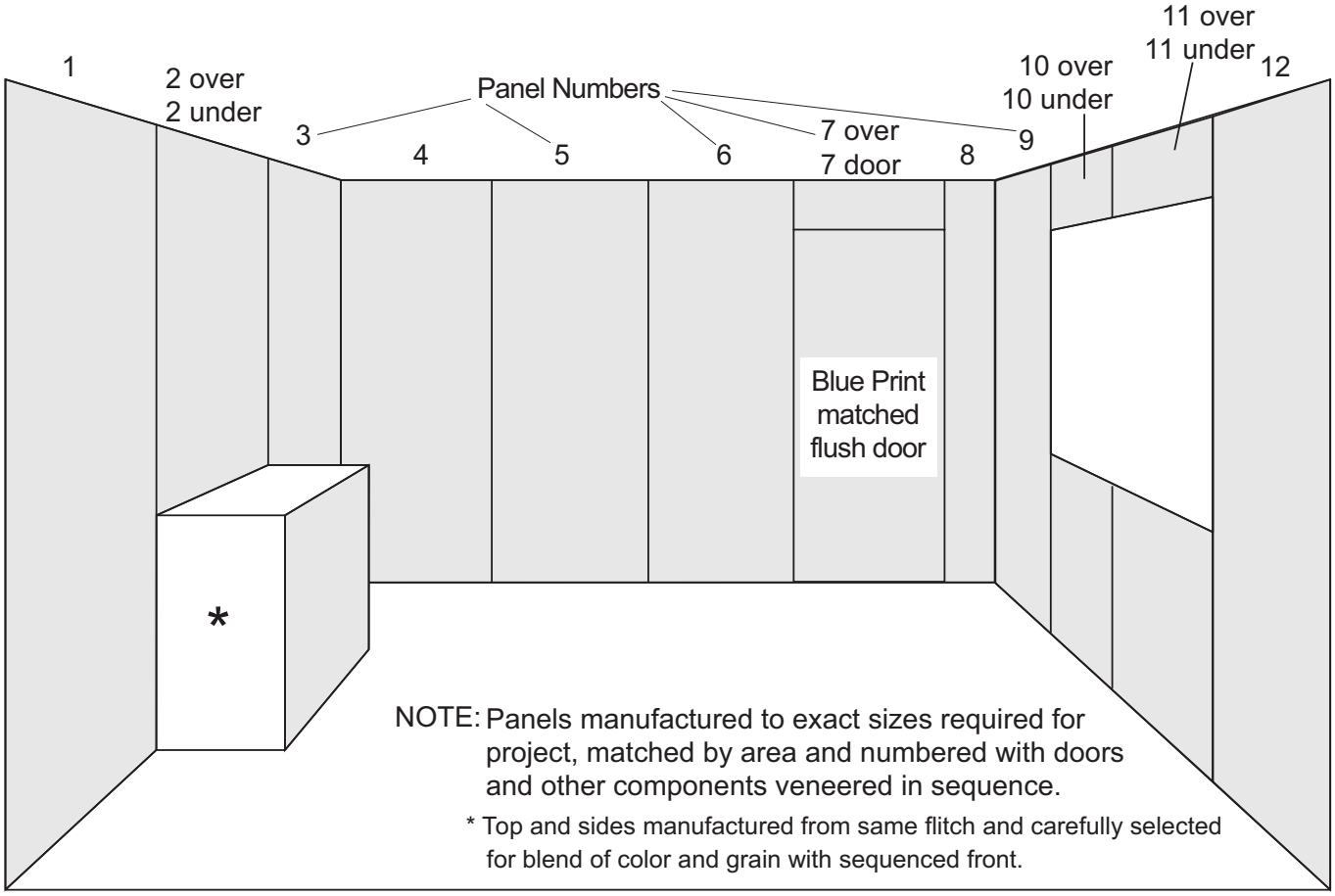
FLOOR PLAN KEY



BLUE-

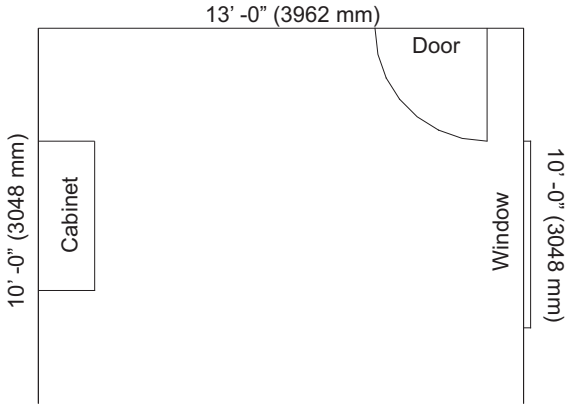
4 - Sheet Products

PRINT-MATCHED PANELS AND COMPONENTS



This method of panel matching achieves maximum grain continuity since all panels, doors, and other veneered components are made to the exact sizes required and in the exact veneer sequence. If possible, flitches should be selected that will yield sufficient veneer to complete a prescribed area or room. If more than one flitch is needed, flitch transition should be accomplished at the least noticeable, predetermined location. This method requires careful site coordination and relatively long lead times. Panels cannot be manufactured until site conditions can be accurately measured and detailed. This panel matching method is more expensive and expresses veneering in its most impressive manner.

FLOOR PLAN KEY



5
Finishing

5 - Finishing

DESCRIPTION AND PURPOSE

Specifying of factory finish is usually selected for high-quality work where superior appearance and performance of the finish is desired. Benefits of factory finishing include consistency, control of film thickness, environmental compliance, and the curing of the finish in a controlled atmosphere. Its use assumes a maximum degree of shop prefabrication so that site installation can be performed with a minimum amount of cutting, fitting, and adjustment to facilitate project completion.

The purpose of finishing woodworking is twofold. First, the finish is used traditionally as a means to enhance or alter the natural beauty of the wood. Second, the finish must protect the wood from damage by moisture, contaminants, and handling. It is important to understand that a quality finish must offer acceptable performance and also meet the aesthetic requirements of the project.

The AWS illustrates a number of finishing systems. The finishing system provides a protective surface for the product. Some of these systems are in general use; others are intended for special conditions and can only be applied under a strictly controlled environment. The cost of the systems vary, the higher performing finishes usually being more costly than the lower performing finishes. Unnecessary cost could be added to a project through over-specification.

- Systems are usually not compatible with each other. Trying to intermix systems could cause quality and/or performance problems.
- Old fashioned or consumer-oriented brush applied finishes are not recommended for factory finished fine architectural woodwork, and are not covered by the AWS.
- Finish systems often fail because too much top coat material is applied. Check with the finish system supplier for advice.

When specifying, please use the system name as set forth in the AWS. Involve your woodwork manufacturer early in the design process to evaluate the systems in relation to your project requirements. Choose performance characteristics which meet, but do not exceed, the needs of your project in the interest of value engineering.

Many prefinished real wood panels and decorative overlays have aesthetic and performance characteristics which meet or exceed the AWS, and shall be evaluated, approved and specified by the design professional when desired.

The listing of a finish system in the AWS does not imply an endorsement of the materials and/or methods or compliance with federal and/or local Environmental Protection Agency or other requirements. Some finishing professionals have, for example, found that polyurethanes and/or polyesters require special finishing procedures for a quantity of laboratory casework. Check with the finishing supplier for recommendations in the use of these products. In cases like these, catalyzed vinyl shall be the topcoat of choice.

WOOD FINISHES, STEPS AND COLOR

A variety of finishes are available for wood products. Aesthetically, systems may vary from no stain, to a single stain, to a multiple step application. Some samples will require multiple color and finish steps in order to meet the architect's requirements. The existing system specified may not include all steps necessary to match the architect's example or requirements. Color and grain enhancement of some finishes require the build of one color step on another. This will sometimes require an additional step of a protective wash coat between color steps. Generally, this procedure adds to the depth and beauty of the finish. Each added step increases costs and shall be specified.

Special consideration should be given to raw wood parts on high pressure decorative laminate-clad (HPDL) cabinets such as wood pulls, wood trims, applied moldings, banded doors, drawer bodies, and wood cabinet interiors. Specifications regarding the responsibility for finishing (if any) shall be clarified by the design professional.

NOTE TO SPECIFIER

Too often, specifications call for finishes based on samples or guide language from a specialty manufacturer.

Examples include the over-specification of polyurethane or polyester top coats when they are neither necessary or available from the custom fabricator.

FINISH CURING

There are a variety of ways to cure a finish. For the most part the method should not concern the design professional or specification writer. It is the performance of the top coat which is important. Select the performance criteria which best meets the needs of your client from the finish tables. Finish chemistry, performance, value-to-performance ratio, and your finisher's abilities should be considered.

UV (ultraviolet light) curing is one of the methods for curing topcoats. It is typically used for high volume, repetitive applications, and requires special reactors to cure. It is currently done by a limited number of finishing operations. The process is environmentally friendly. A number of prefinished panel products are coated with materials designed specifically for UV curing. While UV cured top coats are not all alike, most are very high performance finishes. Consult with the fabricator for performance tests and details

All factory finish systems utilize top coats with spray or flat line application that air dry within one hour, as is common practice, with the exception of waterborne polyesters, and two-component urethanes which may extend these time limits but will be dust free within 24 hours. Finishing materials will be selected for chemical compatibility with each other and with the substrate by the finishing professional.

COLOR "MATCH" AND CONSISTENCY

The term "color match" is often misleading. The best case achievable using a natural product like wood in a wide variety of lighting conditions is a good "blend" of color and tone throughout the project area. The natural color of the wood product is altered by the application of even a clear topcoat. Further alteration is achieved through the use of stains, glazes, bleaches, etc. All wood changes color; especially Cherry, Fir, genuine and African Mahogany, Walnut, Teak, and others. Filled nail holes will not

5 - Finishing

change with wood. The apparent consistency of the color is a combination of light reflectance, cellular structure, natural characteristics, applied colors, and sheen.

Color and "matching" of a sample are often highly subjective. Individual perception, ambient lighting, and reflectivity influence judgement. Design professionals are encouraged to consult directly with a woodworker during the design and selection phase of each project.

PREFINISHED WOOD PANELS

Many prefinished real wood panels and decorative overlays have aesthetic and performance characteristics which meet or exceed the AWS, and should be evaluated, approved and specified by the design professional when desired.

VENEER FINISHING

The fundamental construction of flush wood doors and hardwood veneered panel products is very similar. Both products use various substrates, or plies, with a top ply of hardwood veneer. As a result, the following observations and considerations apply equally to flush wood doors and hardwood veneered panel product

BLOTCHY APPEARANCE OF THE FINISHED SURFACE

Blotching occurs because some wood species exhibit an uneven distribution of large and small pores in their structure. The occurrence of this is readily apparent in such hardwood species as Maple and Birch and, to a lesser degree, in Cherry. This irregular distribution of pores usually causes an uneven absorption of stain, hence, an apparent blotchy appearance in the finish. Reduction of the blotching condition can sometimes be achieved by proper sanding, wash coating (prior to staining) or by choosing non-penetrating pigments, such as dyes, alcohol stains or glaze. When these steps are required or desired, they shall be specified in addition to finish system selection.

BARBER POLE, OR CANDY STRIPING

This effect is most evident when veneer leaves are book matched. Because book matched veneer panel or door faces are made up by turning every other piece (leaf) of veneer over, like the pages of a book, the face of one leaf and the back of the next leaf is exposed. This exposes the "tight" and "loose" face of the leaves. One of the most striking examples of Barber Pole effect can be seen in book matched rift and quarter cut oak. Check with your woodworker when you are considering specifying rift or quartered veneers.

TECHNIQUES TO CONSIDER

While a blotchy appearance and the "barber pole effect" may occur in any species, due to the natural characteristics of wood, there are steps that can be taken to reduce these effects. The following are two of the techniques that are of particular importance.

SANDING

While the selection of species, cut and match are major factors in the final appearance of any project, the first step, in controlling the quality of finished appearance, is proper sanding.

An important element of this standard is the statement "just prior to staining." Specifications that indicate "factory shall finish sand prior to shipment" do not provide a correct solution for proper surface preparation. Such a directive fails to take into account the length of time panels will be stored at the job site, potential damage from handling and the effects of changes in the relative humidity. Proper sanding can only be done, just prior to staining/ finishing.

The successful sanding of panels, or flush doors, is best accomplished with a hand block, powered pad sander, wide belt sander or stroke sander, exerting uniform pressure over the entire surface. Depending upon the condition of the surface it may be necessary to use successively finer grits of abrasive to properly prepare the surface, brushing off the surface between grits. The AWS sets forth the smoothness requirement for all Grades of work. Proper and complete surface preparation is the key factor in the successful finish procedure.

WASH COAT

A washcoat is a thin coat of material, usually clear lacquer or vinyl sealer (6 to 10 parts thinner to one part sealer, topcoat). A washcoat can fulfill several purposes such as: to stiffen the small wood fibers that are raised by the staining operation, so they can be cut off easily with fine sand paper (320 grit), to seal the stain, particularly if it is a bleeding type, to aid in the wiping and clean up of filler, and to minimize excessive penetration of stain or filler to minimize blotchiness. As with any finish process, samples should always be prepared to ensure that the desired finish is achieved.

BLUE STAIN

Blue stain occurs in Oak veneers when natural tannic acid in the wood comes in contact with iron and or moisture. Enough moisture may occur during heavy rains or high humidity in buildings not yet temperature controlled. The following is from a door manufacturer's care and handling brochure.

"To prevent blue stain, never use steel wool on the bare wood. Fine particles of the wool will cling to the door and cause trouble later. If you use shellac (a solvent for iron), it should not be stored in iron containers. To remove blue stain prior to finishing doors, we recommend a solution of oxalic acid crystals. The solution is made by dissolving 12 ounces of crystals in one gallon of lukewarm water. Use a plastic or rubber container. Wear rubber gloves while working with the solution. Apply it to the stained areas with a brush or sponge; allow the door to dry and sand with 150 to 180 grit sandpaper. The entire door surface should be treated to avoid spotting. Important: Failure to rinse the treated area adequately may have a damaging effect on the finish subsequently applied, or may cause damage to nearby glass, porcelain or other surfaces in confined areas. Damage may not result immediately, but may result during storage or after installation."

5 - Finishing

FIRE-RETARDANT TREATED LUMBER AND COATINGS

Fire retardant treatments may affect the finishes intended to be used on the wood, particularly if transparent finishes are planned. The compatibility of any finishes should be tested before they are applied.

"Fire-retardant" coatings usually are of the intumescent type. They may be water-based or solvent-based, but both contain ingredients which, under the influence of heat, produce gases and char-like products, resulting in the formation of a thick nonflammable crust that effectively insulates combustible substrates from heat and flame. However, these ingredients are for the most part water-sensitive and therefore reduce durability and range of usage of the coatings.

These coatings only delay the spread of fire and help contain it to its origin. To be of any appreciable value, fire-retardant coatings must be applied in strict conformance with the manufacturer's instructions. These finishes are not particularly durable and their use should be restricted to application over interior surfaces.

The need for, and effectiveness of, fire-retardant and fire-resistant finishes depends on the type of construction, nature of occupancy, and other technical features of the building. Because these finishes are considerably more expensive and have reduced durability, their use should be carefully limited to those areas where confining fire spread is the overwhelming consideration; for example, interior entrances, hallways, stairwells and ceilings.

STRIPPING RECOMMENDATION (WHEN SPECIFIED)

While them AWS does not cover the removal of existing finishes on woodwork, the methods and skill involved in large measure determines the quality of preservation, conservation, and restoration during Historical Work. Stripping is usually performed by specialists trained in historic work, but there are some architectural woodworkers who have such specialists on the staff. Regardless of the assignment of responsibility for existing finish removal, the following guidelines should be inserted in the contract documents by the design team:

• Strippers shall be environmentally sound, solvent based. Alkaline based products are not acceptable. All strippers shall be neutral based, not requiring additional neutralization treatment.

• Before stripping begins, all surfaces shall be tested (with the process and results recorded) to provide the least intrusive and damaging methods. Approval of the architect, design professional or conservator is required before execution of the work.

• Completely remove existing finish using multiple applications of the approved methods without gouging, splintering or otherwise damaging sound surfaces.

• Thoroughly remove all stripping residuals, include wax, before proceeding.

• Stripped surfaces shall be tested for evidence of acid or alkali, reworking the surface until it tests pH neutral.

• Carefully sand all surfaces by hand with no coarser than 220 grit garnet or aluminum oxide sandpaper to remove all signs of raised grain.

6
Interior and Exterior Millwork

6 - Interior and Exterior Millwork

METHODS OF PRODUCTION

Flat Surfaces:

- Sawing - This produces relatively rough surfaces that are not utilized for architectural woodwork except where a “rough sawn” texture or finish is desired for design purposes. To achieve the smooth surfaces generally required, the rough sawn boards are further surfaced by the following methods:
- Planing - Sawn lumber is passed through a planer or jointer, which has a revolving head with projecting knives, removing a thin layer of wood to produce a relatively smooth surface.
- Abrasive Planing - Sawn lumber is passed through a powerful belt sander with tough, coarse belts, which remove the rough top surface.

Moulded Surfaces:

Sawn lumber is passed through a moulder or shaper that has knives ground to a pattern which produces the moulded profile desired.

SMOOTHNESS OF FLAT AND MOULDED SURFACES

Planers and Moulders: The smoothness of surfaces which have been machine planed or moulded is determined by the closeness of the knife cuts. The closer the cuts to each other (i.e., the more knife cuts per inch [KCPI]) the closer the ridges, and therefore the smoother the resulting appearance.

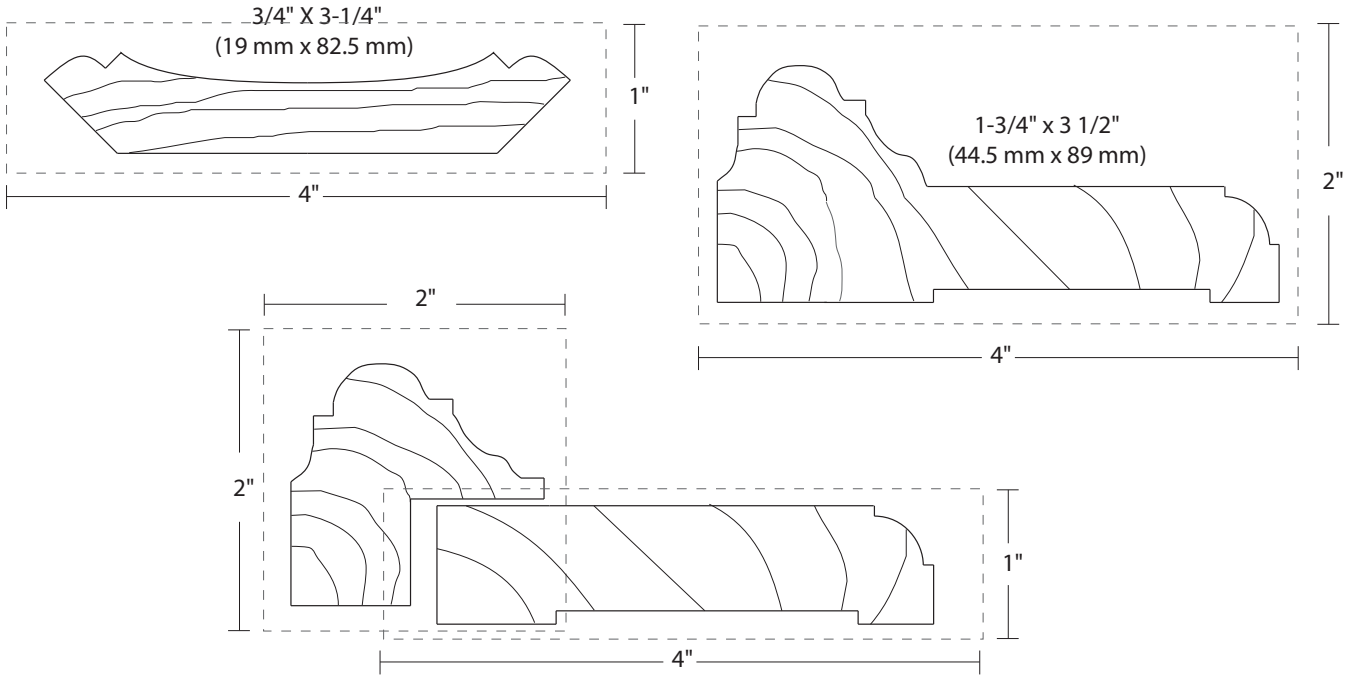
Sanding and Abrasives: Surfaces can be further smoothed by sanding. Sandpapers come in grits from coarse to fine and are assigned ascending grit numbers. The coarser the grit, the faster the stock removal. The surface will show the striations caused by the grit. Sanding with progressively finer-grit papers will produce smoother surfaces.

DESIGN AND USE OF RESOURCES

Moldings should be cut from lumber approximately the same size as the finished piece to make the best use of our natural resources. Designing moldings with the size of typical boards in mind has several advantages.

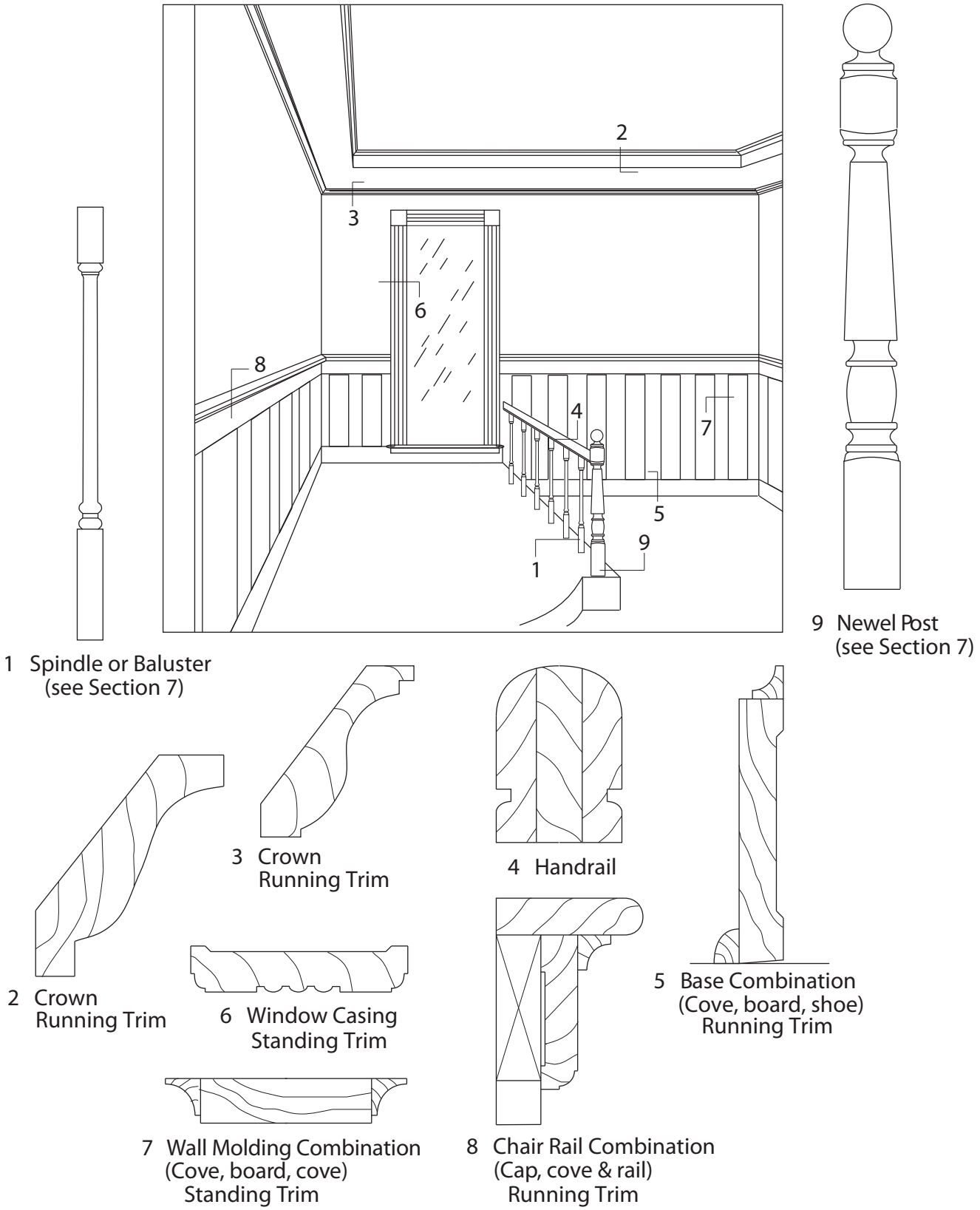
The typical 1” x 4” (25.4 mm x 101.6 mm) will yield a very nice 3/4” (19 mm) thick molding, but will not be thick enough to develop a molding which is a full 1” (25.4 mm) thick in finish dimension. The typical 2” x 4” (50.8 mm x 101.6 mm) piece of lumber can be made into moldings about 1-3/4” (44.5 mm) thick in a similar manner.

Deep or large moldings are often best cut from more than one piece and built up to make the final profile. Just as in the manufacturing of single moldings, this process minimizes waste and reduces the tendency of the finished profiles to twist, warp, cup, or bow as a result of removing too much material from either side of the initial board.



6 - Interior and Exterior Millwork

IDENTIFICATION OF STANDING AND RUNNING TRIM AND RAIL PARTS



1 Spindle or Baluster (see Section 7)

9 Newel Post (see Section 7)

3 Crown Running Trim

4 Handrail

2 Crown Running Trim

6 Window Casing Standing Trim

5 Base Combination (Cove, board, shoe) Running Trim

7 Wall Molding Combination (Cove, board, cove) Standing Trim

8 Chair Rail Combination (Cap, cove & rail) Running Trim

6 - Interior and Exterior Millwork

RADIUS MOLDINGS

Both traditional and nontraditional architectural styles often call for radius standing and running trim either in plan, elevation, or both. In situations where the size of the molding and the radius to which it is to be formed is such that a straight molding will not conform to the substrate, the architectural woodworker can use several methods to fabricate radius moldings. Moldings applied to radii can be segmented, bent, laminated and formed, pre-shaped, or machined to the radius. Woodworkers will fabricate the moldings in the longest practical lengths, with the purpose of minimizing the field joints.

The architectural woodworker frequently uses band sawing for fabricating radius moldings. With this technique, the woodworker starts with a large, often glued-up piece of material and band s*AWS* to get a curved piece. In order to cut down on waste, the woodworker tries to get several curved pieces from one large piece by nesting, as shown in Illustration A. Characteristically, this method of fabricating radius moldings limits the length of pieces that can be developed without a joint. It also yields a piece of material with grain straight on the face, not following the curve.

When dealing with profiles with a flat face (see Illustration B), the woodworker may saw the pieces from a sheet of plywood and then apply an edge band. This will yield larger pieces with more consistent grain.

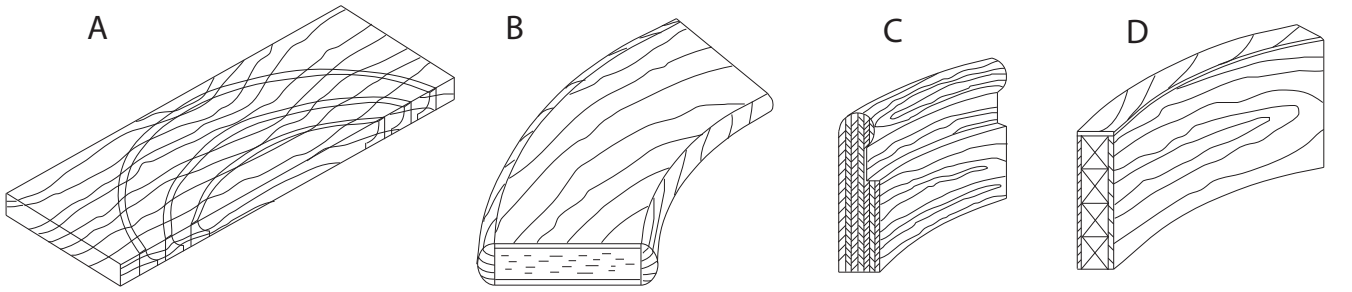
Another technique for fabricating a radius mould involves laminating thin, bendable plies of lumber in a form (see Illustration C). Laminated pieces hold their shape without being secured to another surface. This curved piece will then be milled to the desired profile. The glue lines follow the edge grain and the curve, thus minimizing their visibility. The species of wood and the tightness of the radius determine the maximum thickness of each ply.

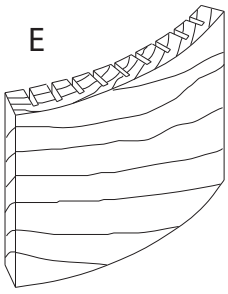
When dealing with some cross Sections, it can be advantageous to combine band sawing and laminating. The woodworker band s*AWS* a core of common lumber and laminates finish material to the exposed faces. From looking at Illustration D, it is apparent that this technique must be limited to certain profiles. It does, however, offer the ability to minimize glue joints and control grain directions. Finally, the simplest method for obtaining a radius molding is kerfing.

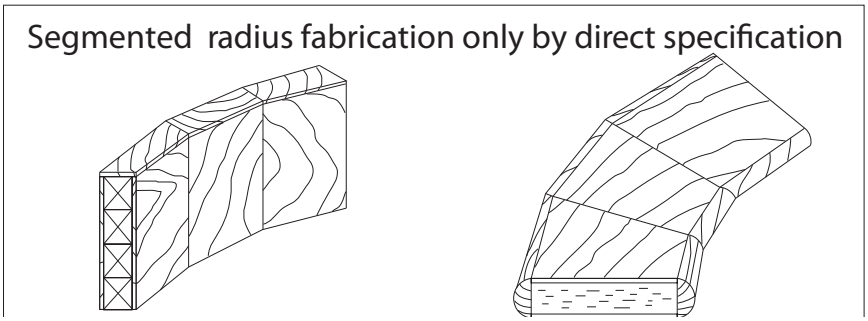
As seen in Illustration E, kerfing consists of making repeated saw cuts on the back face of the piece, perpendicular to the bend. The tightness of the radius determines the spacing and depth of the kerfs. Kerfing allows the piece to be bent to the required radius, and then secured in place to hold the bend. Kerfing almost always results in “flats” on the face which show in finishing. When dealing with a large radius, it is sometimes possible to stop the kerf prior to going through an exposed edge. In most cases, however, the kerf runs all the way through, and the edge must be concealed .

Unless specifically called out, the architectural woodworker will have the option of which method to use for fabricating radius molding. Since the fabrication method determines the final appearance of the pieces, especially regarding the direction of grain and visibility of glue joints, the architect or designer may wish to specify the method. It is recommended that an architectural woodwork firm be consulted before making a selection. Mock-ups may be required to visualize the end product.

Some acceptable methods of radius fabrication



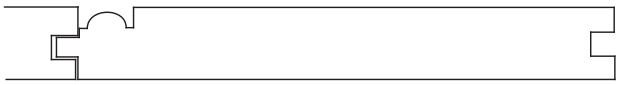




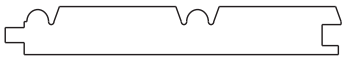
6 - Interior and Exterior Millwork

Solid Lumber Paneling Patterns

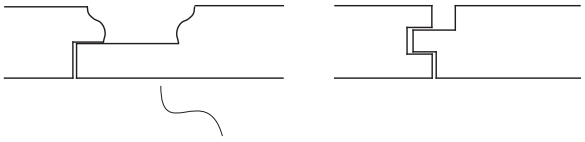
The variety of solid lumber paneling is only limited by the imagination of the design professional. Virtually any machinable profile can be custom manufactured. The following profiles are some of the traditional patterns associated with solid board paneling. They are not dimensioned intentionally, allowing the design professional to determine the scale and proportions most appropriate for the project.



Single Bead

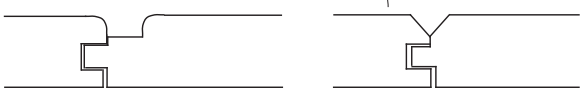


Beaded Ceiling or Wainscot

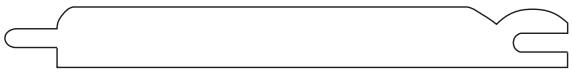


Some Reveal Detail Options

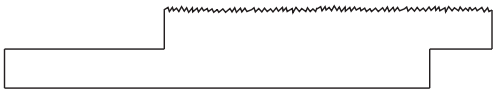
Pickwick Paneling



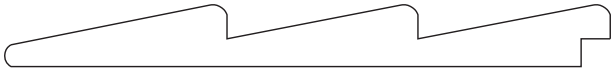
Tongue and Groove "V" Joint



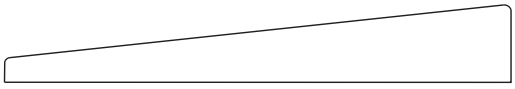
Beaded Siding



Rough Sawn Reveal

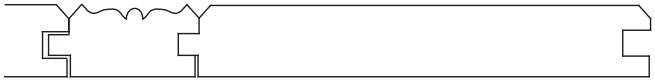


Simulated Lap Siding

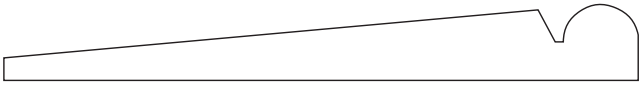


Bevel Siding with plough

Drop/Lap Siding



Molded Insert

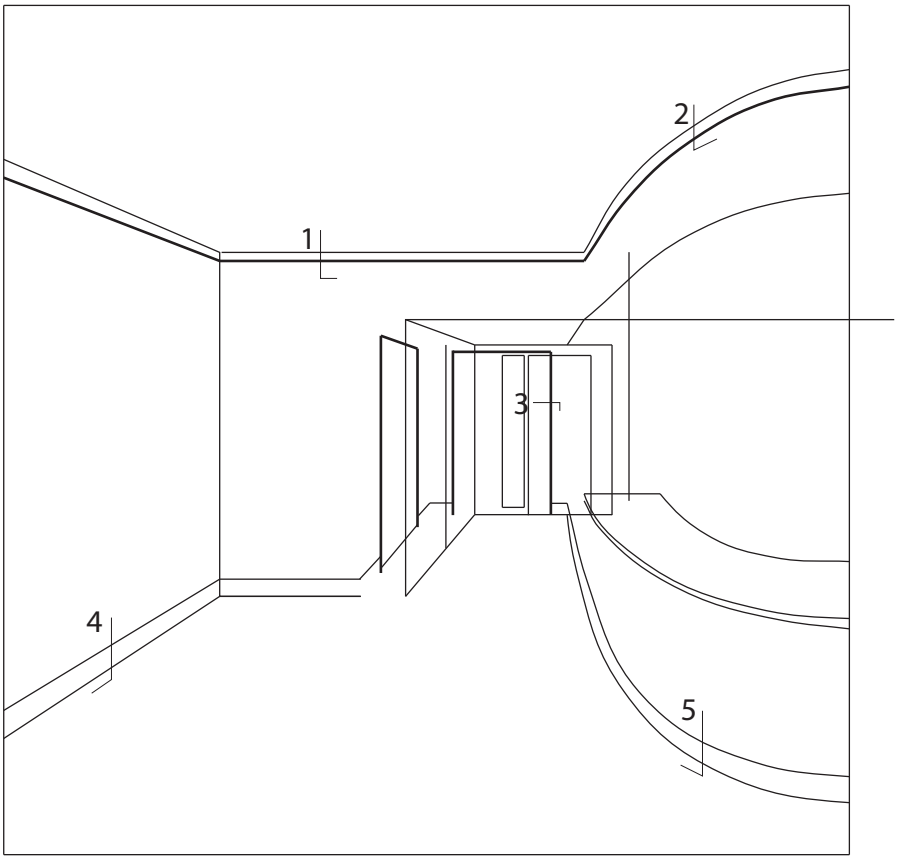


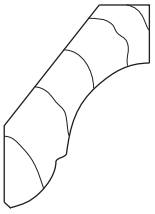
Beaded Bevel Siding

Coved Paneling

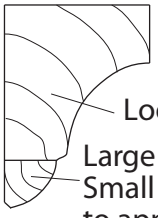
6 - Interior and Exterior Millwork

TYPICAL USES OF STANDING AND RUNNING TRIM AND RAILS

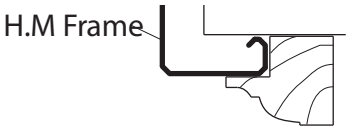




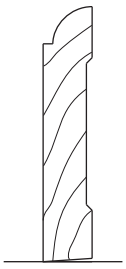
1 Cove (straight)



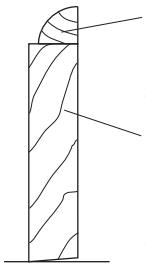
2 Cove (radius)



3 Back band

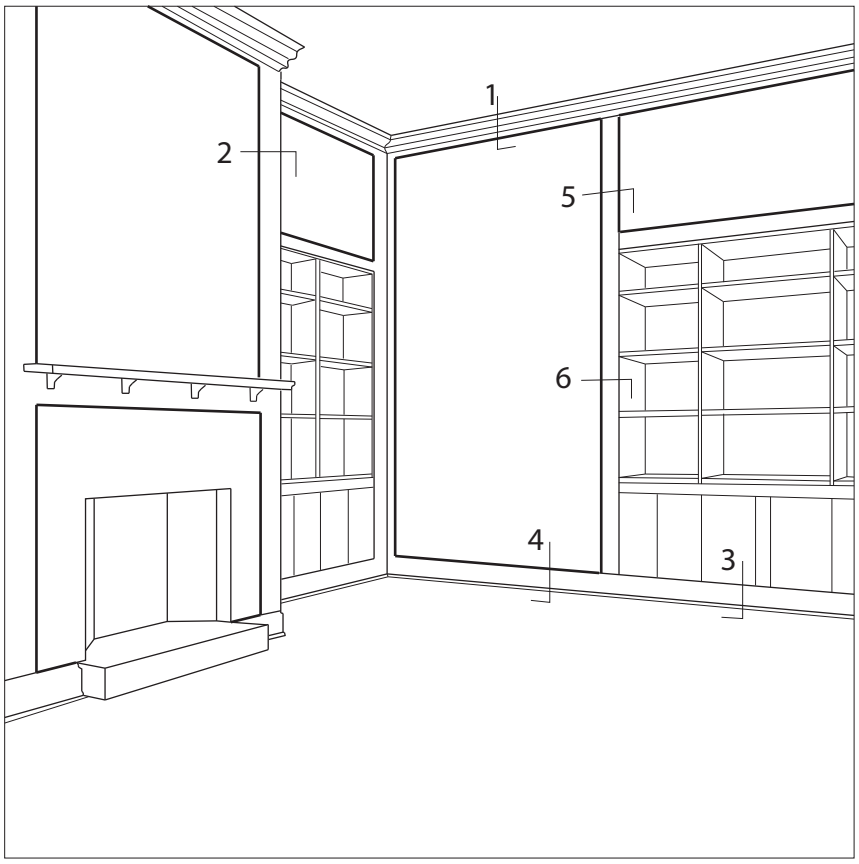


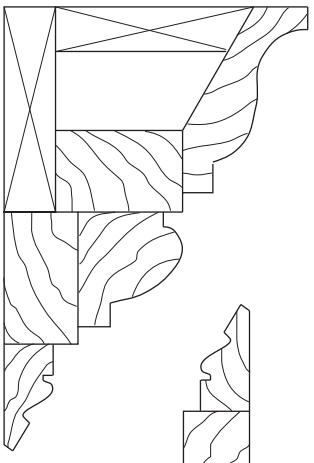
4 Base (straight)



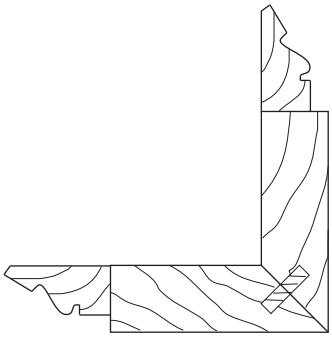
5 Base (radius)

6 - Interior and Exterior Millwork

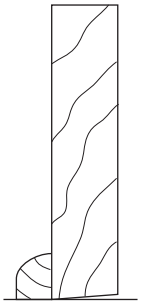




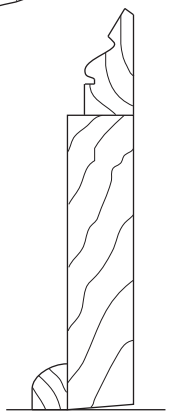
1 Built-up Cornice



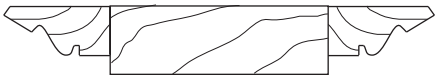
2 Outside Corner



3 Base (at bookcase)



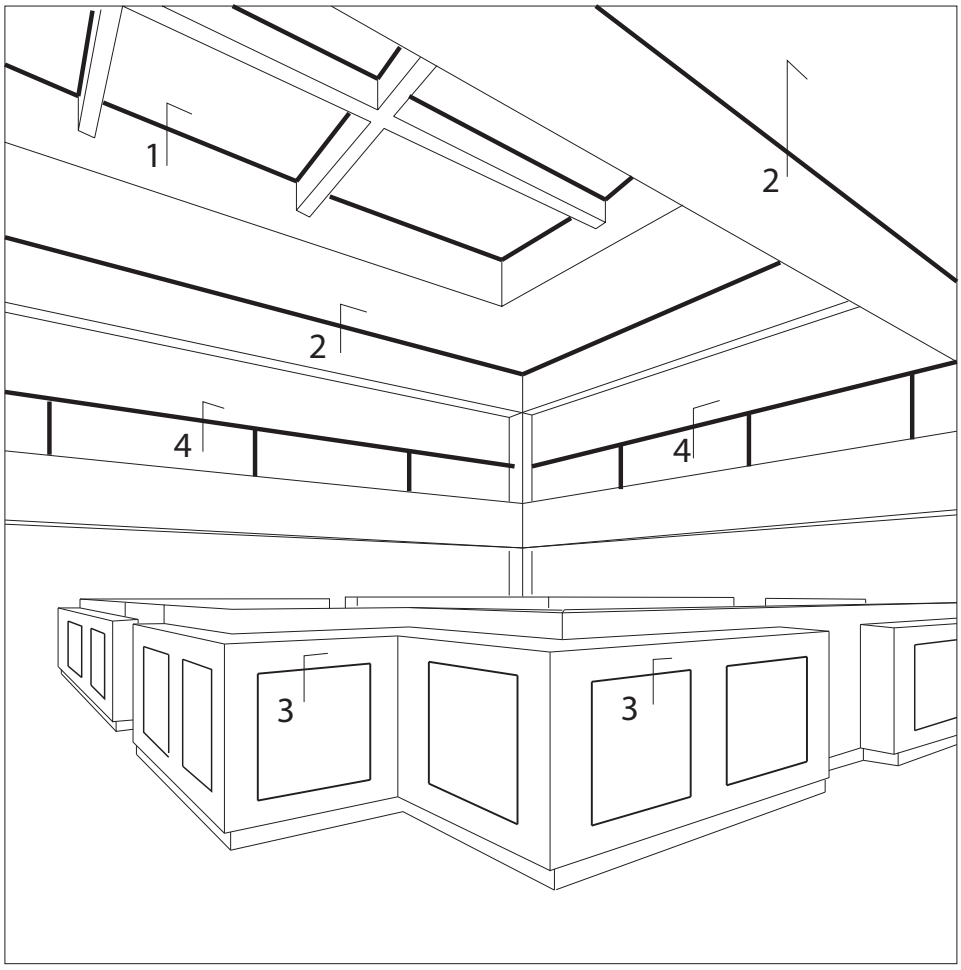
4 Base (at wall)

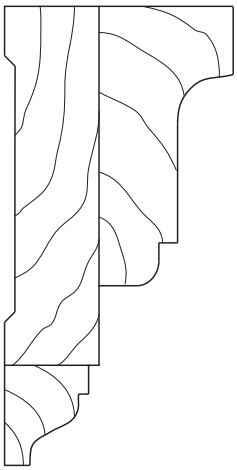


5 Wall Molding (at wall)

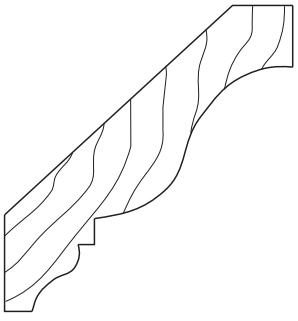
6 Wall Molding (at bookcase)

6 - Interior and Exterior Millwork



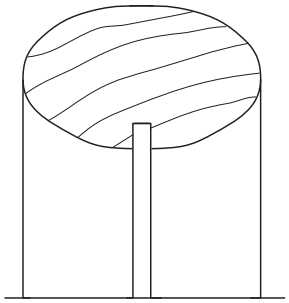


1 Skylight Cornice



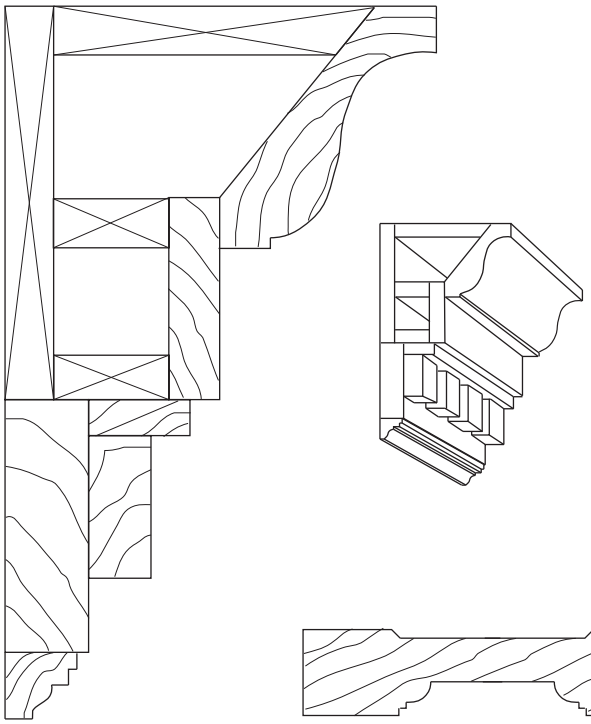
2 Crown

3 Panel Molding



4 Handrail

6 - Interior and Exterior Millwork

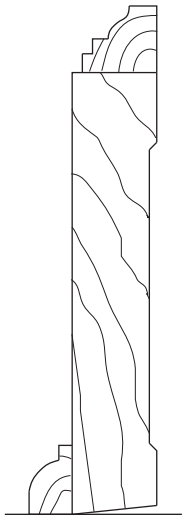


1 Cornice

2 Chair Rail

4 Casing

5 Panel Molding



3 3-piece Base

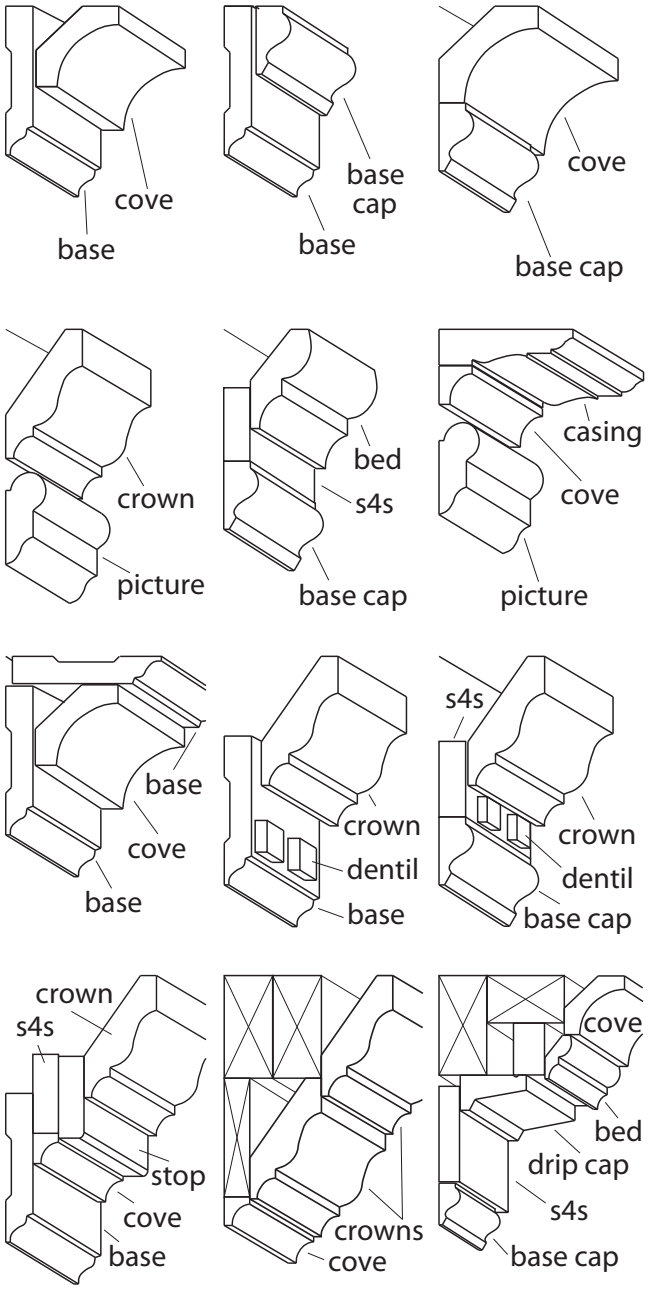
6 - Interior and Exterior Millwork

"BUILT-UP" MOLDINGS FOR LARGER PROFILES

(Used with permission of the Wood Molding and Millwork Producers Association.)

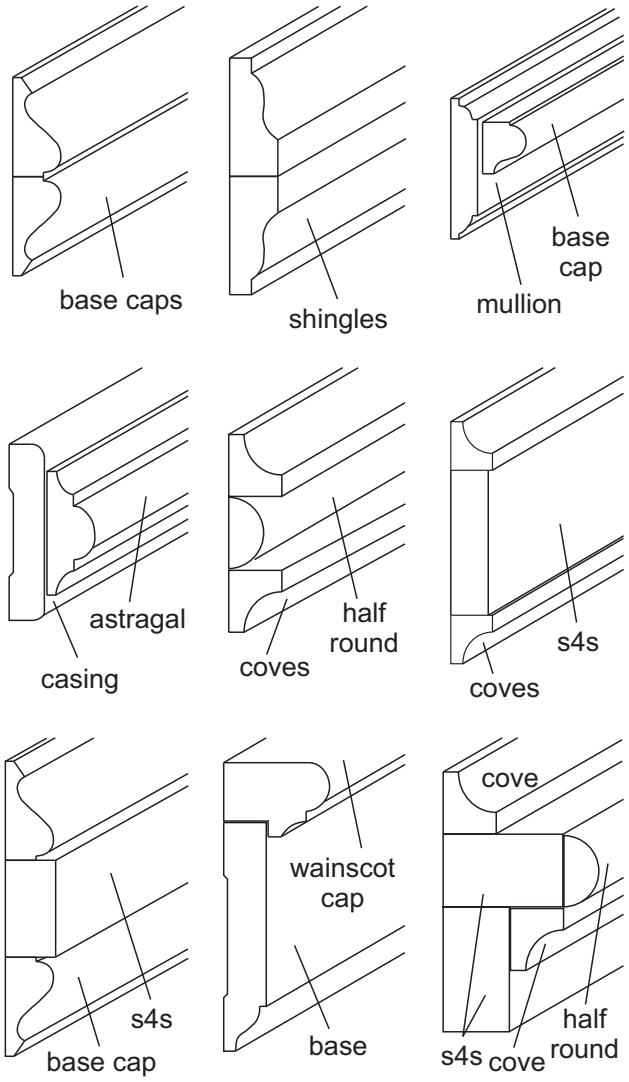
Ceilings

The most obvious area for "built-up" moldings is where the walls meet the ceiling. This is primarily true of rooms with high ceilings. In low-ceiling rooms (8' (2438 mm)), single molding profiles usually work best. A series of "built-up" moldings would have a tendency to make a low ceiling appear even lower. But if your ceilings are high (10' (2540 mm) or higher), there is no limit to the rich three-dimensional elegance you can add to the room's appearance with the creative application of moldings. Below are several suggested combinations. Let your imagination create your own combinations and designs.



Chair Rails

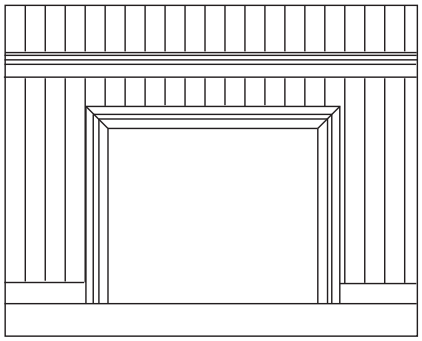
Adding chair rails to a room is a very traditional method of breaking up walls, adding both interest and protection. They prevent the wall from being bumped or scuffed by chairs and can also be used to separate two types of decorating material such as paneling, wallpaper, and paint. Following are some variations of "built-up" chair rail combinations.

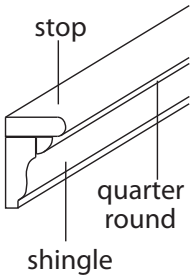


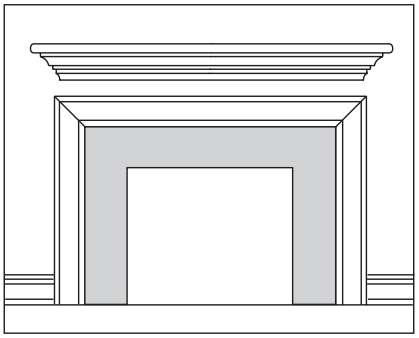
6 - Interior and Exterior Millwork

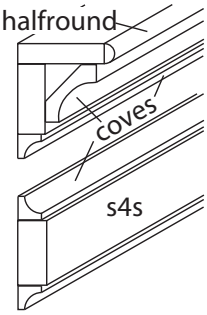
Fireplaces

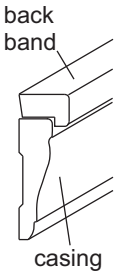
The use of "built-up" moldings is also an excellent way to highlight or frame a fireplace or add depth and richness to the fireplace mantel. Below are a few creative but simple-to-install profile combinations.

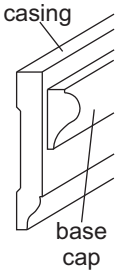


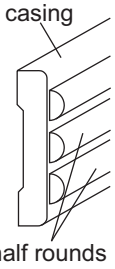


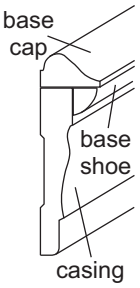






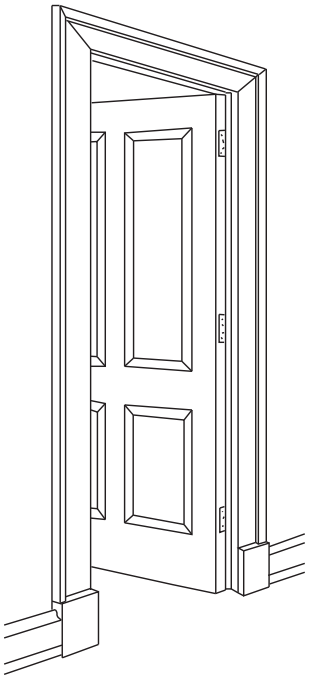






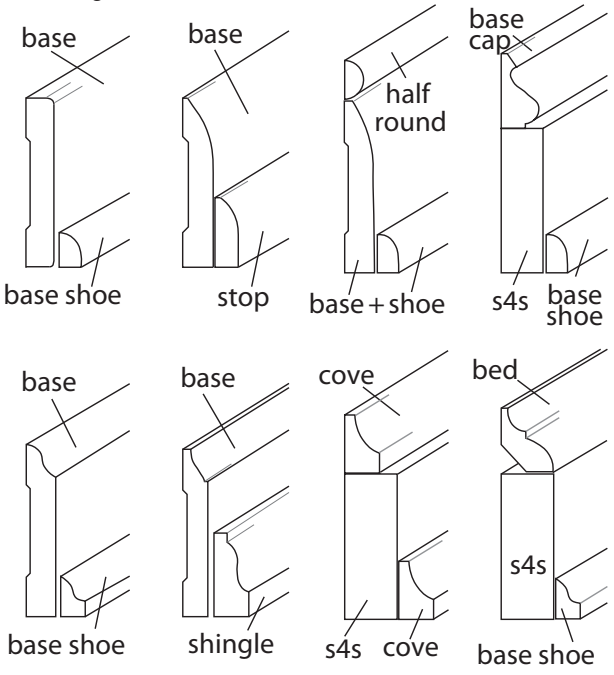
Doors and Windows

The framing of doors and windows is most commonly done with single molding profiles, but by adding other patterns, the basic trim can easily be transformed into a window or door casing of classical depth and beauty. Installing plinth blocks at the bottom of casing further enhances the traditional look.



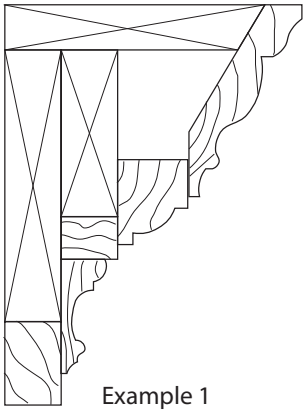
Base

The elaborate look of elegance can even be carried through to base moldings where the wall meets the floor, as illustrated in the following variations.

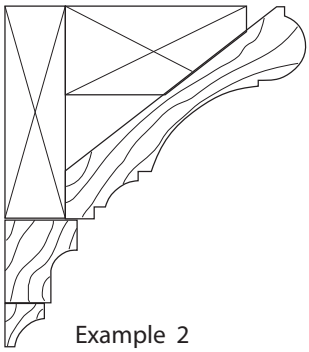


6 - Interior and Exterior Millwork

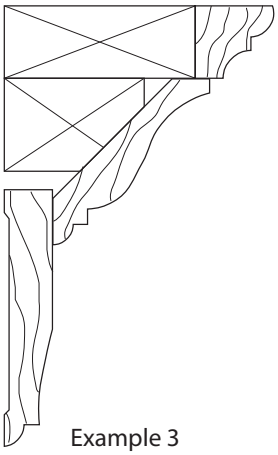
COMBINATION CORNICES AND WALL TRIMS



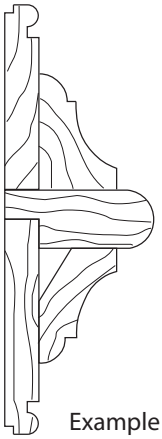
Example 1



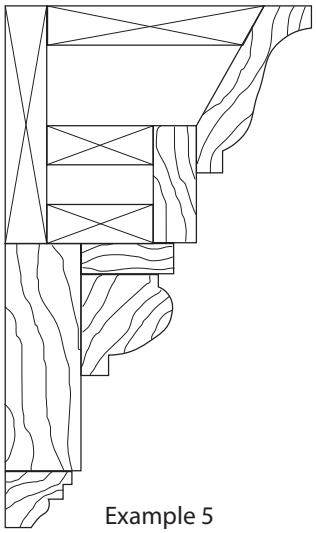
Example 2



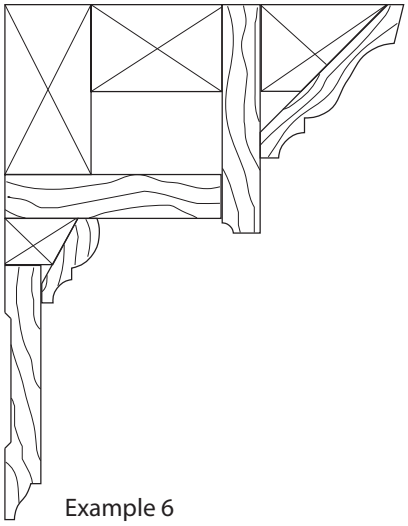
Example 3



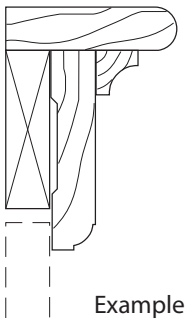
Example 4



Example 5

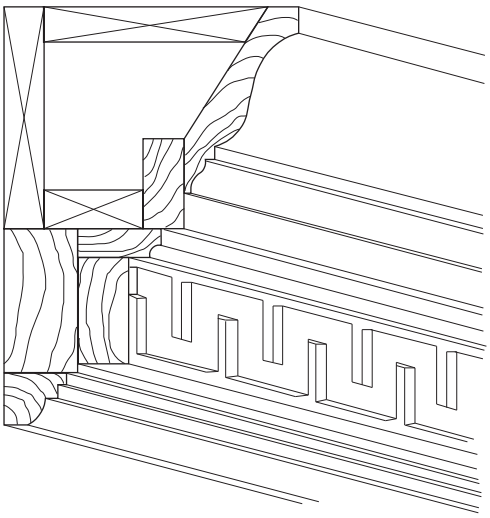


Example 6

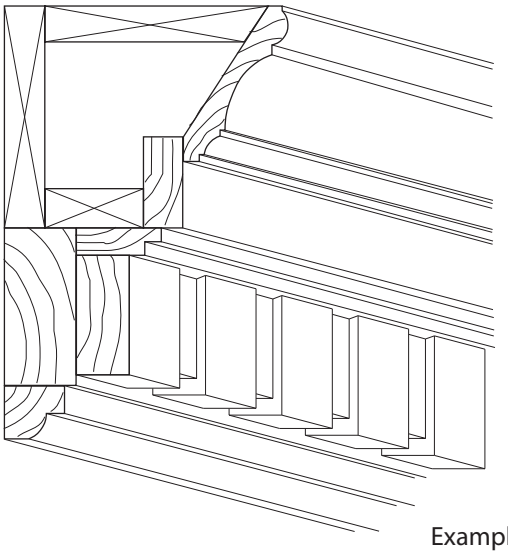


Example 7

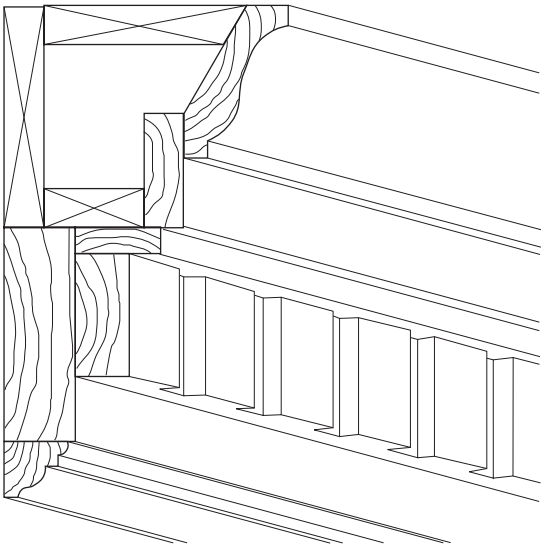
6 - Interior and Exterior Millwork



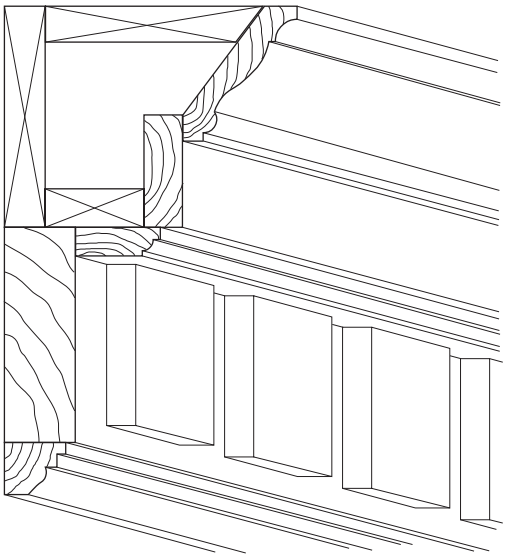
Example 8



Example 9



Example 10

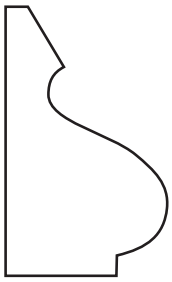


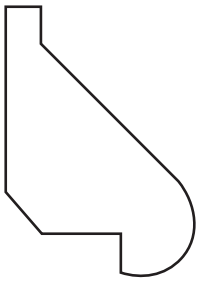
Example 11

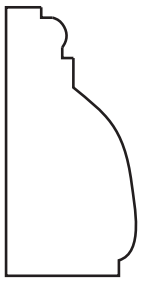
IMPORTANT NOTE: The following drawings are illustrations, not measured or engineered. They are offered for general profile shape only. Some manufacturers may vary the profile or sizes. They are not dimensioned intentionally, allowing the design professional to determine the scale and proportions most appropriate for the project.

6 - Interior and Exterior Millwork

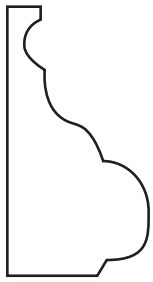
Base Caps and Bases


BAS-1000


BAS-1001


BAS-1002


BAS-1003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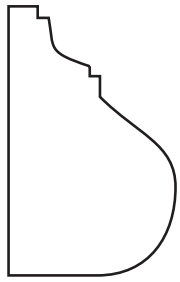
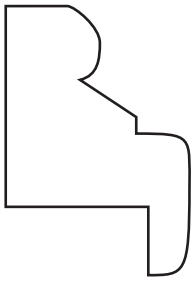
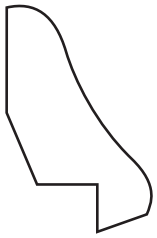

BAS-1005


BAS-1006


BAS-1007


BAS-1008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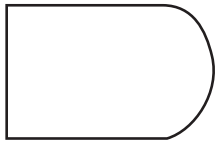
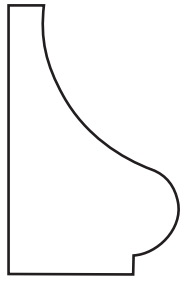

BAS-1010


BAS-1011


BAS-1012


BAS-1013


BAS-1014


BAS-10015


BAS-1016


BAS-1017

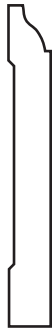

BAS-1018


BAS-1019


BAS-1020


BAS-1021


BAS-1022

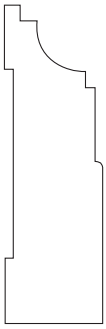

BAS-1023

6 - Interior and Exterior Millwork

Base Caps and Bases


BAS-1012


BAS-1013


BAS-1014


BAS-10015


BAS-1016


BAS-1017


BAS-1018


BAS-1019


BAS-1020


BAS-1021


BAS-1022


BAS-1023


BAS-1024


BAS-1025

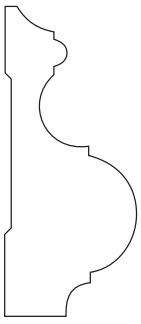

BAS-1026


BAS-1027


BAS-1028


BAS-1029


BAS-1030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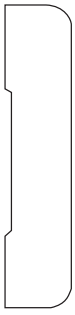
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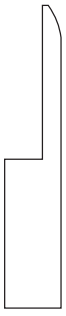
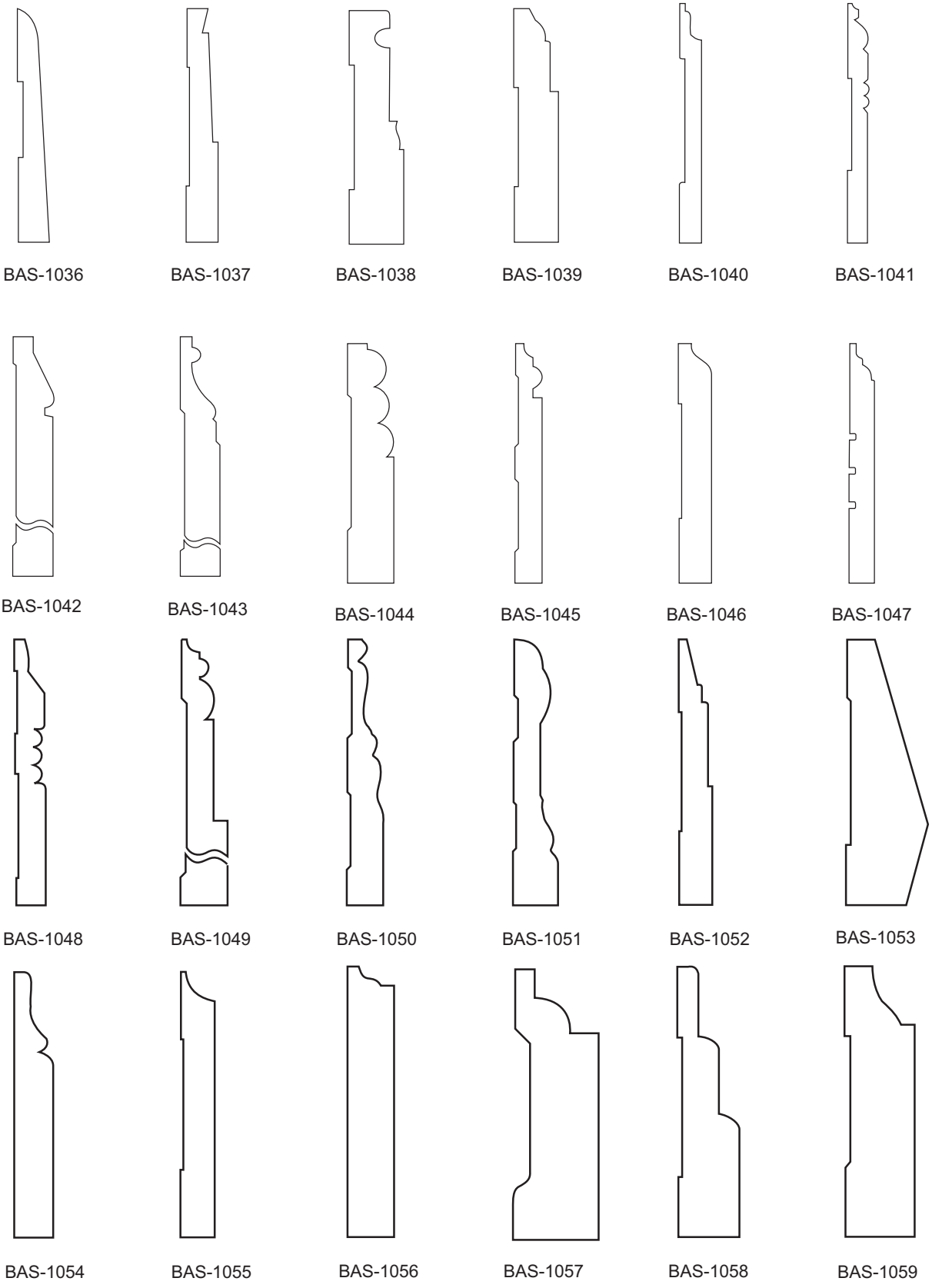

BAS-1033


BAS-1034


BAS-1035

6 - Interior and Exterior Millwork

Base Caps and Bases



6 - Interior and Exterior Millwork

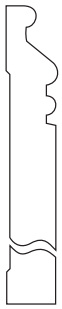
Base Caps and Bases


BAS-1060


BAS-1061


BAS-1062


BAS-1063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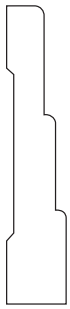
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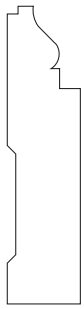
BAS-1066


BAS-1067


BAS-1068


BAS-1069


BAS-1070


BAS-1071


BAS-1072

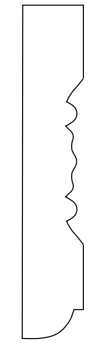

BAS-1073


BAS-1074

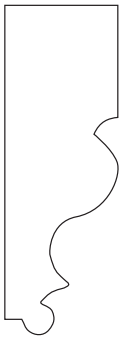

BAS-1075

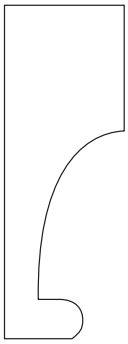
6 - Interior and Exterior Millwork

Casings


CAS-2000

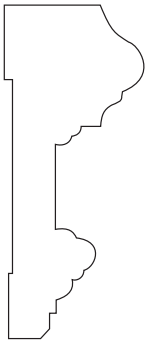

CAS-2001


CAS-2002


CAS-2003


CAS-2004


CAS-2005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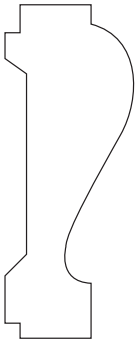
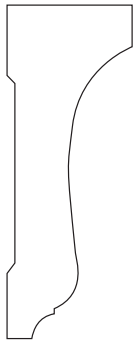
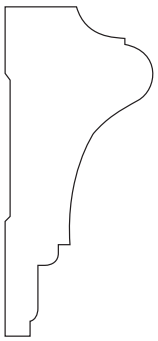

CAS-2007


CAS-2008


CAS-2009

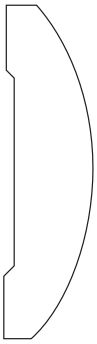

CAS-2010

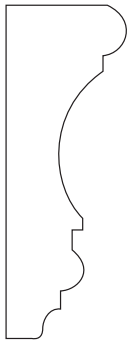

CAS-2011

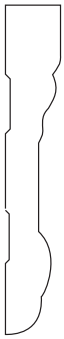

CAS-2012

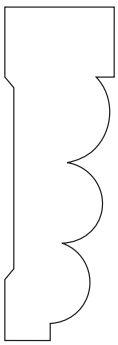

CAS-2013

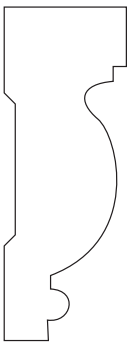

CAS-2014

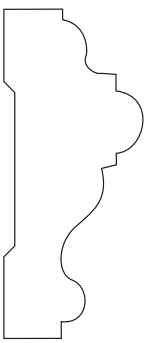

CAS-2015

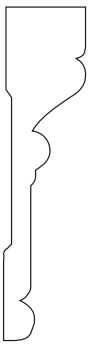

CAS-2016


CAS-2017


CAS-2018


CAS-2019


CAS-2020

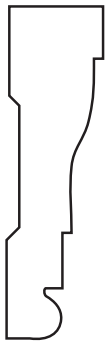

CAS-2021


CAS-2022


CAS-2023

6 - Interior and Exterior Millwork

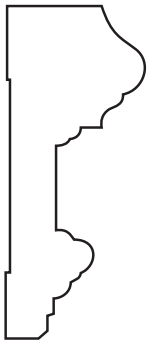
Casings


CAS-2024

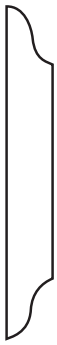

CAS-2025


CAS-2026


CAS-2027


CAS-2028


CAS-2029

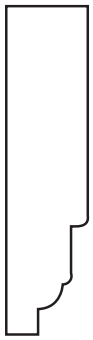

CAS-2030


CAS-2031


CAS-2032


CAS-2033


CAS-2034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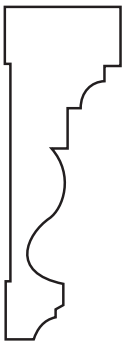
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CAS-2037


CAS-2038


CAS-2039


CAS-2040

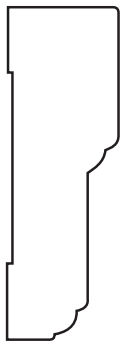

CAS-2041


CAS-2042


CAS-2043


CAS-2044


CAS-2045


CAS-2046


CAS-2047

6 - Interior and Exterior Millwork

Casings


CAS-2048


CAS-2049


CAS-2050


CAS-2051

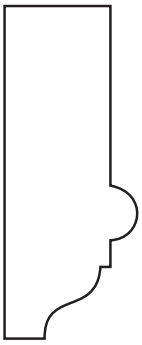

CAS-2052


CAS-2053


CAS-2054


CAS-2055


CAS-2056


CAS-2057


CAS-2058


CAS-2059


CAS-2060


CAS-2061


CAS-2062


CAS-2063


CAS-2064


CAS-2065


CAS-2066


CAS-2067


CAS-2068


CAS-2069


CAS-2070


CAS-2071

6 - Interior and Exterior Millwork

Casings


CAS-2072


CAS-2073


CAS-2074


CAS-2075


CAS-2076


CAS-2077


CAS-2078


CAS-2079

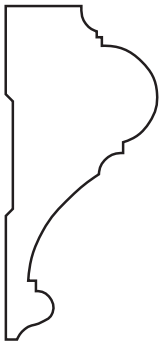

CAS-2080


CAS-2081


CAS-2082


CAS-2083


CAS-2084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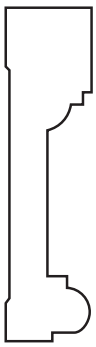
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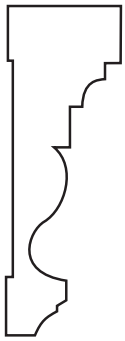
CAS-2087


CAS-2088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CAS-2090


CAS-2091


CAS-2092

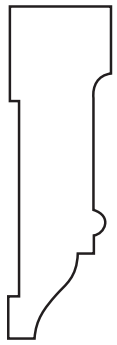

CAS-2093


CAS-2094


CAS-2095

6 - Interior and Exterior Millwork

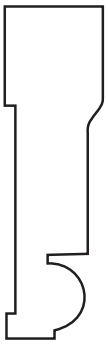
Casings


CAS-2096


CAS-2097

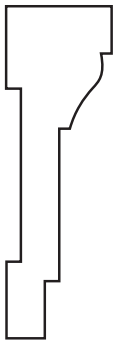

CAS-2098


CAS-2099


CAS-2100


CAS-2101


CAS-2102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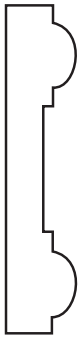
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CAS-2105

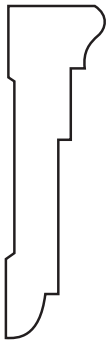

CAS-2106


CAS-2107


CAS-2108


CAS-2109


CAS-2110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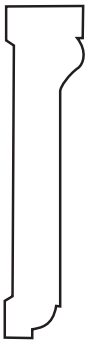
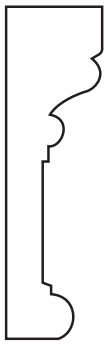

CAS-2112


CAS-2113


CAS-2114


CAS-2115


CAS-2116


CAS-2117

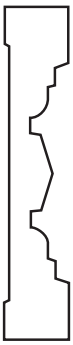

CAS-2118


CAS-2119

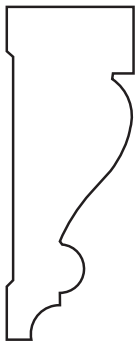
6 - Interior and Exterior Millwork

Casings and Panel Moldings


CAS-2120


CAS-2121

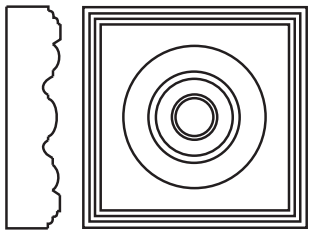

CAS-2122

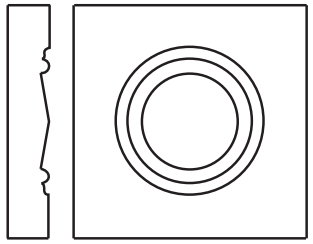

CAS-2123


CAS-2124


CAS-2125


CAS-2126


CAS-2727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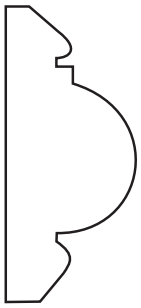
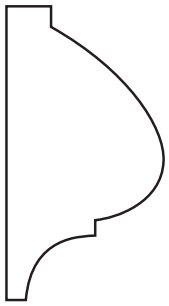

PNL-3000


PNL-3001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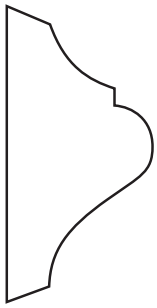
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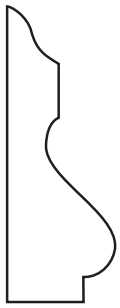
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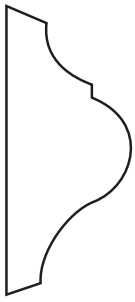
PNL-3005


PNL-3006


PNL-3007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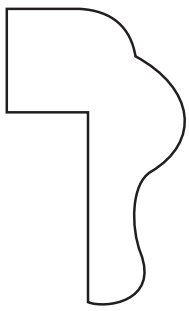
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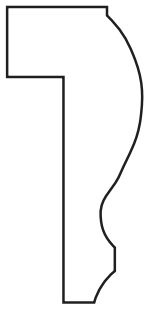
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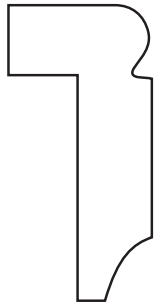
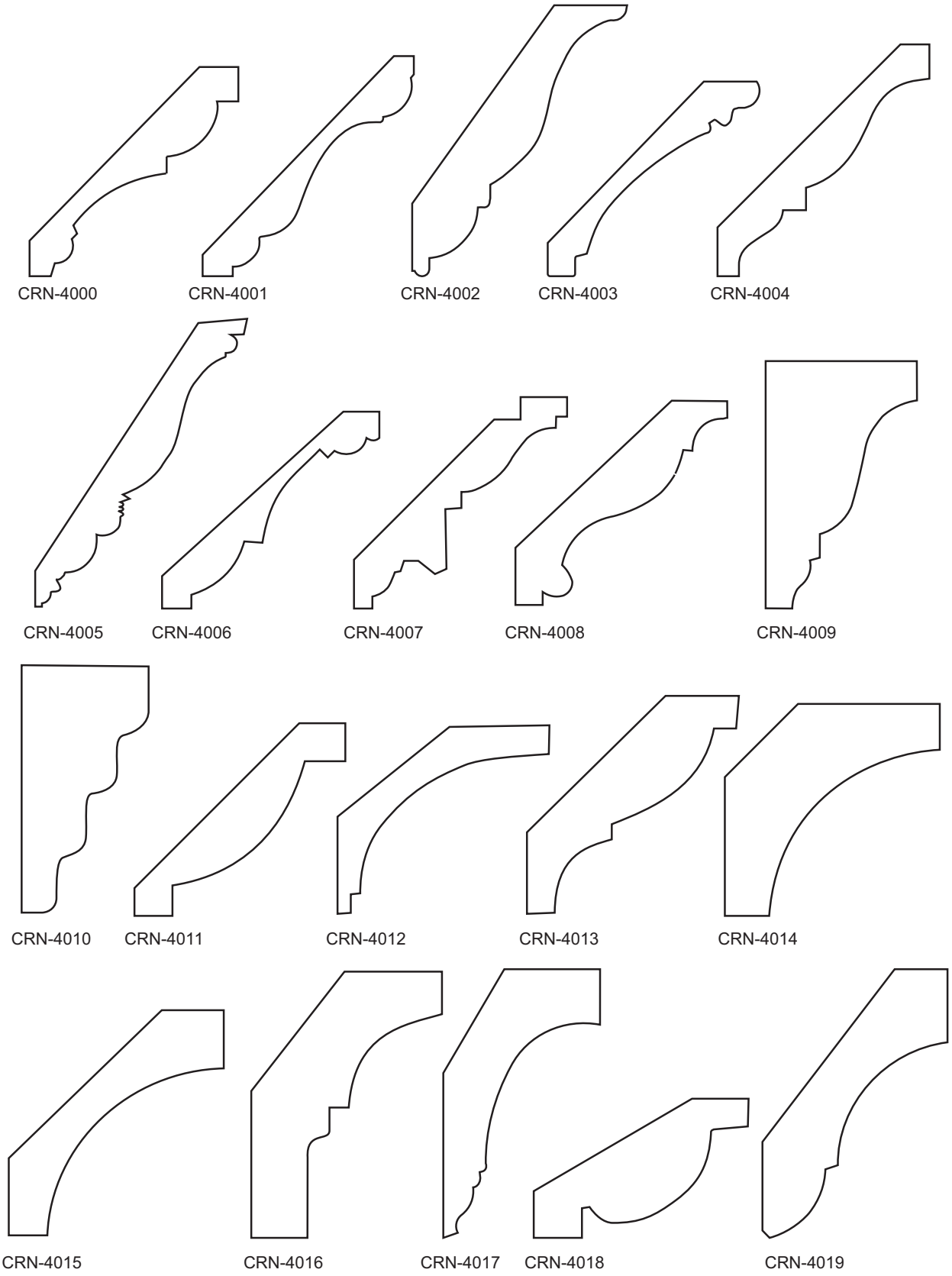

PNL-3011

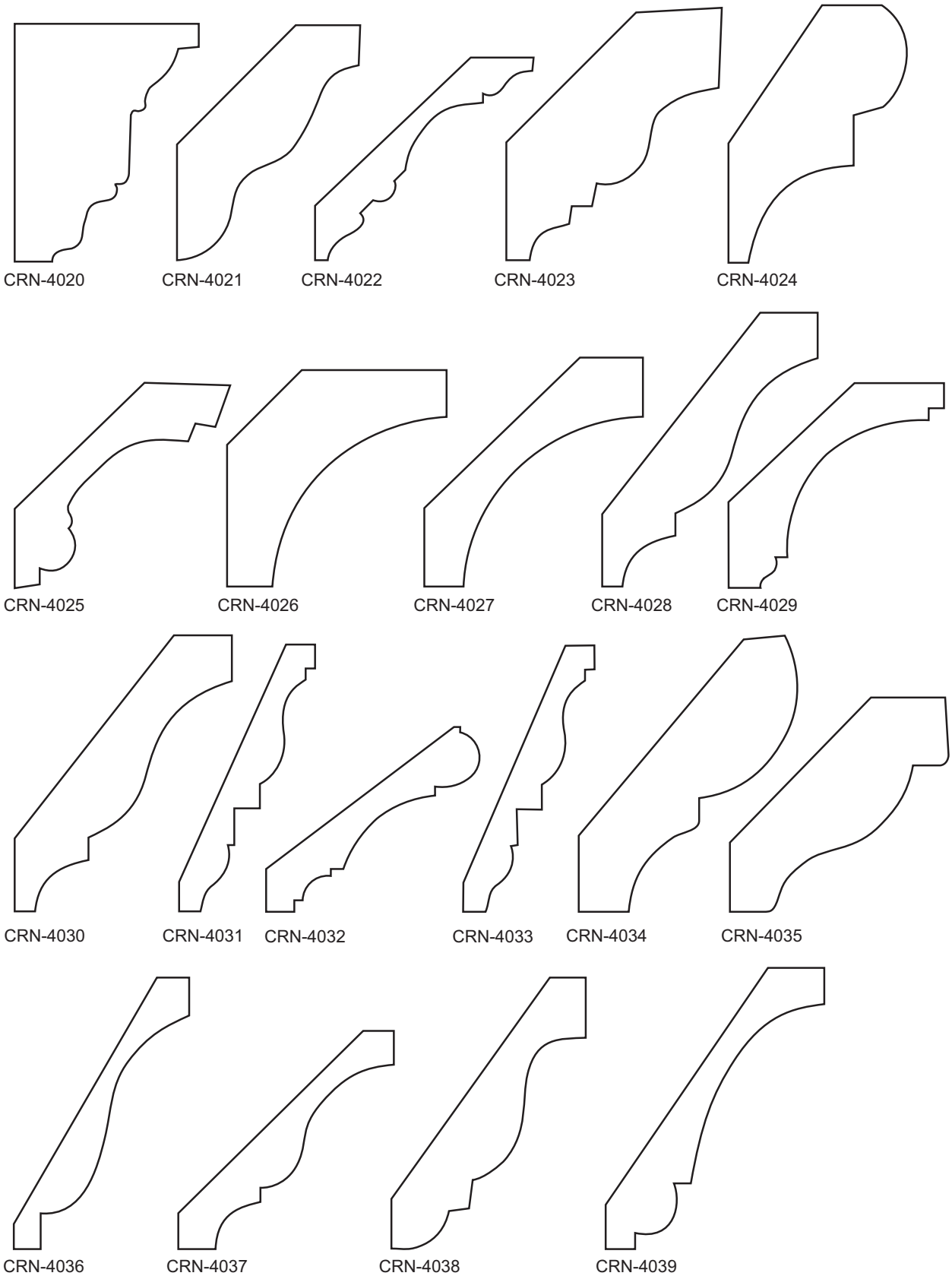
6 - Interior and Exterior Millwork

Crown Moldings



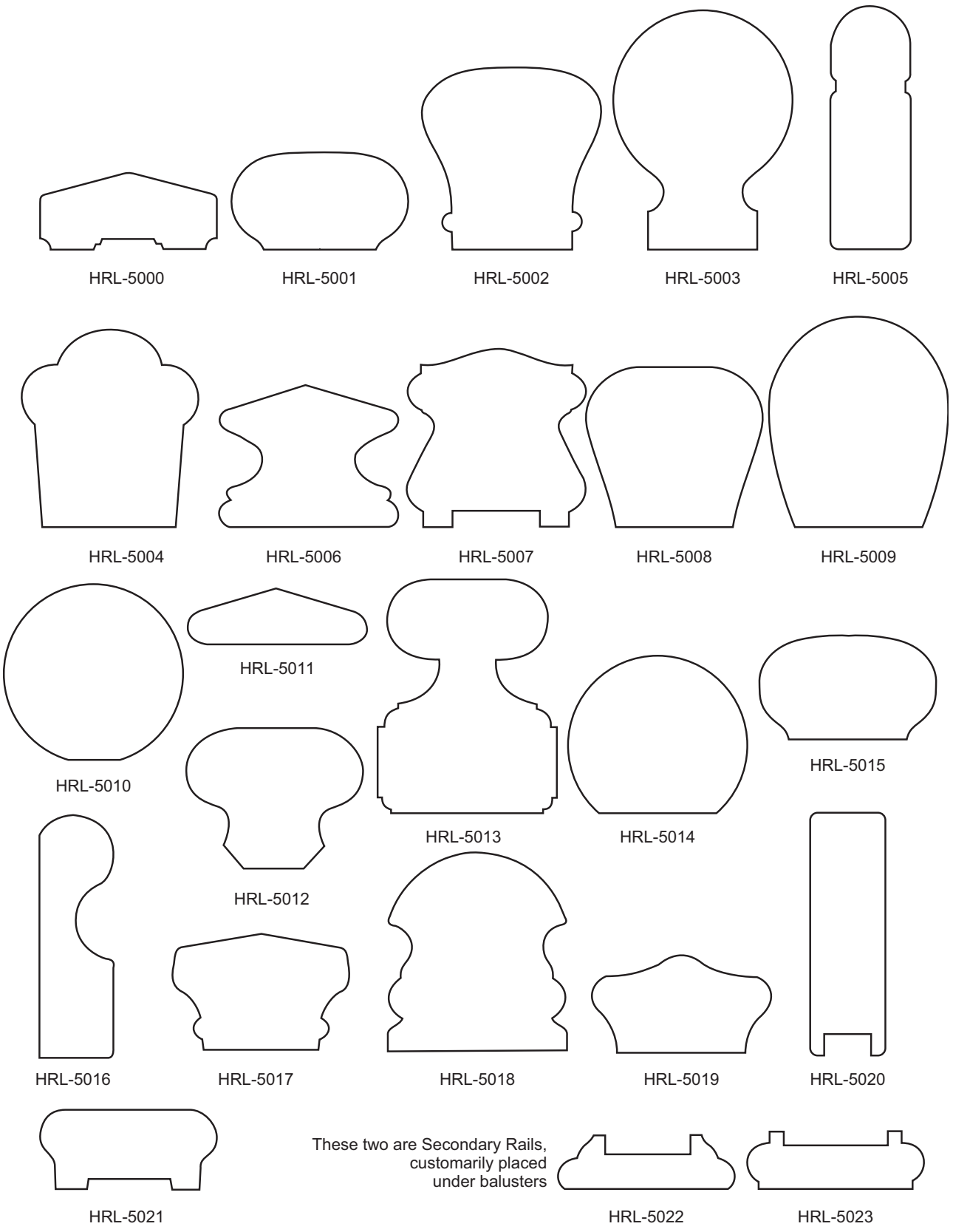
6 - Interior and Exterior Millwork

Crown Moldings



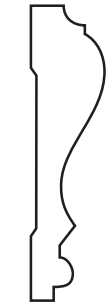
6 - Interior and Exterior Millwork

Handrails



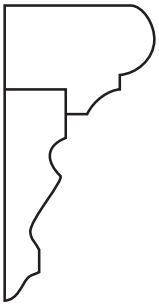
6 - Interior and Exterior Millwork

Chair Rails

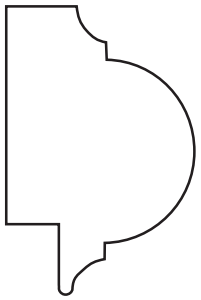

CHR-6000


CHR-6001


CHR-6002


CHR-6003


CHR-6004


CHR-6005

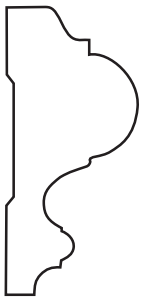

CHR-6006


CHR-6007

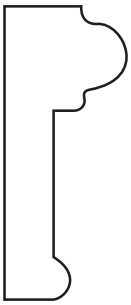

CHR-6008


CHR-6009


CHR-6010


CHR-6011


CHR-6012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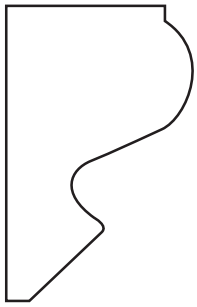
CHR-6014


CHR-6015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CHR-6017


CHR-6018


CHR-6019


CHR-6020


CHR-6021


CHR-6022

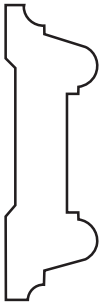

CHR-6023

6 - Interior and Exterior Millwork

Chair Rails


CHR-6024


CHR-6025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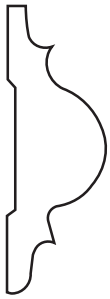
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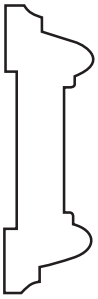
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CHR-6030

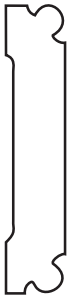

CHR-6031


CHR-6032


CHR-6033


CHR-6034


CHR-6035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CHR-6037


CHR-6038

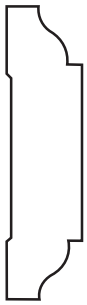

CHR-6039


CHR-6040


CHR-6041


CHR-6042


CHR-6043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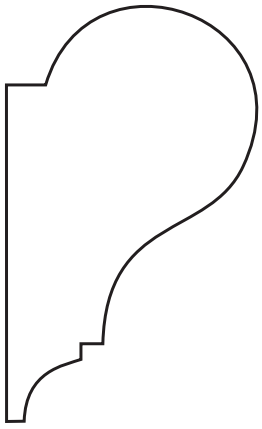
CHR-6045


CHR-6046

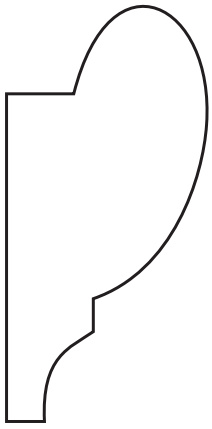

CHR-6047

6 - Interior and Exterior Millwork

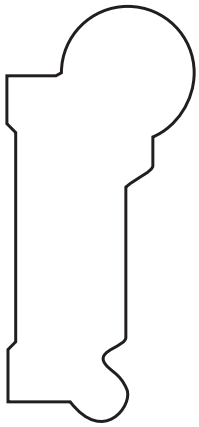
Picture Moldings



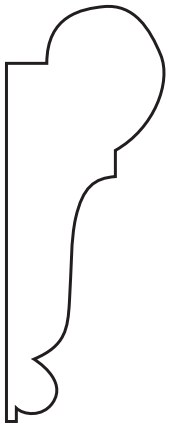
PIC-7000



PIC-7001



PIC-7002



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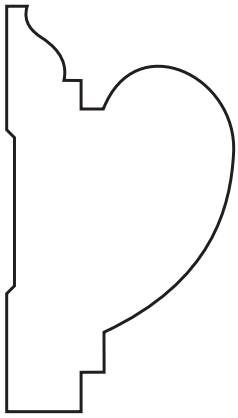

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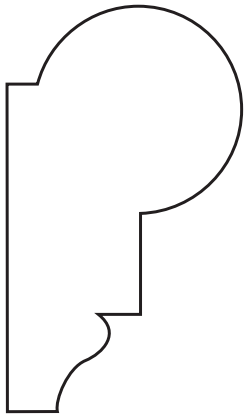
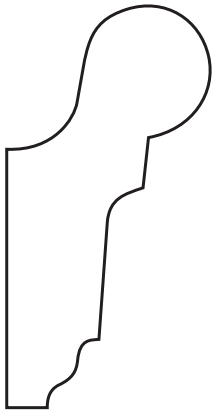


PIC-7005



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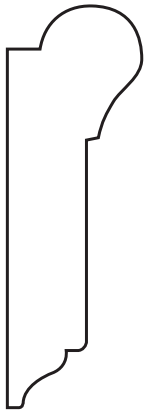

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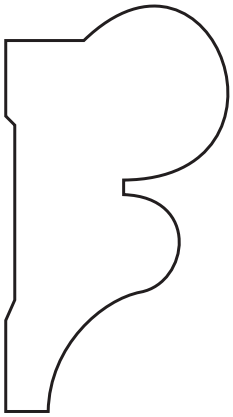

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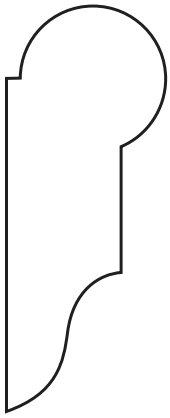
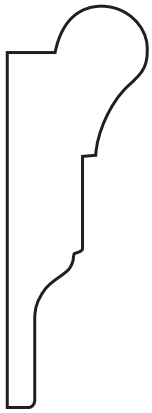
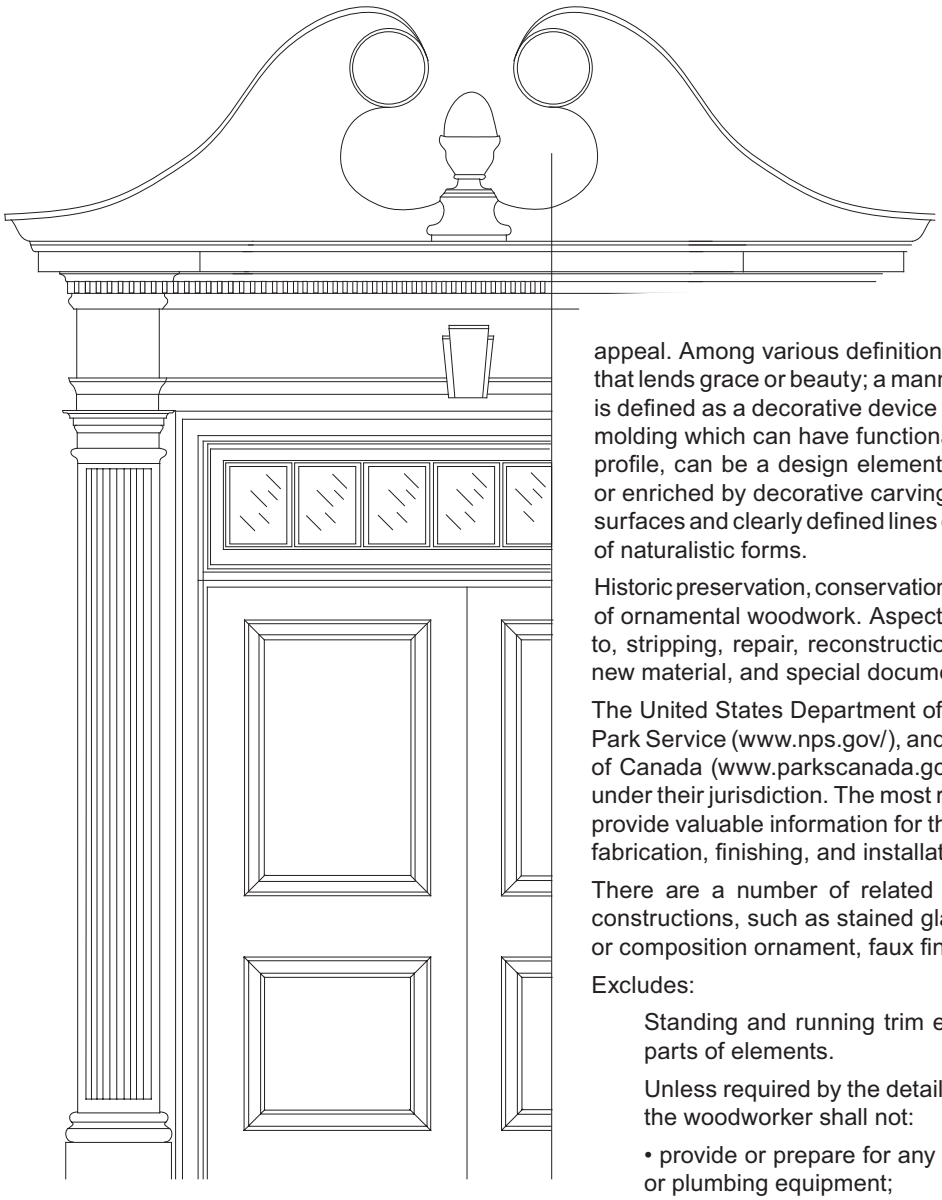


PIC-7009



PIC-7010

6 - Interior and Exterior Millwork



Ornamental woodwork can be considered any addition to the purely functional and may partly rely on context for its aesthetic appeal. Among various definitions, the one pertinent here is: "Something that lends grace or beauty; a manner or quality that adorns." Ornamentation is defined as a decorative device or embellishment. A good example is the molding which can have functional uses such as covering joints, or with a profile, can be a design element. The profile can be further embellished or enriched by decorative carving. Architectural carving combines the flat surfaces and clearly defined lines of geometry with the interpretive modeling of naturalistic forms.

Historic preservation, conservation and restoration disciplines are extensions of ornamental woodwork. Aspects of this work include, but are not limited to, stripping, repair, reconstruction, reuse of historic material, addition of new material, and special documentation for the work.

The United States Department of the Interior (www.doi.gov/), the National Park Service (www.nps.gov/), and the Historic Sites and Monuments Board of Canada (www.parkscanada.gc.ca/) publish documents related to work under their jurisdiction. The most recent publications from these entities will provide valuable information for the design professional and the woodwork fabrication, finishing, and installation.

There are a number of related arts which are incorporated into wood constructions, such as stained glass, ceramic tiles, mosaic, fabric, plaster or composition ornament, faux finishes, metal hardware and stone inlays.

Excludes:

Standing and running trim except as incorporated as integral parts of elements.

Unless required by the details and/or woodwork specifications, the woodworker shall not:

• provide or prepare for any electrical, telephone, mechanical, or plumbing equipment;

• install woodwork or furnish common blocking, furring or hanging devices for the support or attachment of the woodwork;

• supply exposed materials other than wood or plastic laminate;

• factory finish; or

• supply "stock" or specialty products. If they are to be supplied, they must be specified by a brand name or manufacturer.

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FIRE-RETARDANT SOLID LUMBER

Finishing of Fire-Retardant-Treated Lumber: Fire retardant treatments may affect the finishes intended to be used on the wood, particularly if transparent finishes are planned. The compatibility of any finishes should be tested before they are applied.

Built-up Construction to Improve Fire Rating: In lieu of solid lumber, it is often advisable, where a fire rating is required, to build up members by using treated cores (Fire rated particleboard or medium density fiberboard) clad with untreated veneers not thicker than $^{1}/_{28}$" (0.9 mm). Some existing building codes, except where locally amended, provide that facing materials $^{1}/_{28}$" (0.9 mm) or thinner finished dimension are not considered in determining the flame spread rating of the woodwork.

SOURCES FOR WOOD ORNAMENTATION

There are two possible sources for wood ornamentation: machine-produced elements and the custom carver.

A. The mass-produced product is often limited in available species, sizes and design, which is often a hodge-podge of historic styles. Often the detail lacks clarity because of the tooling, sanding or finish. However, the product is relatively inexpensive, consistent in appearance and appropriate for many applications.

B. On the other hand, there are a number of reasons to contact a custom carver.

1. When the pieces required are impractical or impossible to shape on conventional shop machinery. Examples are tapering profiles as in keystones, acute (interior) corners such as in Gothic tracery and compound curves as in stair handrails.
2. When small quantities are specified which are impractical or too expensive to fabricate by computerized methods.
3. When there is a need to replicate missing (hand carved) elements for restoration or renovation.
4. When elements of specified dimensions are required and unavailable otherwise.
5. When a particular wood species is required.
6. When customized logos or lettering is desired.
7. When patterns are required for casting in another material such as plaster, metal, or glass.
8. When uniqueness is valued by the customer.

Hand tooled and carved work has a special appearance. It has a depth and clarity or crispness which machine tooling often cannot achieve. Because it is done by a skilled artisan there will be slight irregularities, but this is deemed desirable as it lends character and credence to the work. Whether the surface is sanded smooth or the texture of tool marks is left, is one of the points of discussion between the millwork company and carver.

WORKING WITH THE ARTISAN

The custom carver usually works by him- or herself in a studio situation, but this does not necessarily indicate limitations either in quality, production time or fabrication capability. Work is done on a commission basis, so it is common to expect reasonable lead times.

A. What the woodcarver will need to know (from millwork specifier or customer):

1. Type of element - molding, capital, bracket, etc.
2. Sizes - drawings showing elevations and Sections are absolutely necessary for accurate cost estimates, whether provided by the millwork company or drawn by the carver. Often the carver will redraw computer-generated designs or ones not full sized.
3. Species of wood and who will supply the "blanks.". Finishes (paint grade, gilding, faux finish) should also be discussed.
4. Context and/or installed location should be made clear in order to understand lighting and the degree of detail necessary.
5. Intended schedule or completion date.
6. Budget if available as the carver can propose subtle changes in order to oblige a tight budget.

The millwork company should make reasonable efforts to provide as much information as possible as to design, and material. If providing blanks, effort should be made to fabricate them as accurately as possible. Material should be straight grained and contain a minimum of glue lines and therefore, grain directional changes. Consultation concerning what should be provided (sizes, species, special fabrication such as turning) with the carver is essential.

B. What to expect from the carver

1. The carver provides skill and knowledge through experience. The cost is in labor not material. Carving is a unique product which adds immeasurably to the character and attractiveness of the overall project.
2. The carving should closely resemble what is represented in drawings and verbal descriptions.
3. The product should be cleanly carved without distracting irregularities and chips or fuzz in the recesses. The agreed upon surface treatment: sanded, tool textured, primed or gilded, etc. should be consistent throughout.
4. Work should be done in a timely manner as agreed upon.

Quality in artistic handwork is often a subjective matter, but proper communication and agreement among parties should reduce variance of interpretation.

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ARCHITECTURAL ORNAMENTATION

Discussing ornamental style is a difficult endeavor because it is historically complex and subject to interpretation. North America is made up of ethnic groups from around the world and each has brought its own cultural history to the mix. The notes here do not intend to exclude any style of ornamentation, but concentrate on the predominant influence of Western Art and Architecture. Risking over-simplification, style tends to vacillate over time between two extremes — formal, restrained classicism and emotional and vivacious Romanticism.

Much of Western Architecture derives from the art and architecture of ancient Greece and Rome. Classicism is based on symmetry and proportion providing mathematical relationships among all elements of the building. One characteristic is the use of columns for support, though engaged columns and pilasters were used, sometimes in conjunction with arches. The *orders* of architecture, have been codified and reinterpreted ever since Vitruvious wrote a treatise on architecture in 30 BCE. In reality there was wide variation and great adaptability over a thousand years of evolution in many disparate geographical areas. The Parthenon in Athens, the Maison Carée in Nîmes, France, or the Pantheon in Rome are familiar examples. In succeeding revivals an abundance of government and academic building reflect these archetypes - the United States Capital building, many state and county courthouses, and Jefferson's University of Virginia.

Romanticism, on the other hand, is subjective, derived from the randomness of nature, *spiritual*, and introduces asymmetry, exuberance, and complex lines. Many designs are eclectic, fantastic and mix a number of exotic motifs. Though there are many of the same mathematical concerns in Romanesque and Gothic buildings as there are in Classical buildings, the ornamentation conveys a different feeling. The achievement of Gothic architecture was the introduction of the pointed arch which solved some structural limitations of Romanesque vaulting. While classicism appears to be simple in concept, romanticism seems to relish complexity. A Gothic cathedral when viewed from any angle except frontally does not seem to have much order, with flying buttresses and pinnacles and windows complicating one's perception of the form of the building.

Reacting to Gothic embellishments, Renaissance architects rediscovered classicism, but in time the classical tenets were corrupted (Mannerism) and the Baroque, which emphasized undulating surfaces, complicated interior spaces and dramatic decoration, permeated Europe. As a reaction to the flamboyance of the Baroque, interest in Classicism reemerged in the 18th Century. But in this era the Rococo style and the "Chinese" style, (Chinoiserie), especially in furniture, were also in vogue. The 19th Century saw continued classicism, but also an eclectic mix of revivals - Romanesque, Gothic and Eastern styles.

CLASSICAL ORDERS

The *orders* of architecture refer to the configurations and relationship of parts of Greek and Roman buildings. (See illustrations on the following pages.) Over the centuries, the relationship of parts of the classical building have been systematized, but one should keep in mind that Greek and Roman architecture had many variations and evolved through time. Generally, the orders refer to the proportions of the building; some being squarish or heavy, while others are taller and therefore lighter. The trabeated or post and lintel system of building consists of columns and a superstructure supporting the roof. This entablature is made up of the architrave, the frieze and the cornice. The architrave is the beam, which spans from column to column. The frieze is derived from the band covering the joist ends, while the cornice creates the eaves. The columns have base moldings (except the Doric order) a shaft, plain or fluted, and a capital, which supports the architrave. Because the capitals are very different in appearance for each order it is an easy way to distinguish among them. Because the roof line ran the length of the building the triangular area above the entablature is called the pediment.

There are three Greek orders and two Roman ones.

The Doric column has no base but rests directly on the stylobate or *floor*, of the building, is fluted and has a simple turned bowl-like capital. The bulging shape is the echinus. The frieze of the Doric is divided into triglyphs and metopes; the latter often decorated with sculptural figures (as on the Parthenon). This order appears sturdy and well planted, having a horizontal appearance.

The Ionic order has a column which has several rounds of base moldings, usually consisting of two tori or half-round moldings, divided by a scotia or concave recess, a shaft which is fluted and a capital with distinctive scrolls or volutes. The frieze is relatively plain, or contains sculptural figures in an uninterrupted procession. Above the frieze is the characteristic dentil molding.

The Corinthian order proportionally is similar to the Ionic though some examples have very slender proportions. The column is similar, but the capital has acanthus leaves, and volutes spring like sprouts from the foliage. The entablature is similar to the Ionic, but the use of modillions or brackets in the eaves (separating rosettes in the soffit) sets this order apart.

The Roman orders are the Tuscan and the Composite.

The first is derived from native antecedents and is a relatively plain style with unfluted columns, simply echinus capital and entablature like the Ionic without the dentil course.

The Composite has a capital, which is an amalgamation of the Ionic volutes, and the Corinthian acanthus leaves. The entablature is similar to the Corinthian. The Romans introduced several building innovations, but the use of the arch (the arcuated system), and therefore vaults and domes, changed architecture immeasurably.

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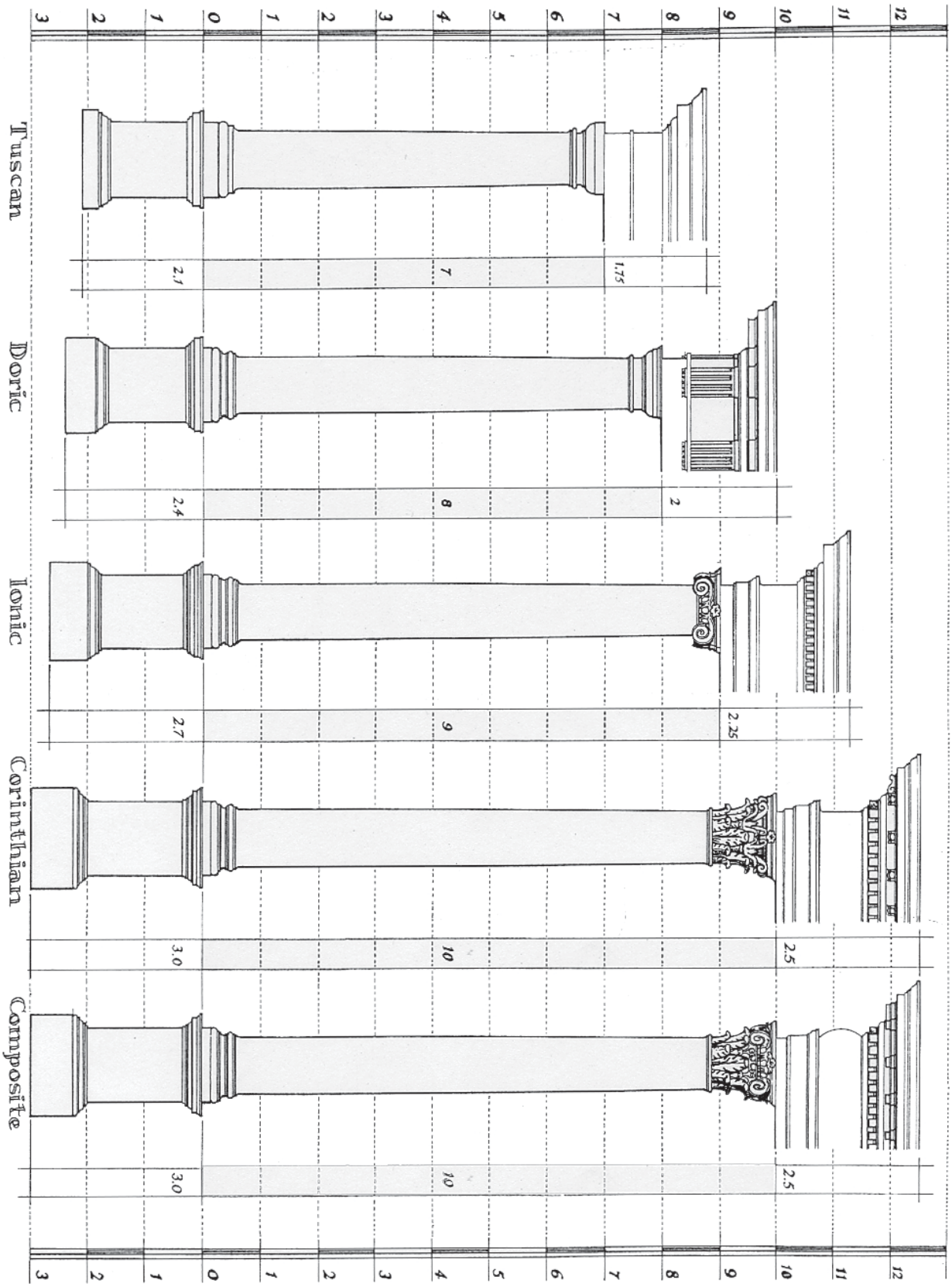

THE FIVE ORDERS - CHITHAM, ROBERT. THE CLASSICAL ORDERS OF ARCHITECTURE; USED WITH PERMISSION.

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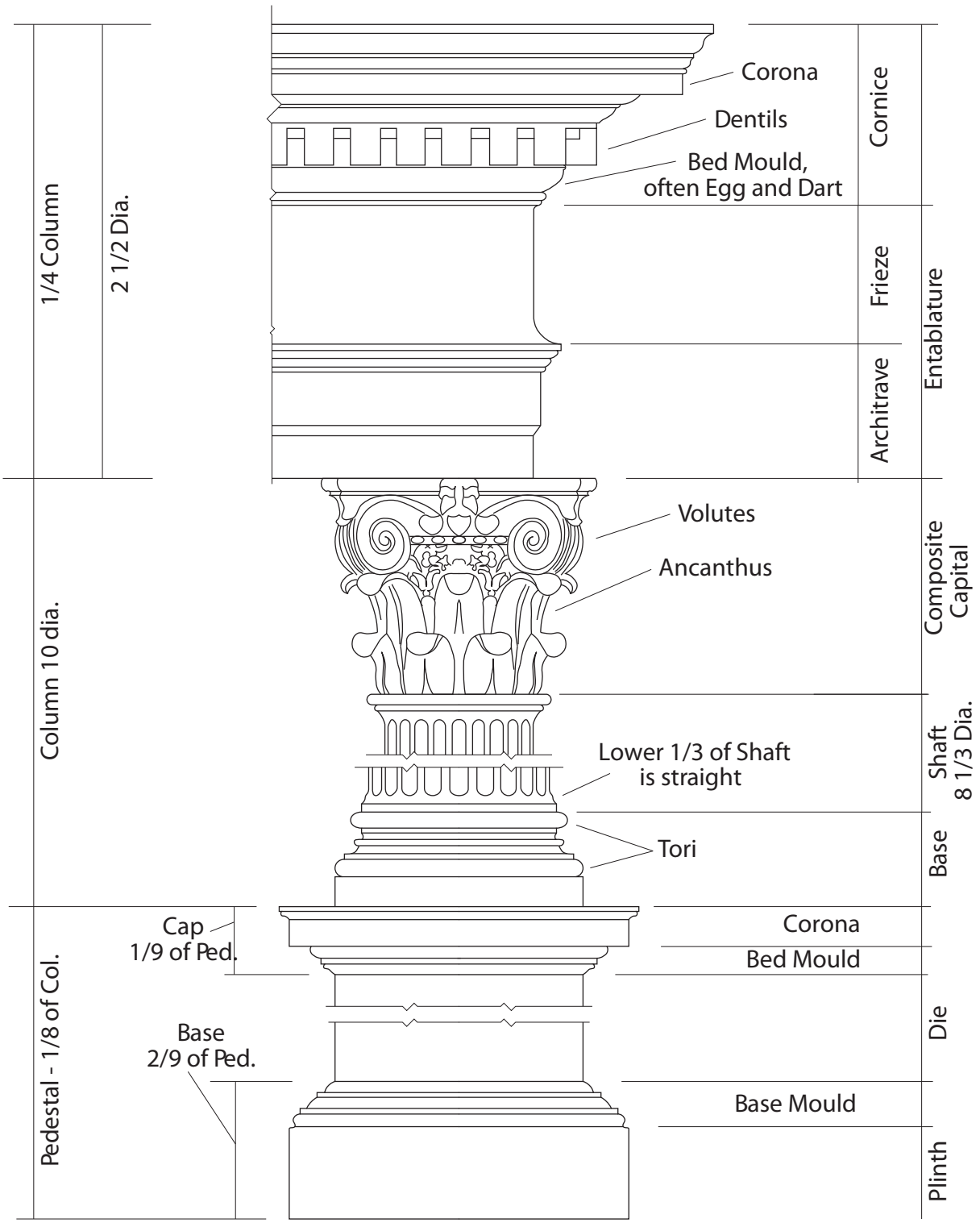

The columns of the classical orders of Greek and Roman architecture are often adapted for modern construction. These orders are Tuscan, Doric, Ionic, Corinthian, and Composite. The Composite figure (above) names the basic features of a classical order and gives some of the proportions of the column in relation to the shaft diameter as a basic unit of measurement. Pilasters are rectangular in plan, without taper from top to bottom. If used structurally they are usually referred to as piers, but are treated architecturally as columns. The typical pilaster extends a third or less of its width from the wall surface behind it.

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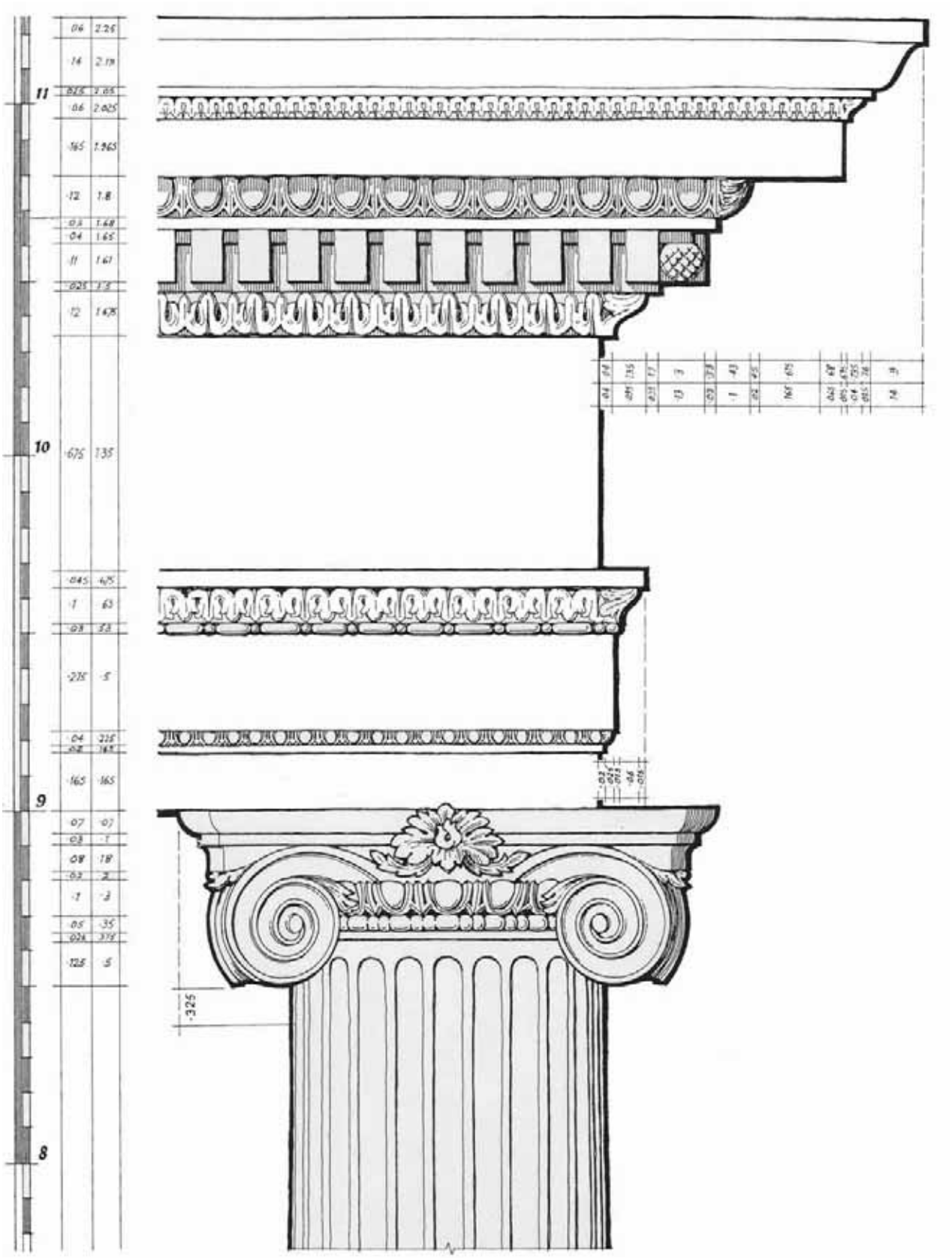

Ionic Capital and Entablature - Chitham, Robert. The Classical Orders of Architecture; used with permission.

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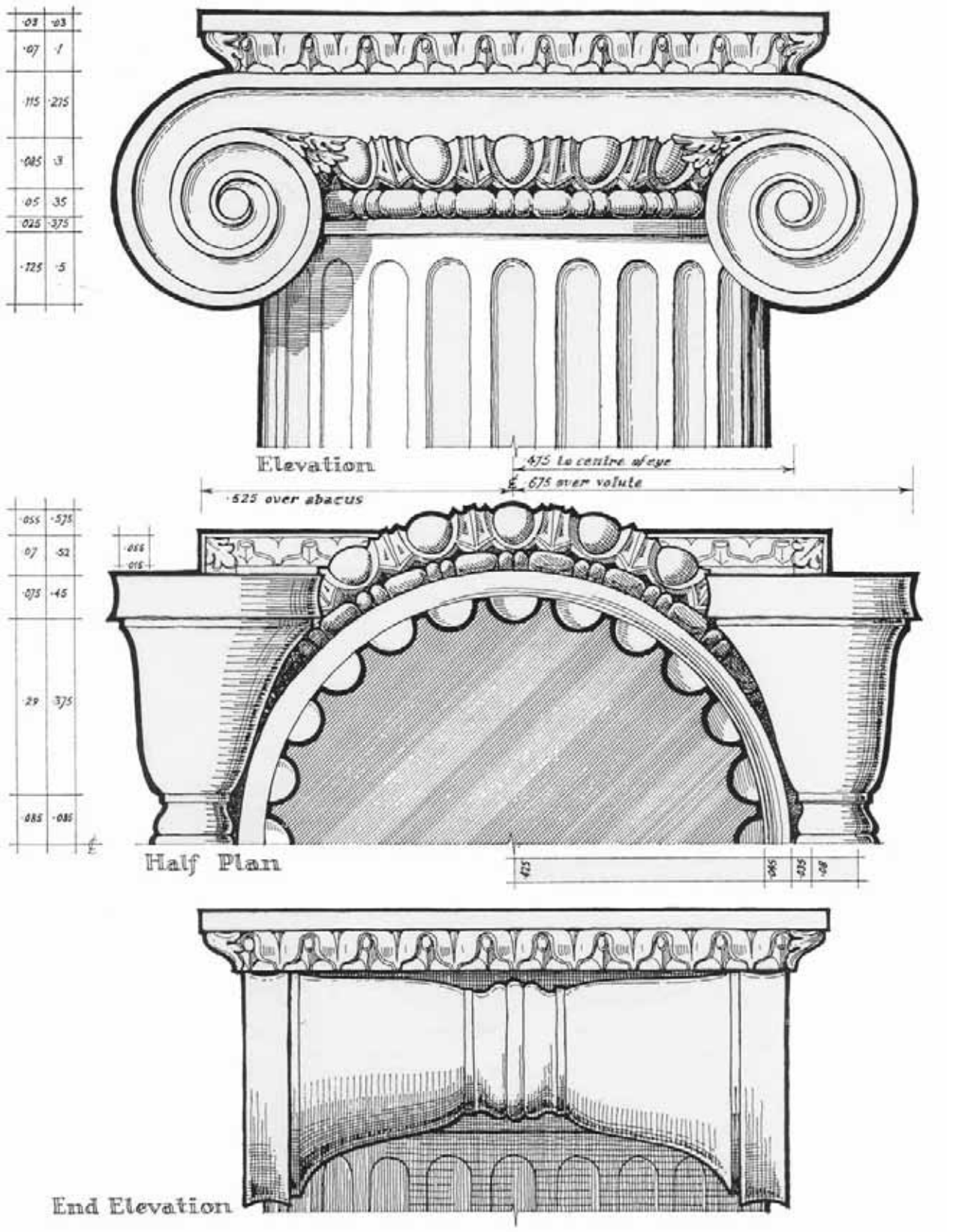

Ionic Capital detail - Chitham, Robert. The Classical Orders of Architecture; used with permission.

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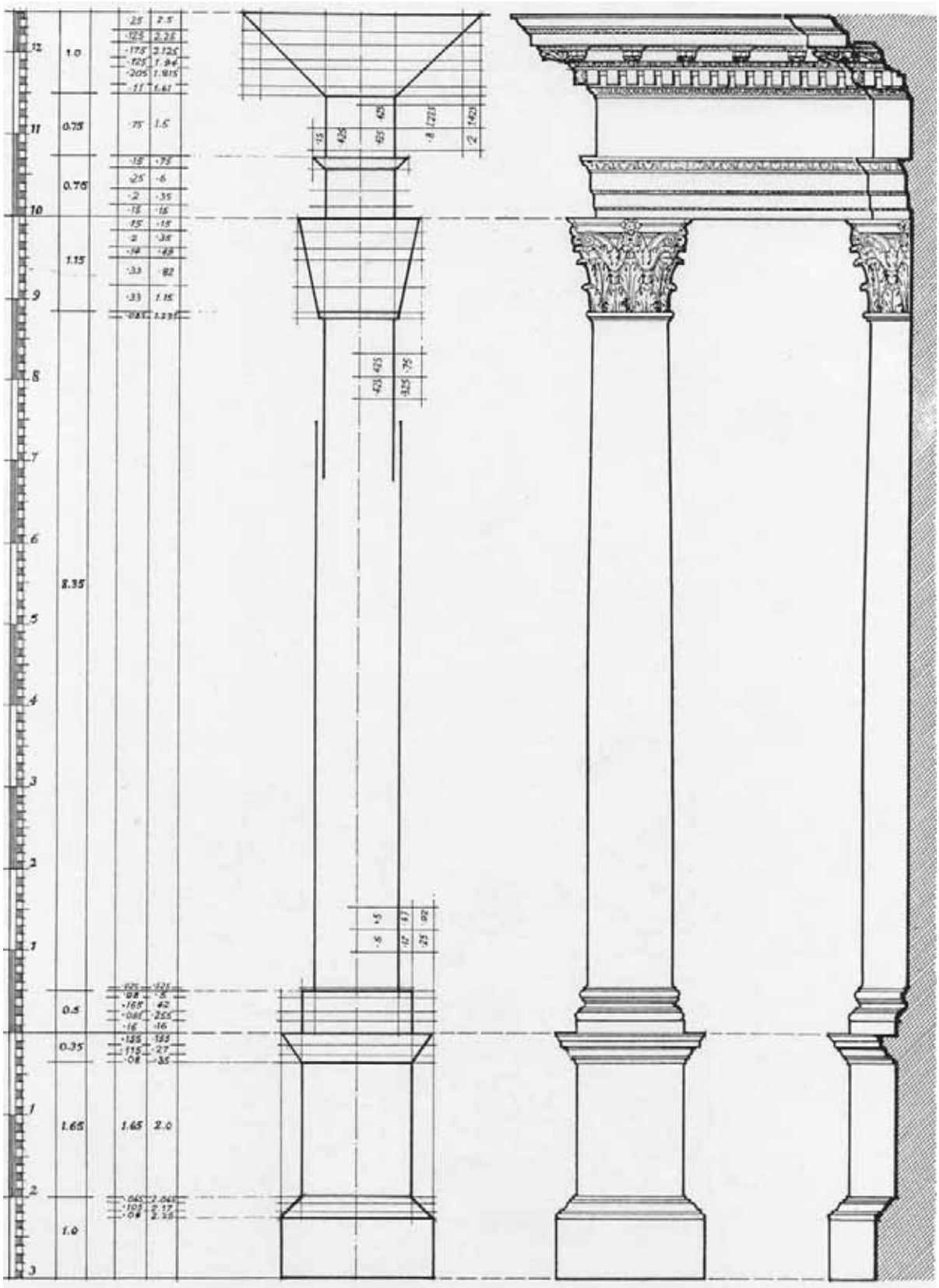

CORINTHIAN ORDER PROPORTIONS - CHITHAM, ROBERT. THE CLASSICAL ORDERS OF ARCHITECTURE; USED WITH PERMISSION.

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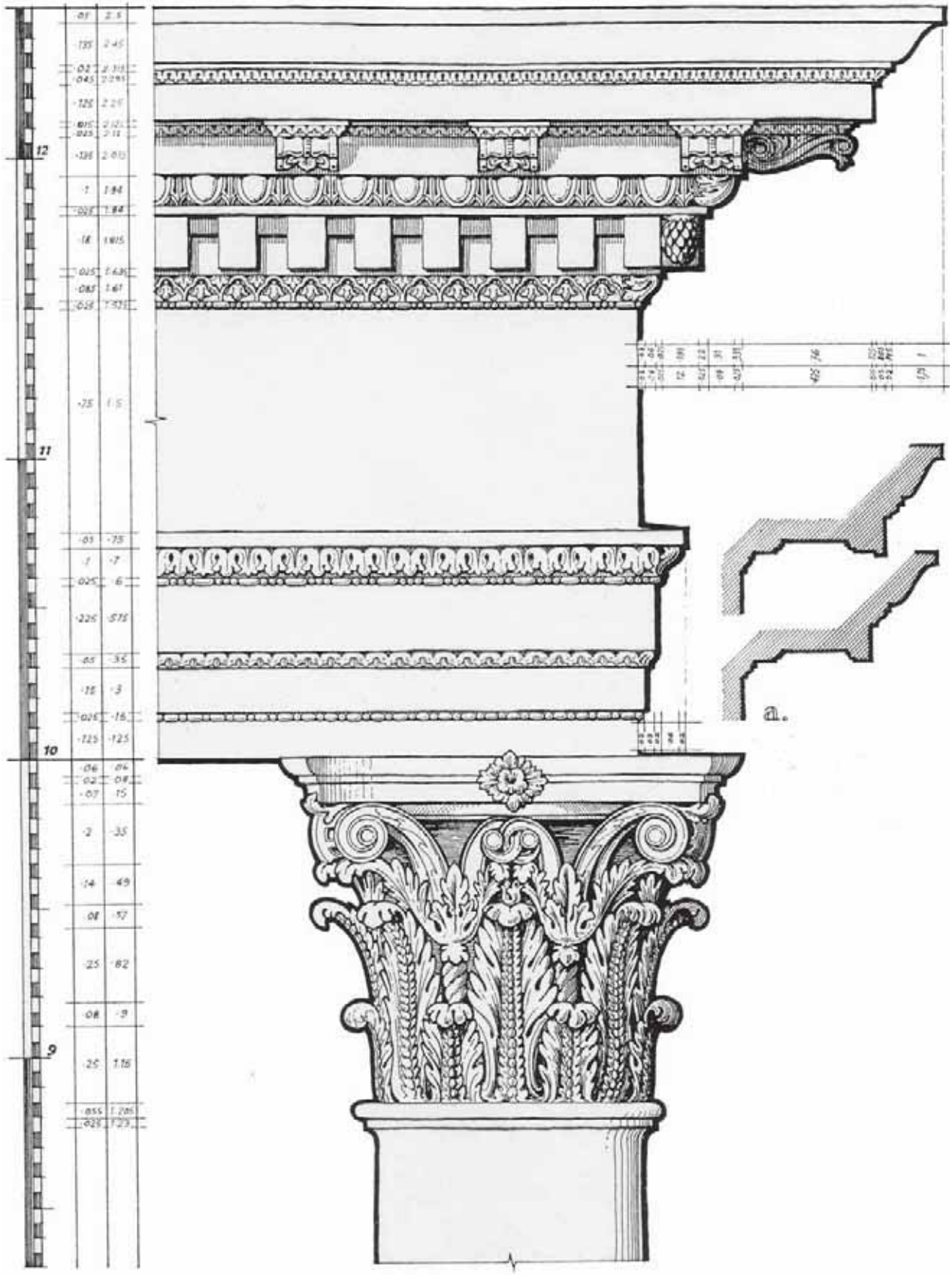

Corinthian Capital detail - Chitham, Robert. The Classical Orders of Architecture; used with permission.

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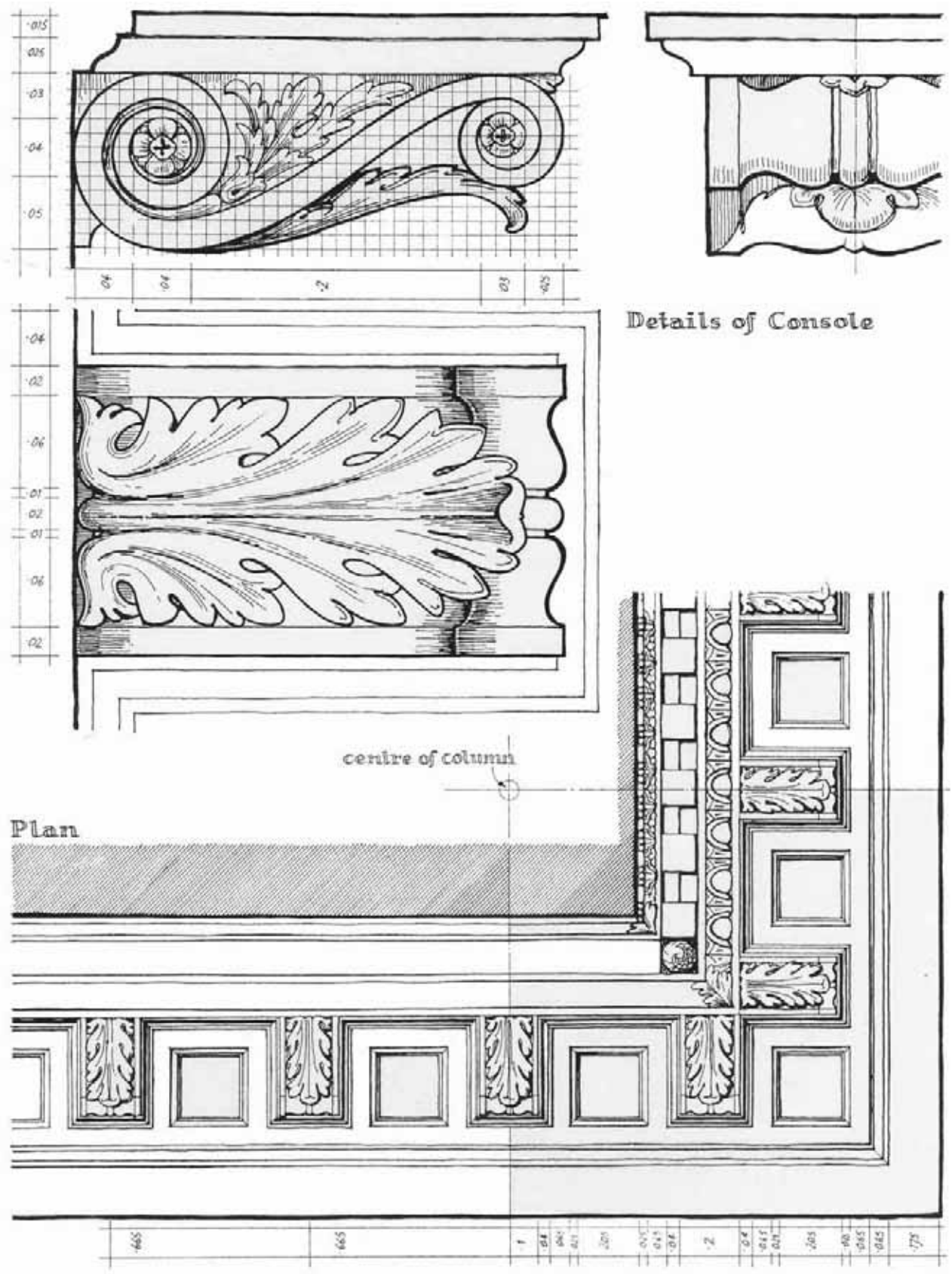

Corinthian Entablature detail - Chitham, Robert. The Classical Orders of Architecture; used with permission.

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TERMINOLOGY OF ORNAMENTATION

A rudimentary explanation of some carving terms will assist the millwork specifier in communicating with the custom carver.

There are four methods of depicting a design in wood.

- *Incised*: Incised designs are simply made by shallow grooves in the surface of the material.
- *Relief*: Most architectural carving is carved in relief. The degree to which the design is *lifted*, off the surface is described as *low*, or *high*, relief.
- *Pierced*: Some voids in the design are literally cut through the material and are termed pierced carvings.
- *Sculpture*: Carving in-the-round or sculptural works are also incorporated into architectural surroundings.

Moldings have multiple uses but one important one is to visually set apart various elements. For instance, they are transitions between the parts of the *entablature*. They accentuate the trim (*architrave*) around doors and windows, and around an arch (*archivolt*). The various terms depend primarily on the profiles, but there are a few terms which indicate use, location or size.

The curving profiles are often separated or off set by a relatively small flat called a *fillet*.

The small half round is an *astragal*, often decorated with *beads* or *bead and billet.* A larger half round, usually associated with the base of a column or base of a structure is called a *torus* (plural *tori*) molding, sometimes decorated with *ribbon-bundled* bay laurel, oak leaves, or reeds.

The *ovolo* is a quarter ellipse (Greek) or quarter round (Roman) profile, most often carved with *egg and dart* design, but many other possibilities make it a very popular molding.

The *cyma recta* is a double-curved molding with the concave curve on the outside of the molding, pointing toward the viewer as if *reaching*, outward. The *cyma reversa* is the opposite, the convexity nearer the viewer and seems to support or bolster the element to which it is attached. Both profiles are often carved with foliage, generically termed *acanthus leaf*. Both of these profiles as well as the ovolo often have the curved portion separated from the fillet by deep valleys or *quirks*.

Medieval moldings were often made of a number of closely placed profiles, often with deep hollows and repeated rounds.

Romanesque architecture continued many of the same principles of classical architecture, though much of the decoration; such as column capitals became more idiosyncratic and depicted the profusion of natural foliage. The innovation of the pointed arch (loosely called the Gothic arch), ubiquitous in Gothic architecture, allowed buildings to soar to great heights and to redistribute weight. This allowed larger windows and the lacy stone work termed *tracery*. The designs of this tracery are geometrically derived from, for the most part, overlapping and intersecting circles. The circular voids are called *foils* and the pointed interSections *cusps*; thus a three lobbed design is a trefoil, while one of four is a quatrefoil, one of five is a cinquefoil. Tracery was found incorporated into the woodwork of choir stalls, paneling and memorial structures.

Much decoration was derived from nature in depictions of vines and animals. Of course, religious figures and symbols were also a primary motif. Foliage climbing the edges of pinnacles and spires consists of the leaves, called *crockets*, and the terminating leaves, a *finial* or (especially on pew ends) *poppyhead*. Moldings were made of multiple profiles and combined with running vines and crestings, or stylized leaves. Square flowers and ballflowers were often spaced along moldings. At interSections of the ribbed vaults were *bosses*, which depict foliage (like a *rosette*), figures, or heraldic devises. A selected partially illustrated glossary related to ornament and architecture follows.

ORNAMENTAL WOODWORK GLOSSARY

abacus

The uppermost member of the **capital** of a **column**; often a plain square slab, but sometimes moulded or carved. The plate or bearing surface at the top of a column upon which the **architrave** rests.

acanthus

An indigenous plant of the Mediterranean area depicted on the **Corinthian capital** and used as a decorative motif on many objects throughout history. Today nearly a generic term for any multi-leafleted foliage.

arch

A curved construction which spans an opening; usually consists of wedge-shaped blocks called **voussoirs** and a keystone, or a curved or pointed structural member which is supported at the sides or ends (often contrasted to **trabeated** construction of post and lintel).

architrave

1. In the classical **orders**, the lowest members of the **entablature**; the beam that spans from column to column, resting directly on their **capitals**. 2. The ornamental moldings around the faces of the jambs and lintel of a doorway or other opening.

archivolt

The face molding of an arch (the **architrave** of an **arch**).

astragal

1. a **bead**, usually half-round, with a **fillet** on one or both sides. It may be plain, but the term is more correctly used to describe the classical molding decorated with a string of beads or bead-and-reel shapes. A small molding of half round Section, often carved with beads; often referred to as a ***bead*** by furniture-makers.

bead

1. A bead molding. 2. A narrow wood strip, moulded on one edge, against which a door or window sash closes; a stop bead. 3. A pearl-shaped carved decoration on moldings or other ornaments, usually in a series, or in conjunction with other shapes; a beading.

bead-and-reel

A semiround convex molding carved with a pattern of disks alternating with round or elongated beads.

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bolection molding

A molding which covers the joint between panel and stile and projects above the surface of stile; a molding applied to a flat ground.

boss

1. A projecting, usually richly carved ornament, decorative rosette, portrait, heraldic devise or similar motif, placed at the interSection of ribs, groins, beams, etc., or at the termination of a molding. 2. In masonry, a roughly shaped stone set to project for carving in place.

bracket

A general term for an element projecting from a wall or other surface to support another element such as a beam or **cornice**.

capital

The topmost member, usually decorated, of a **column** or **pilaster**, etc., it provides a larger bearing surface for the **architrave**; different in appearance according to the order of the building.

cavetto

A cove; a molding profile whose arc is a segment of a circle, (unlike **scotia** whose profile has two centers).

cinquefoil

A five-lobed pattern divided by **cusps;** in Gothic **tracery** a geometric design with five round open areas.

column

1. In structures, a relatively long, slender structural compression member such as a post, pillar, or strut; usually vertical, supporting a load which acts in (or near) the direction of its longitudinal axis. 2. In classical architecture, a cylindrical support of the **entablature**, consisting of a base (except Greek Doric), shaft, and capital.

Composite order

One of the five classical orders. A Roman order of classical architecture which has proportions close to the **Corinthian** order, but the capital is a combination of the **Ionic** and the Corinthian capitals. The entablature is also similar or identical with the Corinthian entablature.

console

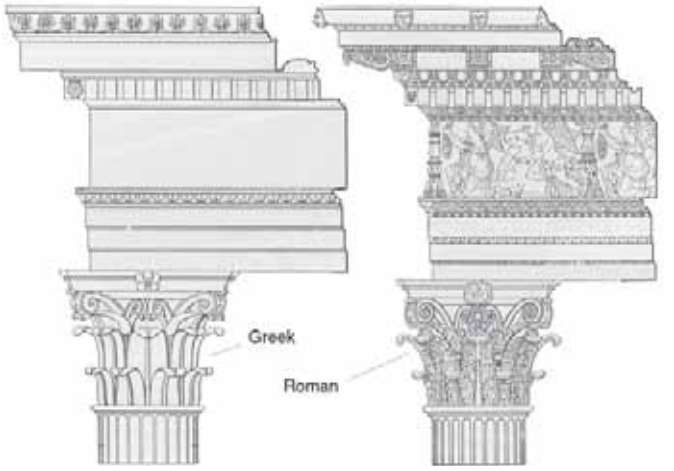
A scrolled bracket used to support an architectural element such as a **cornice**, **entablature** over a door, mantel shelf or in furniture, a table top.

corbel

A projection from a wall which supports a beam, **arch** or vault ribbing.

Corinthian order

One of the Greek orders characterized by slender proportions; the column shaft is fluted, with a **capital** depicting **acanthus** leaves and scrolled *sprouts* (caulicoli) and with an **entablature** with **dentil** course and **modillions** under the soffit. Roman adaptations often highly decorated.



Cornice

1. Any moulded projection which crowns or finishes the parts to which it is affixed. 2. The third or uppermost division of an **entablature**, resting on the **frieze** consisting of **corona** and **cymatium**. 3. An ornamental molding, usually of wood or plaster, running round the walls of a room just below the ceiling; a crown molding; the molding forming the top member of a door or a window frame.

corona

The overhanging vertical member of a **cornice**.

crockets

Regularly spaced leaves projecting along the gable of a Gothic arch, spire, or pinnacle. Sometimes as terminations of the interior **cusps** of an arch or **trefoil**, **quartrefoil**, etc.

cusp

In Gothic **tracery**, the intersection or termination of arcs which define foliations or spaces.

cyma recta

A molding with an S curve Section; orientation is with concave curve foremost toward viewer. Example is **cymatium** of **cornice**; opposite of cyma reversa.

cyma reversa

A molding with a S curve Section; orientation is with convex curve foremost toward viewer. Example is panel (**bolection**) molding.

cymatium

The top molding of the cornice; usually a cym profile, but can be an ovolo or (rarely) a cavetto.

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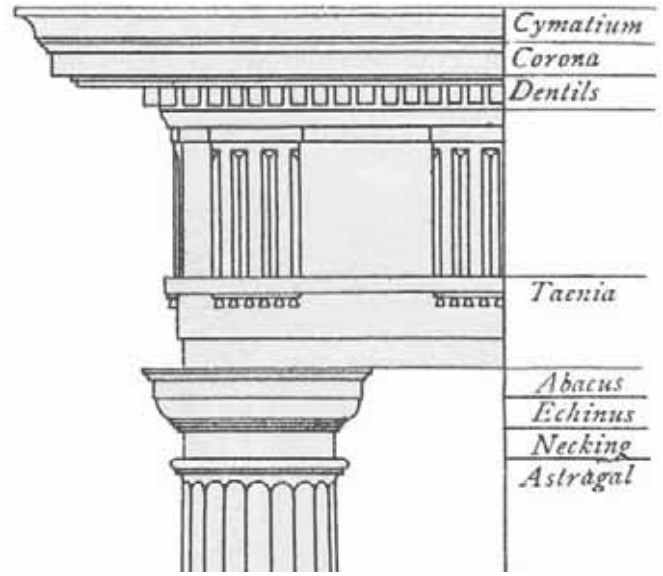
dentil

One of a band or small, square, tooth-like blocks forming part of the characteristic ornamentation of the Ionic, Corinthian, and Composite orders.

Doric order

One of the Greek orders; the sturdiest order with stout proportions; the **column** has no base, is fluted and has a relatively simple flaring **capital**; the **frieze** of the **entablature** is divided into **triglyphs** and **metopes.** Example is the Parthenon.



echinus

The bulging or flaring of a **capital**; of elliptical Section as in the **Doric** order, often an **ovolo** molding.

egg and dart

The egg-shaped ornament alternating with a dart-like ornament, used to enrich **ovolo** and other moldings.

entablature

In classical architecture, the elaborated beam member carried by the **columns**, horizontally divided into **architrave** (below), **frieze**, and **cornice** (above).

entasis

The intentional slight convex curving of the vertical profile of a tapered column used to overcome the optical illusion of concavity that characterized straight-sided columns.

fillet

A molding consisting of a narrow flat band, often square in Section; the term is loosely applied to almost any rectangular molding used to visually separate molding profiles.

finial

An ornament which terminates the point of a spire, pinnacle, etc., often turned or carved (downward pointing decorations are called *drops*).

foil

In **tracery**, any of several lobes, circular or nearly so, tangent to the inner side of a larger arc, as of an **arch**, and meeting each other in points, called **cusps**, projecting inward from the arch, or circle. Five foils make a **cinquefoil**.

frieze

1. The middle horizontal member of a classical **entablature**, above the **architrave** and below the **cornice**. 2. A similar decorative band near the top of an interior wall below the **cornice**. 3. Any broad horizontal band near the top of the wall or element (such as a mantelpiece).

fret

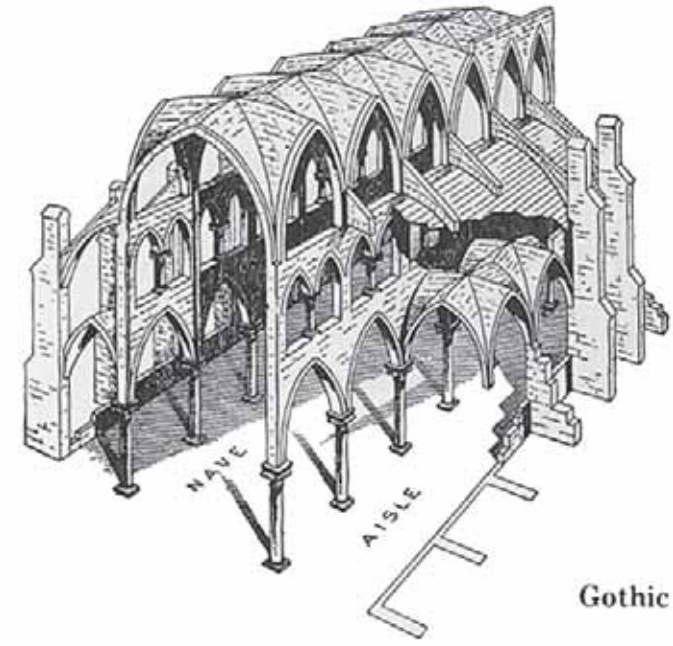
An essentially two-dimensional geometric design consisting of shallow bands; example is Greek key.

gadroon

Elongated bulbous shapes in series, as on decorative urns and turnings; a molding of repeated tear-drop shaped elements, often on a thumbnail profile.

Gothic arch

A loose term denoting a pointed arch consisting of two (or more centers) as opposed to Roman or Romanesque arch which is semicircular.



groin

The ridge, edge, or curved line formed by the interSection of the surfaces of two intersecting **vaults**.

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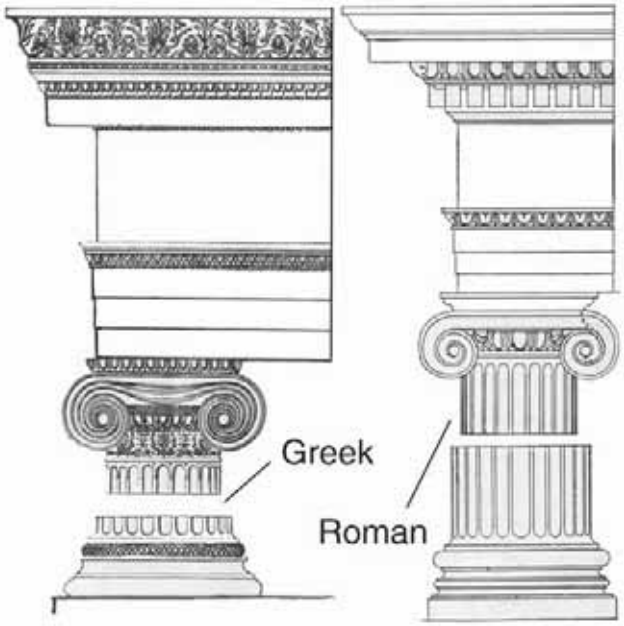
guillouche

Shallow design of overlapping circles, sometimes in-filled with **rosettes**.

Ionic order

The classical order originated by the Ionian Greeks, characterized by its **capital** with large **volutes**, a fasciated **entablature**, continuous **frieze**, usually **dentils** in the **cornice**, and by its elegant detailing.



metopes

The panel between the **triglyphs** in the **Doric** frieze, often carved.

modillions

A horizontal bracket or console, usually in the form of a scroll with acanthus, supporting the **corona** under a **cornice**.

mutule

A sloping flat block on the soffit of the **Doric cornice**

order

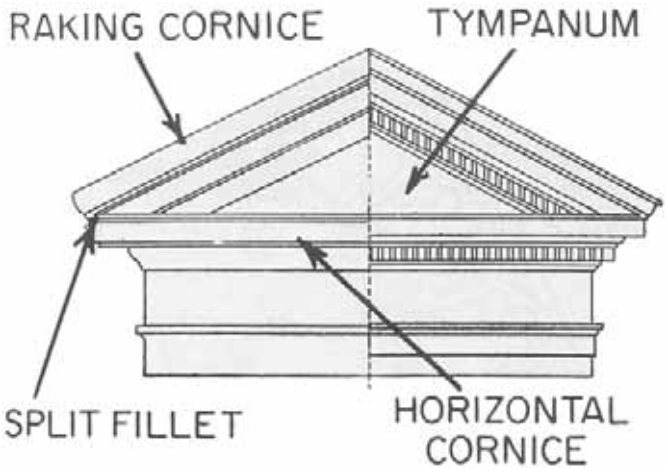
1. An arrangement of **columns** with an **entablature**. 2. In classical architecture, a particular style of **column** with its **entablature**, having standardized details. The Greek orders were the **Doric**, **Ionic**, an **Corinthian**; the Romans added the **Tuscan** and **Composite** orders.

ovolo

A convex molding, less than a semicircle in profile; usually a quarter of a circle or approximately a quarter-ellipse in profile, often decorated with egg and dart design.

pediment

1. In classical architecture, the triangular gable end of the roof above the horizontal cornice, often filled with sculpture. 2. In later work, a surface used ornamentally over doors or windows; usually triangular but may be curved.



pilaster

An engaged pier or pillar, often with capital and base.

poppyhead

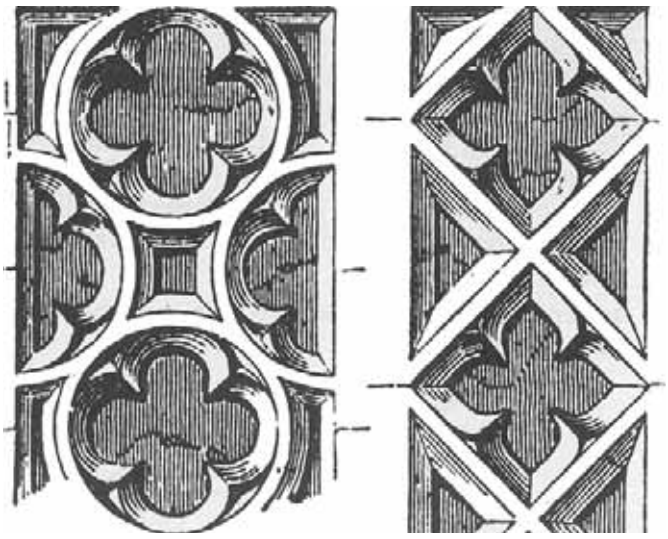
A carved foliage ornament generally used for the finials of pew ends and similar pieces of church furniture.

plinth

1. A square or rectangular base for column, pilaster, or door framing. 2. A solid monumental base, often ornamented with moldings, etc.

quatrefoil

A four-lobed pattern divided by **cusps**.



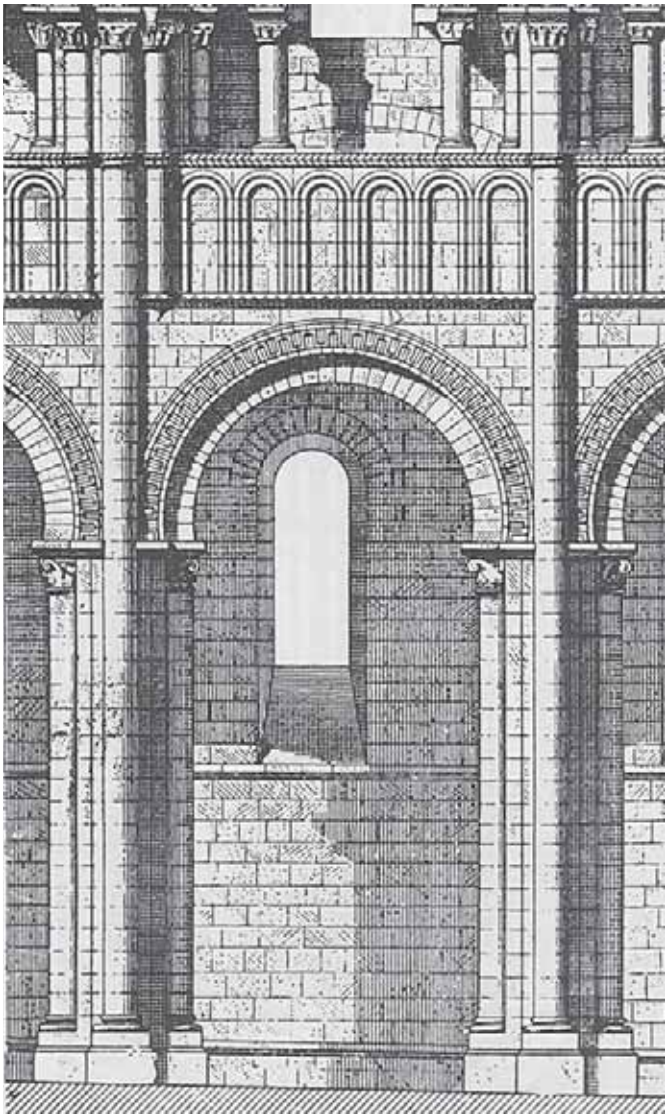
quirk

An indentation separating one element from another, as between moldings; a valley between fillet and profile of a molding; between abacus and echinus of **Doric** capital.

6 - Interior and Exterior Millwork

Romanesque

The style emerging in Western Europe in the early 11th century, characterized by massive articulated wall structures, round arches, and powerful vaults, and lasting until the advent of Gothic architecture in the middle of the 12th century (illustration follows).



rosette

1. A round pattern with a carved or painted conventionalized floral and/or foliage design where petals/leaves radiate from center.

2. A circular or oval decorative wood plaque used in joinery, such as one applied to a wall to receive the end of a stair rail.

scotia

A deep concave molding defined by two varying arcs, especially one at the base of a **column** in Classical architecture.

shaft

The portion of a **column** or **pilaster** between the **base** and the **capital**.

soffit

The exposed undersurface of any overhead component of a building, such as an **arch**, balcony, beam, **cornice**, lintel, etc.

stylobate

The *floor* of classical temple; top step of crepidoma.

torus, tori

A bold projecting molding, convex in shape, generally forming the lowest member of a base over the **plinth**.

trabeated

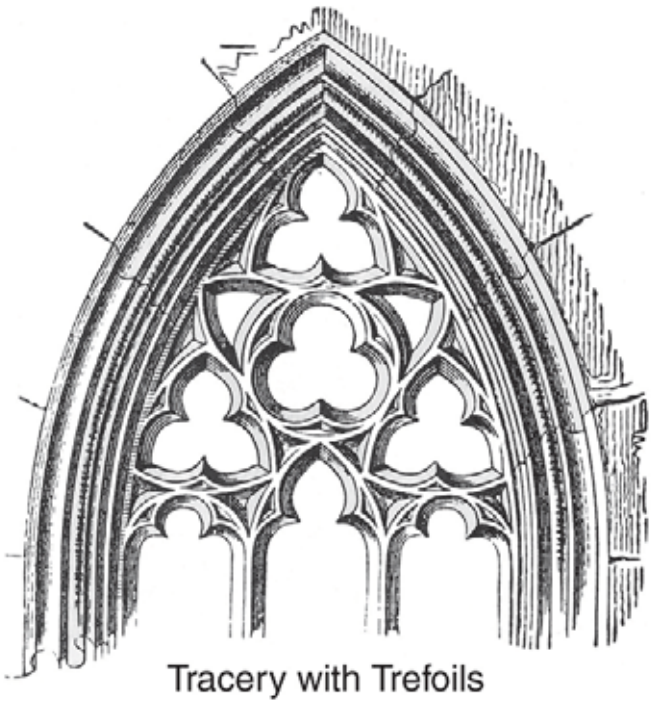
1. Descriptive of construction using beams or lintels, following the principle of post and lintel construction, as distinguished from construction using arches and vaults. 2. Furnished with an **entablature**.

tracery

The pierced designs of window mullions in the Medieval period consisting of geometrically derived curving shapes; the same designs on furniture panels, walls and the decorative arts.

trefoil

A three-lobed pattern divided by **cusps**.



Tracery with Trefoils

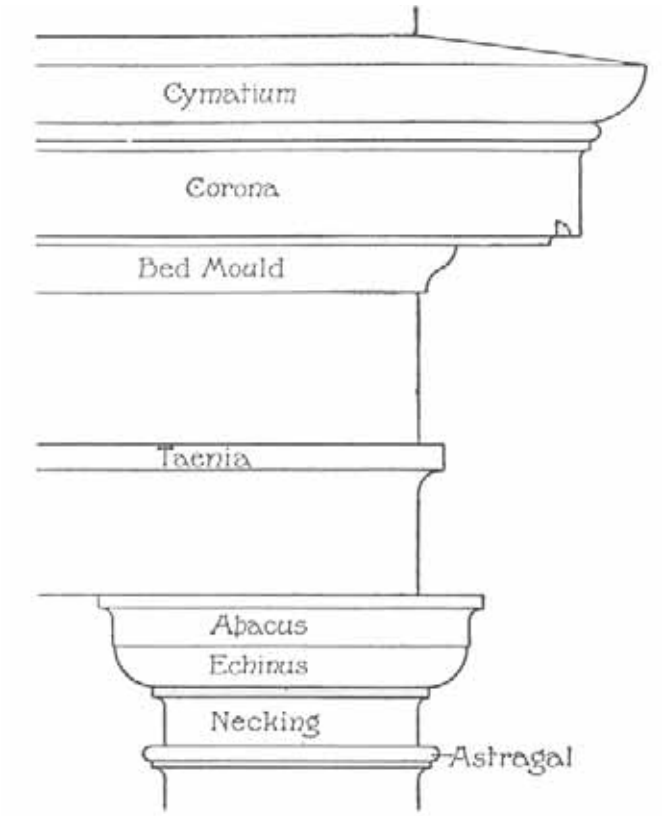
triglyph

The characteristic ornament of the **Doric frieze**, consisting of slightly raised blocks of three vertical bands separated by V-shaped grooves. The triglyphs alternate with plain or sculptured panels called **metopes**.

6 - Interior and Exterior Millwork

Tuscan order

A simplified version of the Roman **Doric** order, having a plain **frieze** and no **mutules** in the **cornice**.



Tuscan order entablature and capital

volutes

1. A spiral scroll, as on **Ionic**, **Corinthian**, or **Composite capitals**, etc.

2. A stair crook having an easement with a spiral section of stair rail.

voussoir

A wedge-shaped masonry unit in an arch or vault whose converging sides are cut as radii of one of the centers of the arch or vault.

Resources and References

A. Museums with period rooms

There are many historic houses around the country which are open to the public. Eighteenth Century homes such as Gunston Hall in VA, and Drayton Hall, near Charleston, SC, along the Eastern Seaboard and Neoclassical houses as one moves West. There are museums with *period* rooms as well. The Metropolitan Museum in New York, the Philadelphia Museum of Art, and Colonial Williamsburg are only a few.

B. Publications

Dover Publications, Inc.
31 East Second Street
Mineola , NY 11501

Dover Publications has an incomparable listing of books which, for the most part, are reprintings of older publications; from Andrea Palladio's *Four Books of Architecture* to Augustus Charles Pugin's *Gothic Ornament* as well as handbooks and specialized subjects.

One invaluable Dover handbook is *Illustrated Dictionary of Historic Architecture* by Cyril M. Harris. It is from Harris that the definitions and many of the illustrations in the Glossary have been used with permission.

Three others which offer good illustrations are:

Colling, James K. *Medieval Decorative Ornament*, New York, (Reprint of 1874 edition); Dover Publications, Inc. 1995.

Griesbach, C.B. *Historic Ornament: A Pictorial Archive,* New York, Dover Publications, Inc., 1975.

Speltz, Alesander. *The Styles of Ornament,* (Reprint of German Edition of 1906), New York, Dover Publications, Inc., 1959.

Several books explaining in detail the orders of architecture are:

Adam, Robert. *Classical Architecture: A Comprehensive Handbook to the Tradition of Classical Style*, New York: Harry N. Abrams, Inc., Publishers, 1990.

Chitham, Robert. *The Classical Orders of Architecture*, New York: Rizzoli International Publications, Inc., 1985 (may be out of print).

Ware, William R. *The American Vignola: A Guide to the Making of Classical Architecture,* New York: Dover Publications, Inc., 1994.

A definitive history of architecture is:

Fletcher, Sir Banister. *A History of Architecture on the Comparative Method*, 20th edition ed., Dan Cruickshank and Andrew Saint, Oxford: Architectural Press, 1996.

For carving classical architectural elements:

Wilbur, Frederick. *Carving Architectural Detail in Wood: the Classical Tradition*, Lewes, UK: Guild of Master Craftsmen Publications, Ltd. 2000.

NOTES

7
Stairwork and Rails

7 - Stairwork and Rails

DESIGN SUMMARY

This short summary is a collection of hints and illustrations about the challenges of designing and building safe stairs. The *AWS* cannot and does not offer these data as advice on code compliance. Safe stairs and design and engineering to meet local codes remains the responsibility of the design professional.

The three critical steps in stair design are:

- check local code;
- consult with an experienced stair builder to double-check your geometry; and
- pre-clear your stair design with the local building officials.

NET STAIR WIDTH

The minimum width of a normal stairway is 44” (1118 mm) when expected occupant load is 50 or more. Otherwise, the minimum width is usually 36” (915 mm).

RISER HEIGHT

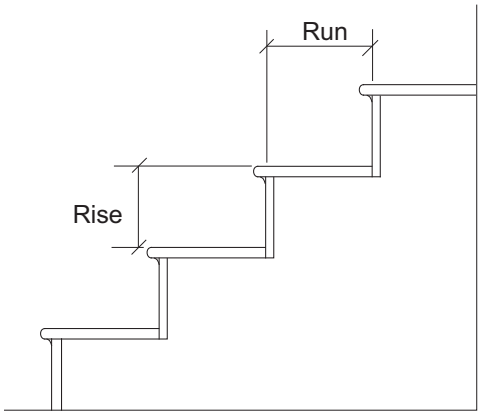
For stairways serving an occupant load of greater than 10 persons, the typical maximum riser height is about 7” (178 mm). For stairways serving an occupant load of fewer than 10, the maximum riser height varies from 7-3/4” (197 mm) to 8-1/4” (210 mm) depending on local code. All codes agree that the height of each riser must be consistent with the others. Riser height is measured from the finished top of a tread to the finished top of the adjacent tread.

TREAD LENGTH (RUN)

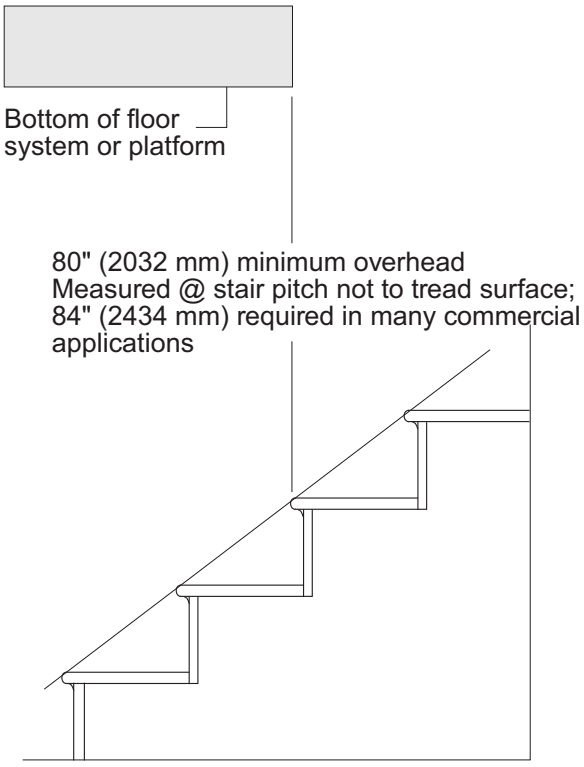
For stairways serving an occupant load of greater than 10, the minimum tread length is usually 11” (279 mm). For stairways serving fewer than 10, the minimum is usually 9-1/2” (241 mm). Just as the rise must be consistent, so must the run.

RATIO OF RISER TO TREAD

There are some well established Imperial guidelines for stair layout. Three rules of thumb for a good relation between the height of a riser and the width of a tread are: (1) the tread width multiplied by the riser height in inches should equal between 72 and 75; (2) the tread width plus twice the riser height should equal about 25; or rise + run = about 17” (432 mm), remembering that the rise and run must work together. It is the pitch of the stair which makes it functional and safe. A stair which meets two of the three guidelines should be easy to use.

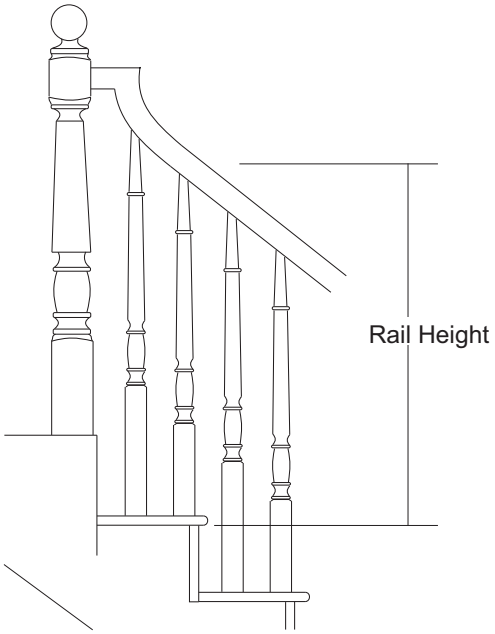


HEADROOM - A minimum of 2032 mm [80”] must be allowed for headroom measured from a plane parallel and tangent to the nose of the treads to all overhead points.

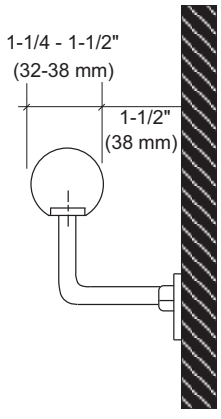


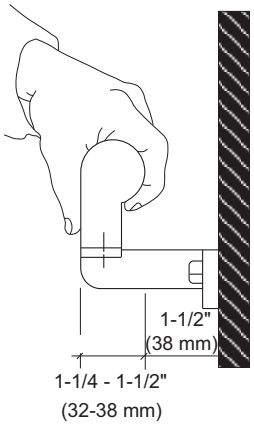
7 - Stairwork and Rails

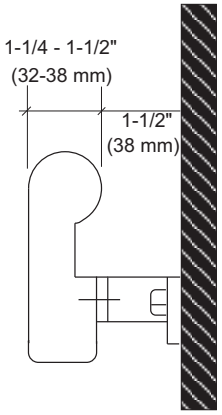
HANDRAILS - Stair handrails should be mounted in such a manner that the top of the handrail be no less than 34” (864 mm) and no more than 38” (965 mm) above tread and landing noses. Stairways wider than 44” (1118 mm) should include a handrail on both sides of the stair. Handrails should clear walls and other obstructions by no less than 1-1/2” (38 mm) to allow for adequate finger clearance, but should not project more than about 4-1/2” (115 mm). Consult all codes and requirements.

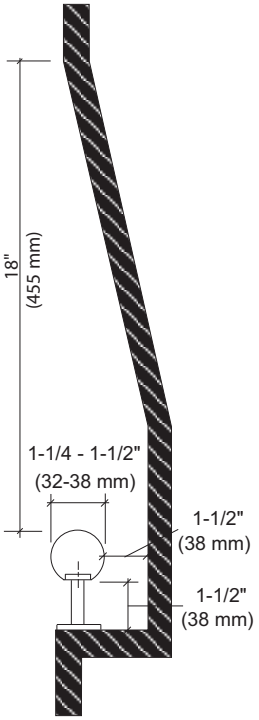


LEVEL BALUSTRADE - Balustrade at balconies or landings must be at least 36” (915 mm) above the finish floor for most residential applications and at least 42” (1067 mm) above the finish floor for most commercial applications. Some jurisdictions require the use of a guardrail in addition to the handrail on the stair.

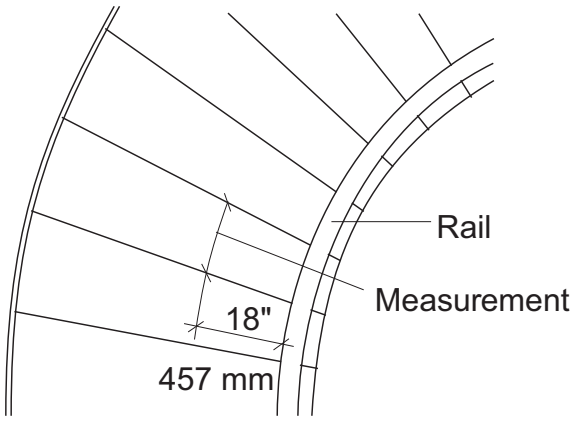








CURVED/CIRCULAR STAIRS - In most regional codes, a circular stair must have an inside radius that is no less than twice the width of the stair. Most books also specify a minimum tread run of 6” (152 mm) at the most restrictive point, but this is not always practical or possible Curved stairways with tighter radii and more limited tread run are usually allowed under stair codes. As a guide, the required tread run should be no less than 10” (254 mm) , measured at a point 12”-18” (305-457 mm) from the most restrictive (narrow) side of the stair.



Please consult with the local building department before committing a stair space to design details and project documents.

7 - Stairwork and Rails

FREEDOM OF EXPRESSION

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.

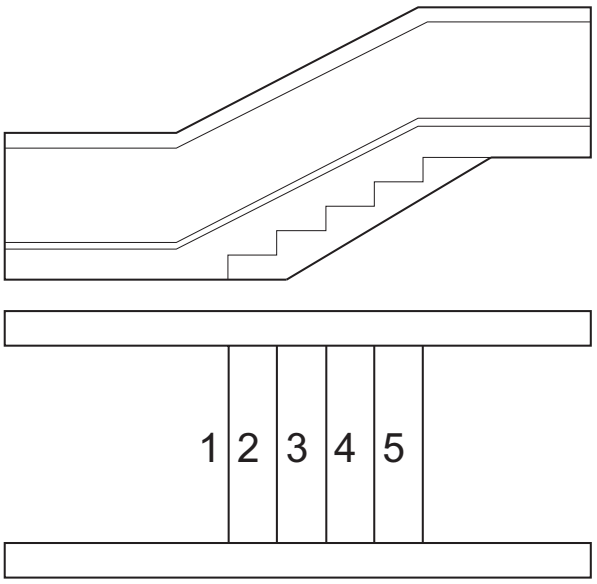
• Cost effective: Custom woodwork does compete favorably with mass-produced millwork, and offers practically limitless variations of design and material. Most woodwork lasts the life of the building - quality counts.

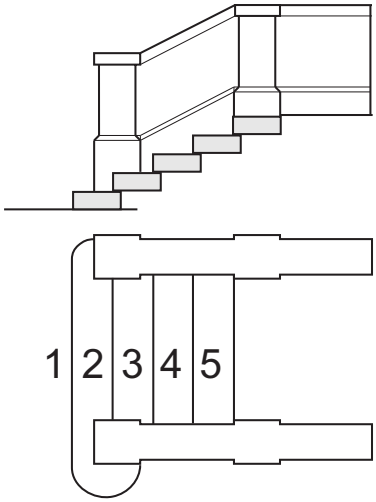
• Complete adaptability: By using custom woodwork, the architect or designer can readily conceal plumbing, electrical and other mechanical equipment without compromising the design criteria.

• 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.

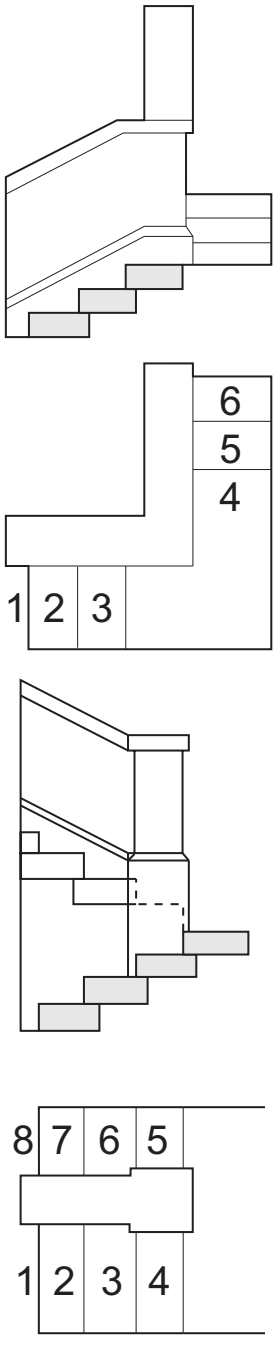
STRAIGHT RUNS



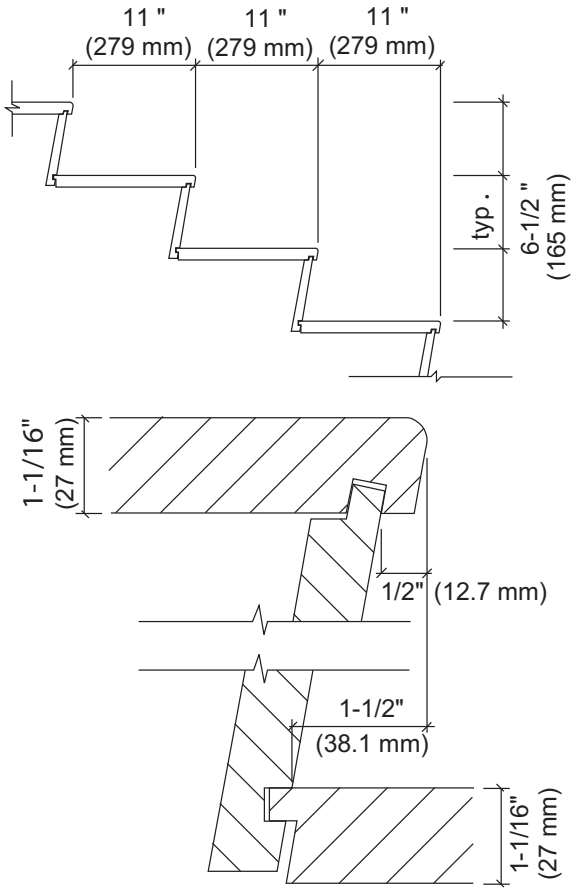


7 - Stairwork and Rails

TURNING RUNS

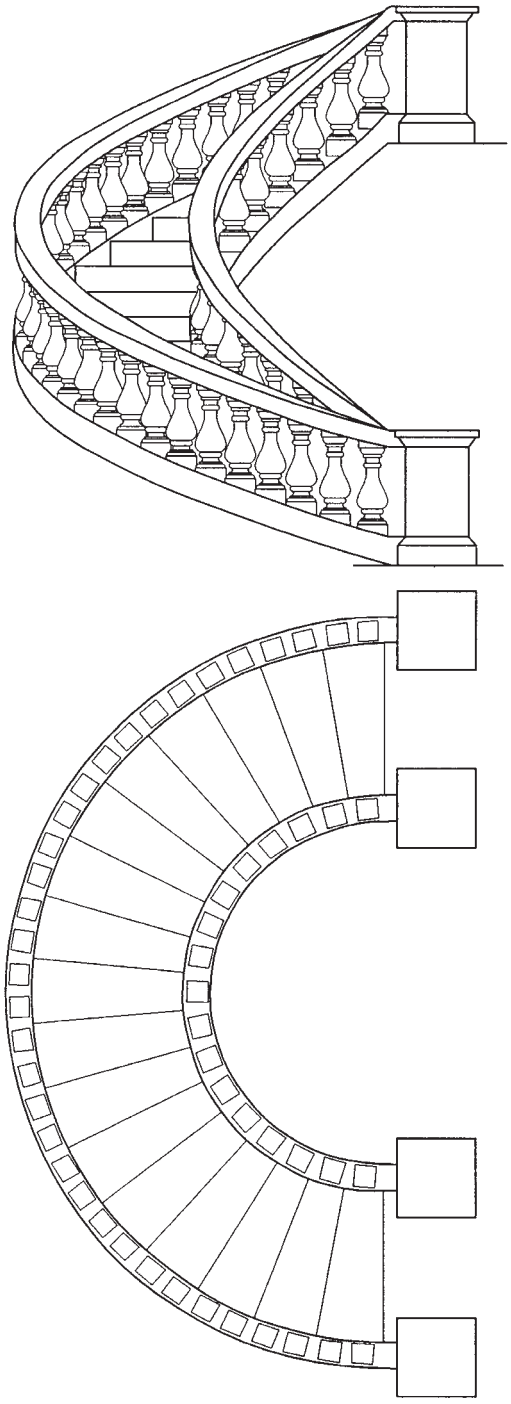


BACKPITCH EXAMPLE



7 - Stairwork and Rails

WINDING RUN



8
Wall Surfacing

8 - Wall Surfacing

Smoothness of Flat and Moulded Surfaces

Planers and Moulders: The smoothness of surfaces that have been machine planed or moulded is determined by the closeness of the knife cuts. The closer the cuts to each other (i.e., the more knife cuts per inch [KCPI]), the closer the ridges, and therefore the smoother the resulting appearance.

Sanding and Abrasives: Surfaces can be further smoothed by sanding. Sandpapers come in grits from coarse to fine and are assigned ascending grit numbers. The coarser the grit, the faster the stock removal. The surface will show the striations caused by the grit. Sanding with finer grit papers will produce smoother surfaces.

Standing and Running Trim

Site-applied cornice, chair rail, base, trim, and mouldings are governed by the areas of the *Architectural Woodwork Standards* covering Standing and Running Trim.

Installation Recommendation

This section does not cover field installation of paneling and doors; however, the methods and skill involved in the installation of paneling and doors in large measure determine the final appearance of the project. 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 panels has the additional advantage of permitting panel movement that results from humidity changes or building movement. Depending upon local practice, many woodworkers will perform the wall preparation and installation of the paneling and related wood doors.

Finishing Recommendation

This Section does not cover finishing. However, site conditions and air quality regulations for finishing are rarely conducive to good results. Poor lighting, dust-laden air, and techniques available are limiting factors. Depending upon local practice, many woodworkers will factory finish, yielding better results than can be achieved from field finishing. Unless specified in the Contract Documents, the manufacturer is not responsible for the appearance of field finished panels or doors.

Material Selections

Design professionals shall specify the following:

A. Veneers for Transparent Finishes - The Big 5!

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

2. Slicing: Select either plain sliced, quarter sliced, or (in the case of Oak only), rift sliced.

3. Matching of individual leaves: Select either book matched (most appropriate for plain sliced), slip matched (most appropriate for quartered and rift sliced), or random matched (for a rustic look, usually more expensive). Specify end matching for tall elevations.

4. Matching on each panel face: Select either running match, balance match, or center balance match. Specify type of end matching for tall elevations.

5. Matching between panels: Select either no sequence, premanufactured sets - full width, premanufactured sets - selectively reduced in width, sequence matched uniform size set(s), or blueprint matched panels and components.

B. Materials for Opaque Finishes

1. Medium Density Overlay (MDO) - This provides the optimum paintable surface for architectural panels and doors. The thermosetting resin overlay is designed to take and hold paint. Opaque finish sheens above 40 Satin require special manufacturing procedures.

2. Close Grain Hardwood - Extra preparation may be required by the finisher as there may be grain show-through, split veneer joints, and other wood characteristics in this Grade.

3. Mill Option - Face materials are determined by the manufacturer.

C. High Pressure Decorative Laminates (HPDL)

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

2. High gloss HPDL will highlight minor core and surface imperfections, often unacceptably.

3. HPDL panels and doors are not recommended for exterior use due to the potential differentials in humidity between the faces.

Variations in Natural Wood Products

Wood is a natural material, with variations in color, texture, and figure. These variations are influenced by the natural growing process and are uncontrollable by the woodworker. The color of wood within a tree varies between the “sapwood” (the outer layers of the tree which continue to transport sap), which is usually lighter in color than the “heartwood” (the inner layers in which the cells have become filled with natural deposits). Various species produce different grain patterns (figures), which influence the selection process. There will be variations of grain patterns within any selected species. The architectural woodworker cannot select solid lumber cuttings within a species by grain and color in the same manner in which veneers may be selected. Color, texture, and grain variations will occur in the finest architectural woodworking.

Shop Drawings and Engineering

Shop drawings are the means by which the design intent is turned into reality. They shall indicate methods of construction, exact material selections, grain direction(s), methods of attachment and joinery, and exact dimensions. They should also include the woodworker’s technical suggestions. Unless specified, sequence of lamination and assembly is determined by the woodworker.

8 - Wall Surfacing

Fire-Retardant Ratings

Fire-Retardant Solid Lumber

The natural fire-retardant qualities and acceptability of treatments vary among the species. Where certain items of architectural woodwork are required to have a flame spread classification to meet applicable building and safety codes, the choice of lumber species must be a consideration. Additional data on various species may be available from U.S. Department of Agriculture Forest Service, Fire Safety of Wood Products Work Unit at (608) 231-9265.

Flame Spread Classification: This is the generally accepted measurement for fire rating of materials. It compares the rate of flame spread on a particular species with the rate of flame spread on untreated Oak.

Most authorities accept the following classes for flame spread:

Class I or A	0-25
Class II or B	26-75
Class III or C	76-200

Fire-Retardant Treatments: Some species may be treated with chemicals to reduce flammability and retard the spread of flame over the surface. This usually involves impregnating the wood, under pressure, with salts suspended in a liquid. The treated wood must be redried prior to fabrication. Consult with your woodworker about the appearance and availability of treated woods prior to specification.

The sizes and species currently being treated (flame spread less than 25), are very limited, and not available in all markets. Fire-retardant treatment does affect the color and finishing characteristics of the wood.

Subject to local codes, untreated wood and wood products can usually be used in up to 10% of an area, according to the traditional model codes:

BOCA - Basic National Building Code

ICBO (UBC) - Uniform Building Code

SBCCI (SBC) - Standard Building Code

NFPA - 101 Life Safety Code

Face veneers are not fire retardant treated, and combining untreated veneers with treated lumber can result in color and finishing contrasts.

Intumescent Coatings for Wood: It is possible to reduce flammability by using intumescent coatings in either opaque or transparent finishes. These are formulated to expand or foam when exposed to high heat, and create an insulating effect that reduces the speed of spread of flame. Improvements are continually being made on these coatings. Consequently, the specifier must ascertain whether they will be permitted under the code governing the project, the relative durability of the finish, and the effect of the coating on the desired color of the finished product.

Finishing of Fire-Retardant-Treated Lumber: Fire-retardant treatments may affect the finishes intended to be used on the wood, particularly if transparent finishes are planned. The compatibility of any finishes should be tested before they are applied.

Built-up Construction to Improve Fire Rating: In lieu of solid lumber, it is often advisable, where a fire rating is required, to build up members by using treated cores clad with untreated veneers not thicker than 1 mm [$^{1}/_{28}$"]. Existing building codes, except where locally amended, provide that facing materials 1 mm [$^{1}/_{28}$"] or thinner finished dimension are not considered in determining the flame spread rating of the woodwork.

Fire-Retardant Panel Products

Flame Spread Factors:

A. Core - The fire rating of the core material determines the rating of the assembled panel. Fire-retardant veneered panels must have a fire-retardant core. Particleboard core is available with a Class I (Class A) rating and can be used successfully with veneer or rated high pressure decorative laminate faces. MDF (Medium Density Fiberboard) is available with a fire rating in some markets.

B. Face - Some existing building codes, except where locally amended, provide that facing materials 1 mm [$^{1}/_{28}$"] or thinner are not considered in determining the flame spread rating of the panel. If state and local codes move toward adoption of the International Building Code provisions, it is possible that the 1 mm [$^{1}/_{28}$"] exemption may not be available.

Note: The International Code is rapidly replacing the traditional codes. In localities where basic panel building codes have been amended, it is the responsibility of the specifier to determine whether the application of the facing material specified will meet the code.

Face veneers are not required to be fire-retardant treated, and such treatment will adversely affect the finishing process.

If a Class I panel assembly is specified with a decorative laminate face, the fire-rated decorative laminate and the laminate balancing sheet must be applied to a Class I core material (usually particleboard), with the laminate manufacturer's recommended adhesive for rated assemblies.

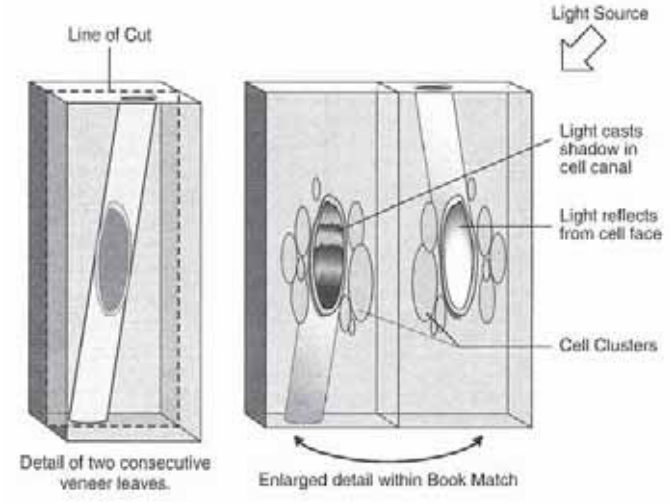
It is the responsibility of the specifier to indicate what fire-retardant rating, if any, is required for the paneling. In the absence of such a specified rating, the woodworker shall supply unrated paneling.

Types of Veneer Cuts

The manner in which a log segment is cut with relation to the annual rings will determine the appearance of the veneer. When sliced, the individual pieces of veneer, referred to as *leaves*, are kept in the order in which they are sliced, thus permitting a natural grain progression when assembled as veneer faces. The group of leaves from one slicing is called a *flitch,* and is usually identified by a flitch number and the number of gross square feet of veneer it contains.

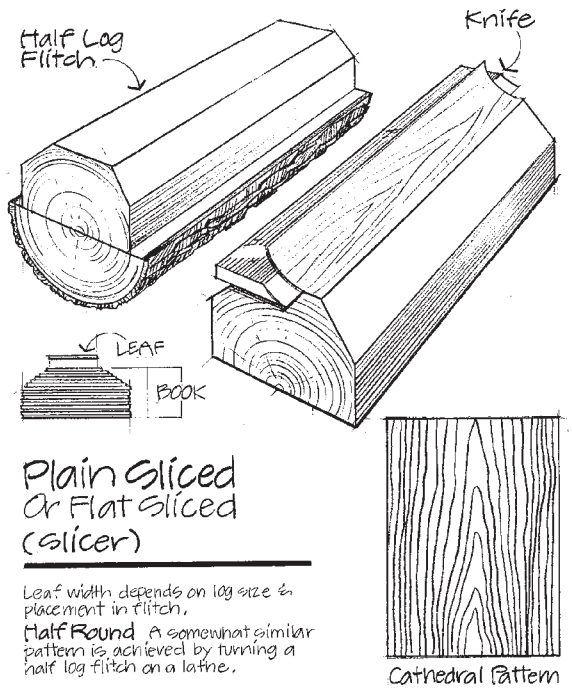
8 - Wall Surfacing

The faces of the leaves with relation to their position in the log are identified as the *tight face* (toward the outside of the log), and the *loose face* (toward the inside or heart of the log). During slicing the leaf is stressed on the loose face and compressed on the tight face. When this stress is combined with the natural variation in light refraction caused by the pores of the wood, the result is a difference in the human perception of color and tone between tight and loose faces.



The principal methods of slicing veneers and the general visual characteristics of the grain are:

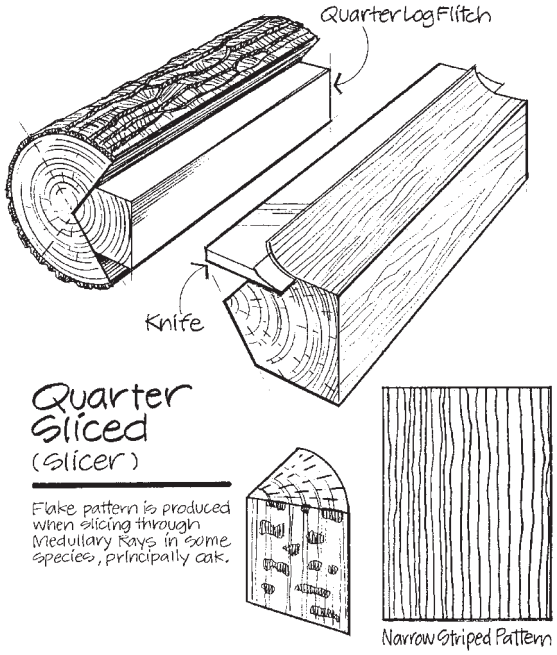
Plain Slicing (or Flat Slicing)



This is the slicing method most often used to produce veneers for high quality architectural woodworking. Slicing is done parallel to a line through the center of the log. A combination of cathedral and straight grain patterns results, with a natural progression of pattern from leaf to leaf.

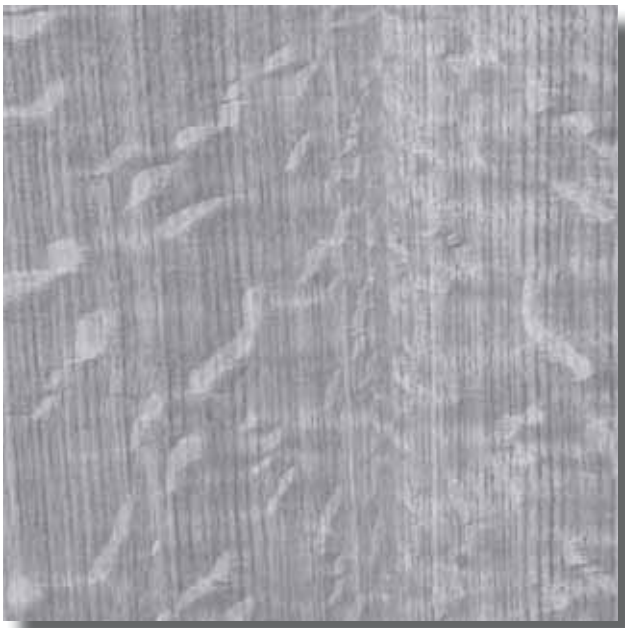
Plain Slicing (Flat Slicing)

Quarter Slicing (or Quarter Cut)



Quarter slicing simulates the quarter sawing process of solid lumber, roughly parallel to a radius line through the log segment. In many species the individual leaves are narrow as a result. A series of stripes is produced, varying in density and thickness from species to species. Flake is a characteristic of this slicing method in Red and White Oak.

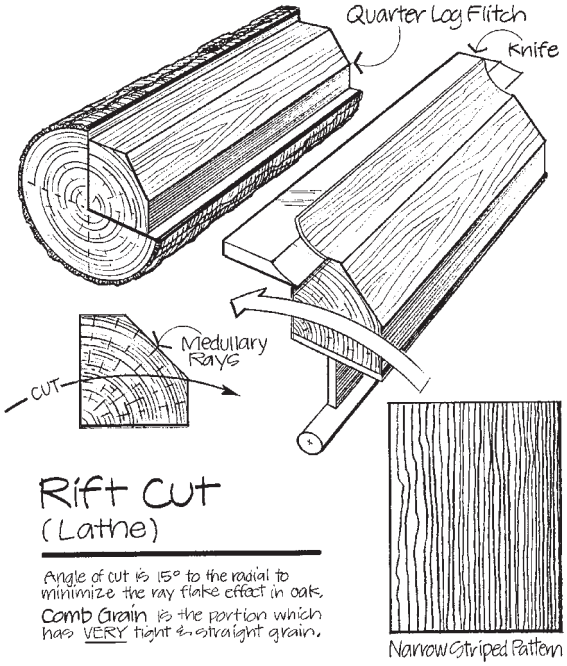
8 - Wall Surfacing



QUARTER SLICING (OAK)

RIFT SLICING

Rift Slicing (or Rift Cut)

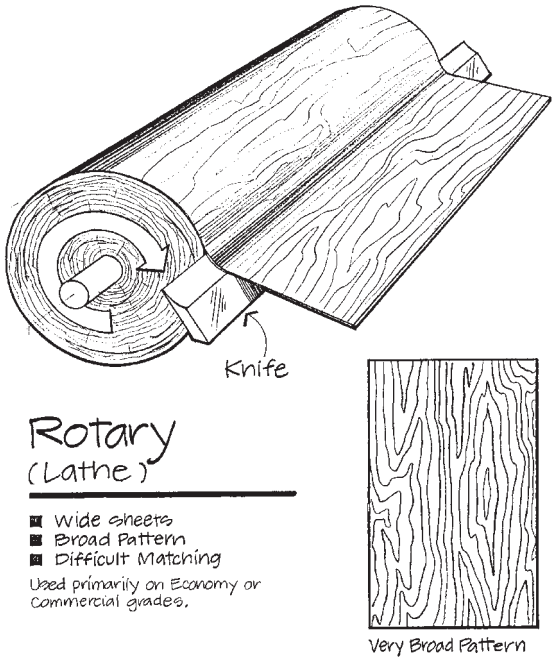


Rift veneers are produced most often in Red and White Oak, rarely in other species. Note that rift veneers and rift sawn solid lumber are produced so differently that a *match* between rift veneers and rift sawn solid lumber is highly unlikely. In both cases the cutting is done slightly off the radius lines minimizing the fleck or flake associated with quarter slicing.

Comb Grain

Limited in availability, comb grain is a select product of the Rift process distinguished by tight, straight grain along the entire length of the veneer. Slight angle in the grain is allowed. Comb grain is restricted to Red and White Oak veneers.

Rotary



The log is center-mounted on a lathe and *peeled* along the general path of the growth rings like unwinding a roll of paper, providing a generally bold random appearance. Rotary cut veneers may

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vary in width and matching at veneer joints is extremely difficult. Almost all softwood veneers are cut this way. Except for a specific design effect, rotary veneers are the least useful in fine architectural woodwork.

NOTE: Rotary sliced fine hardwood veneers are used in a limited way, and usually for special figure and cut, in the manufacture of Premium Grade woodwork. Careful consideration, specification, and communication are recommended when rotary cut is contemplated.

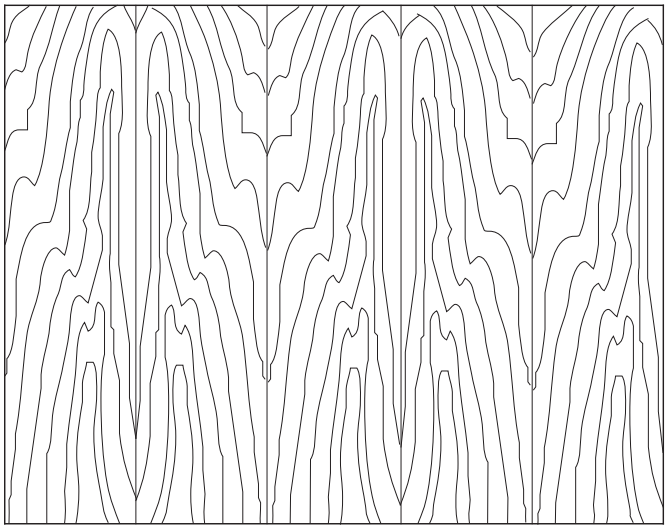
Composite Veneers

Sliced from fast-growing trees, these veneers are dyed and then re-glued in molds to create "grain patterns." The color is established during manufacture because the high percentage of glue-line resists staining by the woodworker. Must be specified by brand name and manufacturer's designation. *Matching* between components may not be possible.

Matching Between Adjacent Veneer Leaves

It is possible to achieve certain visual effects by the manner in which the leaves are arranged. As noted, rotary cut veneers are difficult to match, therefore most matching is done with sliced veneers. The matching of adjacent veneer leaves must be specified. These are the more common types:

Book Matching

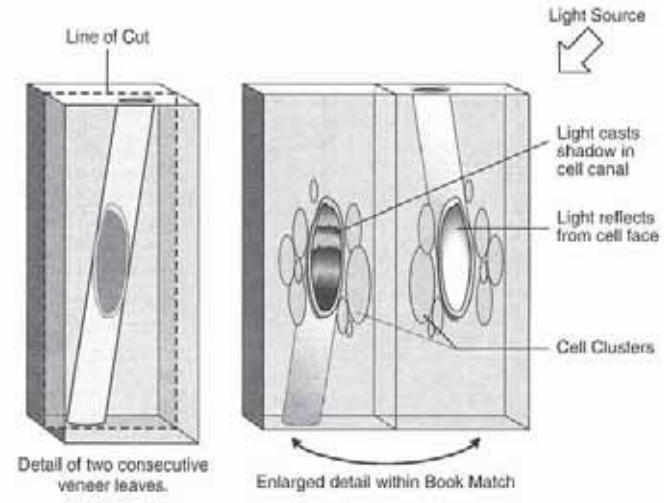


This is the most commonly used match in the industry. Every other piece of veneer is turned over so adjacent pieces (leaves) are "opened" like the pages of a book. and May be used with plain, quarter, or rift sliced veneers.

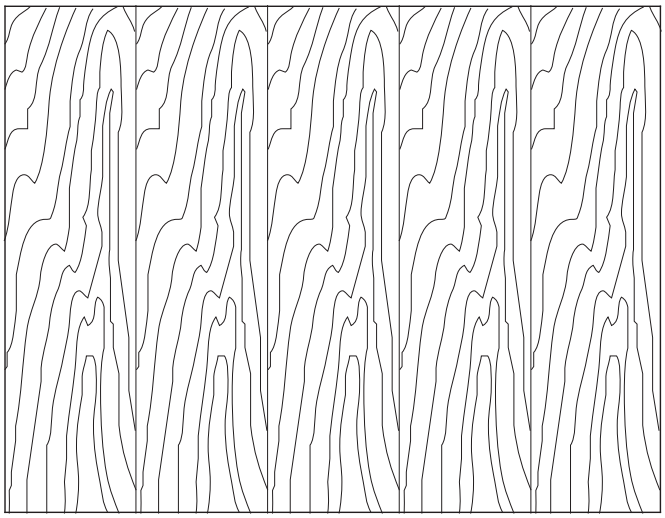
Visual Effect - Veneer joints match, creating a symmetrical pattern. Book matching yields the maximum continuity of grain. When sequenced panels are specified, prominent characteristics will ascend or descend across the match as the leaves progress from panel to panel.

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 Matching



Often used with quarter sliced and rift sliced veneers. Adjoining leaves are placed (slipped out) in sequence without turning, resulting in all the same face sides being exposed.

Visual Effect - Grain figure repeats but joints do not show grain match. When sequenced panels are specified, prominent characteristics will ascend or descend across the match as the leaves progress from panel to panel. The lack of grain match at the joints can be desirable. The relatively straight grain patterns of quartered and rift veneers generally produce pleasing results and a uniformity of color because all faces have the same light refraction.

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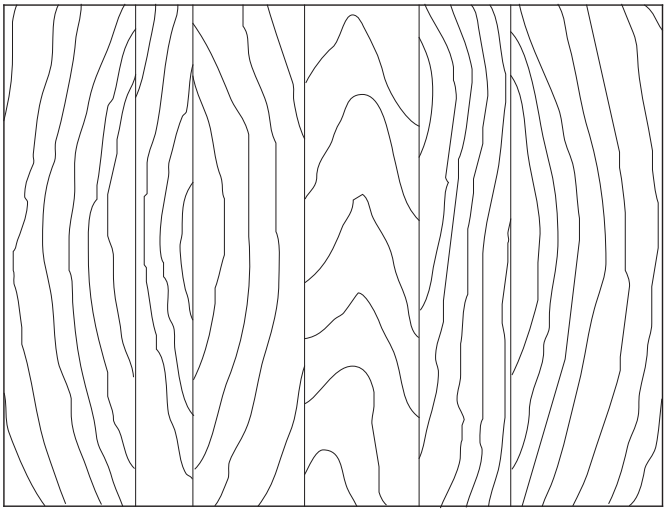
Random Matching



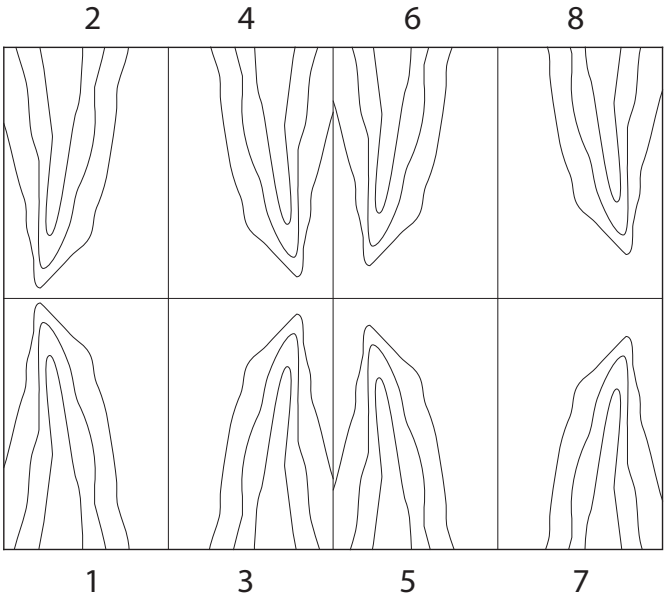
Veneer leaves are placed next to each other in a random order and orientation, producing a “board-by-board” effect in many species.

Visual Effect - Casual or rustic appearance, as though individual boards from a random pile were applied to the product. Conscious effort is made to mismatch grain at joints. Degrees of contrast and variation may change from panel to panel. This match is more difficult to obtain than Book or Slip Match, and must be clearly specified and detailed.

End Matching

Often used to extend the apparent length of available veneers for high wall panels and long conference tables. There are two types of end matching:

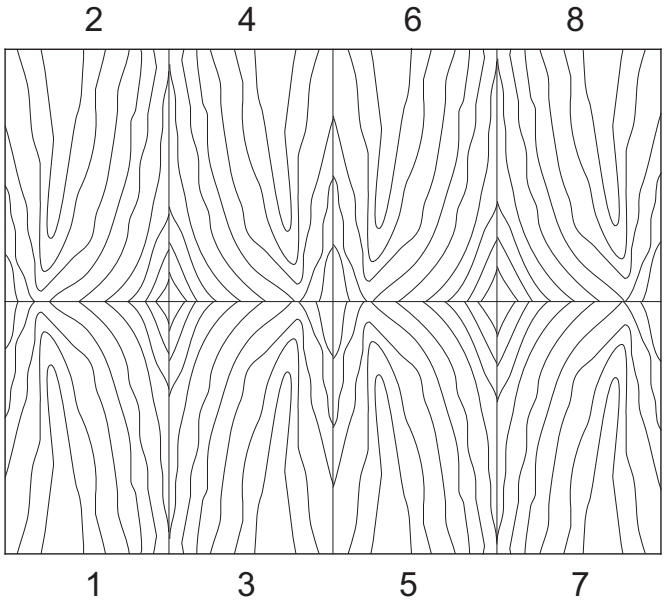
A. Architectural End Match. - Leaves are individually book (or slip) matched, first end-to-end and then side-to-side, alternating end and side. (Book and butt match illustrated.)



Visual Effect - Yields best continuous grain patterns for length as well as width.

B. Continuous Sequenced Match

Leaves are individually book (or slip) matched, separate panels are stacked in sequenced order, either horizontally or vertically in the elevation (Horizontal sequence illustrated.)



Visual Effect Yields sequenced grain patterns for elevations, with pleasing blend of figure horizontally and vertically.

C. Panel End Match Leaves are book (or slip) matched on panel sub-assemblies, with sequenced sub-assemblies end matched, resulting in some modest cost savings on projects where applicable.

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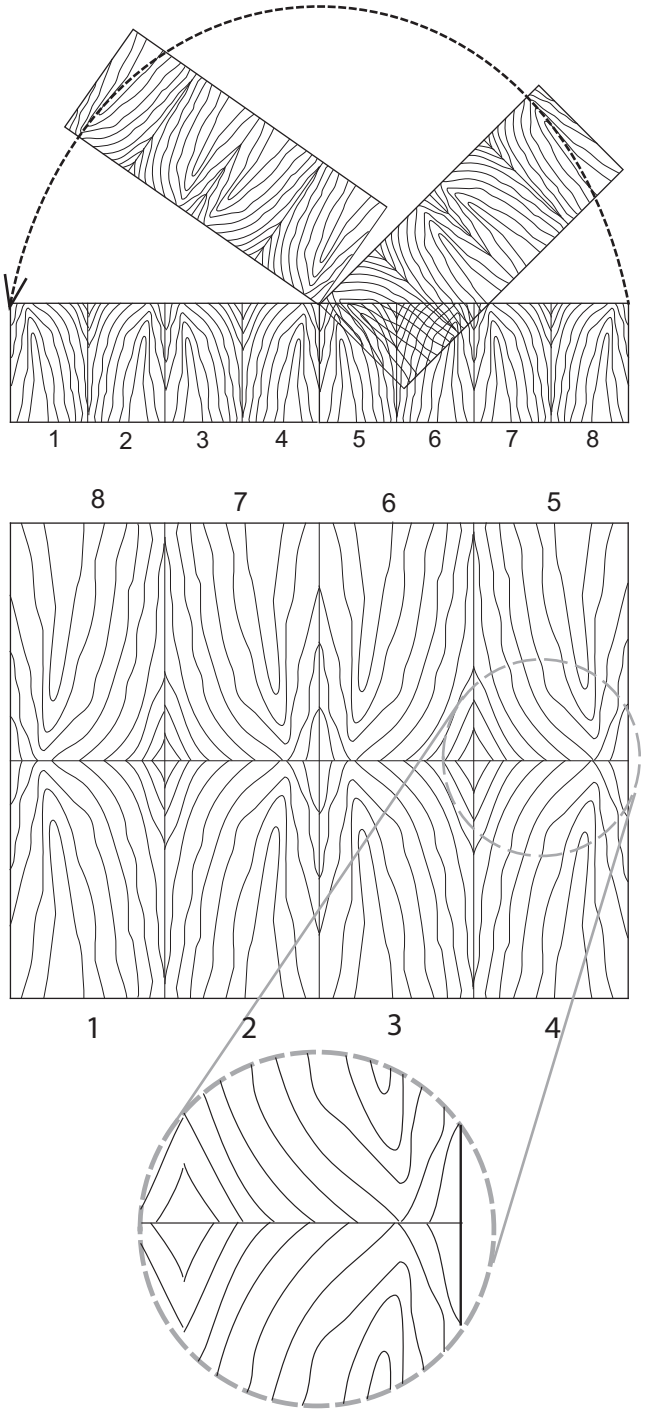


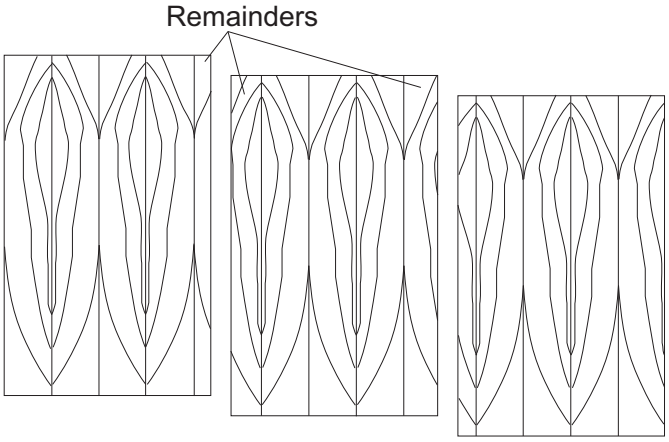
Natural Grain Pattern Mismatch Occurs

Visual Effect - For most species, yields pleasing, blended appearance and grain continuity. Some misalignment of grain pattern will occur, and is not a defect.

Matching within Individual Panel Faces

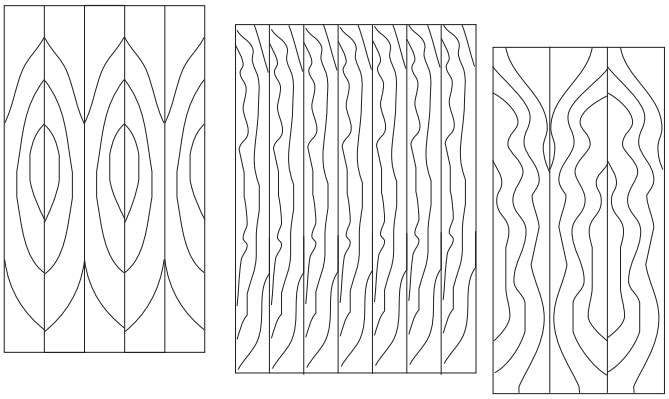
The individual leaves of veneer in a sliced flitch increase or decrease in width as the slicing progresses. Thus, if a number of panels are manufactured from a particular flitch, the number of veneer leaves per panel face will change as the flitch is utilized. The manner in which these leaves are laid up within the panel requires specification, and are classified as follows:

Running Match



Each panel face is assembled from as many veneer leaves as necessary. This often results in a nonsymmetrical appearance, with some veneer leaves of unequal width. Often the most economical method at the expense of æsthetics, it is the standard for Custom Grade, and must be specified for other grades. Running matches are seldom sequenced and numbered for use as adjacent panels. Horizontal grain match or sequence cannot be expected.

Balance Match



Each panel face is assembled from veneer leaves of uniform width before edge trimming. Panels may contain an even or odd number of leaves, and distribution may change from panel to panel within a sequenced set. While this method is the standard for Premium Grade, it must be specified for other Grades. It is the most common assembly method.

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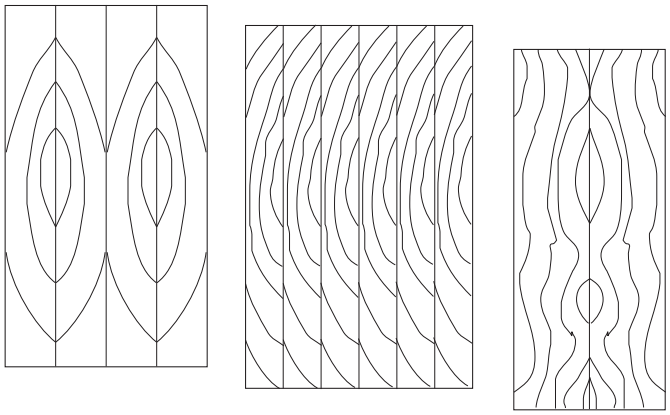
Center Balance Match



Each panel face is assembled of an even number of veneer leaves of uniform width before edge trimming. Thus, there is a veneer joint in the center of the panel, producing horizontal symmetry. In some instances a small amount of figure is lost in the process. Considered by some to be the most pleasing assembly at a modest increase in cost over Balance Match.

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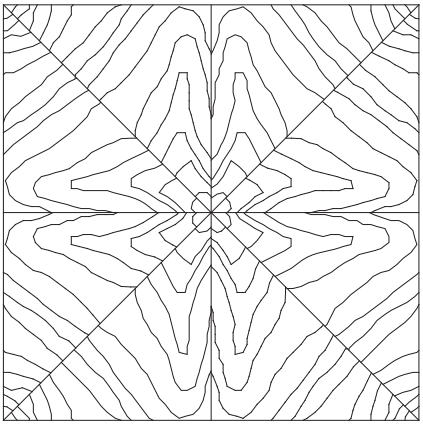
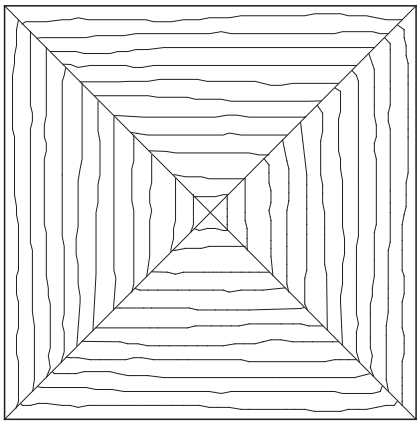
Special Matches

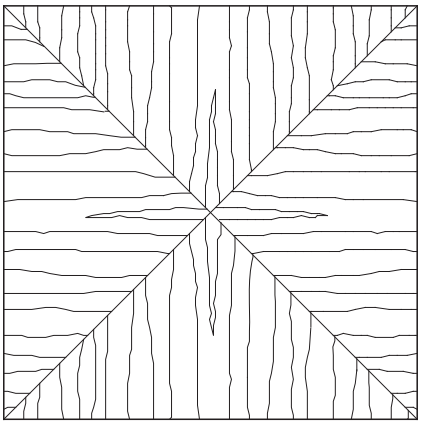
There are regional variations in the names of the following veneer leaf matching techniques. It is strongly recommended the design professional use *both* names and drawings to define the effect desired.



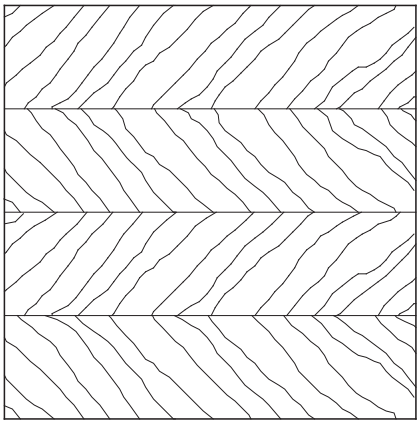
8 Piece Sunburst



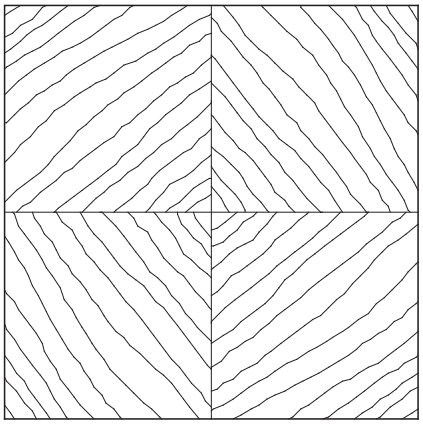
Box Match



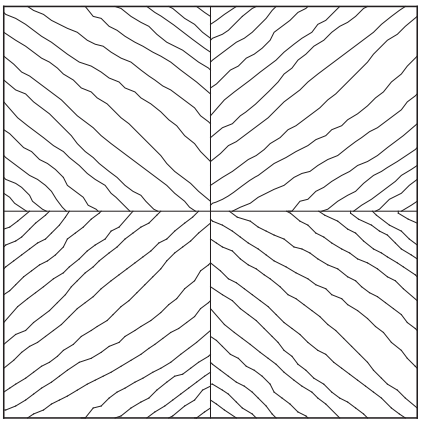
Reverse or End Grain Box



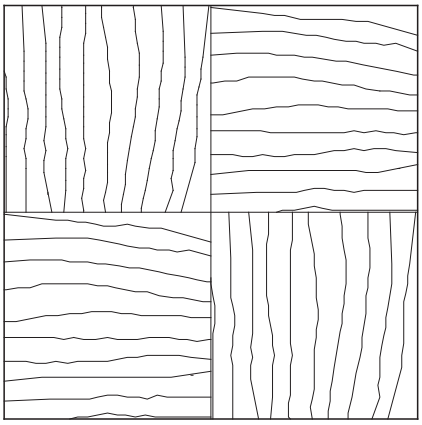
Herringbone or V-Book Match



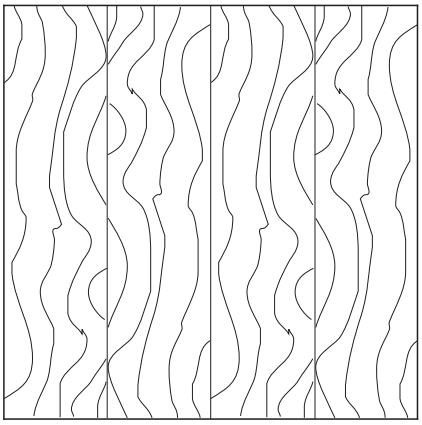
Diamond Match



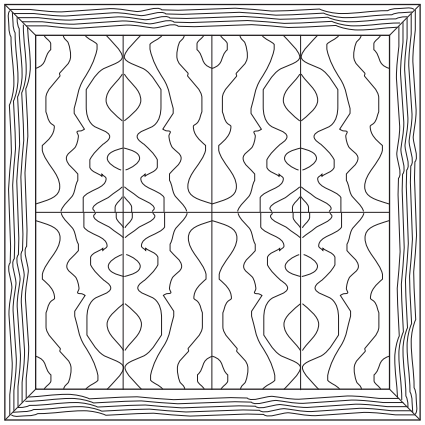
Reverse Diamond Match



Parquet Match



Swing Match



Book & Butt Match w/ Border

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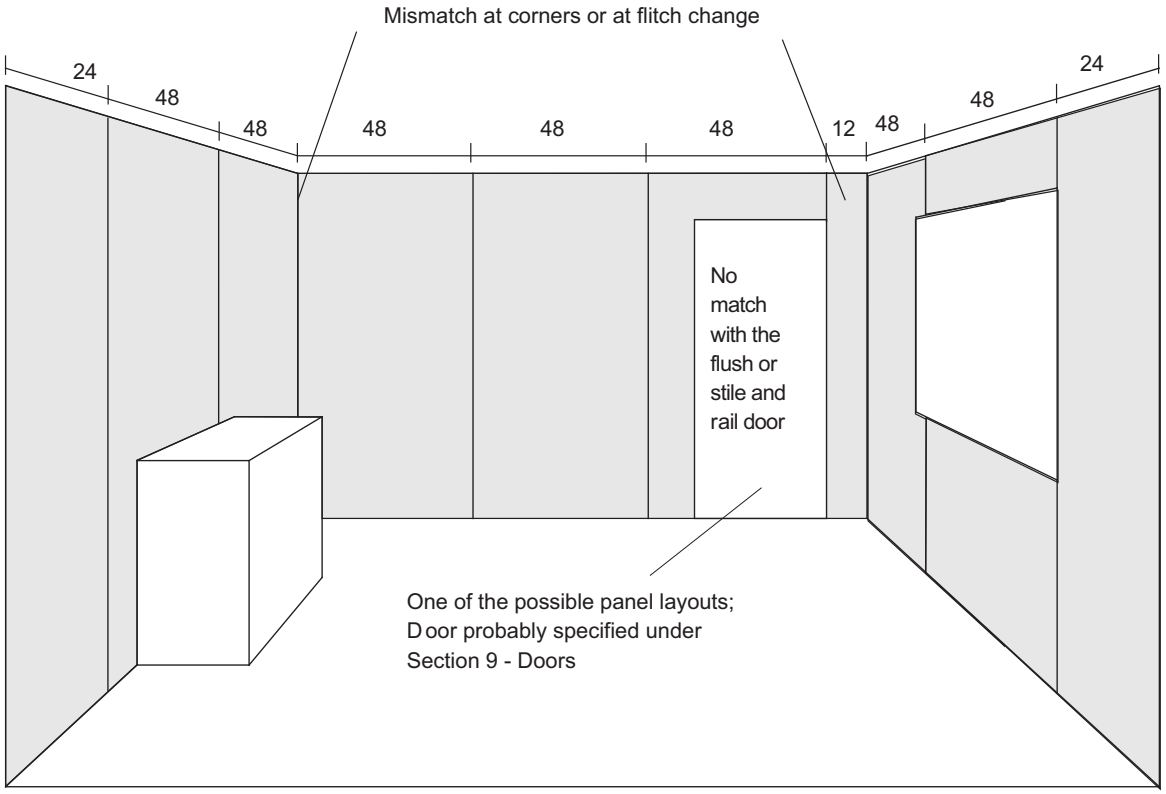
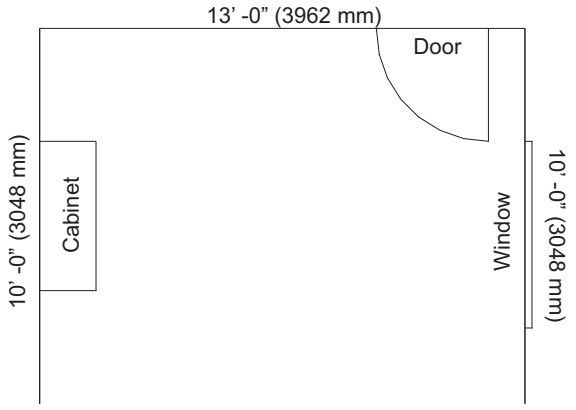
Matching of Panels Within an Area

Veneered panels used in casework or paneling in the same area may be matched to each other. This important component of the project must be carefully detailed and specified. The natural growth patterns of the tree will cause the figure on the sequential panels to ascend, descend, or show a grain progression as the eye moves from panel to panel. The four common methods are:

1 - Premanufactured Sets - Full Width



FLOOR PLAN KEY



These are one step above stock plywood panels, usually made and warehoused in 4' x 8' (1219 mm x 2032 mm), or 4' x 10' (1219 mm x (2540 mm) sheets in sequenced sets. They may be produced from a single flitch or a part of a flitch, usually varying in number from 6 to 12 panels. If more than one set is required, matching between the sets cannot be expected. Similarly, doors or components often cannot be fabricated from the same flitch materials, resulting in noticeable mismatch. This is often the most economical type of special panel products.

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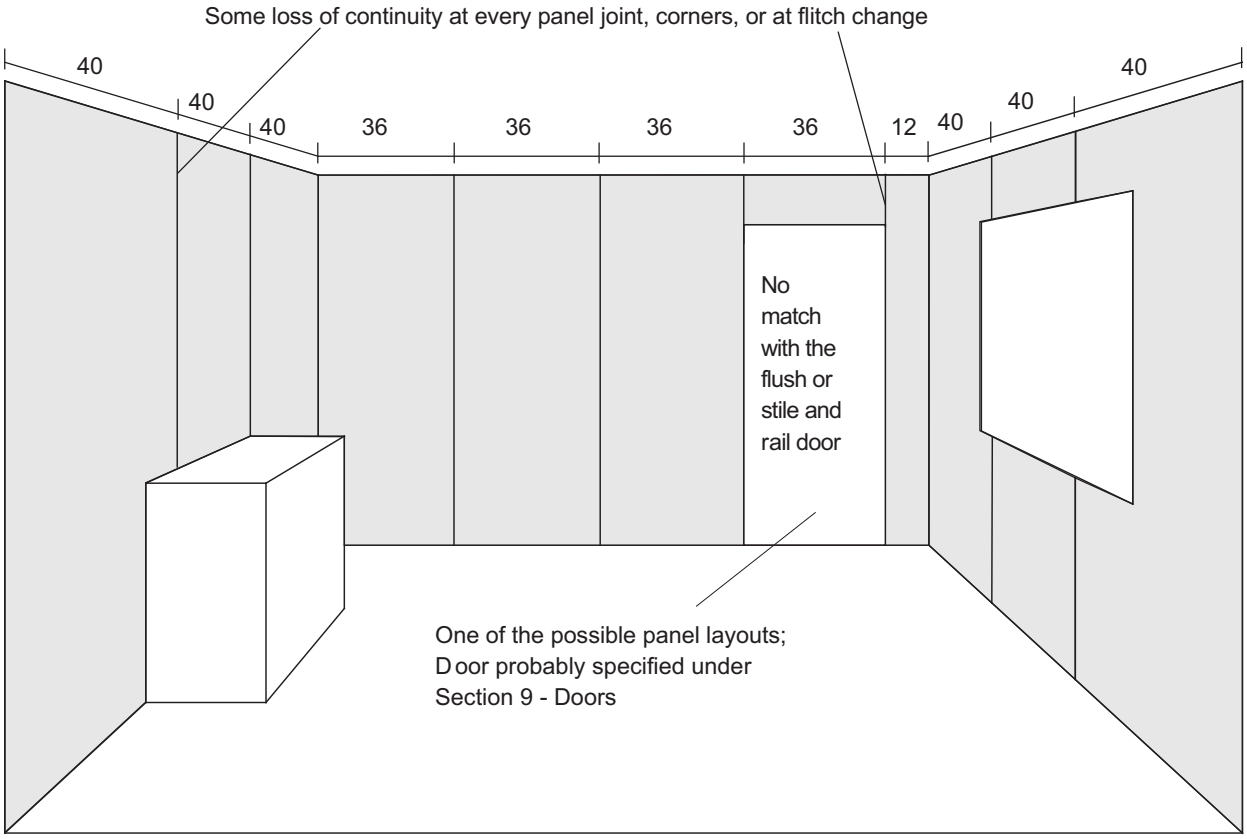
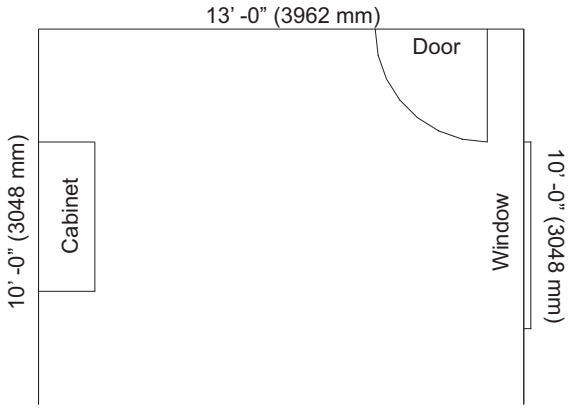
2 - Premanufactured Sets - Selectively Reduced in Width



FLOOR PLAN KEY



These are panels just like those in the previous illustration, usually made and warehoused in 4’ x 8’ (1219 mm x 2032 mm), or 4’ x 10’ (1219 mm x (2540 mm), sheets in sequenced sets. They are often selected for continuity, recut into modular widths, and numbered to achieve the appearance of greater symmetry. If more than one set is required, matching between the sets cannot be expected. Similarly, doors or components often cannot be fabricated from the same flitch materials, resulting in noticeable mismatch.

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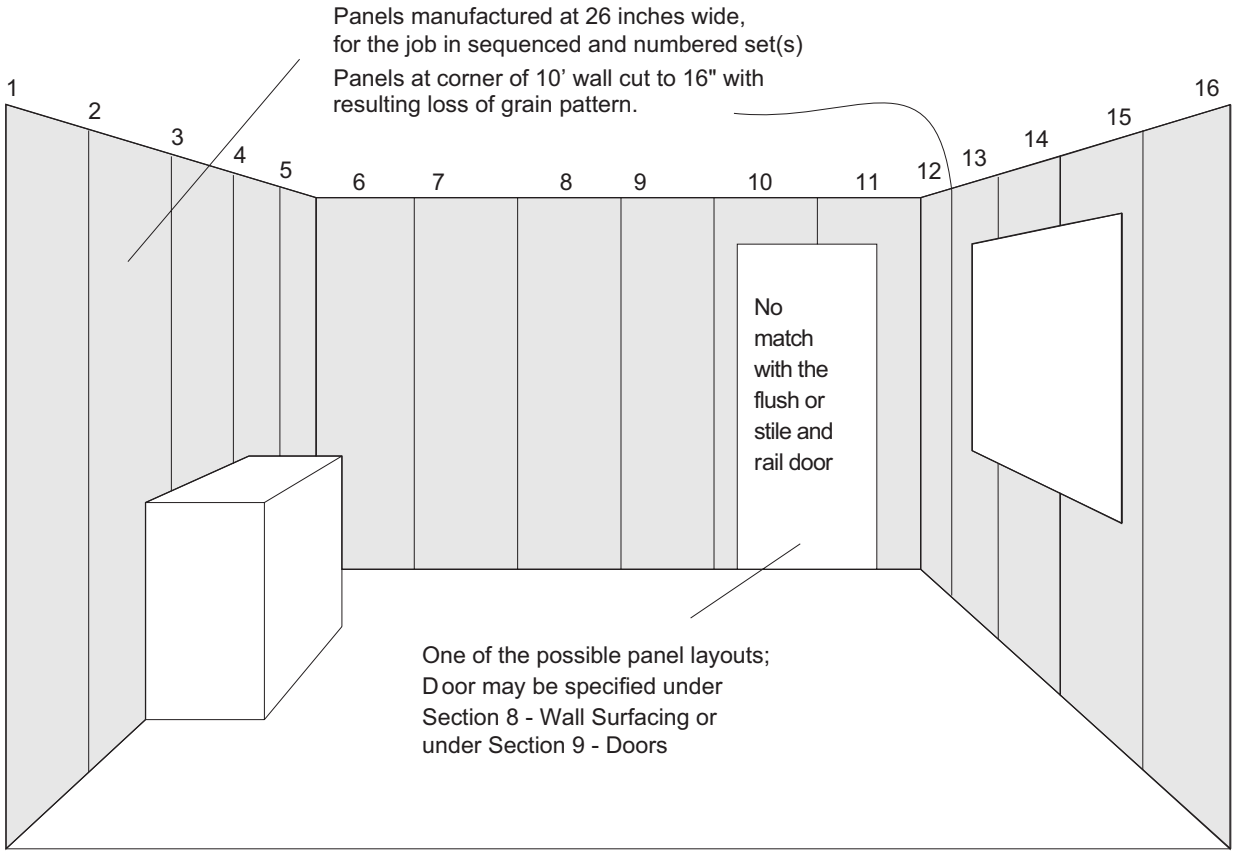
3 - Sequence Matched Uniform Size Set



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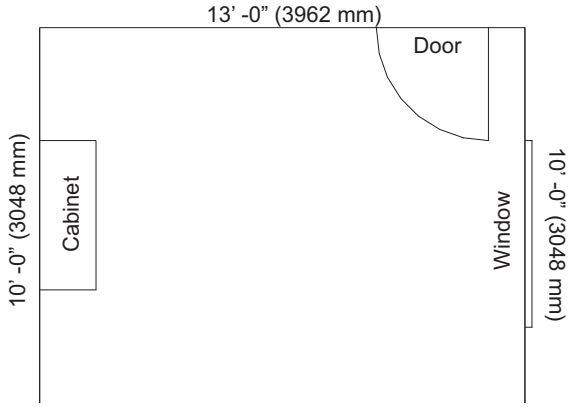

These sets are manufactured for a specific installation to a uniform panel width and height. If more than one flitch is required to produce the required number of panels, similar flitches will be used. This type of panel matching is best used when panel layout is uninterrupted, and when the design permits the use of equal-width panels. Some sequence will be lost if trimming is required to meet field conditions. Doors and components within the wall cannot usually be matched to the panels. Moderate in cost, sequenced uniform panels offer a good compromise between price and aesthetics.

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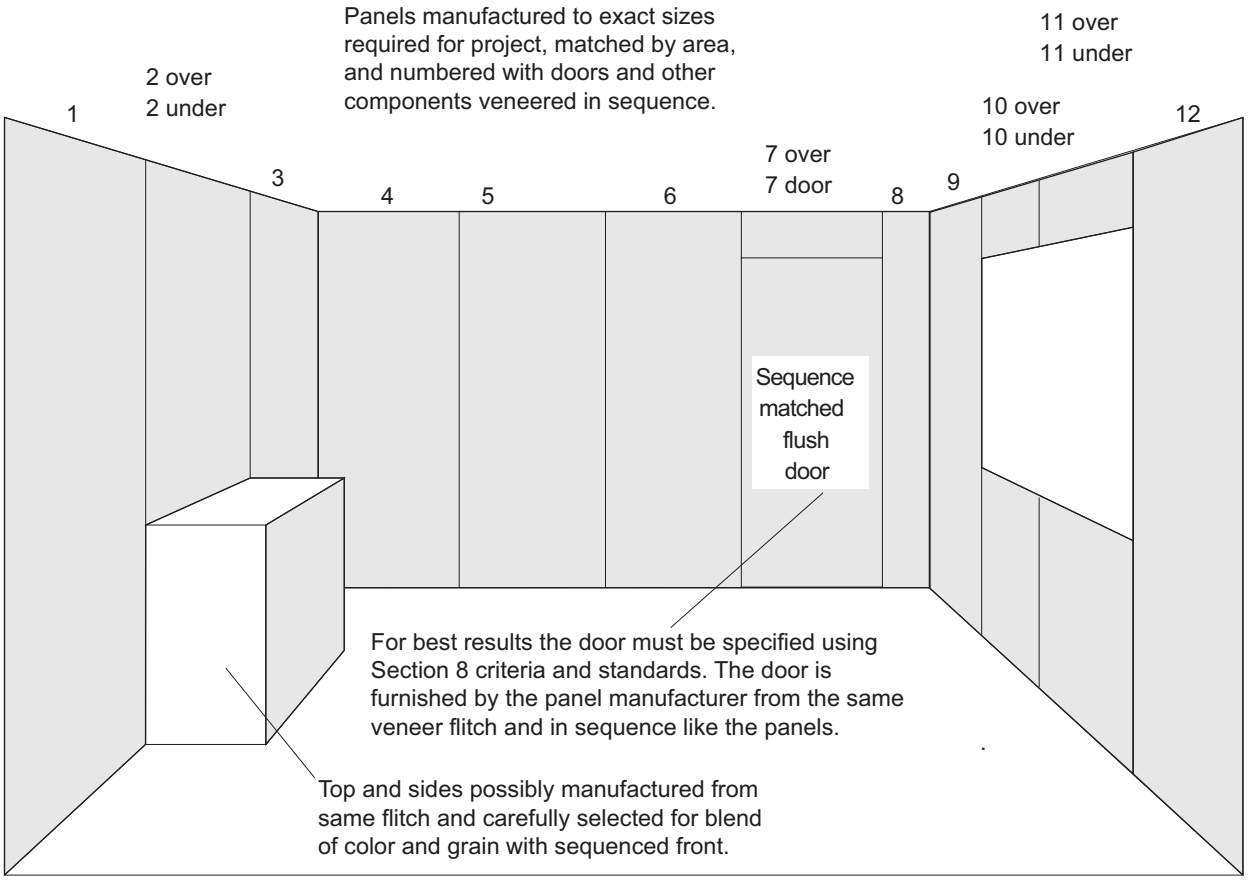
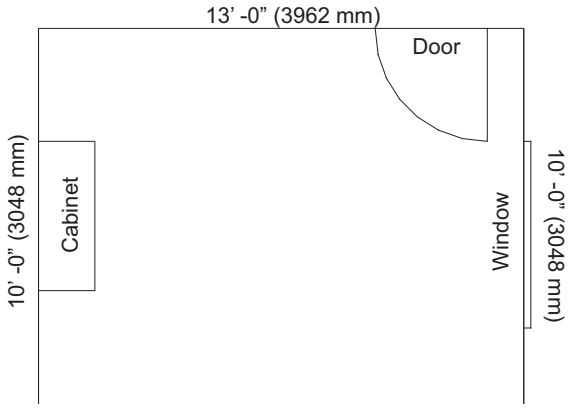
4 - Blueprint Matched Panels and Components



FLOOR PLAN KEY



This method of panel matching achieves maximum grain continuity since all panels, doors, and other veneered components are made to the exact sizes required and in exact veneer sequence. If possible, flitches should be selected that will yield sufficient veneer to complete a prescribed area or room. If more than one flitch is needed, flitch transition should be accomplished at the least noticeable, predetermined location. This method requires careful site coordination and relatively long lead times. Panels cannot be manufactured until site conditions can be accurately measured and detailed. This panel matching method is more expensive and expresses veneering in its most impressive manner.

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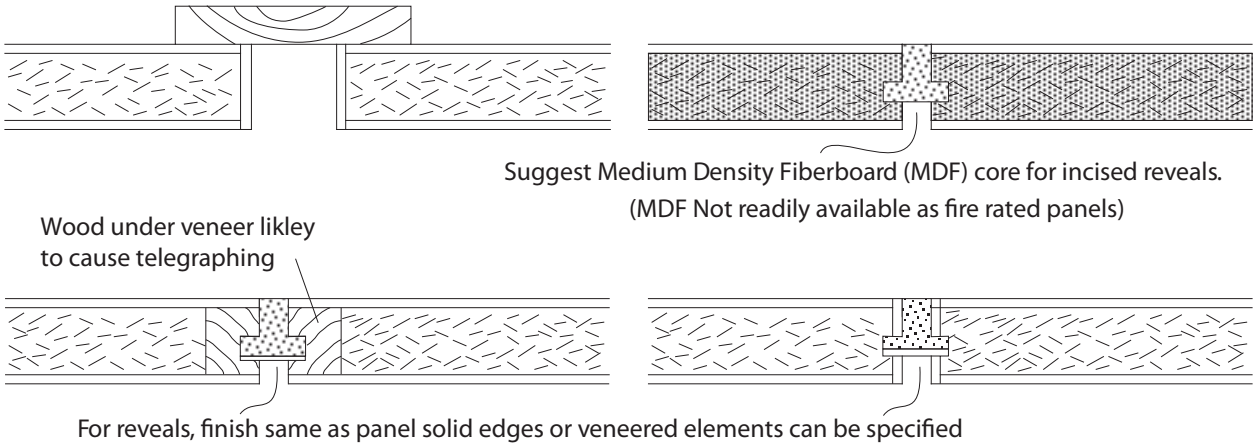
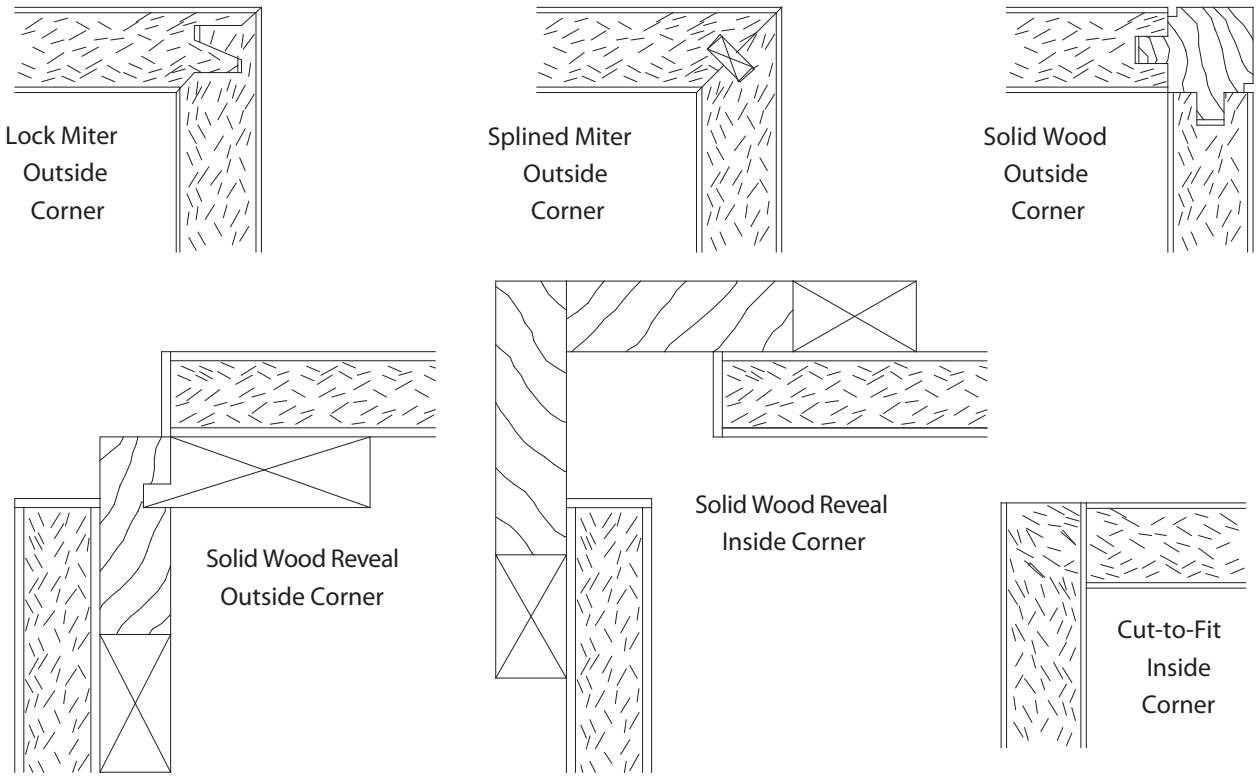
Joints and Transitions





Flitch Selection

NOTE: The architect or designer may choose to see samples of veneer flitches to evaluate color and grain characteristics for other than premanufactured sets. This must be specified. Unless specified, sequence of lamination is determined by the woodworker.

When it is determined that the use of pre-manufactured panel sets is not adequate for the scope of the project, then selecting specific veneer flitches is an option to consider.

When sliced from a log, the individual pieces of veneer are referred to as leaves. These leaves are kept in order as they are sliced and then dried. As the leaves come out of the dryer, the log is literally reassembled. This sliced, dried and reassembled log or parital log is called a flitch. The flitch is given a number and the gross square footage of the flitch is tallied.

To select specific veneer flitches for a project:

1. Determine the net square footage of face veneer required for the project. This should include paneling, casework, built-in furniture items, and when specifying a sequence to a blueprint matched project, the flush doors.

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2. Multiply the net square footage times three (this is the average ratio. Some species require a higher multiplier). Example: 5,000 (net square feet) x 3 = 15,000 square feet; this is the gross square footage that should be sampled for this project.

While this may sound like a daunting quantity of veneer to look through, there is an established process that simplifies the task. When a numbered flitch is sampled, typically, three leaves of veneer are removed from the flitch and numbered sequentially. Starting from the top of the flitch, a leaf is removed from one-third of the way down, then from one-half, and then from two-thirds down in the flitch. These three sequentially numbered leaves of veneer form a representative sample of that flitch.

3. To view a sampling of veneer that will meet the project needs, one should request samples from numbered flitches, that will represent thirty to forty-five thousand square feet of veneer. This means that if the average size of the flitches which are sampled is 2,500 square feet, there will be about 36 to 54 leaves of veneer, representing 12 to 18 flitches of architectural quality veneers.

Since it will take at least 6 flitches, with a gross square footage of 2500 square feet, to meet the project needs, give careful consideration to the following key criteria:

Length - Is the length adequate for the requirements?

Width - What will the net yield for width be from each flitch?

Gross square footage of each flitch - total yield must be 15,000 square feet

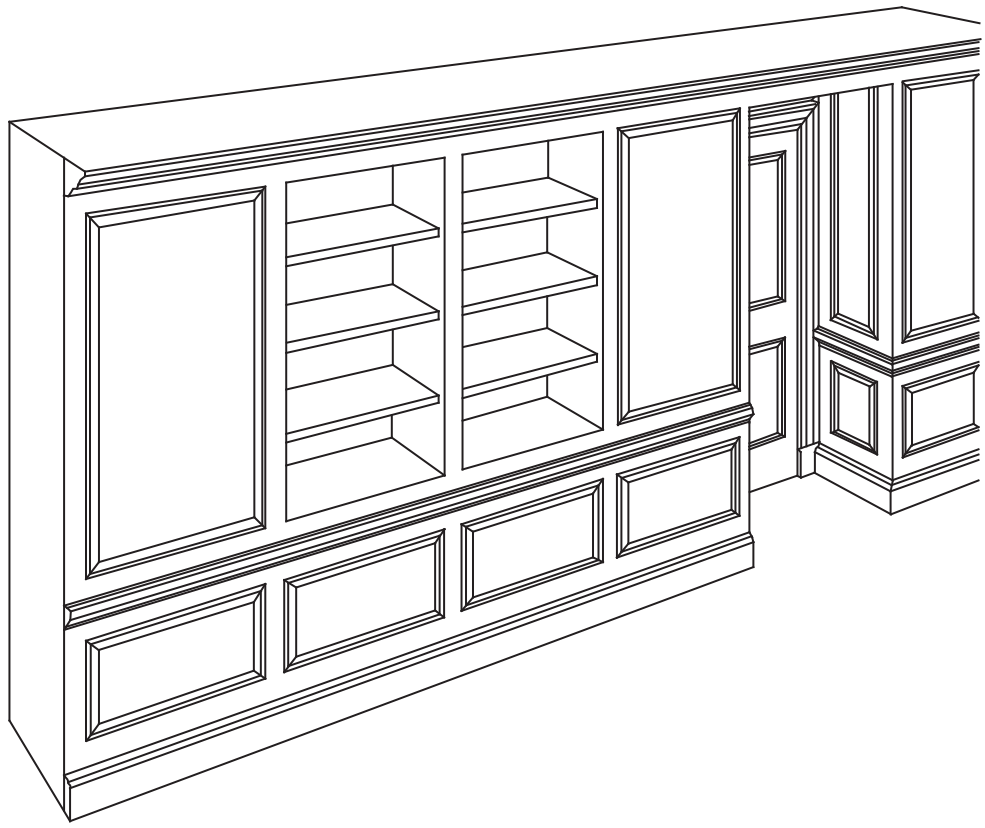
Color and grain compatibility - While exact matching is not possible, from flitch to flitch, this is the opportunity to select the range of color and grain compatibility that will enhance the visual continuity of the entire project.

NOTE: The reality of this process is that the square footage of individual flitches of veneer will probably range from 1,200 square feet up to 3,000 square feet. This means that one may end up selecting 9 or 10 flitches, instead of just 6. But the goal remains the same as in the example: selecting flitches that will satisfy the æsthetic needs, while fulfilling the face veneer requirements for the project.

It is recommended that specifications be written with the foregoing objective in mind. Then, when the project has been awarded to a qualified woodworker, talk directly to the woodworker and be involved in one of the most exciting aspects of bringing the design concepts to reality.

Stile and Rail Paneling

Flat or raised panels with wood veneer faces or of solid lumber, combined with stiles and rails. Design may encompass face application of mouldings. Joints between panels, stiles, rails, and other members to be as designed for functional or decorative purposes.



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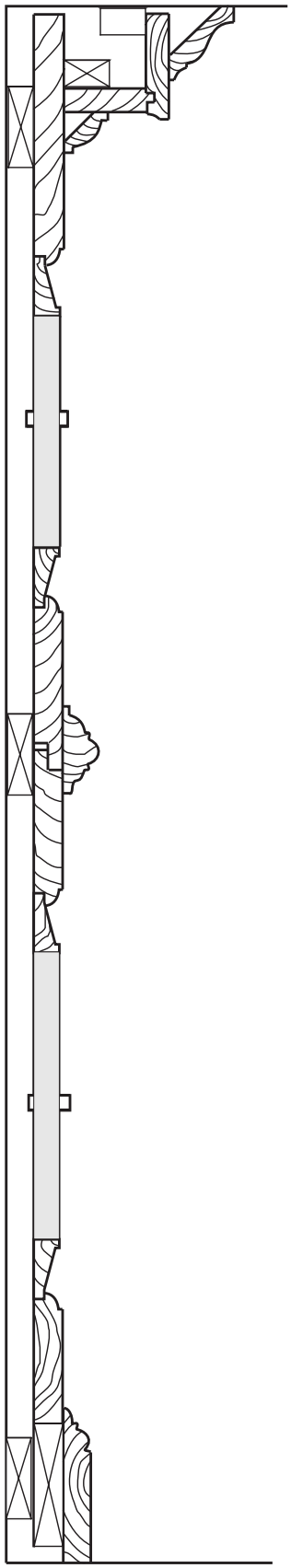
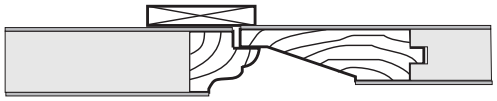
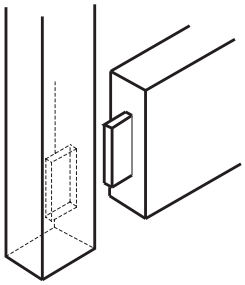


Veneered stile and rail with concealed stile and rail edges and panel rim



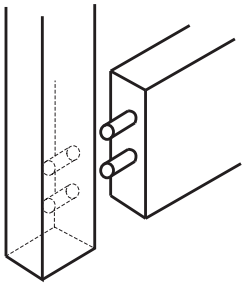
Likely to cause telegraphing through face veneer at lumber joint



Mortise and Tenon construction

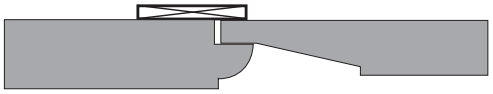
Solid lumber stile and rail with panel products and solid rims

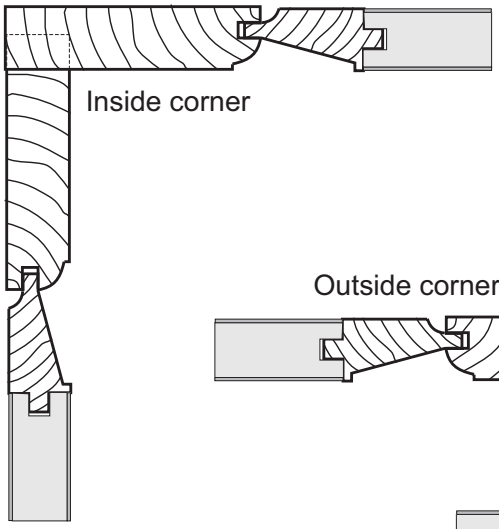
Solid stile and rail with lip moulding and panel product with solid rim



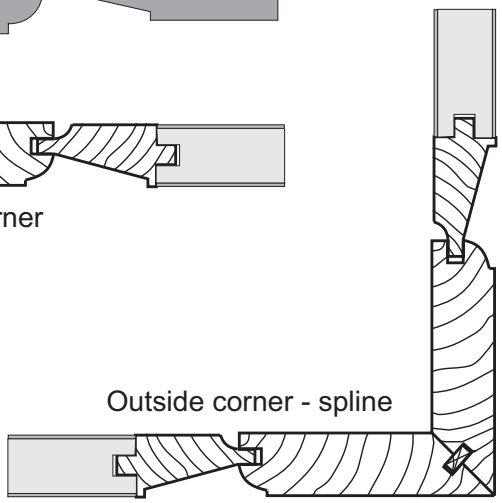
Doweled construction

Medium density fiberboard (MDF) for stiles, rails and panels

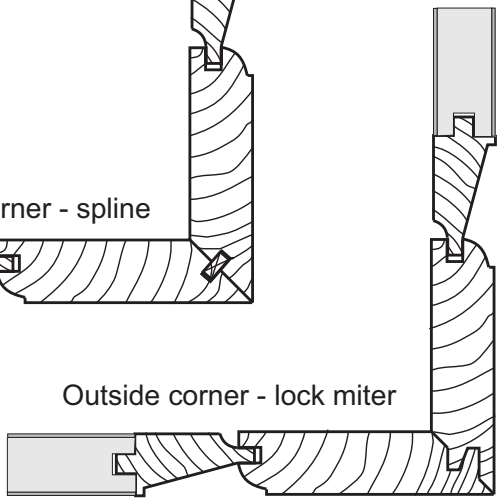




Inside corner



Outside corner - spline



Outside corner - lock miter

8 - Wall Surfacing

Freedom of Expression

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.

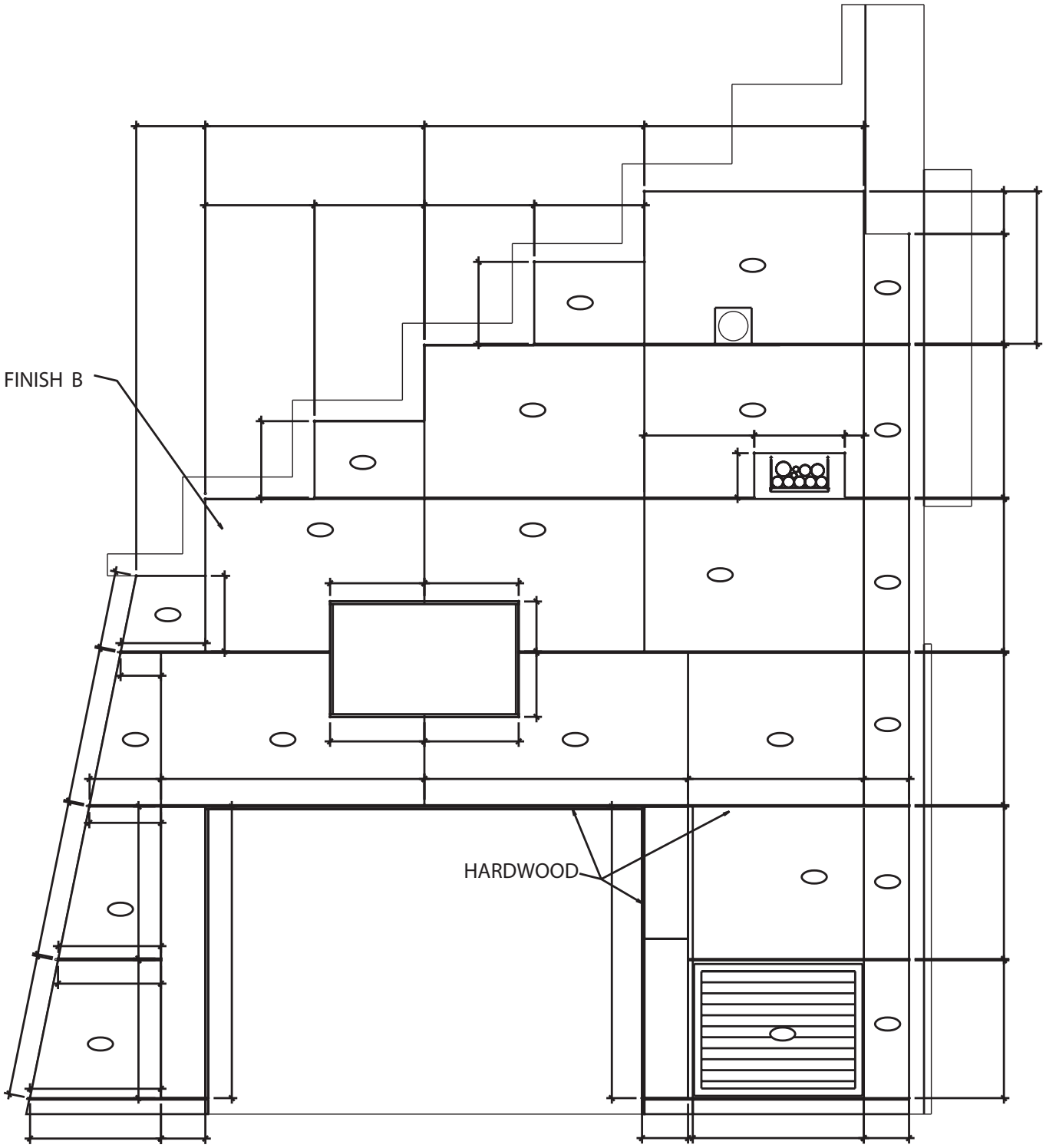
• Complete adaptability: By using custom woodwork, the architect or designer can readily conceal plumbing, electrical and other mechanical equipment without compromising the design criteria.

• 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.

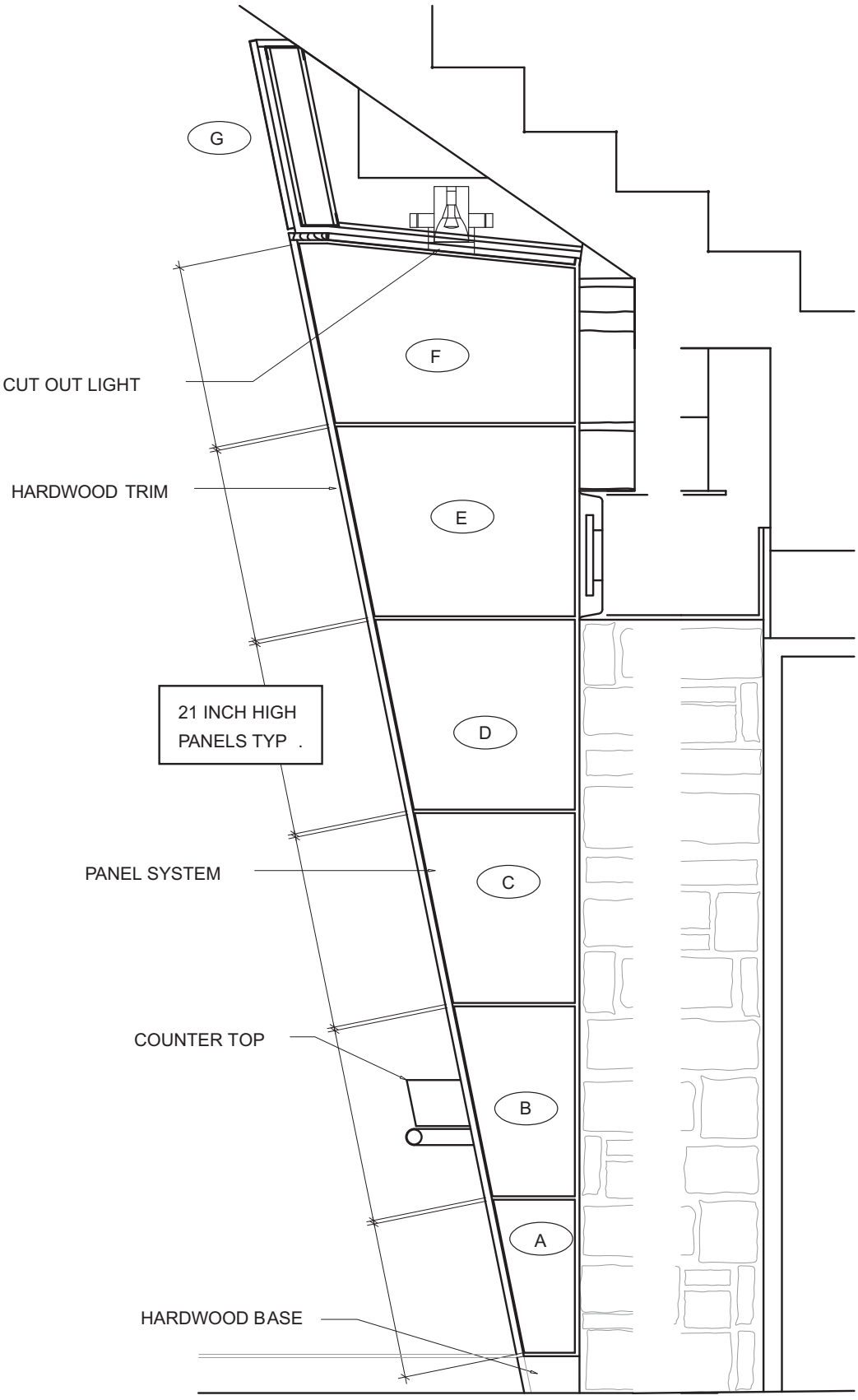
• Dimensional flexibility: Since custom woodwork is normally produced by a specialty architectural woodwork firm, dimensions can easily be changed prior to actual fabrication, if required by job conditions. Special situations such as designing for the disabled can readily be accommodated by the custom architectural woodwork manufacturer.

• Quality assurance: Adherence to the *AWS* and specifications will provide the design professional a quality product at a competitive price.

8 - Wall Surfacing



8 - Wall Surfacing



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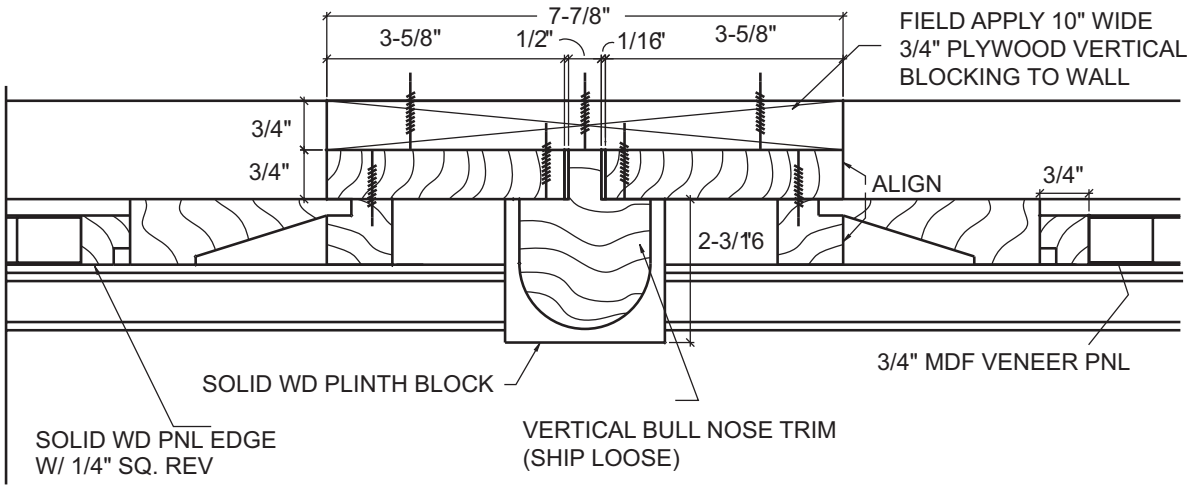

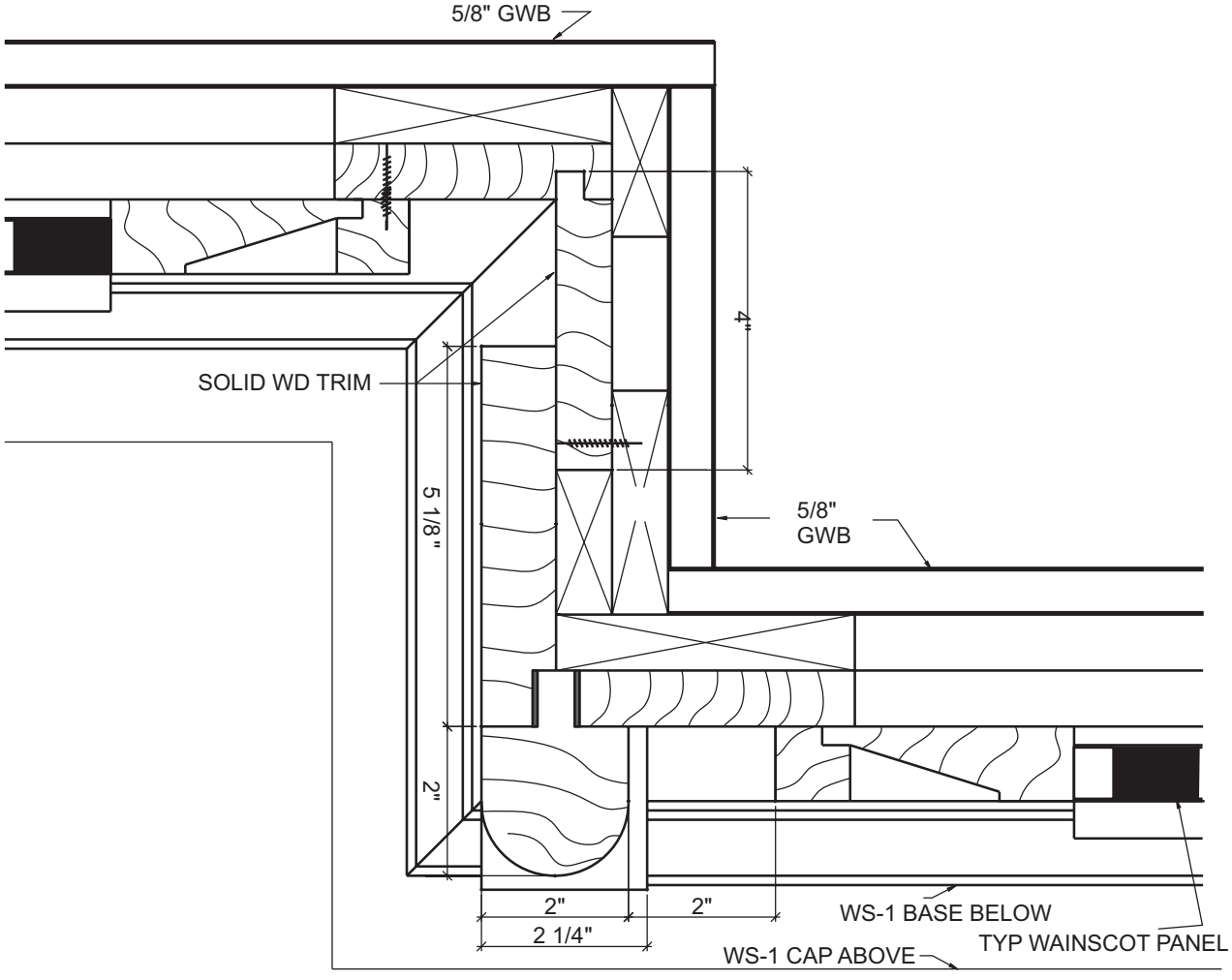

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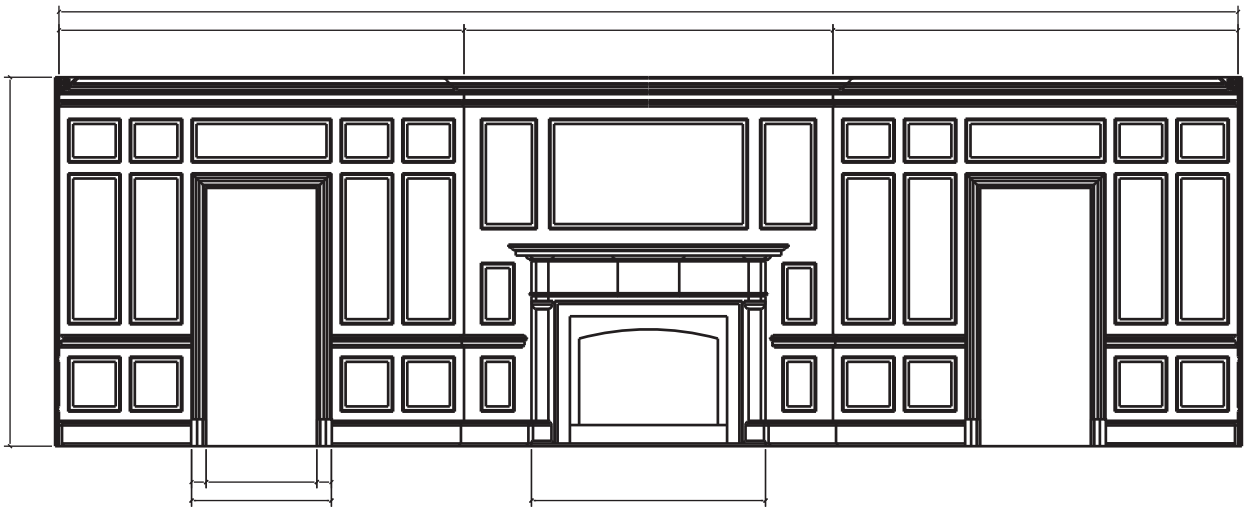
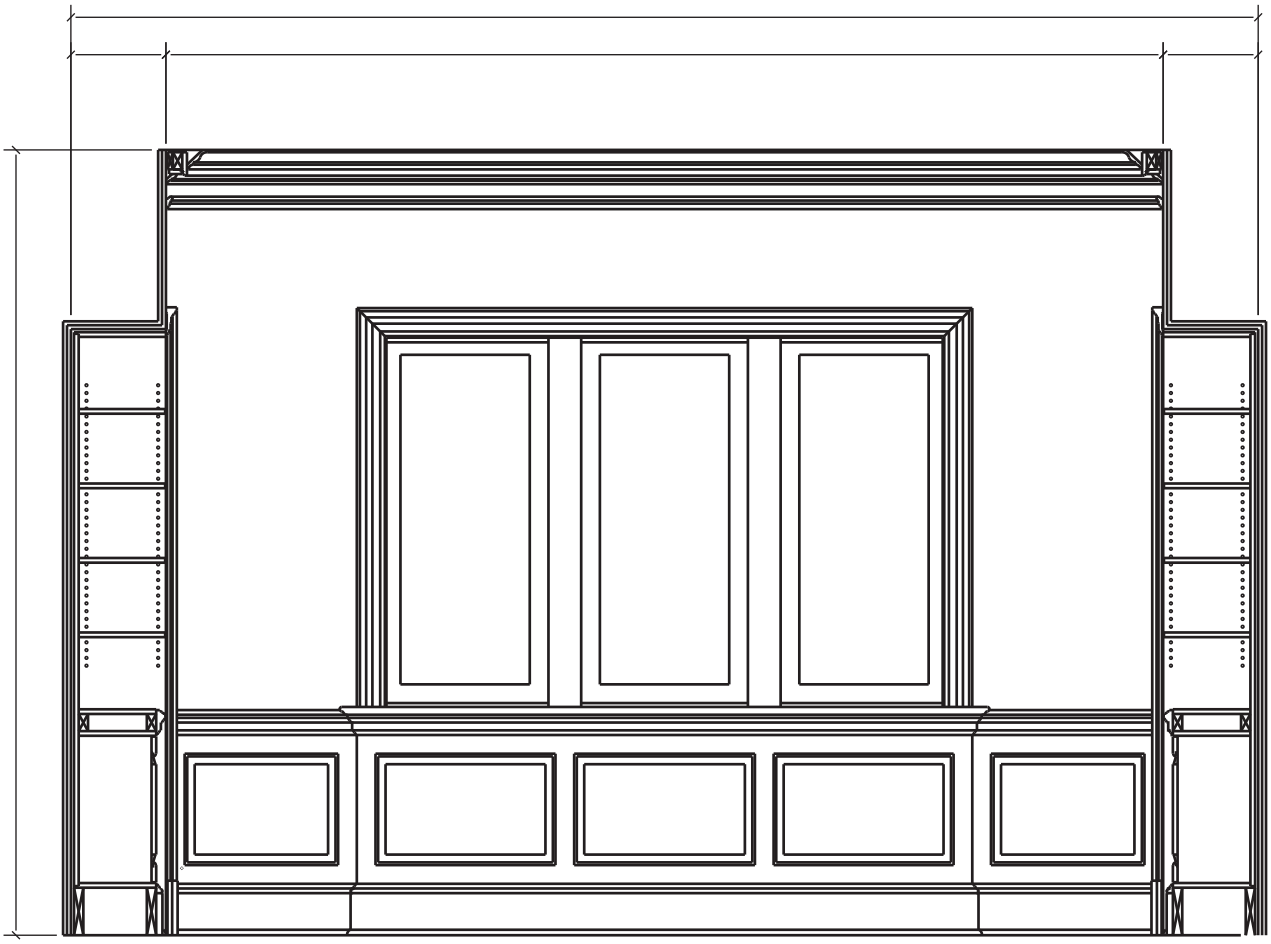
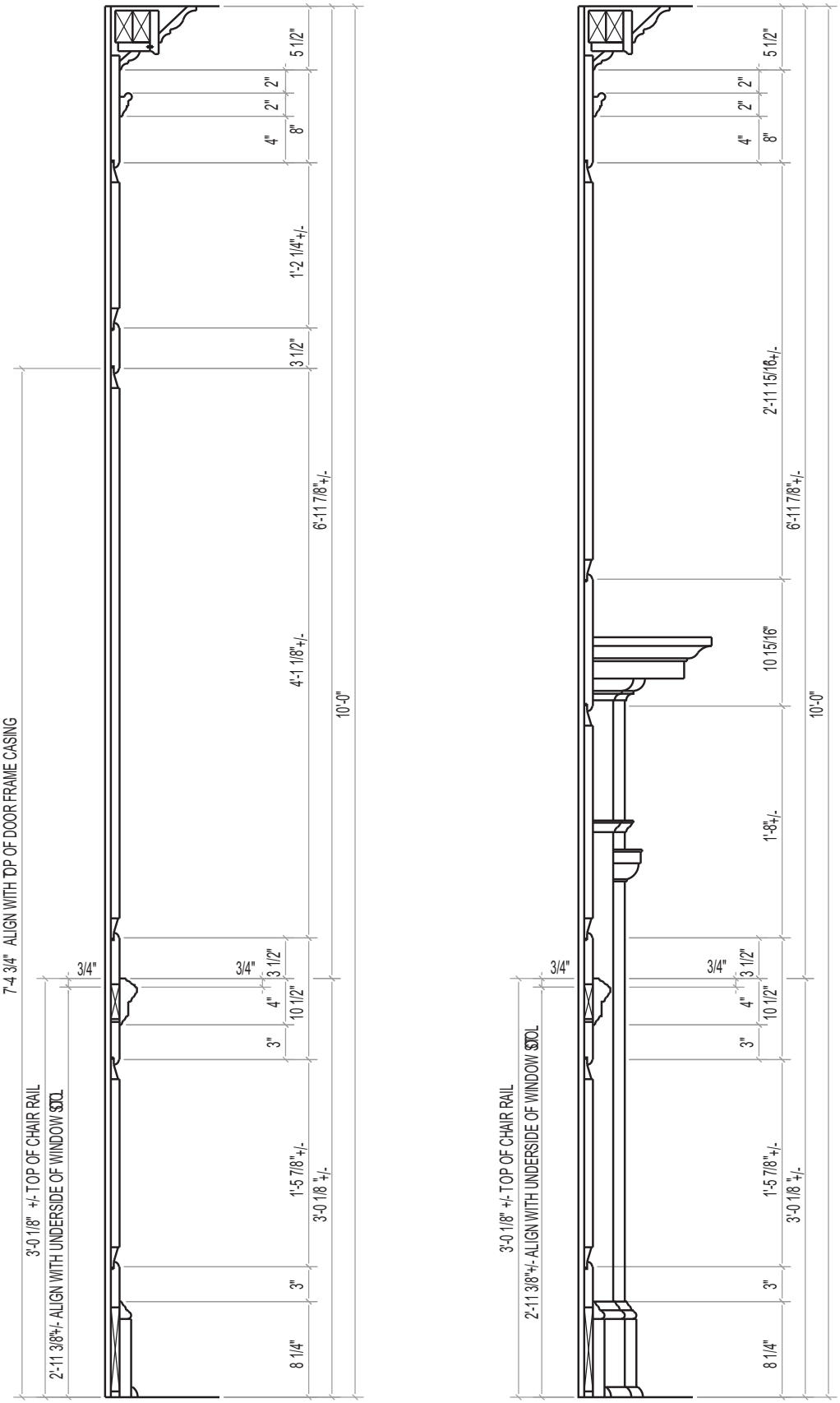
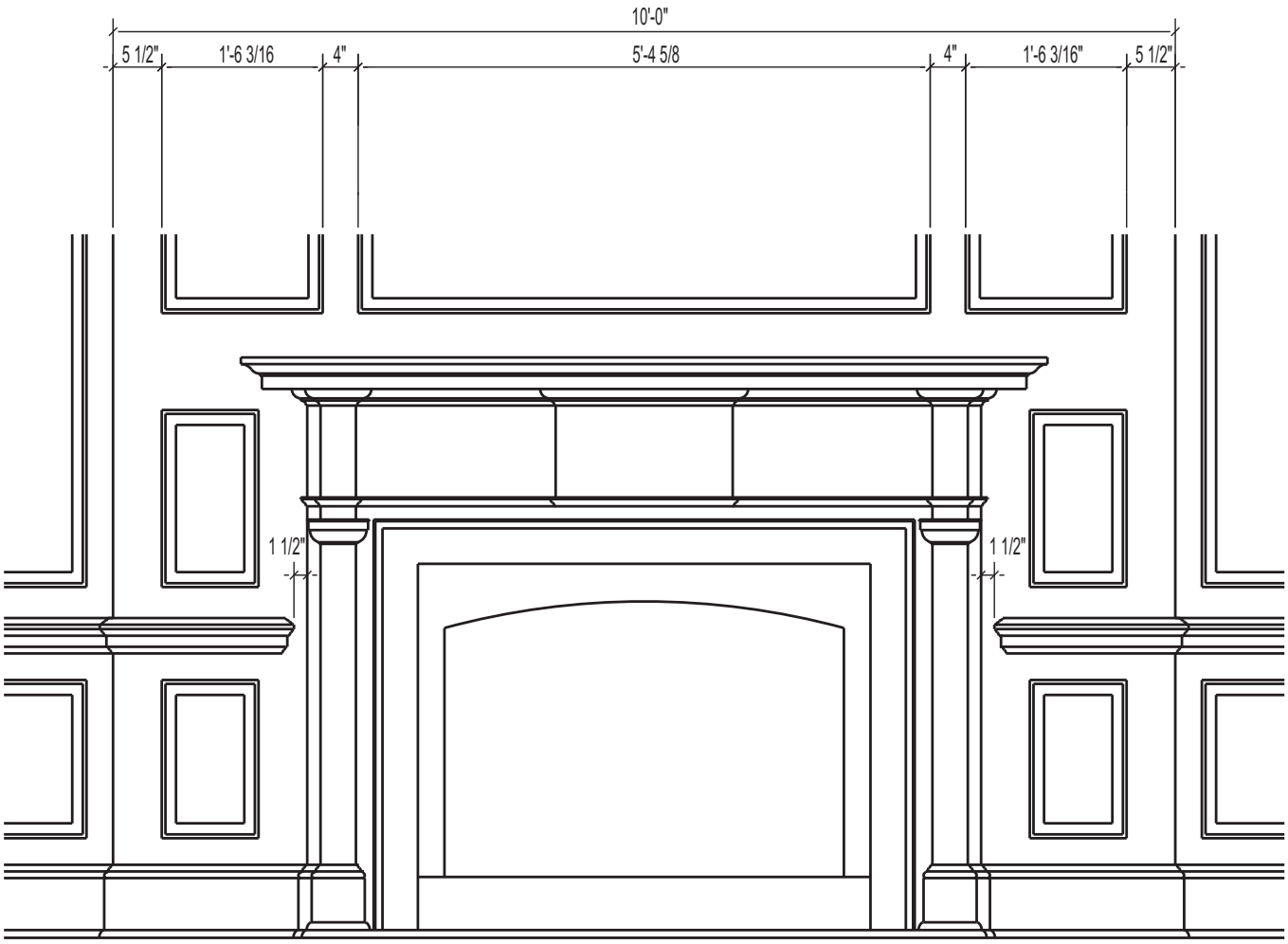




8 - Wall Surfacing



8 - Wall Surfacing



9
Wood Doors

9 - Wood Doors

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

9 - Wood Doors

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.

9 - Wood Doors

APPEARANCE OF INDIVIDUAL PIECES OF VENEER

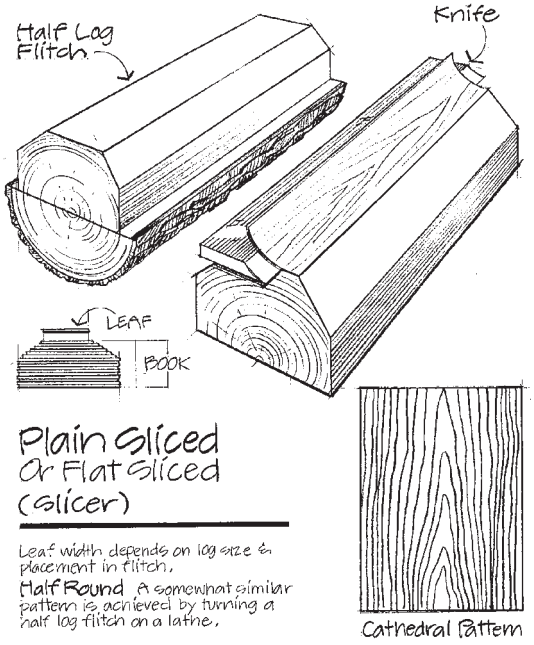
VENEER CUTS

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.

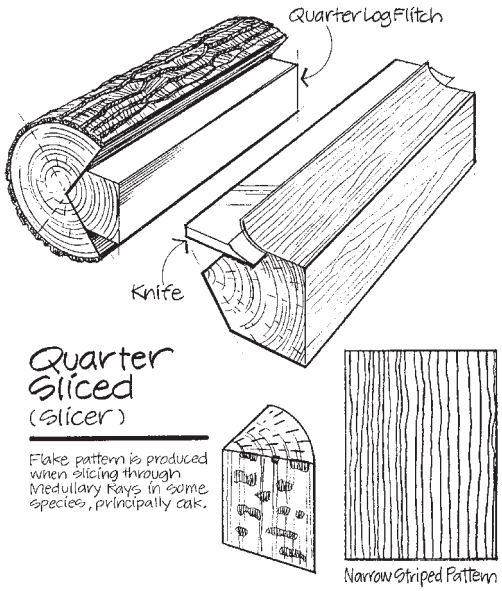
These are representative drawings of real wood veneers. Involve your woodworker early in the design and selection process.

Flat Cut (Plain Sliced)



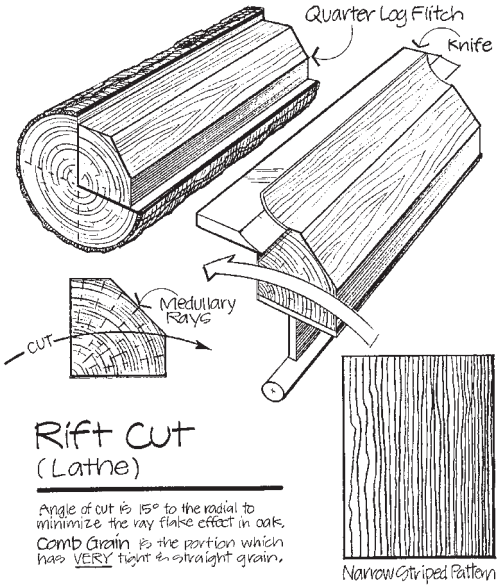
Slicing is done parallel to a line through the center of the log. Cathedral and straight grained patterns result. The individual pieces of veneer are kept in the order they are sliced, permitting a natural grain progression when assembled as veneer faces.

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



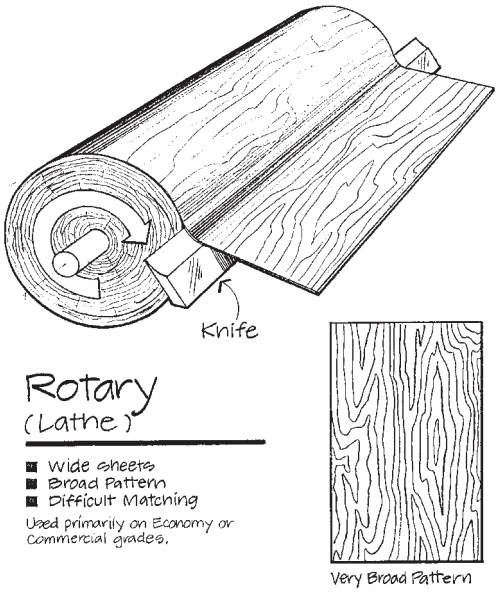
The cut slices slightly across the medullary rays, accentuating the vertical grain and minimizing the “fleck.” Rift grain is restricted to Red Oak and White Oak.

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.

9 - Wood Doors

Rotary



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

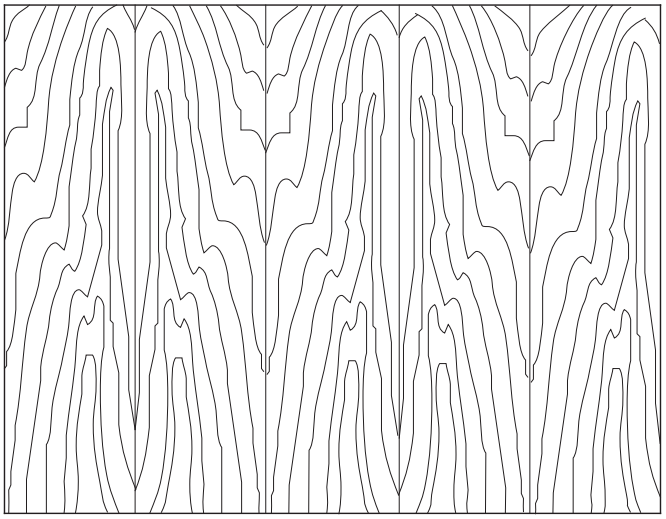
MATCHING BETWEEN INDIVIDUAL PIECES OF VENEER

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.

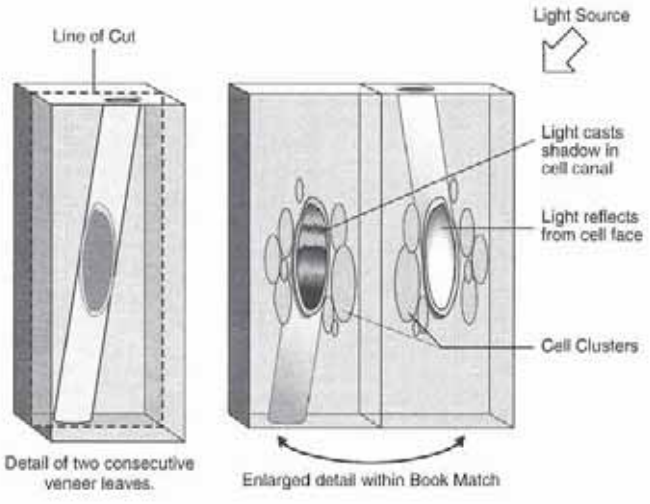
Book Match



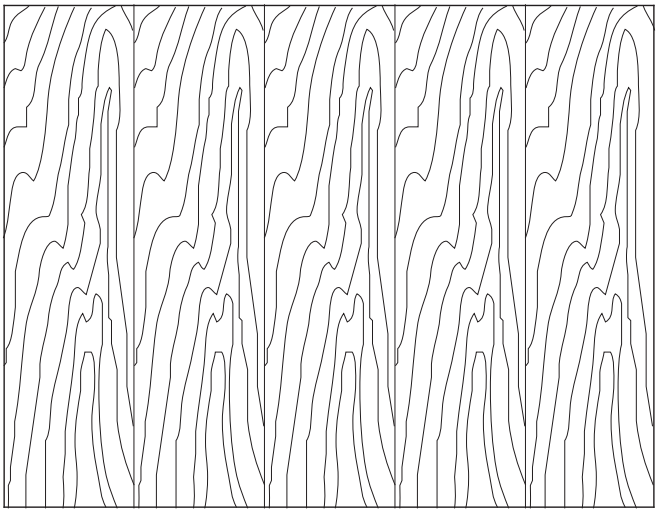
This is the most commonly used match in the industry. Every other piece of veneer is turned over so adjacent pieces are opened like two adjacent pages in a book. The veneer joints match and create a mirrored image pattern at the joint line, yielding a maximum continuity of grain. Book matching is used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



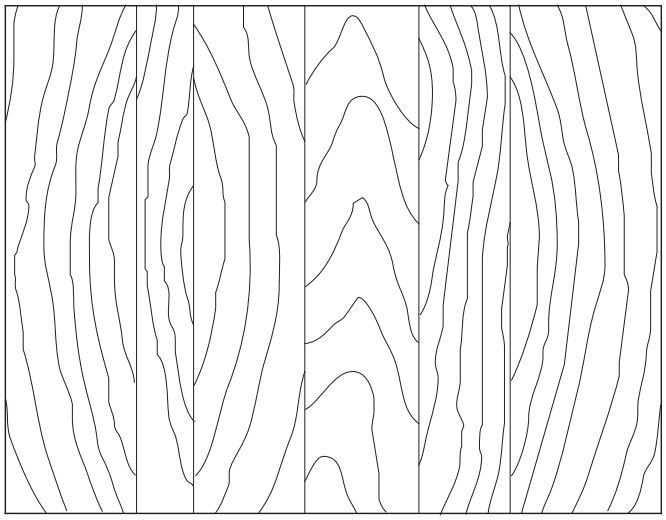
Slip Match



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.

9 - Wood Doors

Random Match

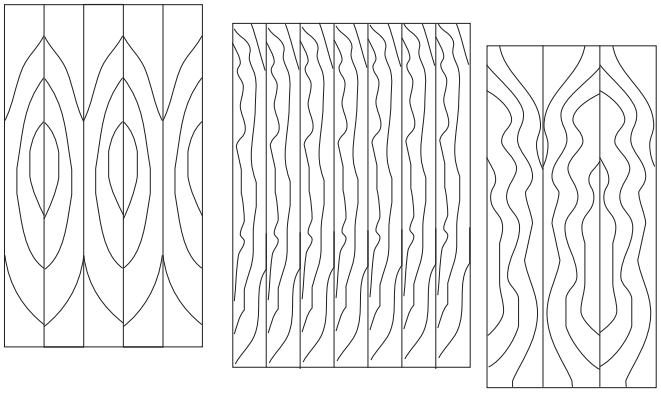


A random selection of individual pieces of veneer from one or more logs. Produces a “board-like” appearance.

ASSEMBLY OF SPLICED VENEER ON A FACE

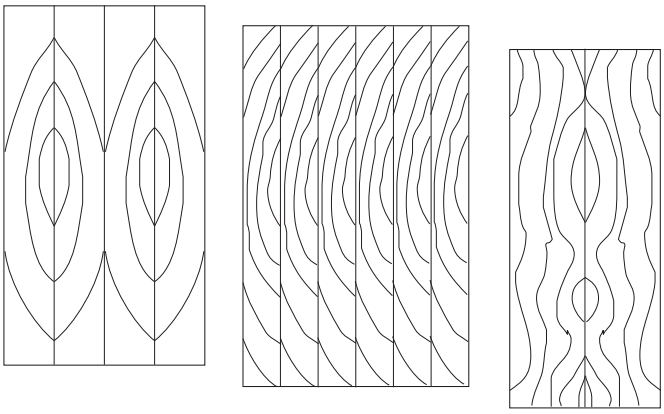
The type of “assembly match” must be specified to obtain a desired appearance. Any sequence matching from opening to opening must be specified. The following three face assembly methods give a wide range of flexibility and cost control to the design professional.

Balance Match



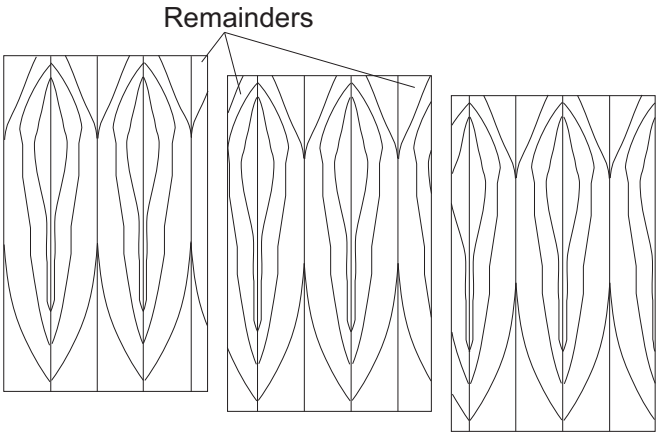
Symmetrical appearance. Each face is assembled from an even or odd number of pieces of uniform width before trimming. This match reduces veneer yield.

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

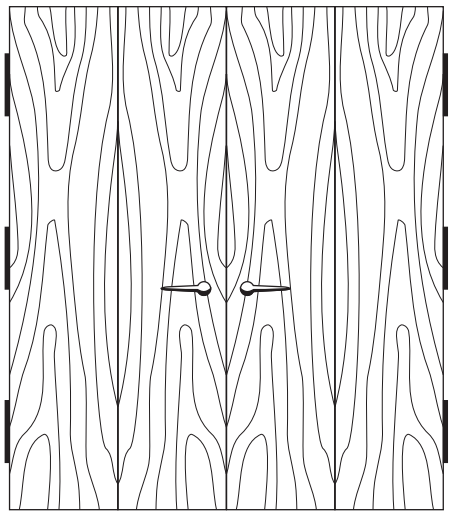


Nonsymmetrical appearance on any single door face. Veneer pieces of unequal width are common. Each face is assembled from as many veneer pieces as necessary.

9 - Wood Doors

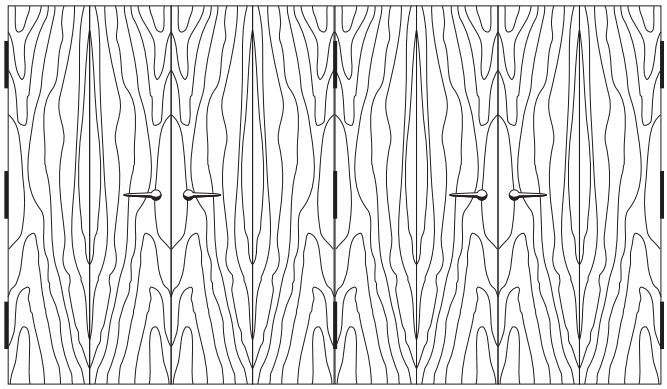
DOORS IN PAIRS OR SETS

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.

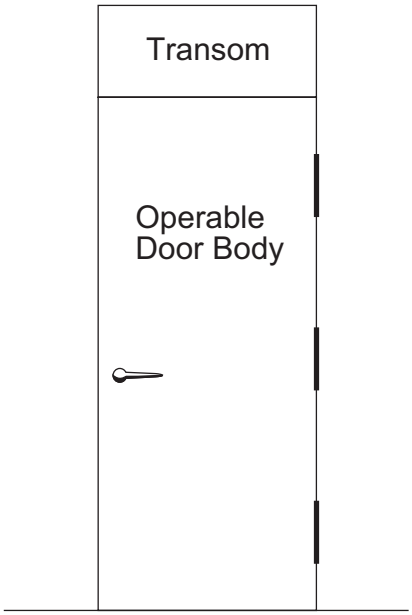
Set Match



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

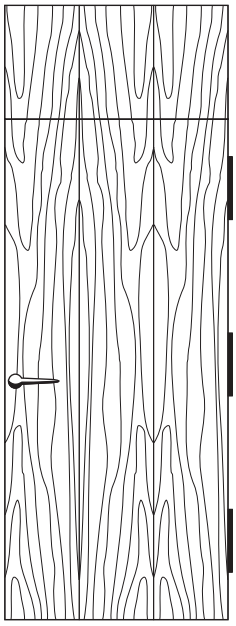
Note to specifiers: The illustration shows book-matched, center balance matched faces. The *AWS* does not require this condition.

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.

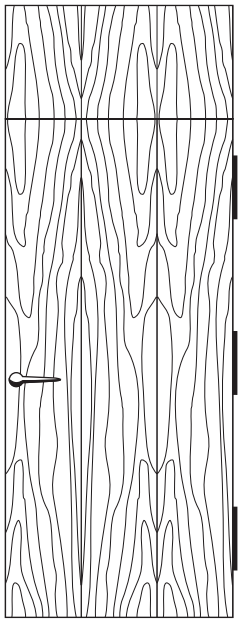
Continuous Match



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.

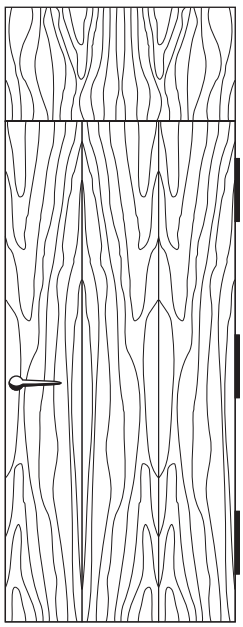
9 - Wood Doors

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.

9 - Wood Doors

Construction Details

General Moulding Requirements

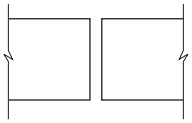
Species shall match or be compatible with face veneer or laminate.

Specify transparent or opaque finish.

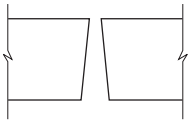
Moulding shall be free of open defects, shake, splits, or doze.

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

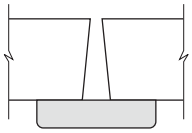
MEETING EDGE OPTIONS



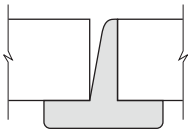
No bevel



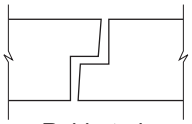
Bevel



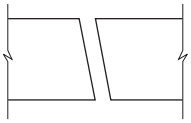
Flat astragal



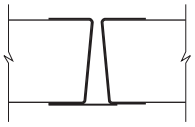
Tee astragal



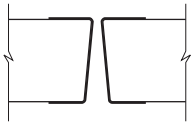
Rabbeted



Parallel bevel
Double egress

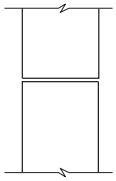


Metal edge guards
and astragal

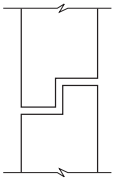


Metal edge guards

TRANSOM MEETING EDGE OPTIONS

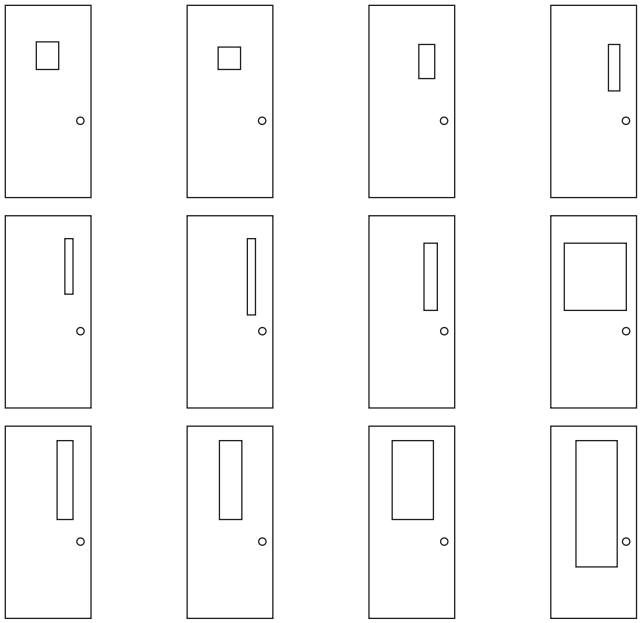


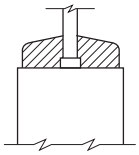
Non-rabbeted

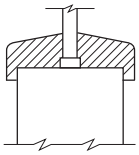


Rabbeted

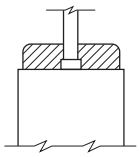
Glazing Options

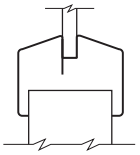






Lip Moulding





Flush Mouldings

Metal vision frame

W = Wood mouldings

M = Metal vision frames

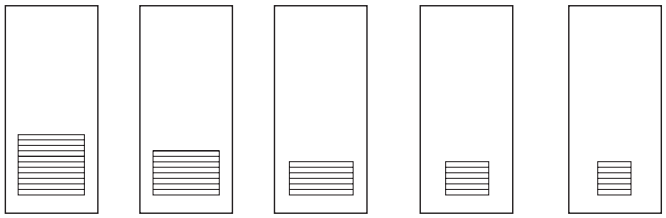
All cutouts for metal or wood vision panels must be a minimum of 6” (152 mm) from the edge of the door and/or other cutouts for louvers, locks, closers, or other hardware for 45-minute though 90-minute doors. 20-minute PC and SLC doors must be a minimum of 5” (127 mm) [5”], and 20 minute SCLC doors must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

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

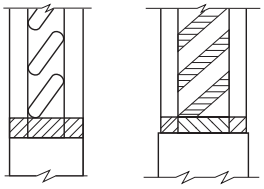
Using a 10” (254 mm) margin between the edge of the door and the edge of any cutout near the lock area will eliminate most label and warranty conflicts.

9 - Wood Doors

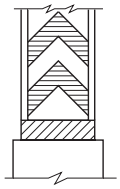
Louver Options



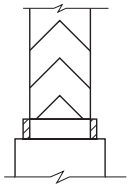
Variety of sizes



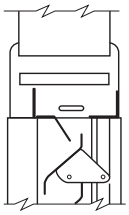
Wood slats



Wood chevrons



Metal chevrons



Fusible link

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

FL = Fusible link louver.

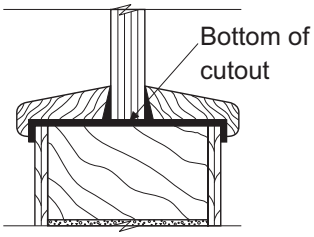
Not allowed by NFPA 80 in means-of-egress fire doors. Generally, fusible link louvers installed in 45, 60, and 90 minute fire-rated doors must comply with individual fire door authorities and ADA requirements.

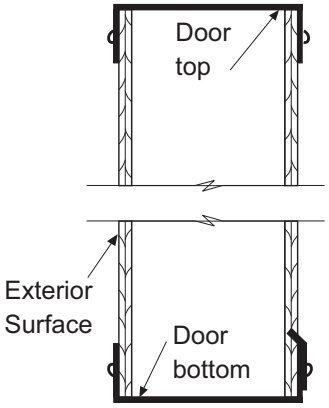
All fusible link louvers must be minimum 8” (203 mm) from the bottom of the door to the bottom of the louver cutout, and 6” (152 mm) from the edge of the louver cutout to the edge of the door and/or other cutouts for vision panels, locks, closers, or other hardware.

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.

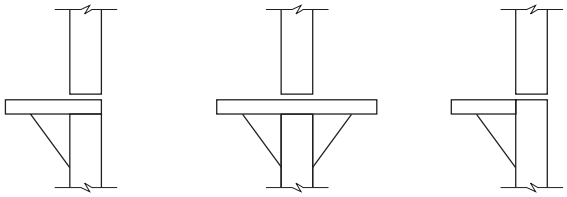
Flashings



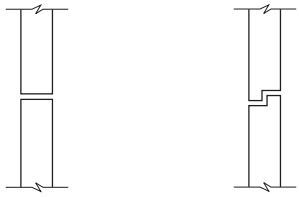


If the woodworker is to flash the top of the door or the bottom edge of cutouts for exterior doors, it must be specified.

Dutch Door Options



One sideshelf Two sideshelf 20-Min. shelf

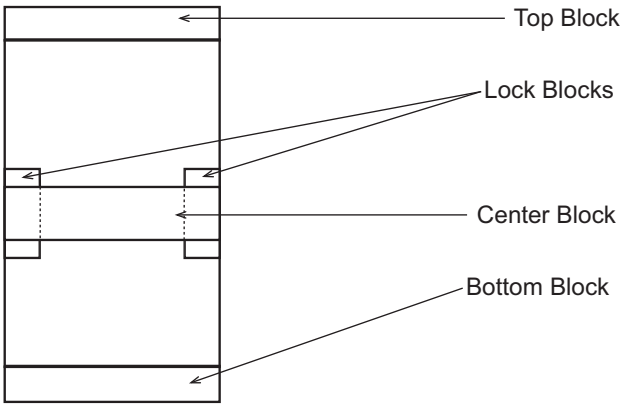


No shelf Rabbeted meeting rails

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.

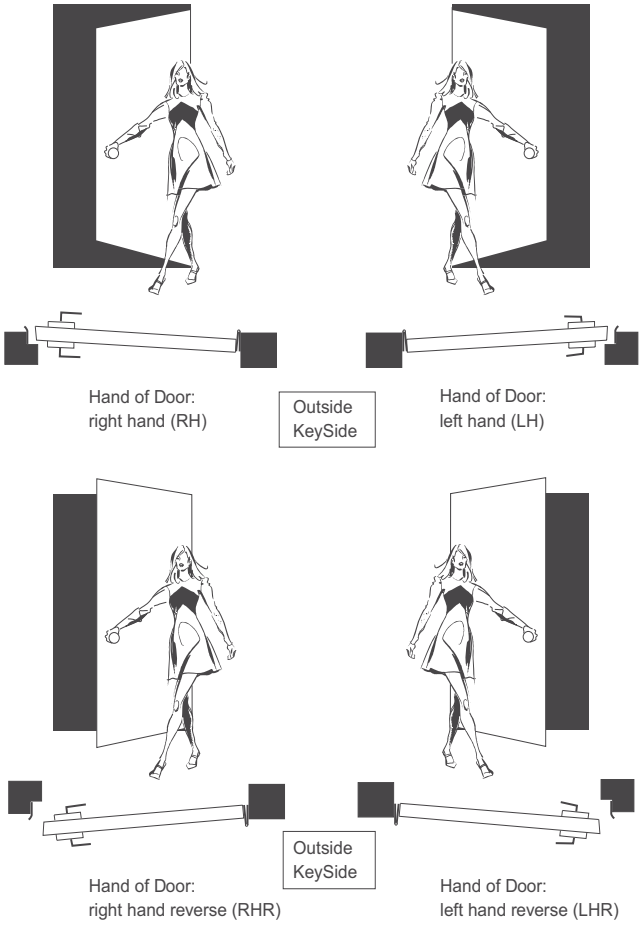
Fire-Retardant Salts

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.

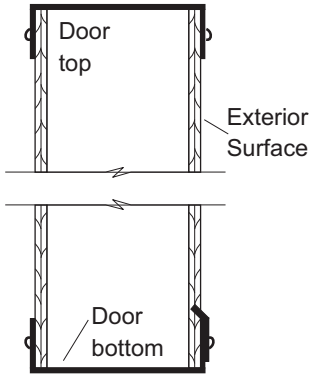
NOTE: Your door manufacturer is the best source of specific guidance when writing door specifications.

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.

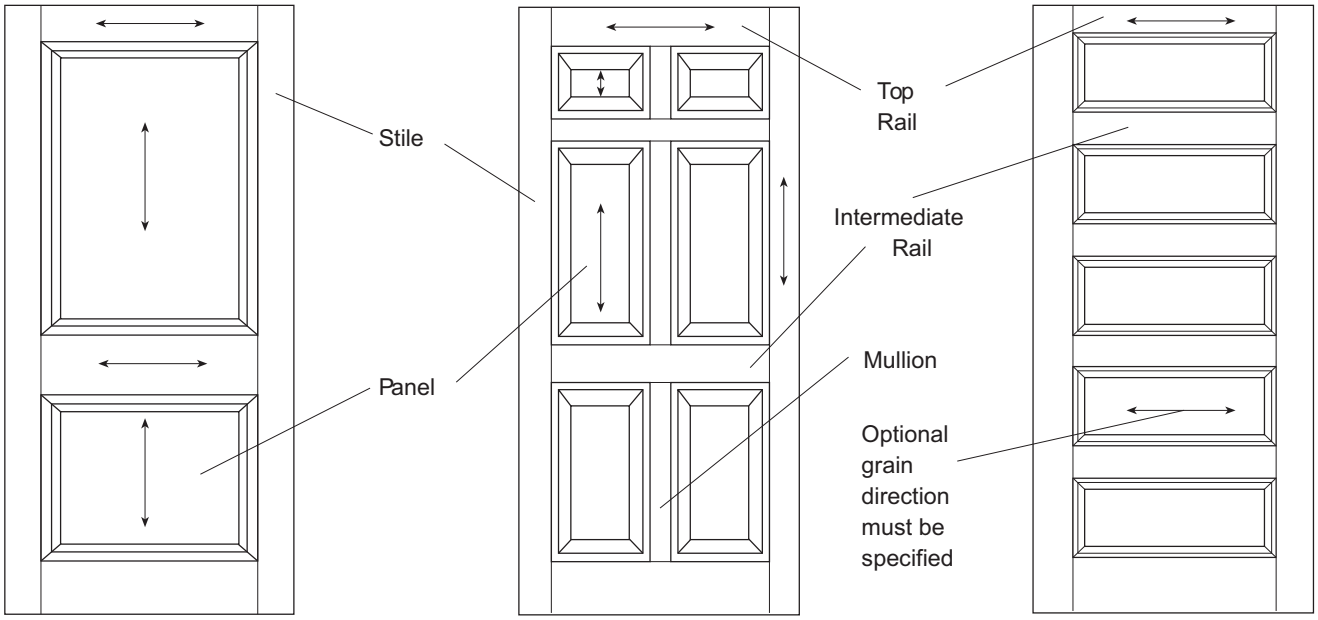
Custom-designed stile and rail doors offer many opportunities for creativity and choice. Some of the variables include:

- 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.

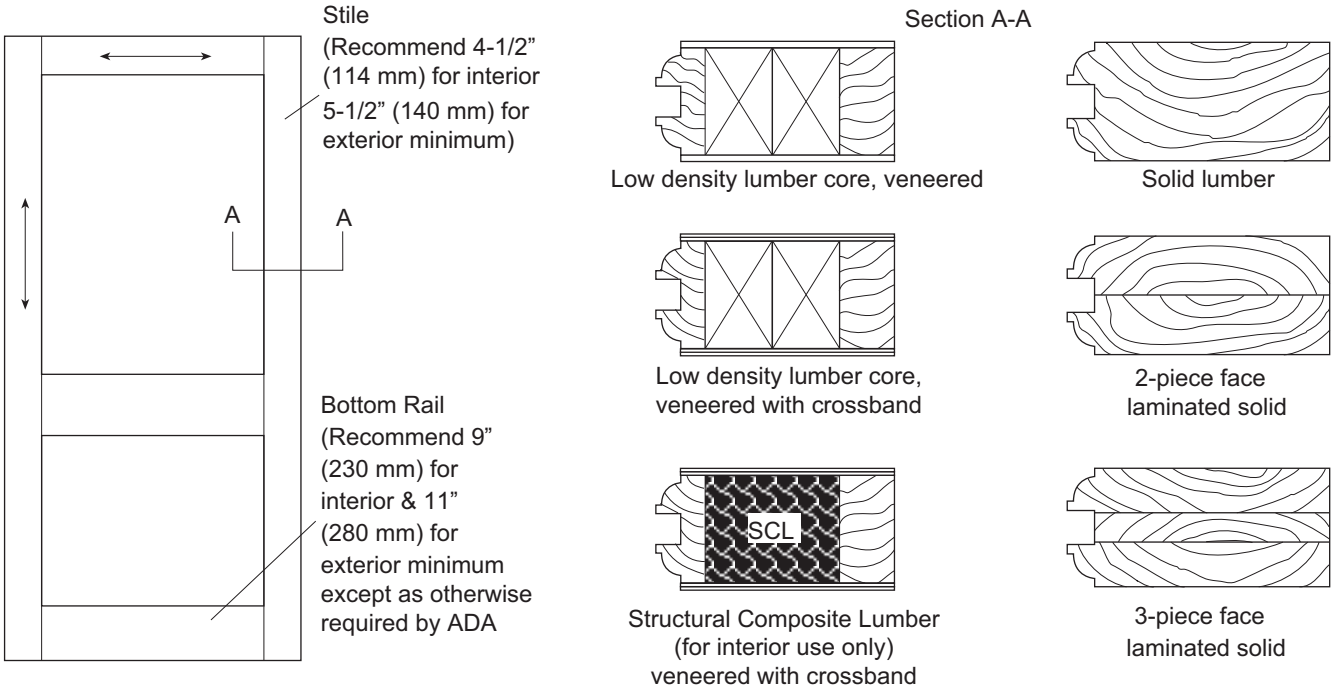
9 - Wood Doors

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.

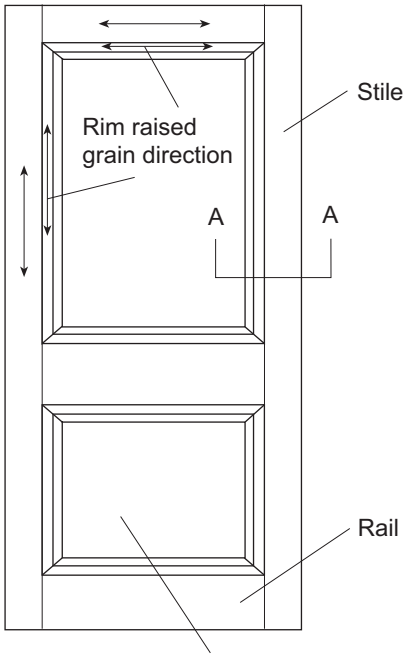
Stile and Rail Construction



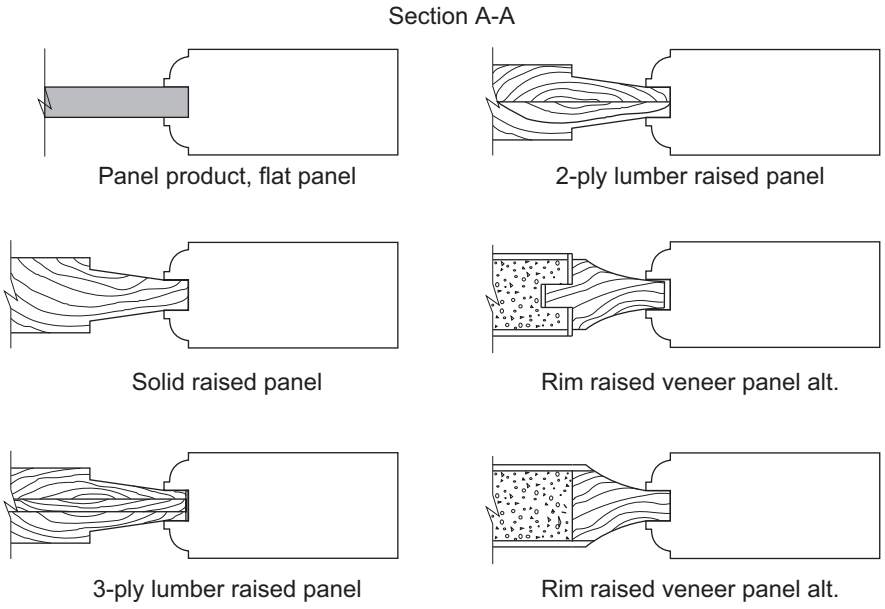
There are a variety of methods of stile and rail fabrication. It is possible to fabricate stile and rail doors that will perform within the tests established in this Standard using any of the illustrated techniques and others.

9 - Wood Doors

Panel Construction



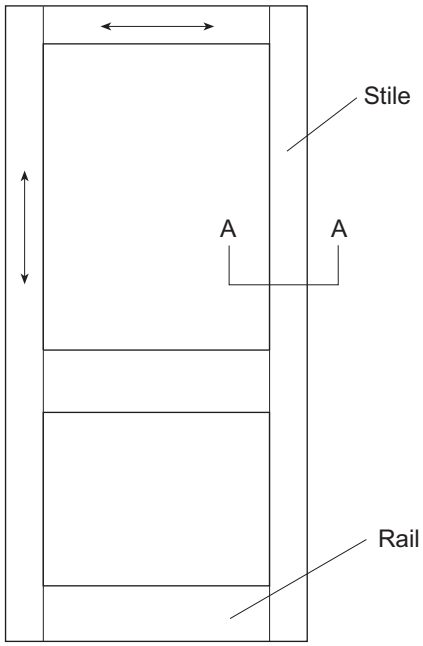
Flat or Raised panel

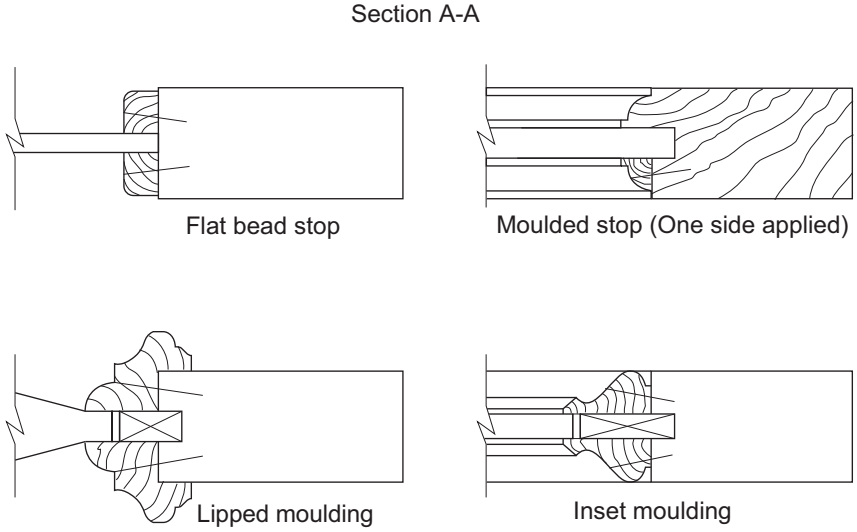


Other configurations may be available

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

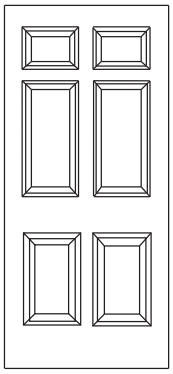


Fig. 1400-D-1

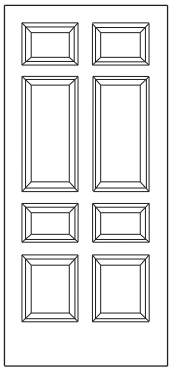
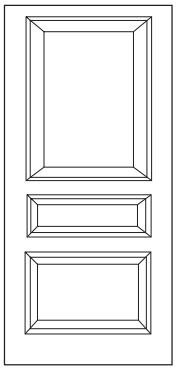


Fig. 1400-D-2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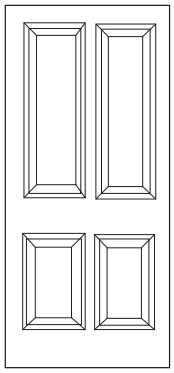


Fig. 1400-D-4

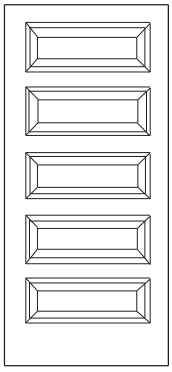
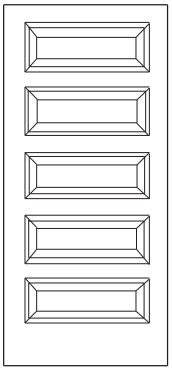


Fig. 1400-D-5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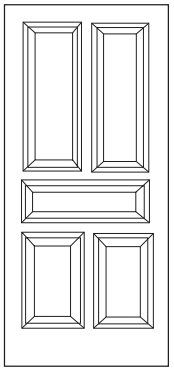
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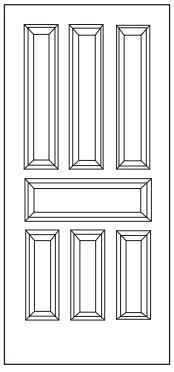
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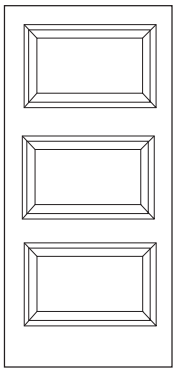
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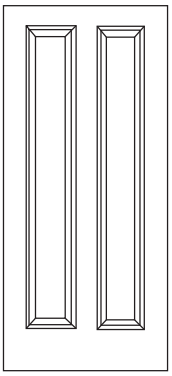
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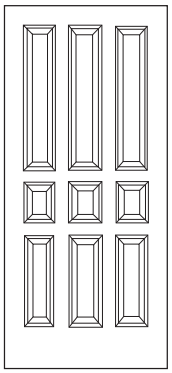
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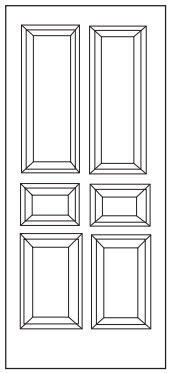
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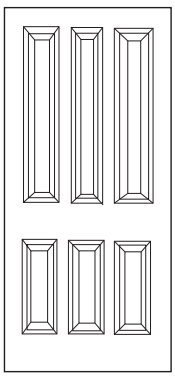
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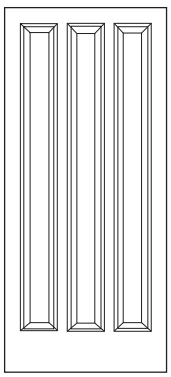
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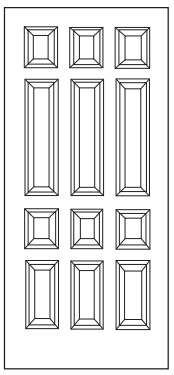
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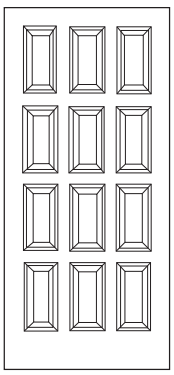
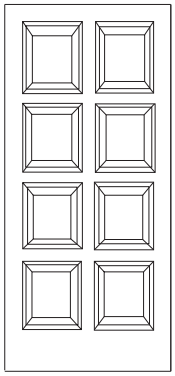


Fig. 1400-D-16

9 - Wood Doors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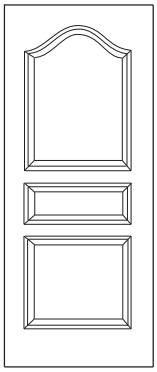
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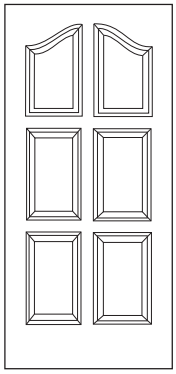
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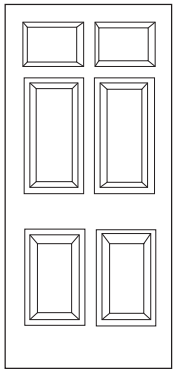
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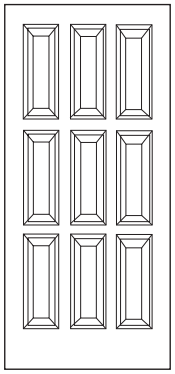
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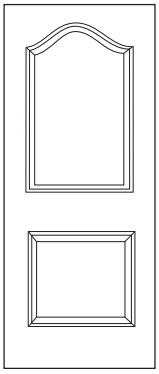
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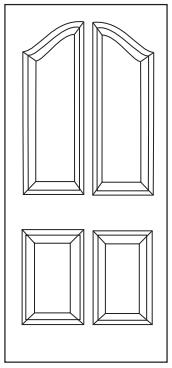
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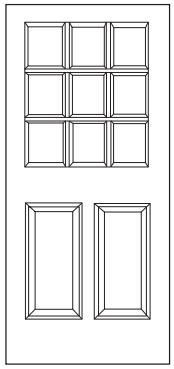
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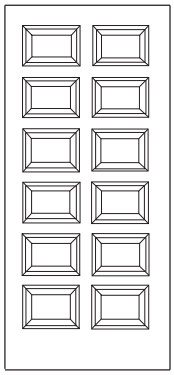
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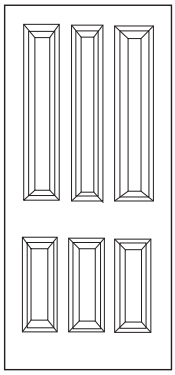
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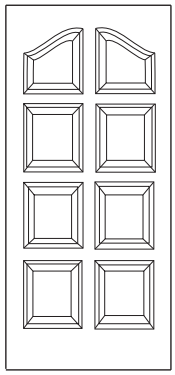
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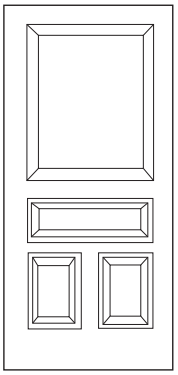
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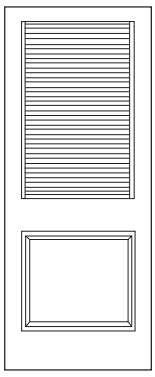
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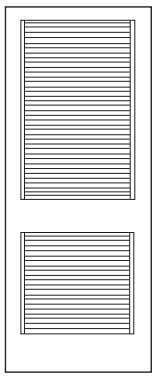
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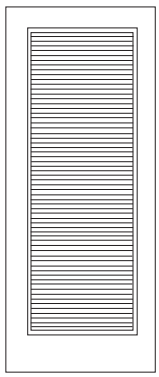
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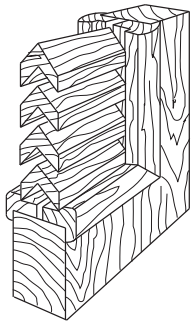


Fig. 1400-D-32

9 - Wood Doors

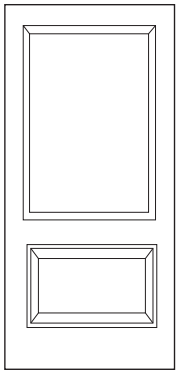


Fig. 1400-D-33

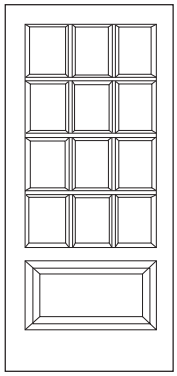
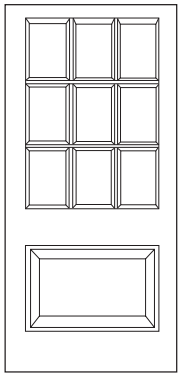


Fig. 1400-D-34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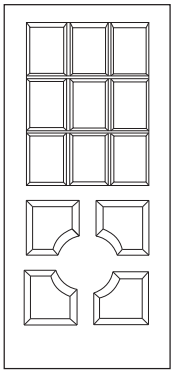
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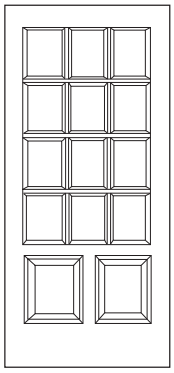
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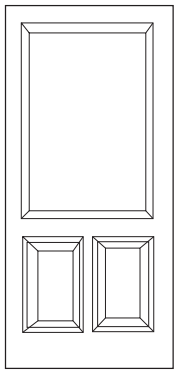
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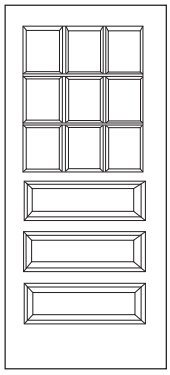
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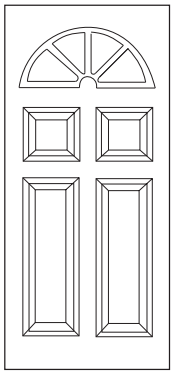
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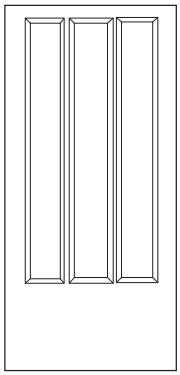
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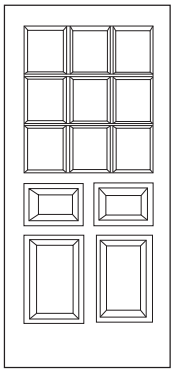
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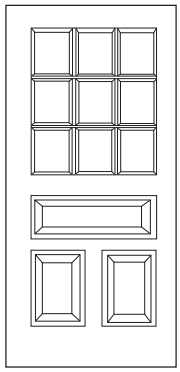
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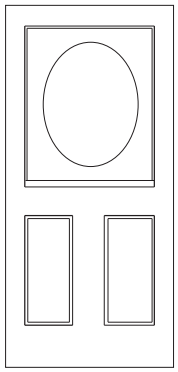
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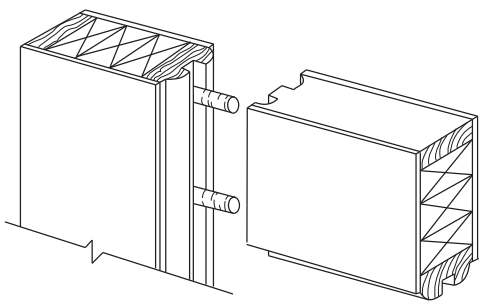
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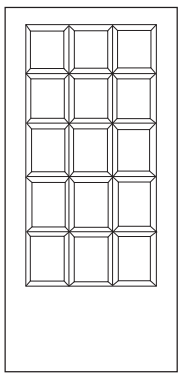
Fig. 1400-D-46

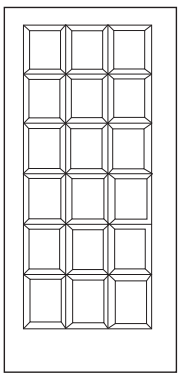
Fig. 1400-D-47

9 - Wood Doors

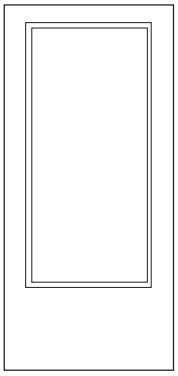

Fig. 1400-D-48

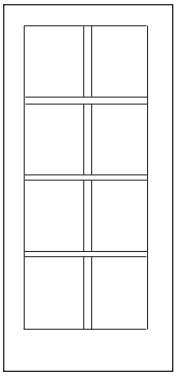

Fig. 1400-D-49

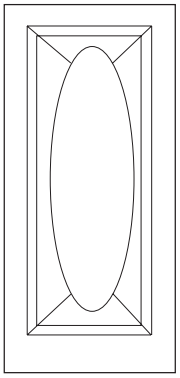

Fig. 1400-D-50

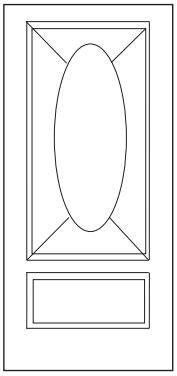

Fig. 1400-D-51

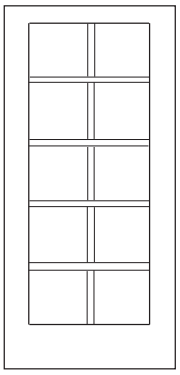

Fig. 1400-D-52

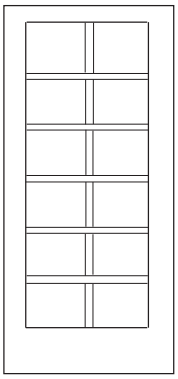

Fig. 1400-D-53

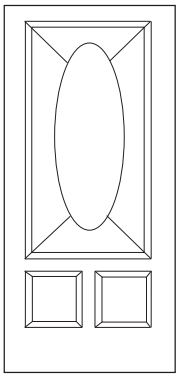

Fig. 1400-D-54

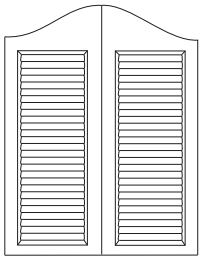

Fig. 1400-D-55

NOTES

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Casework

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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.

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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.

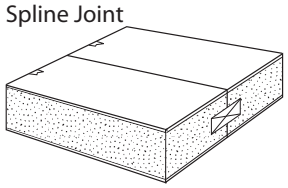
Stop Dado: Another method of concealing dado exposure. Applicable when veneer edging or solid lumber is used. Exposed End Detail illustrates attachment of finished end of case body to front frame using butt joint.

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

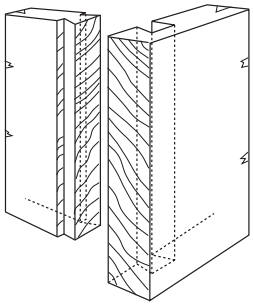
Edge Banding: Method of concealing plies or inner cores of plywood or particleboard when edges are exposed. Thickness or configuration will vary with manufacturers' practices.

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.

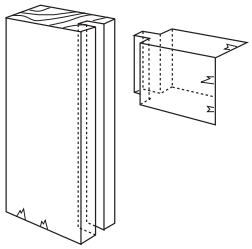
Spline Joint



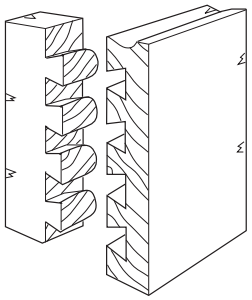
French Dovetail Joint



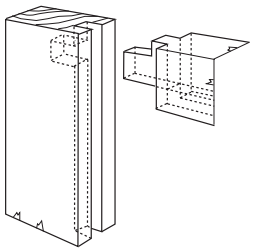
Stub Tenon



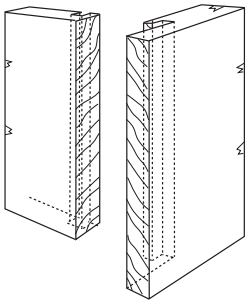
Conventional Dovetail Joint



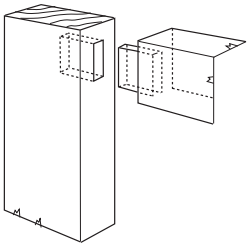
Haunch Mortise and Tenon Joint



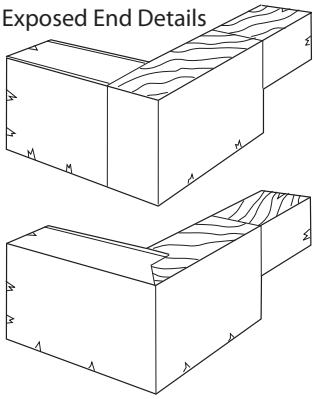
Drawer Lock-Joint



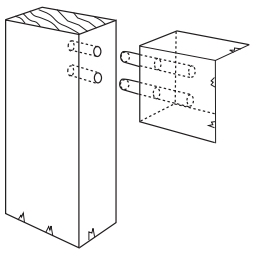
Conventional Mortise and Tenon Joint



Exposed End Details



Dowel Joint



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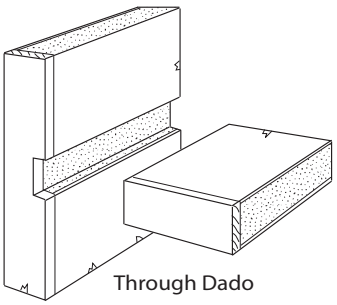
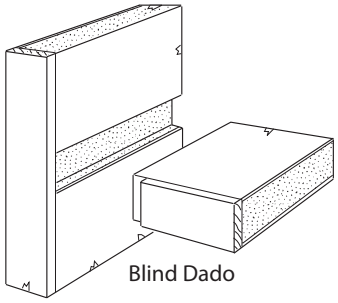
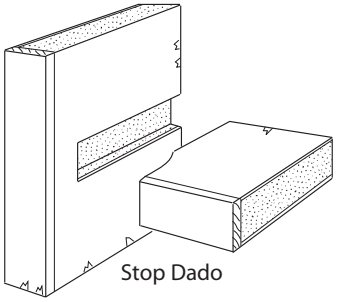


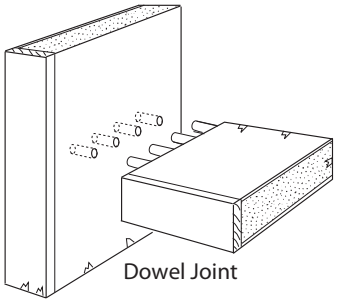
Through Dado



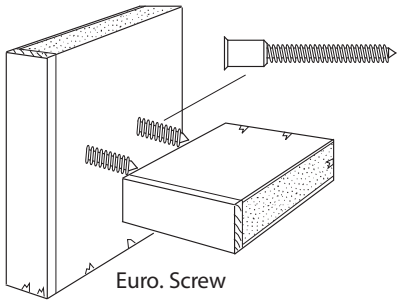
Blind Dado



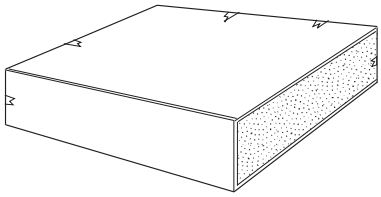
Stop Dado



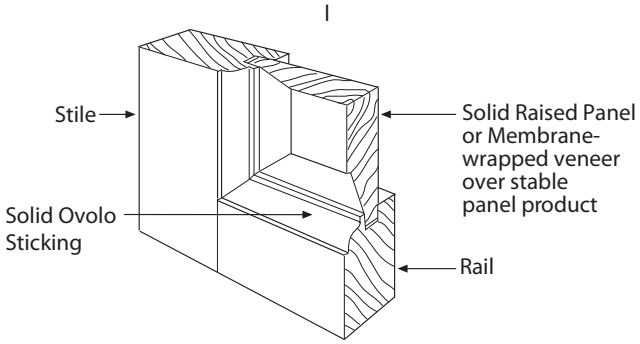
Dowel Joint



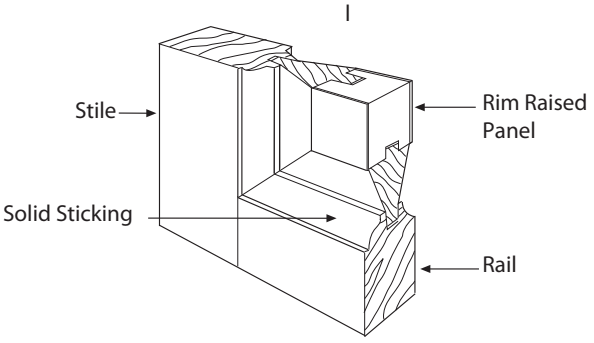
Euro. Screw



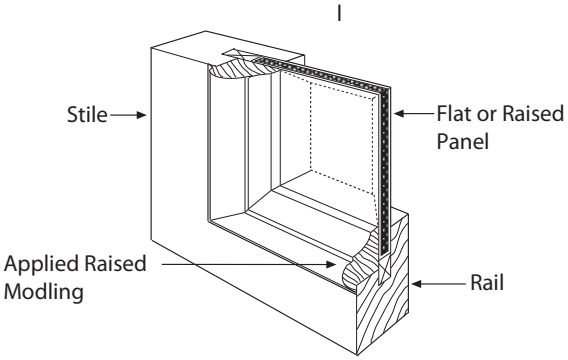
Edge Banding



Paneled Door Detai



Paneled Door Detai



Paneled Door Detai

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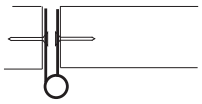
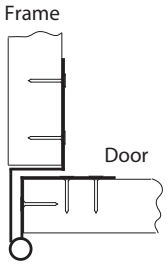
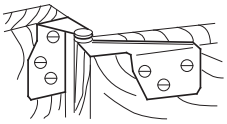
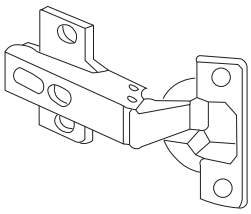
Hinge Selection Guide

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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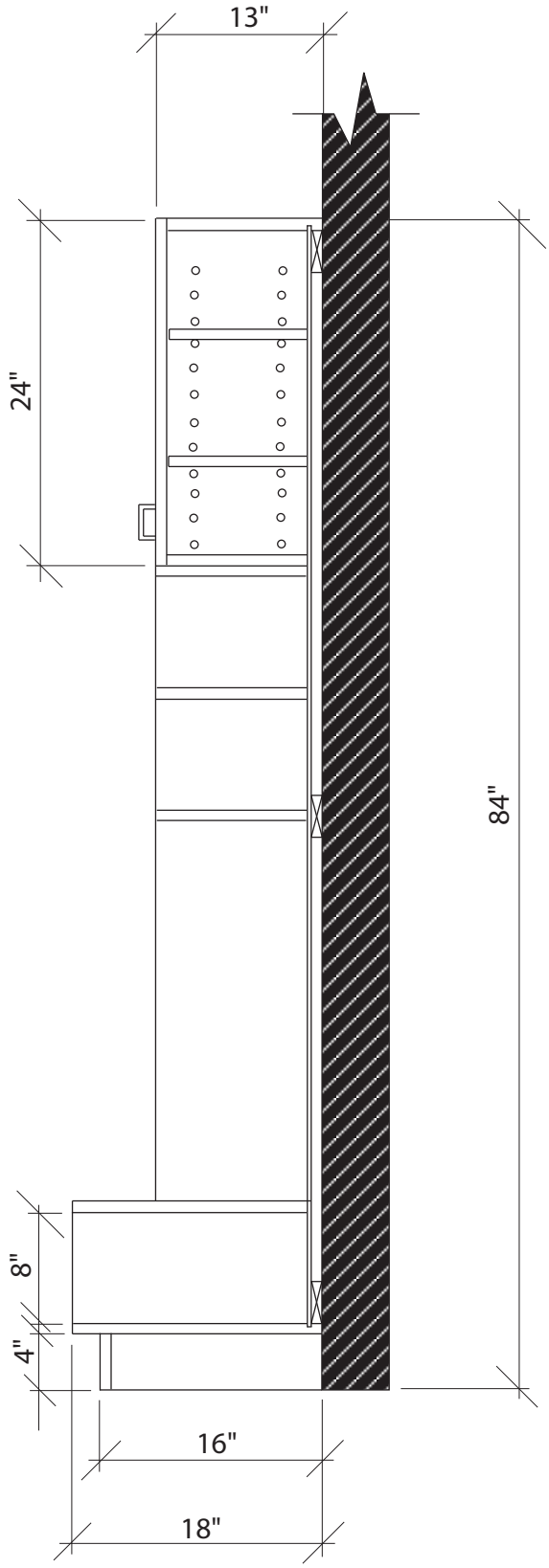
Schools and Libraries



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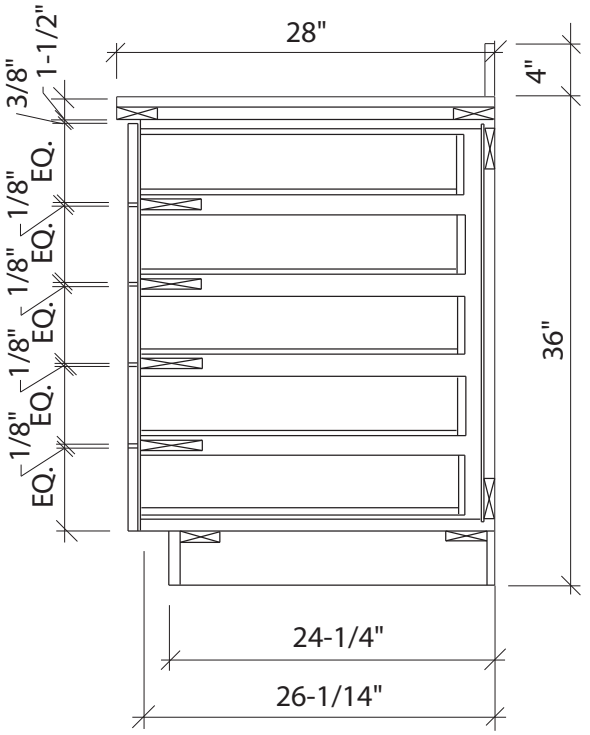
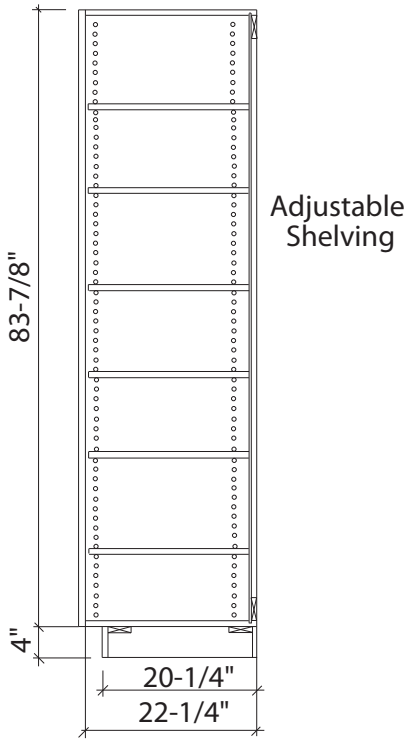
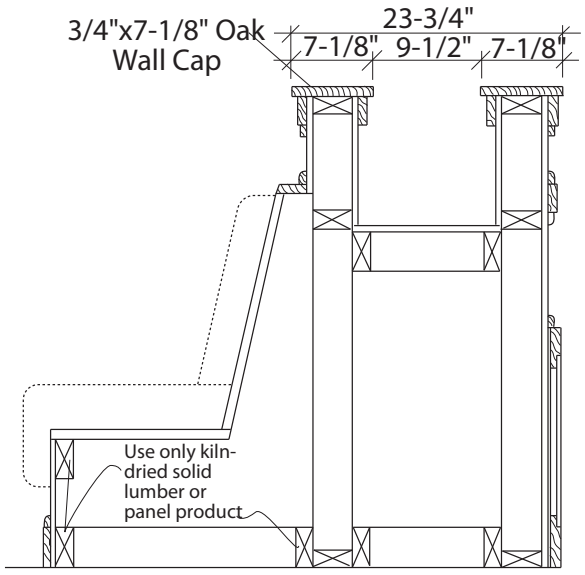
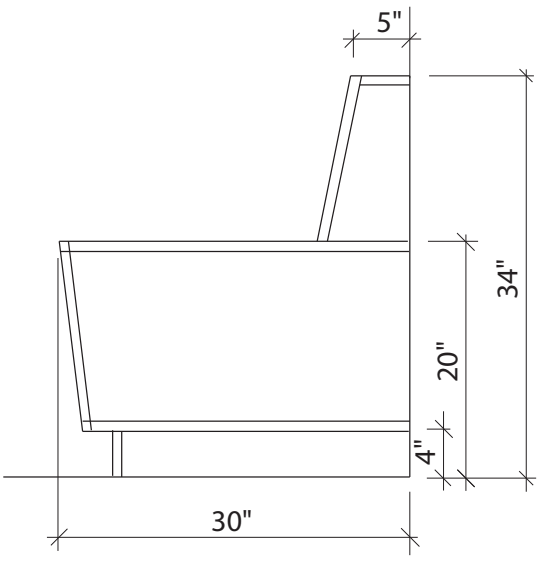
Schools and Libraries









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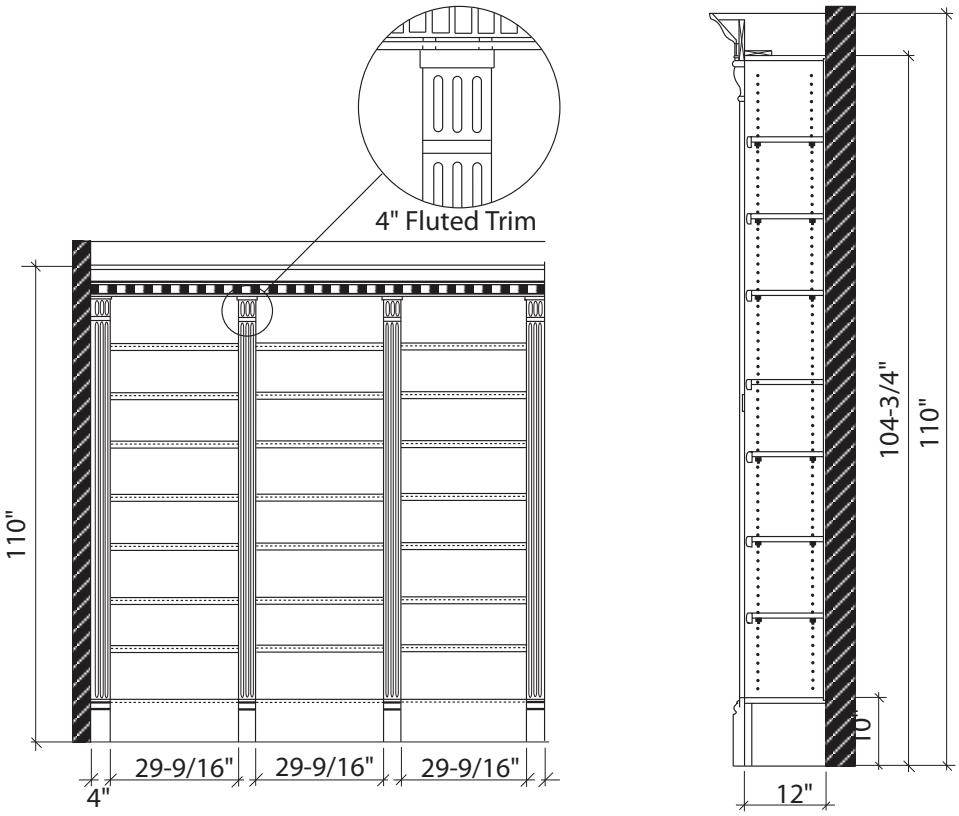
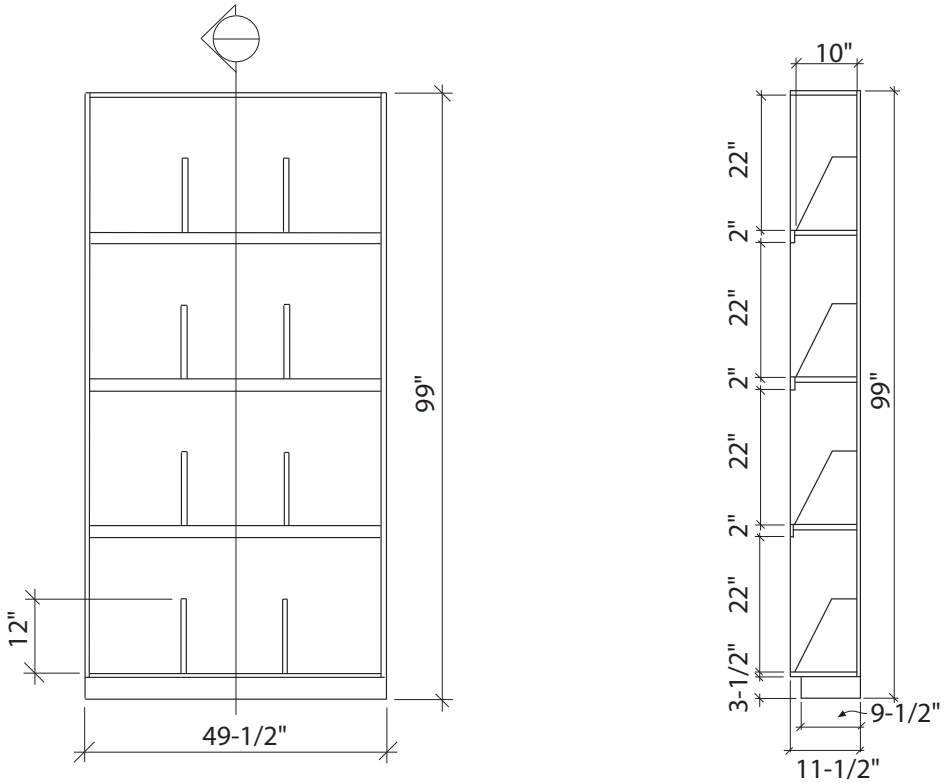
Schools and Libraries





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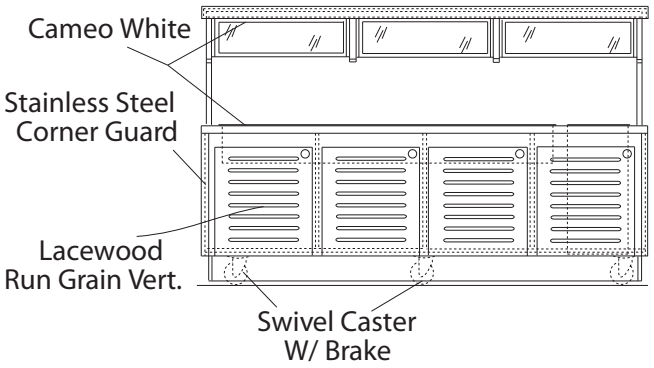
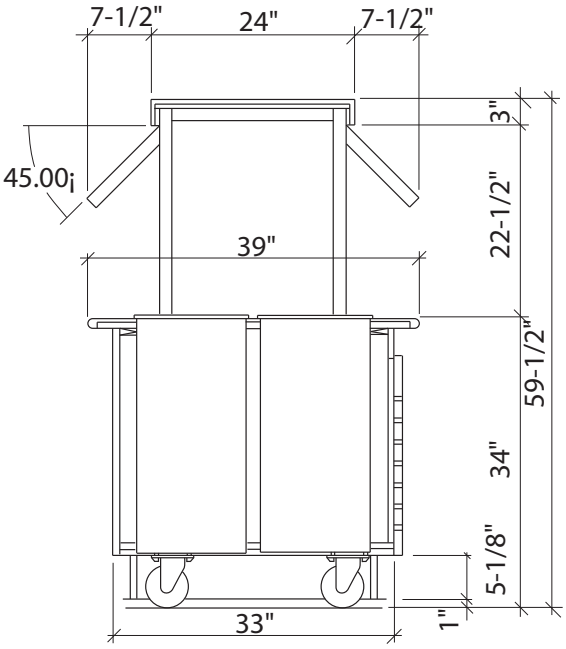
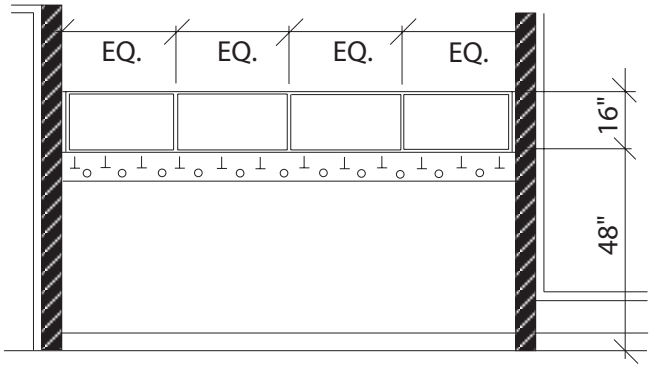
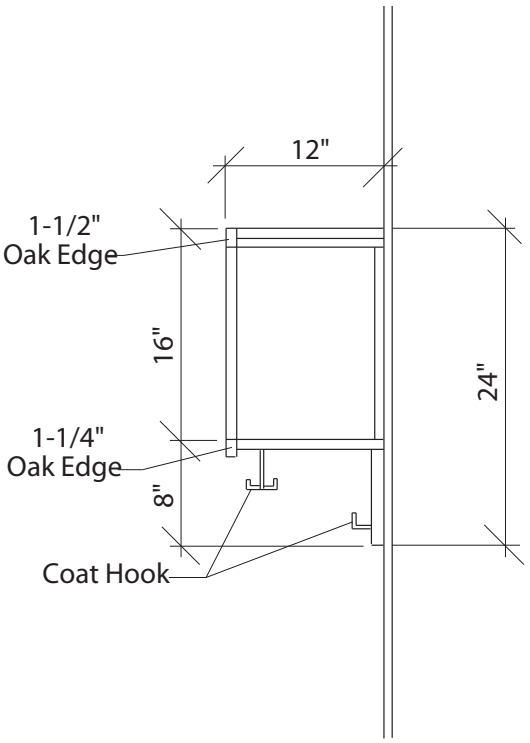
Schools and Libraries









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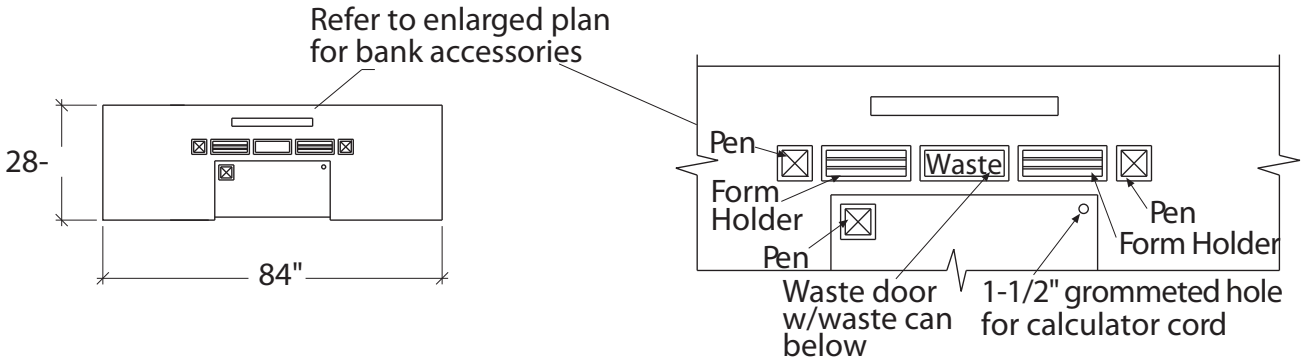
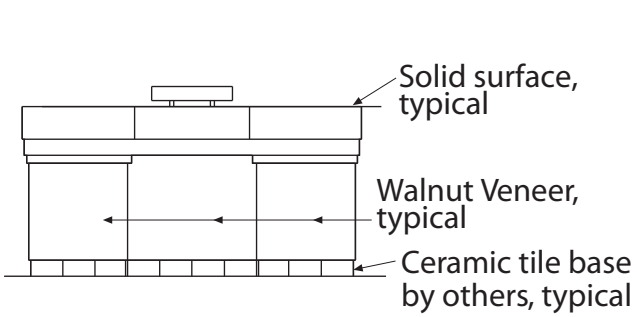
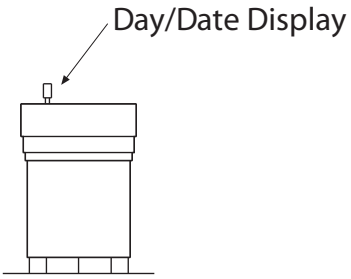
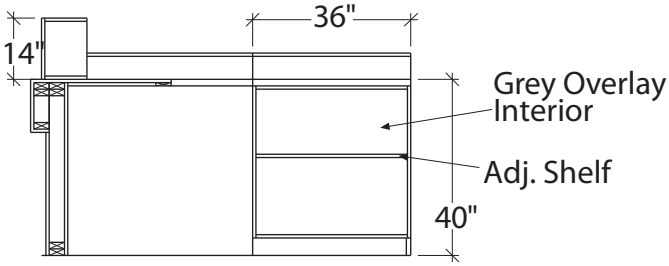
Banks and Courts

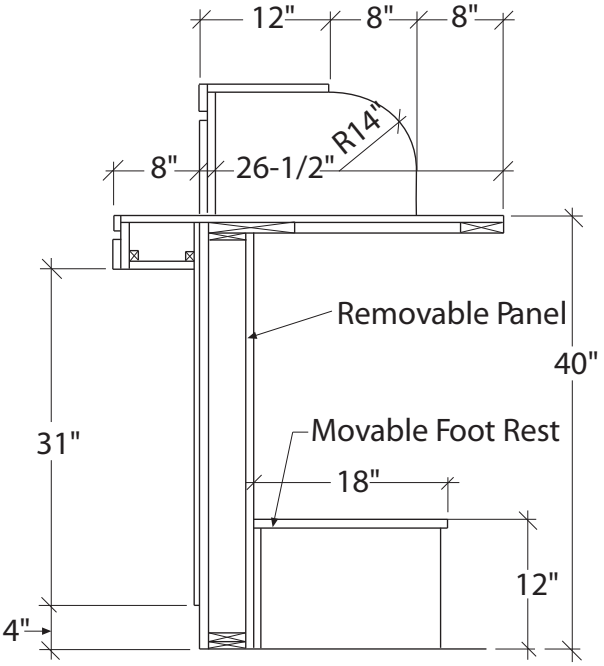






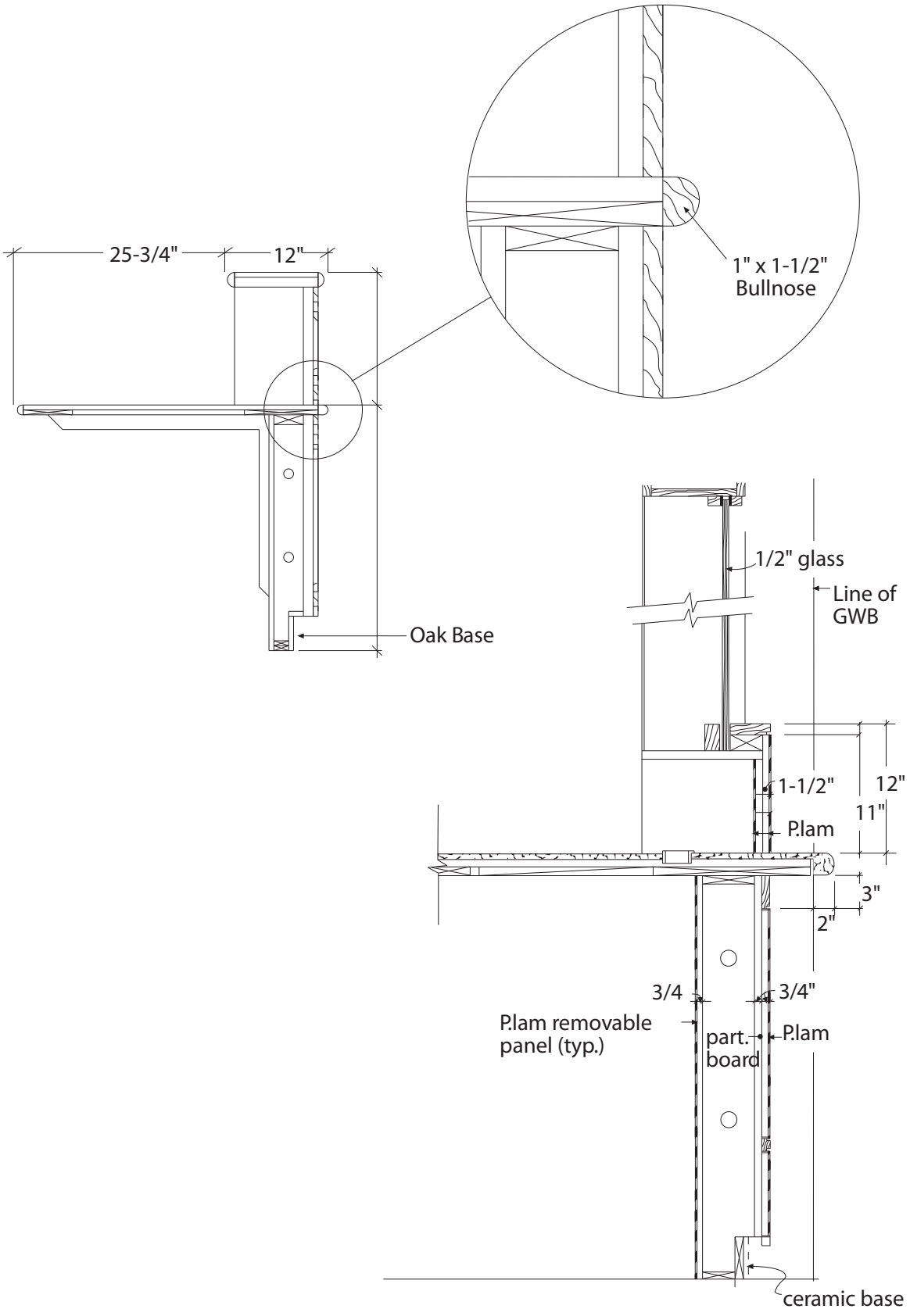


Typical Teller Counter Section



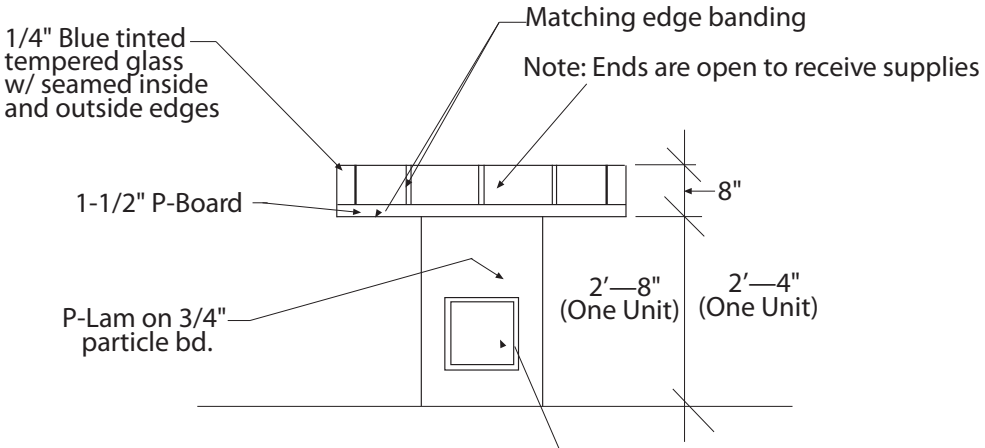
10 - Casework

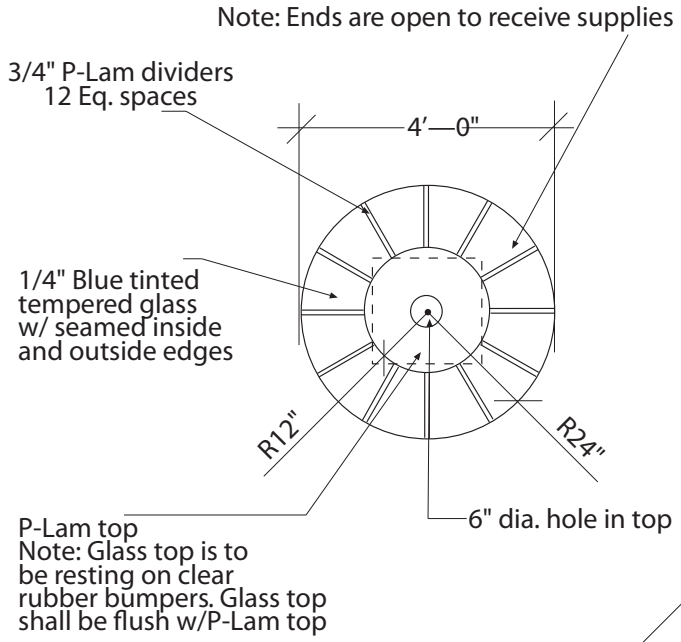
Banks and Courts



10 - Casework

Banks and Courts

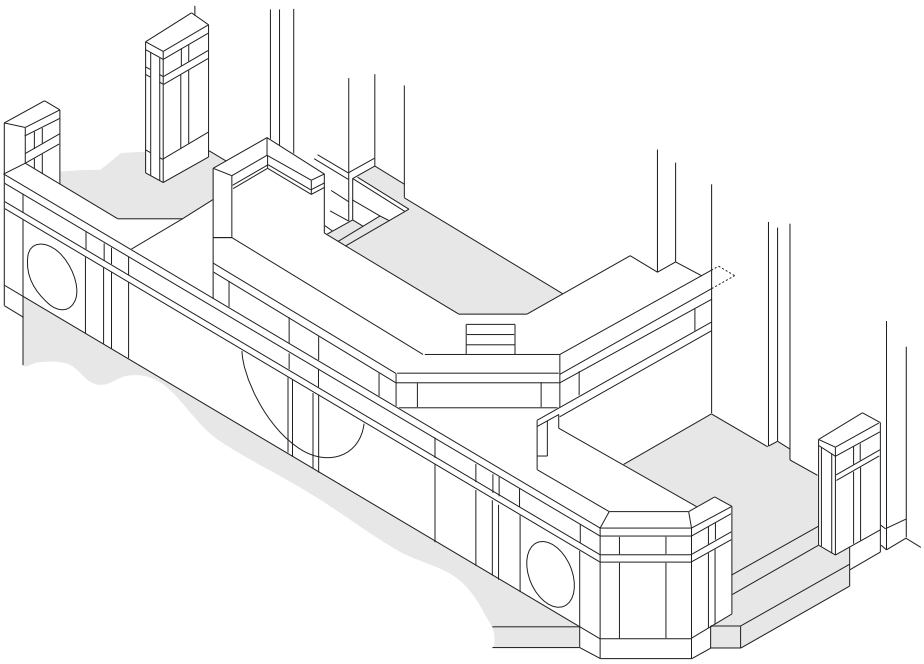


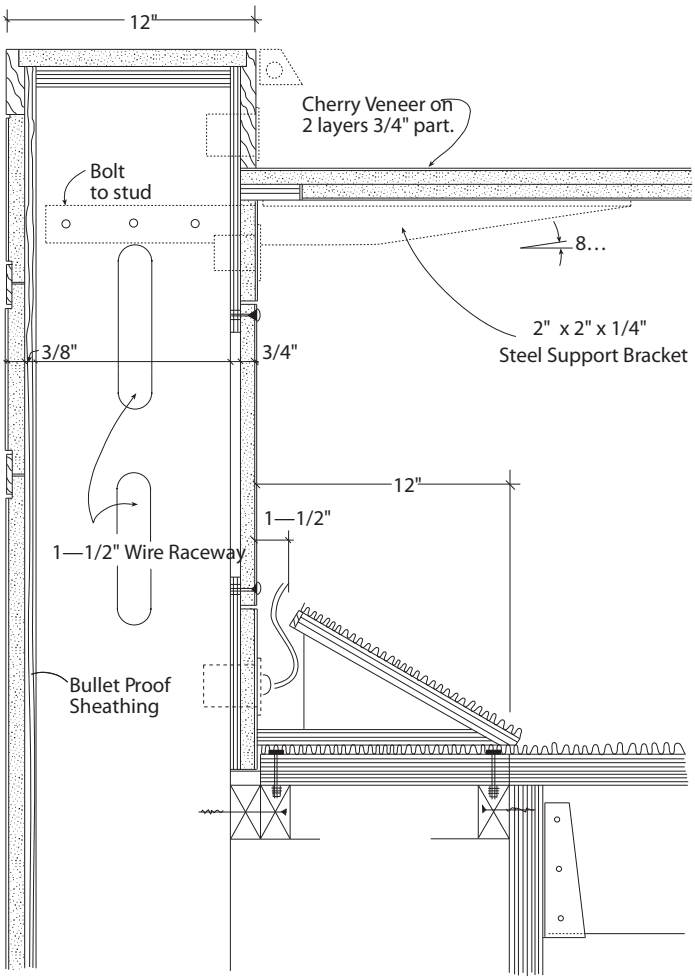


Typical Work Counter with Literature Display below

10 - Casework

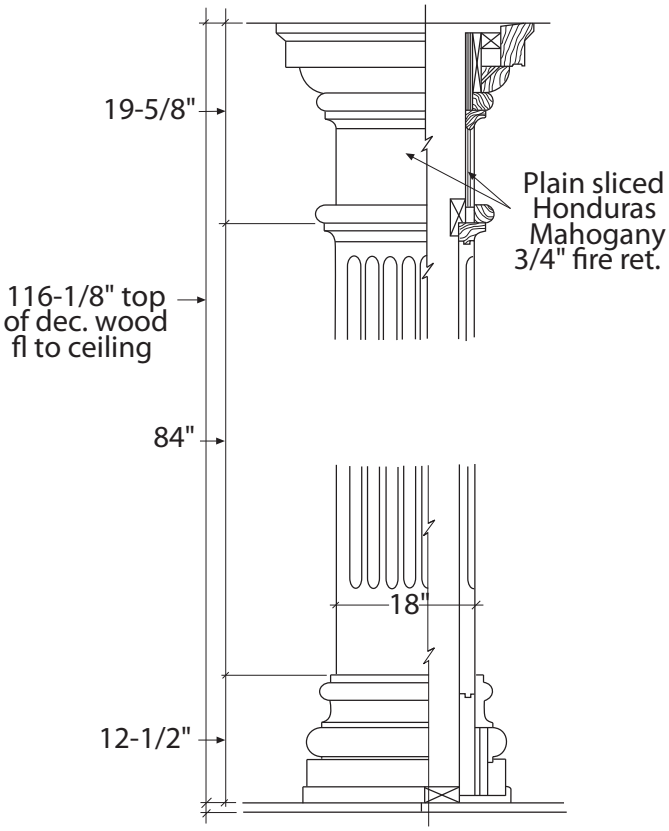
Judge's Bench

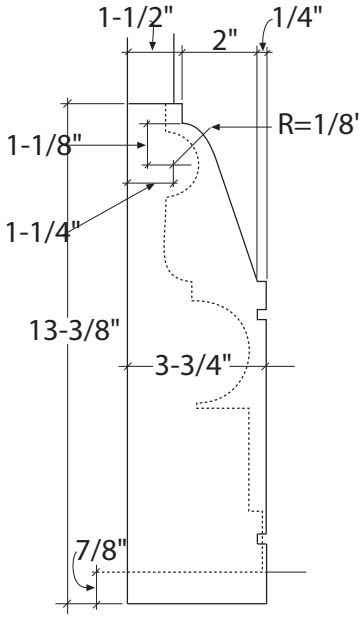


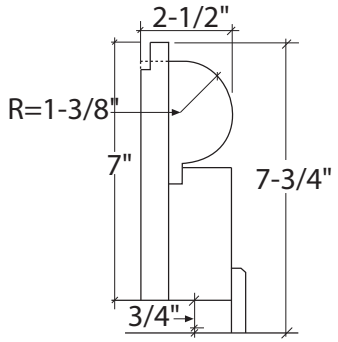


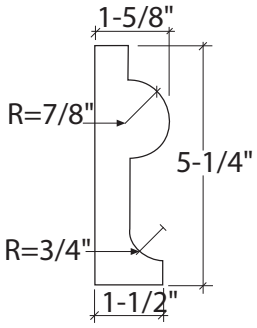
10 - Casework

Corporate Woodwork



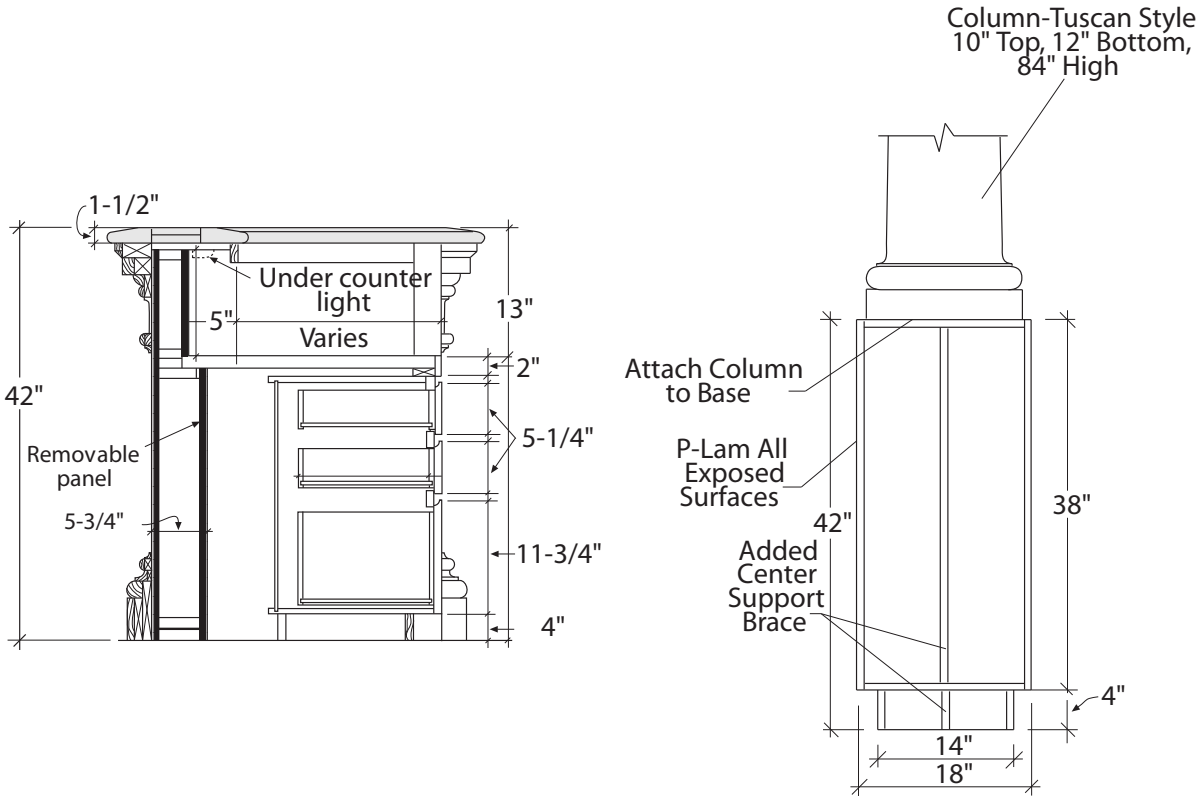


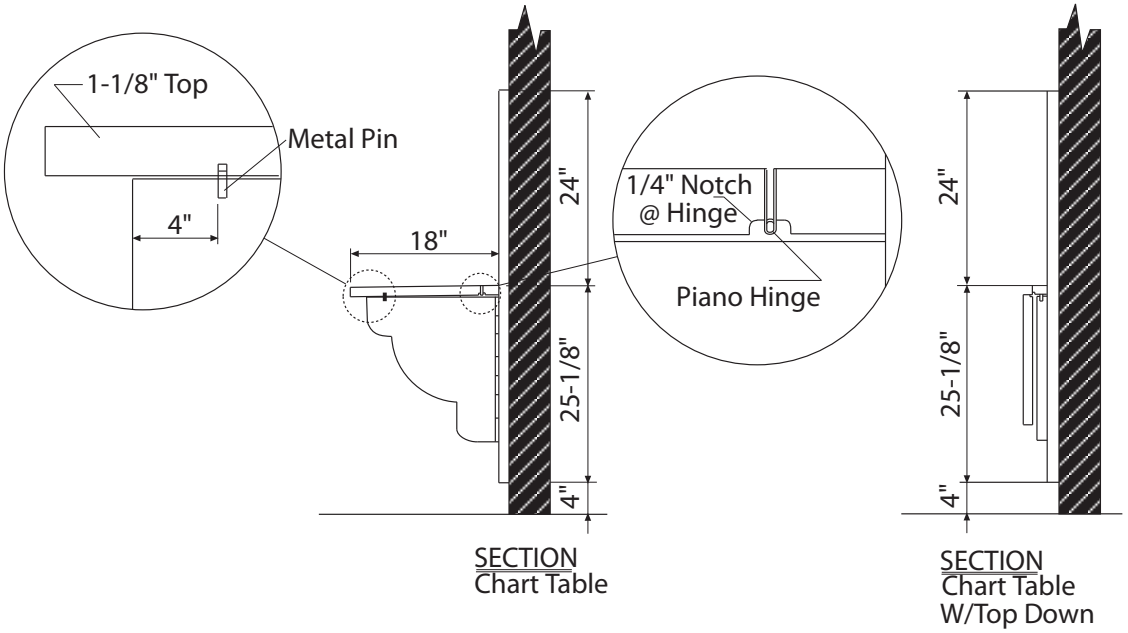




10 - Casework

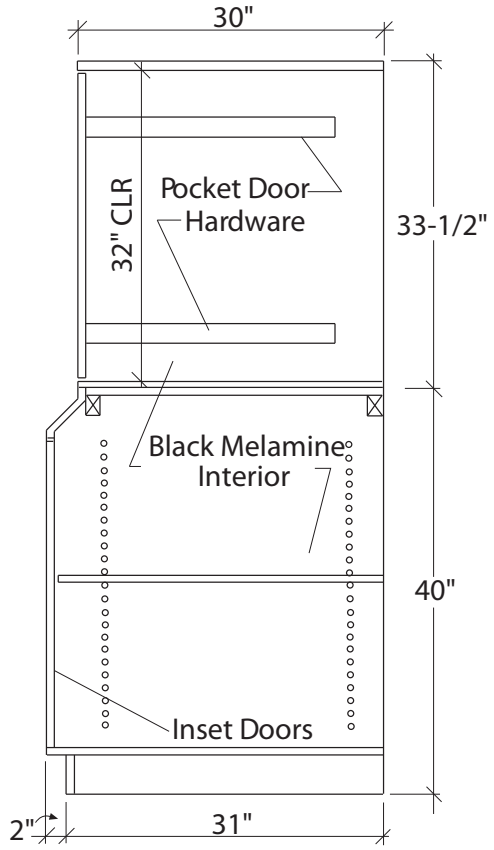
Corporate Woodwork

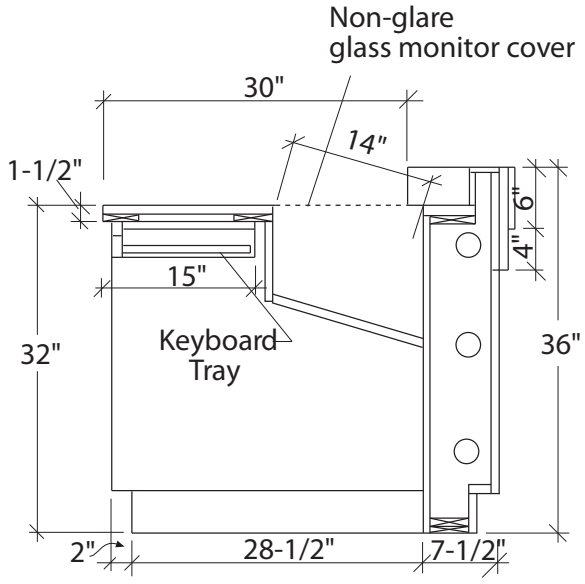


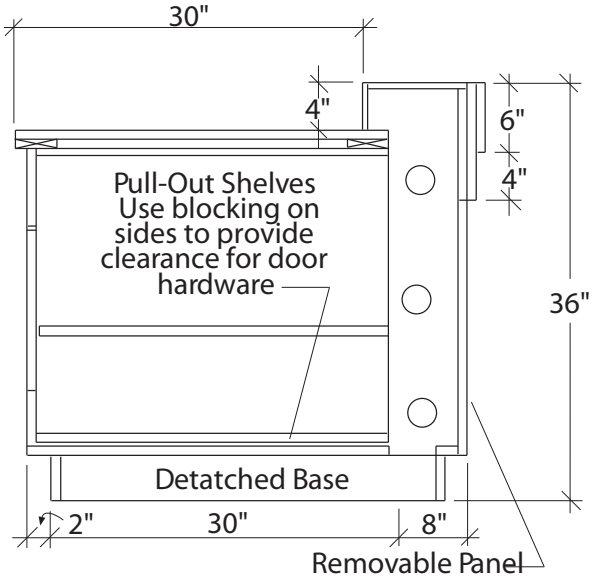


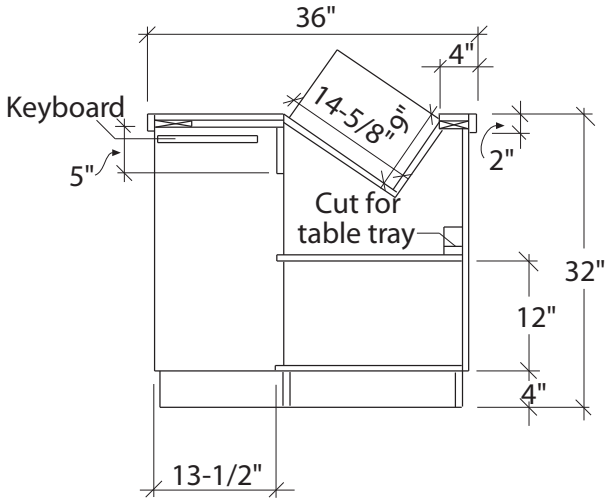
10 - Casework

Corporate Woodwork



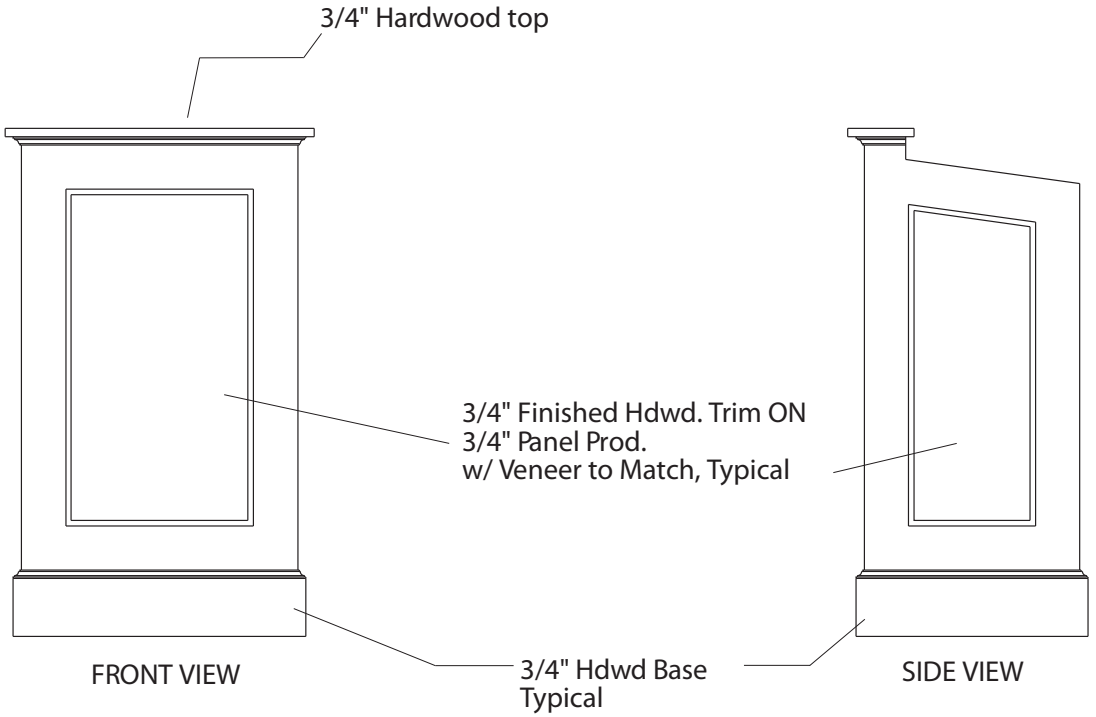


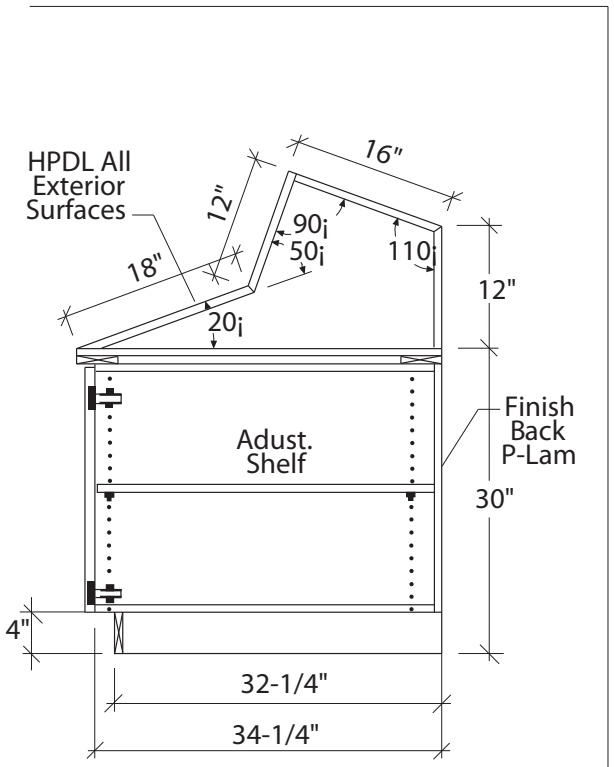


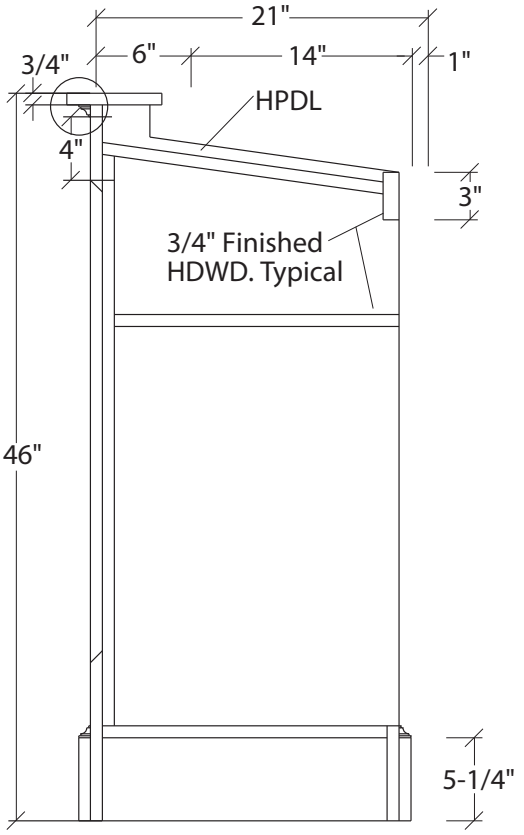


10 - Casework

Corporate Woodwork

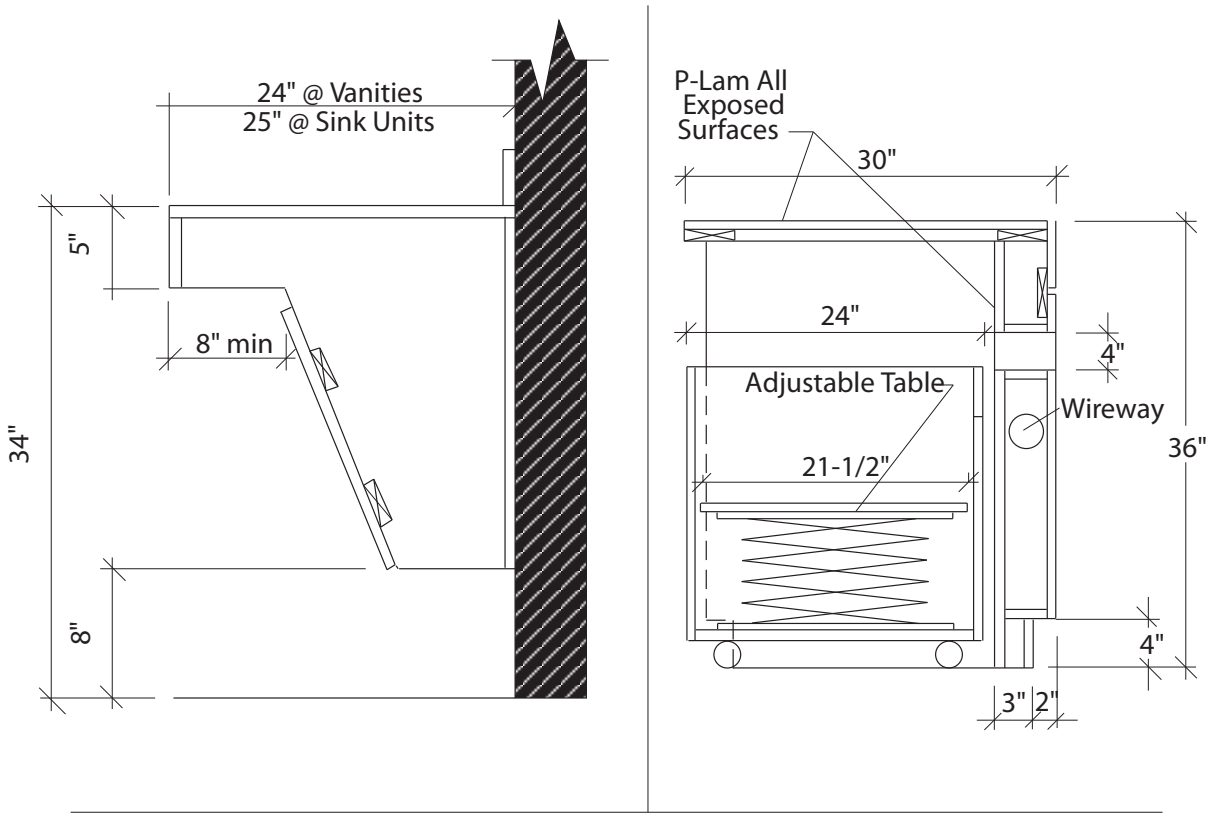


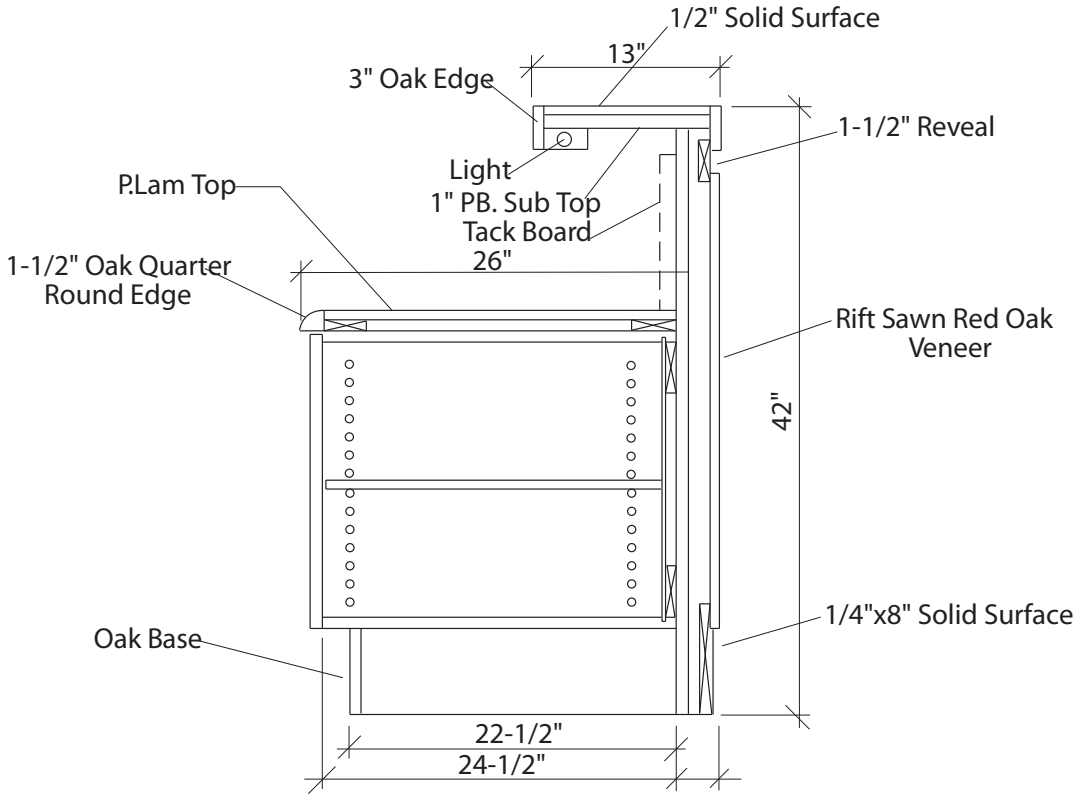




10 - Casework

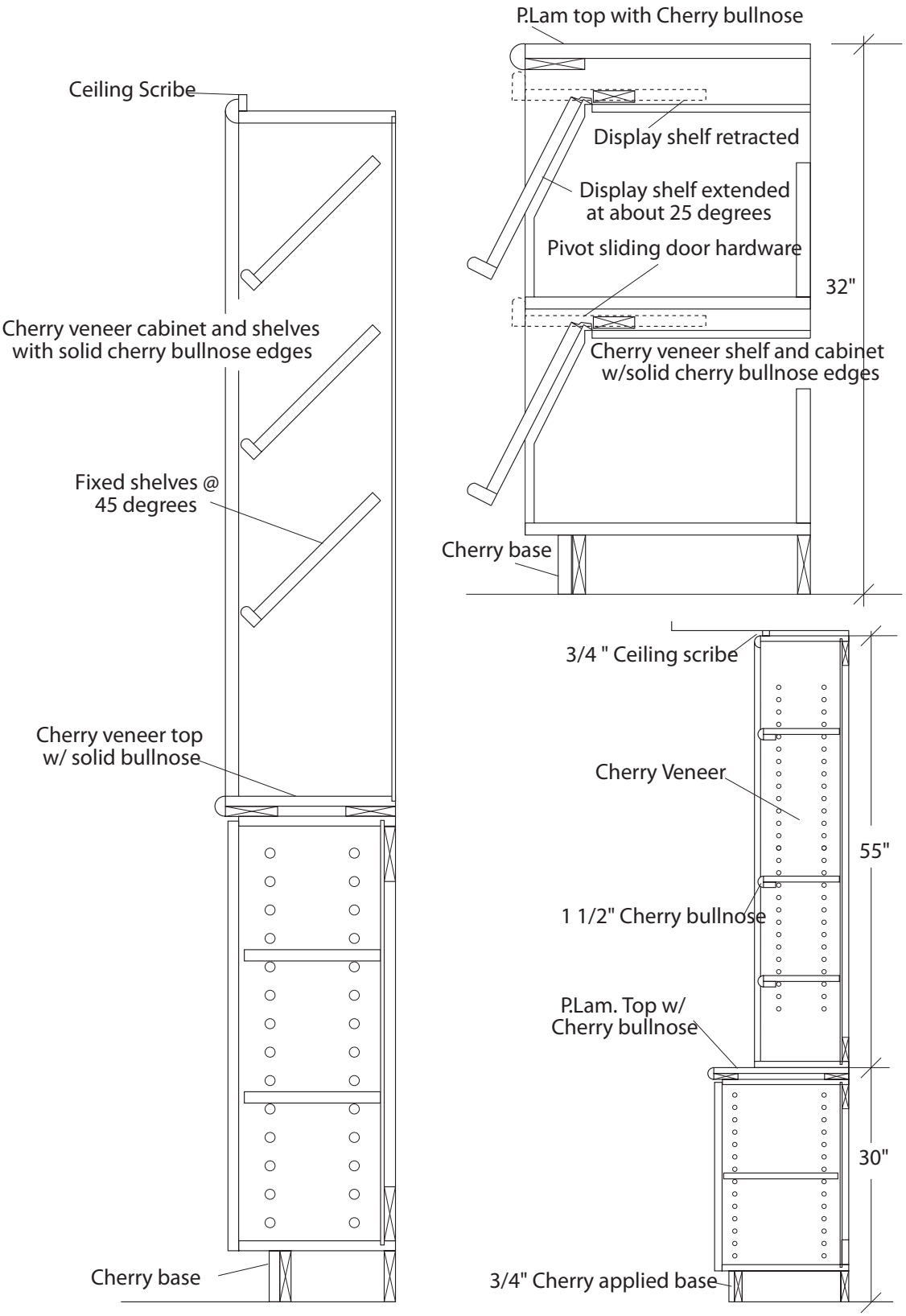
Corporate Woodwork





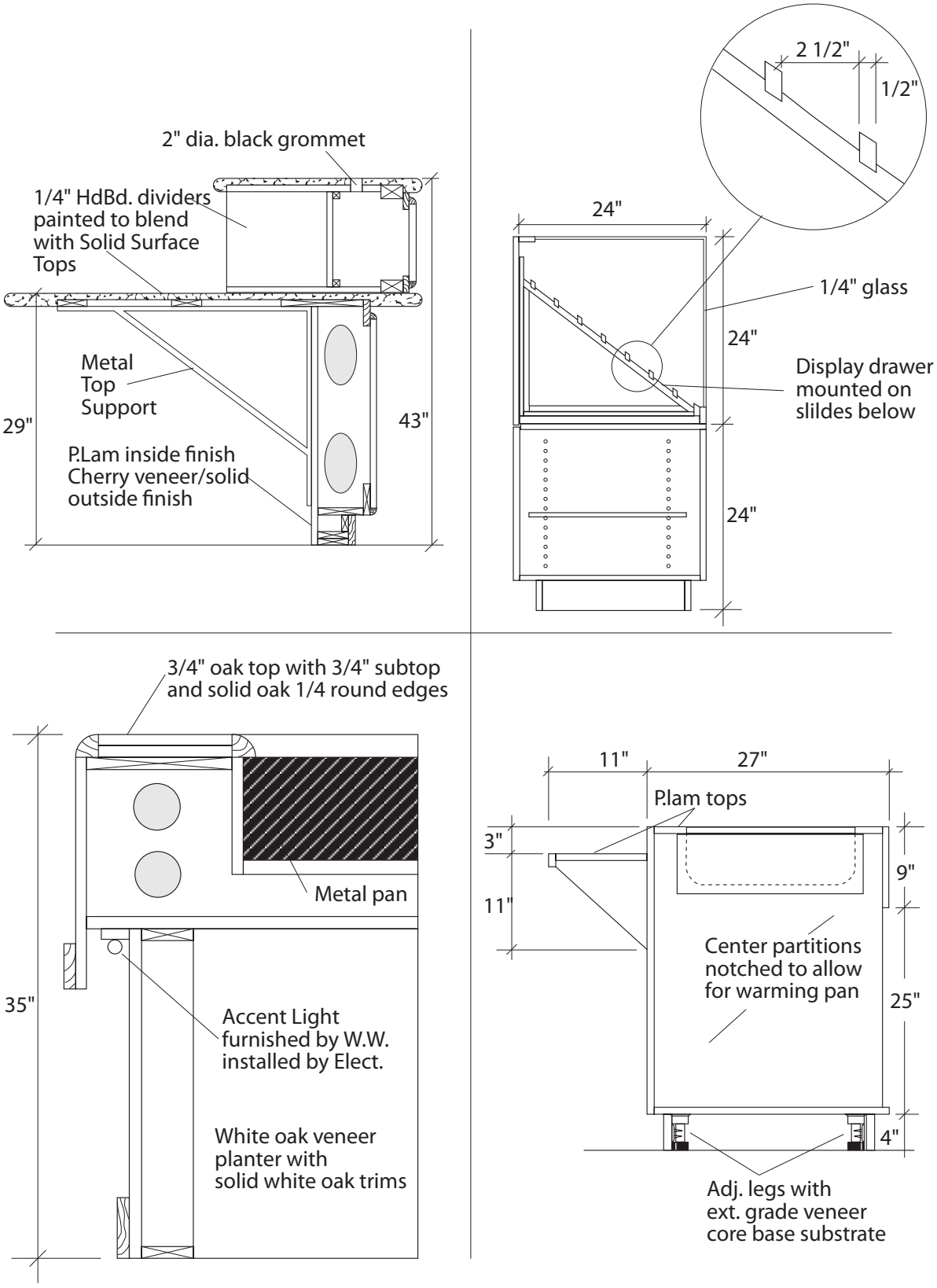
10 - Casework

Furniture and Fixtures



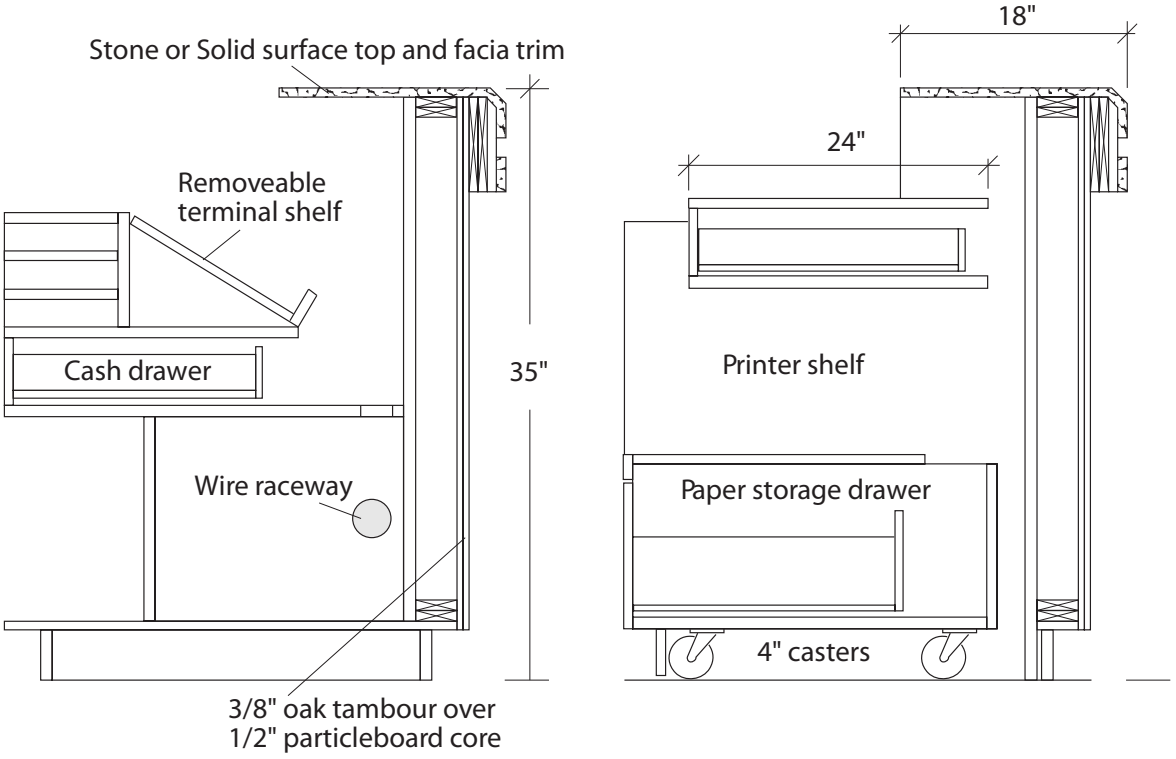
10 - Casework

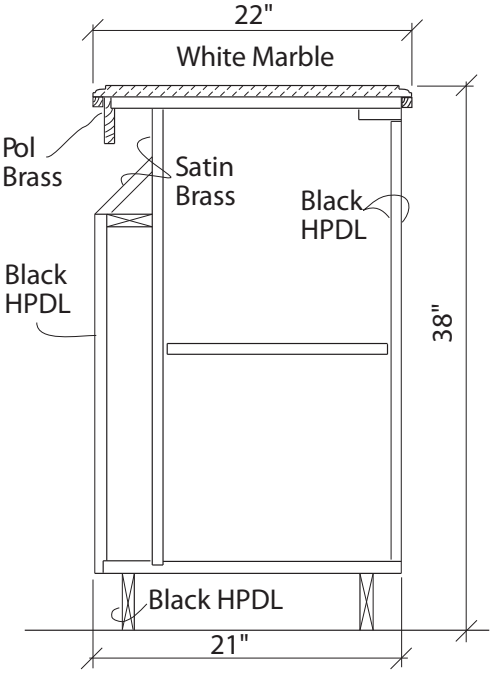
Furniture and Fixtures

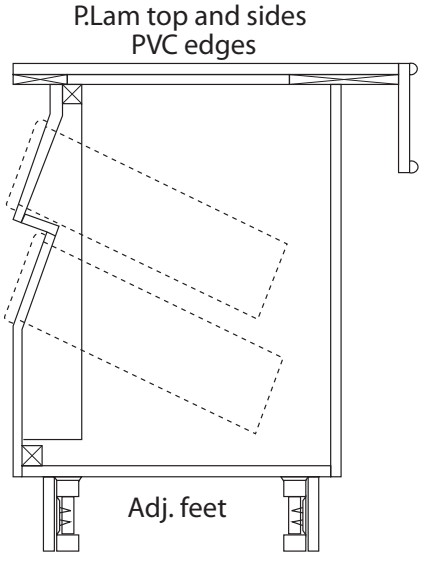


10 - Casework

Furniture and Fixtures



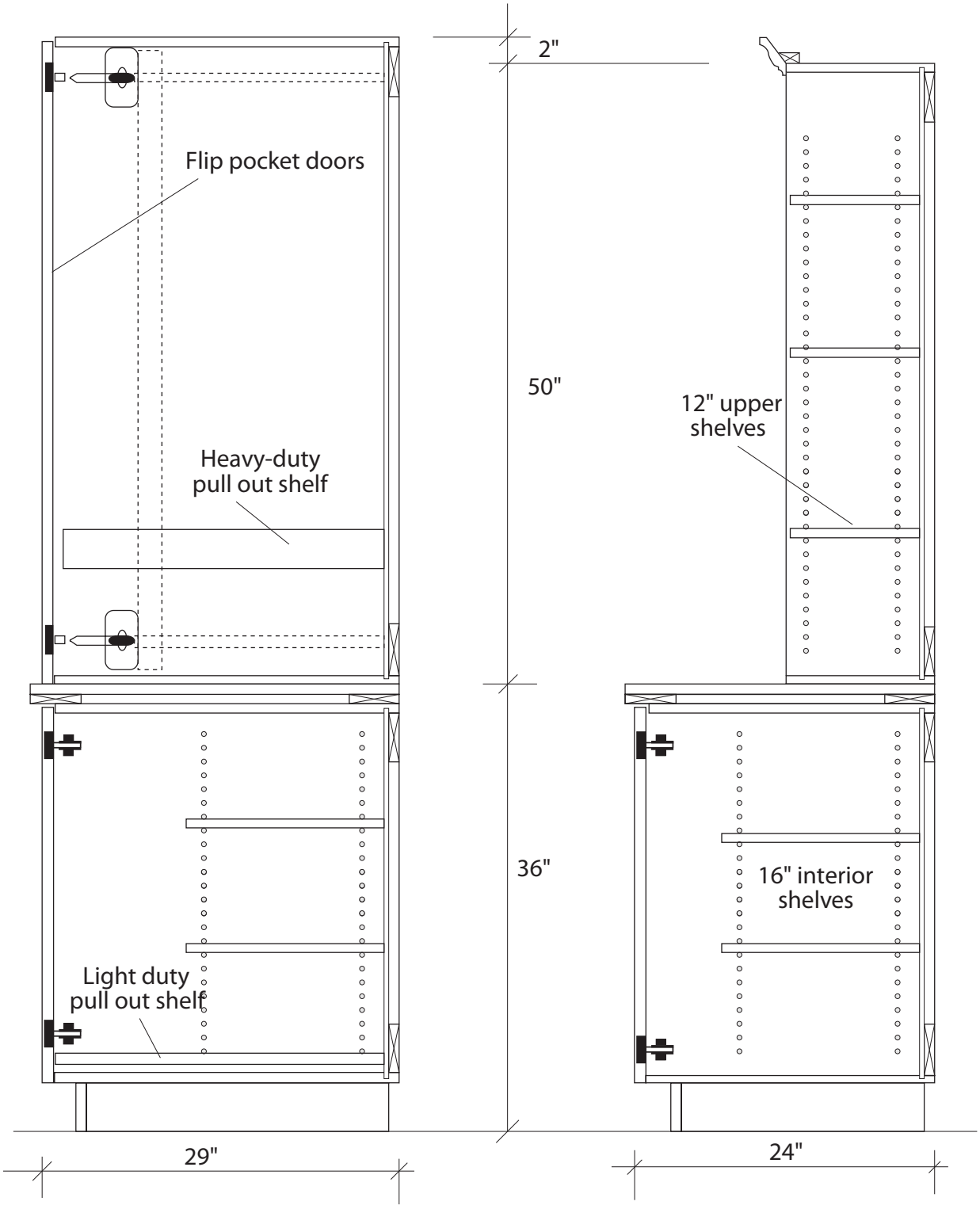




Cup dispenser inserts by owner

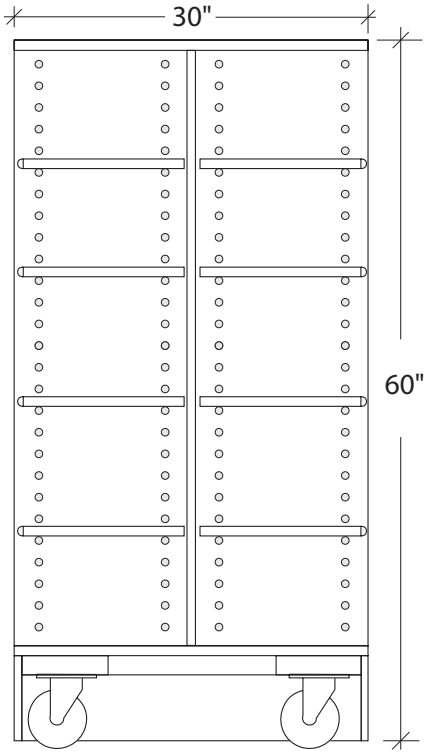
10 - Casework

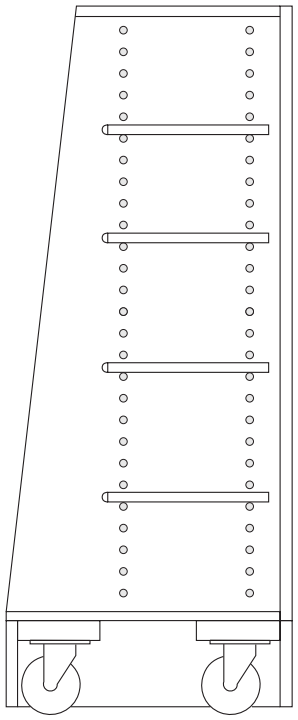
Furniture and Fixtures



10 - Casework

Furniture and Fixtures

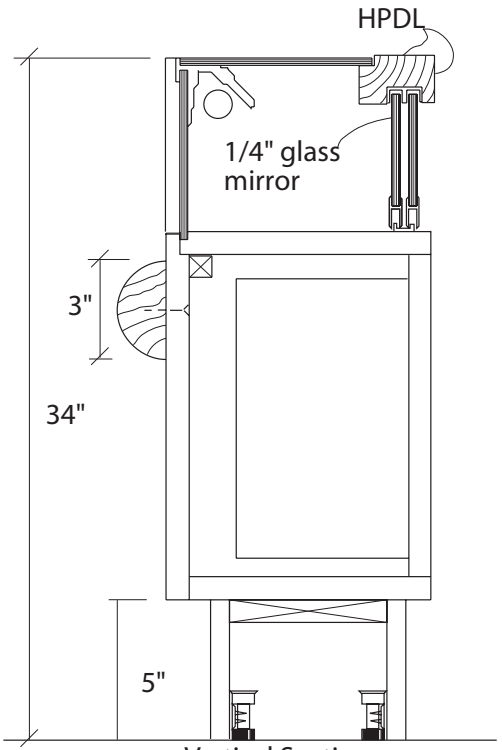




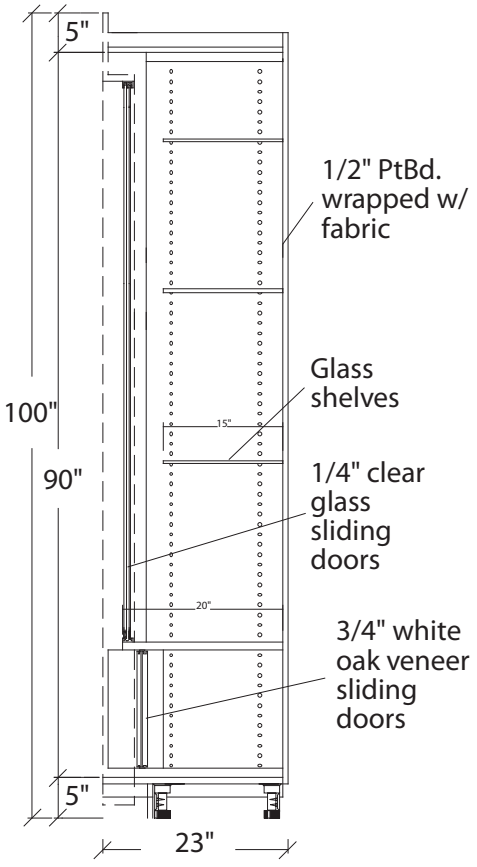
Single and Double-sided Units with bullnosed shelves

Finished back on single sided units

All exposed surfaces White Oak and White Oak veneer

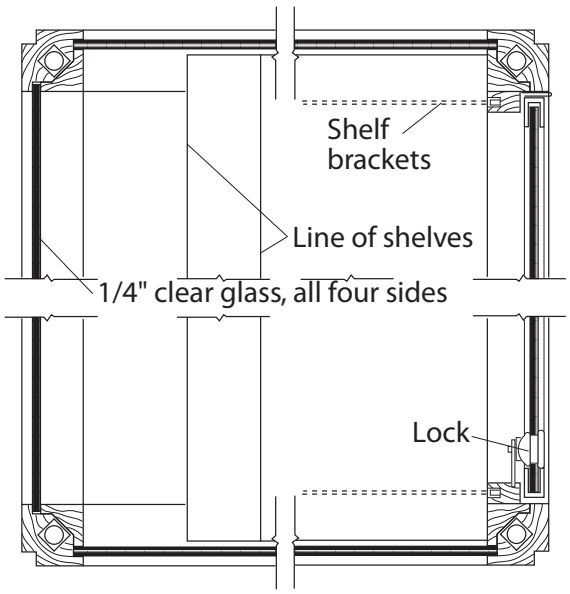


Vertical Section
Jewelry Showcase

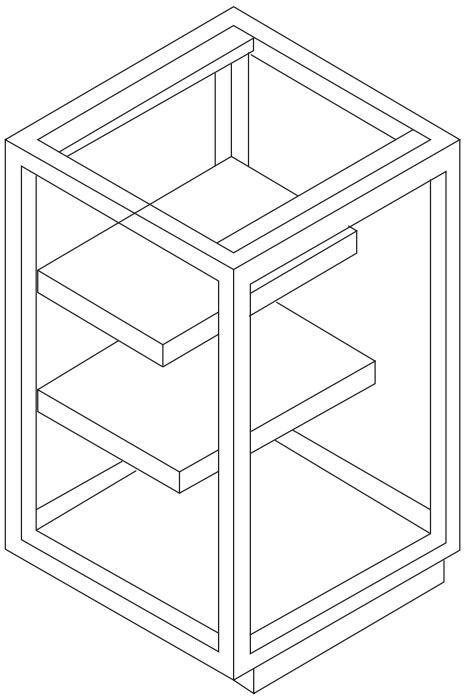


10 - Casework

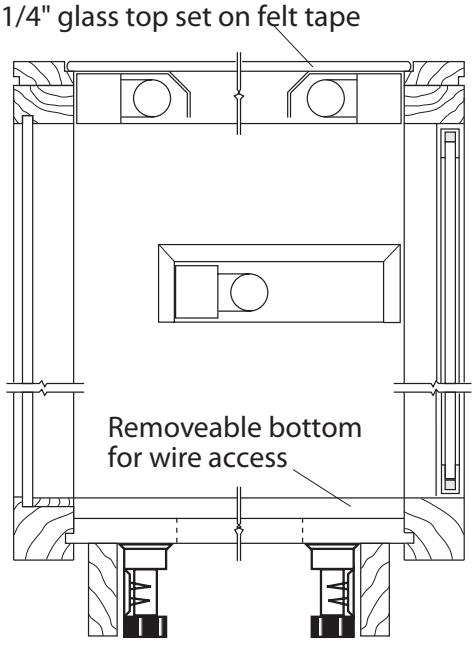
Furniture and Fixtures



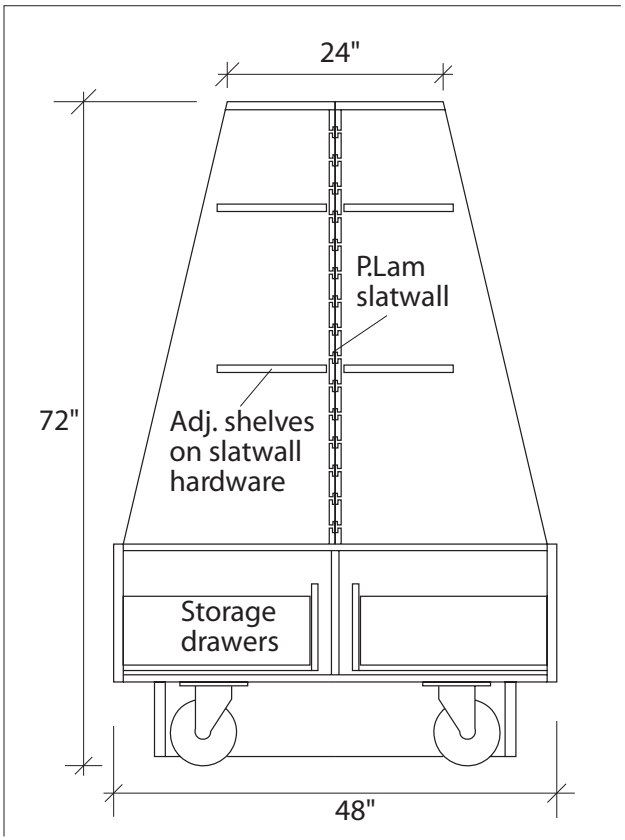
Plan Section



Isometric

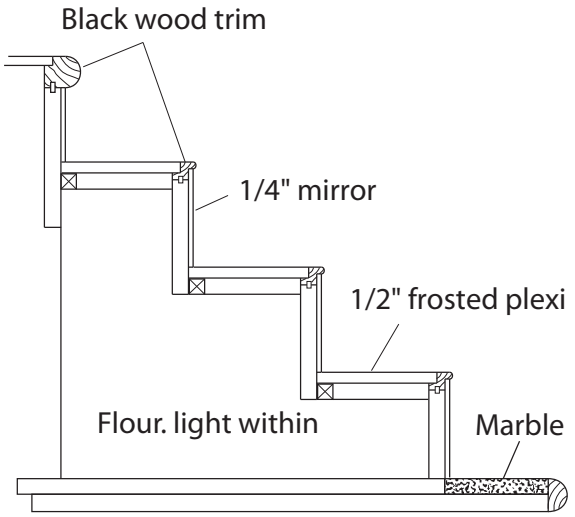


Vertical Section

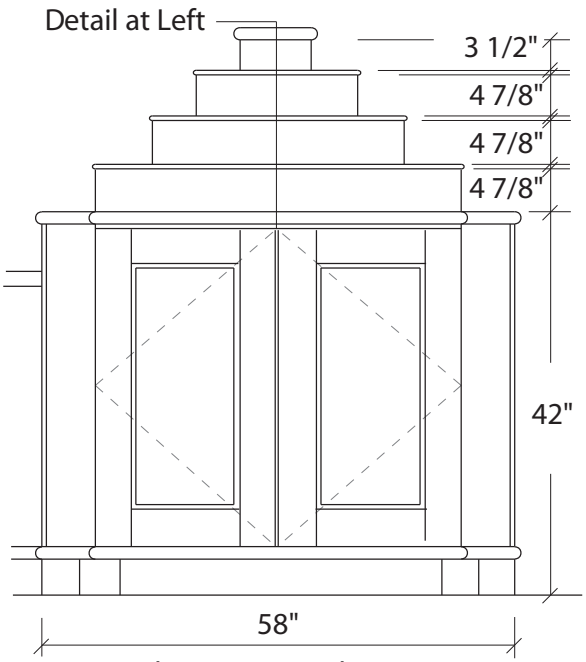


10 - Casework

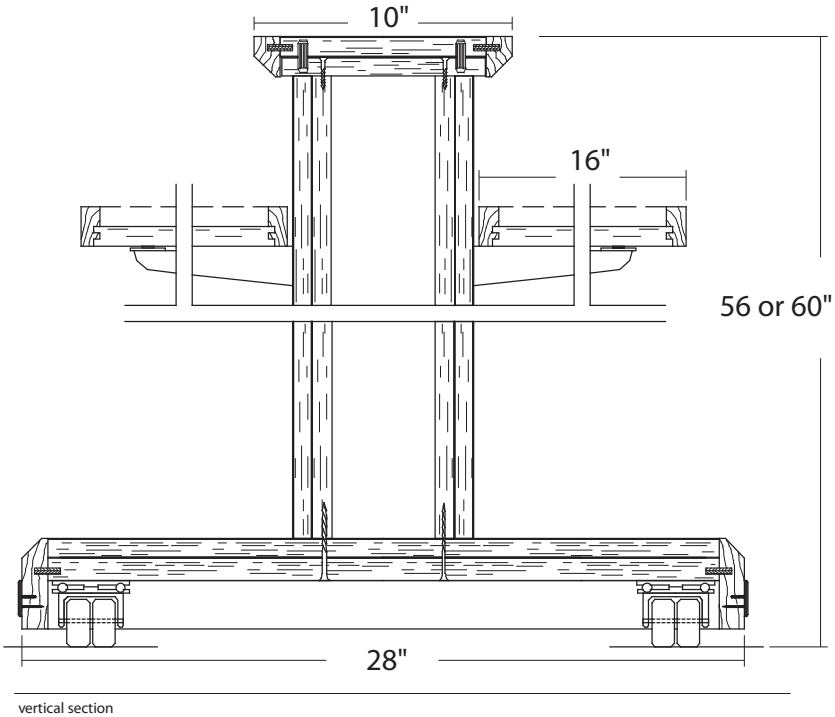
Furniture and Fixtures



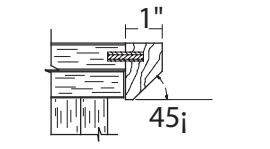
Detail at Top of Back Bar

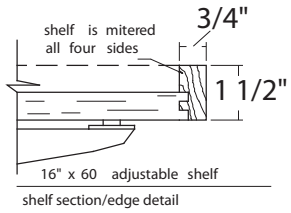


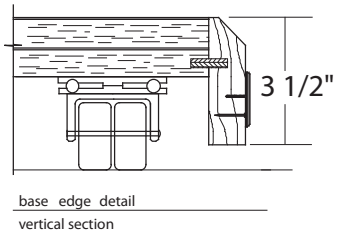
Elevation at Back Bar



Rolling Display Store Fixture

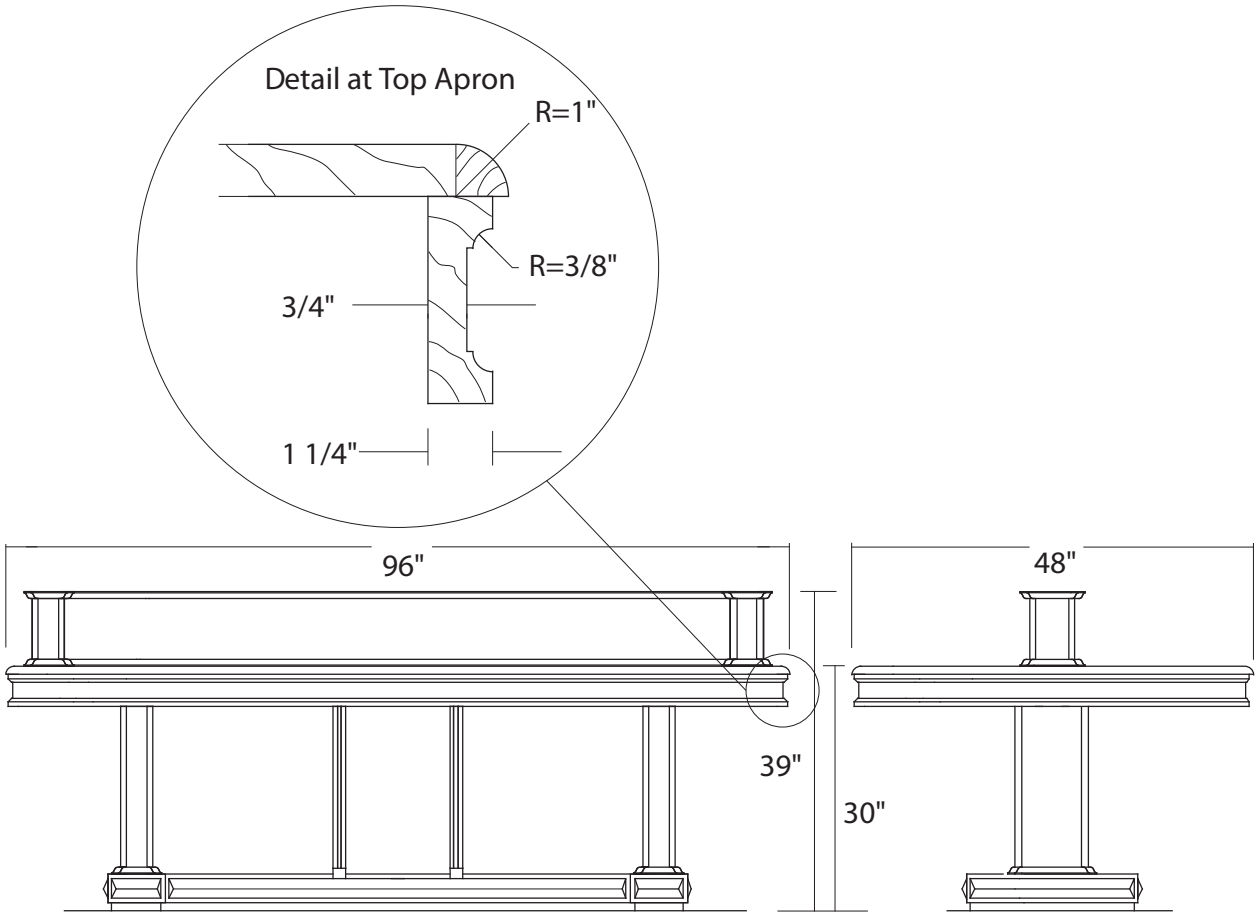






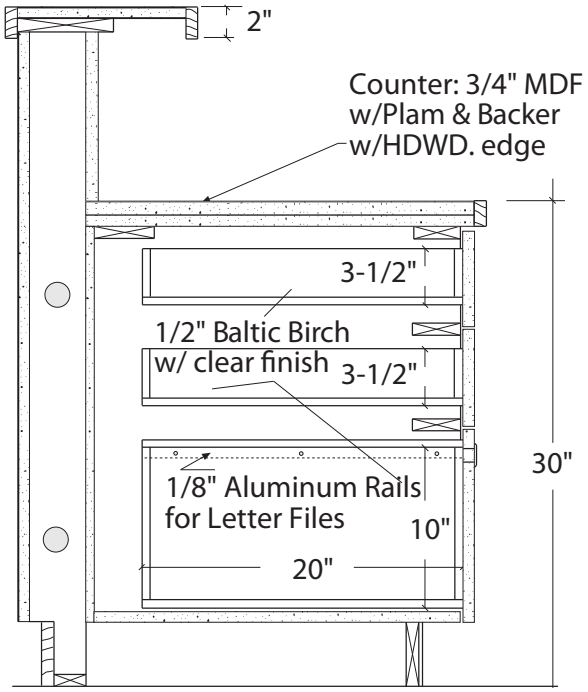
10 - Casework

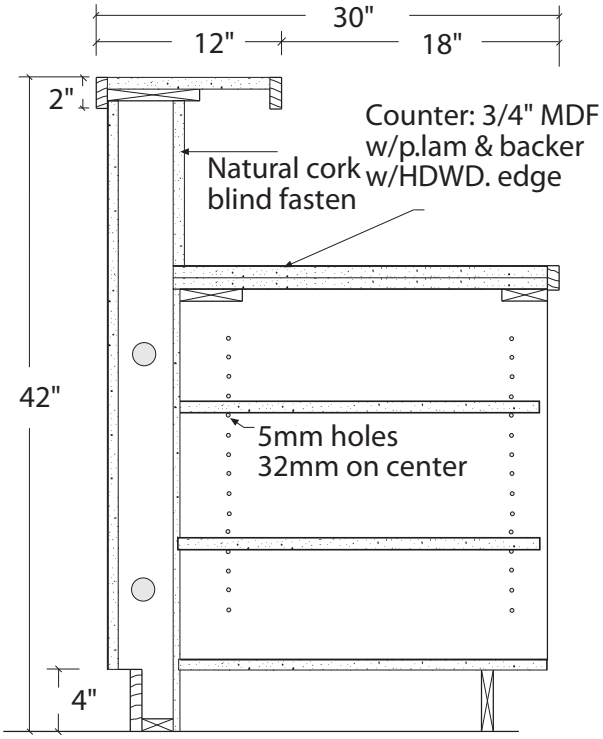
Furniture and Fixtures

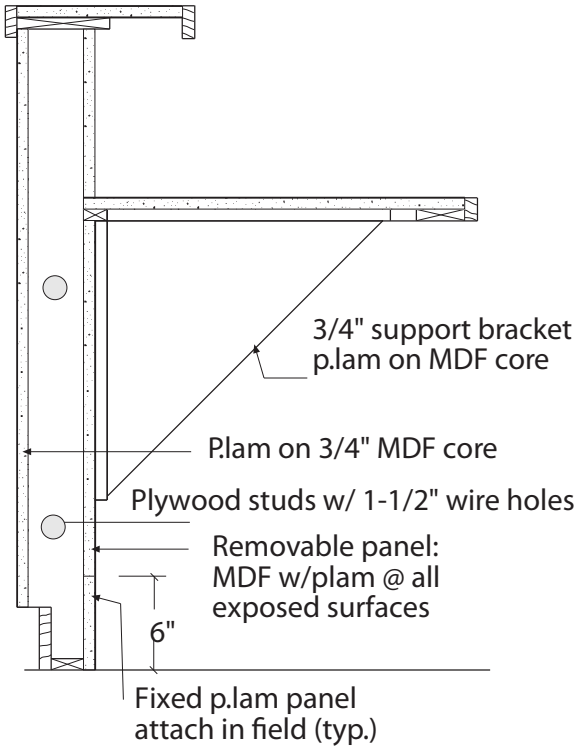


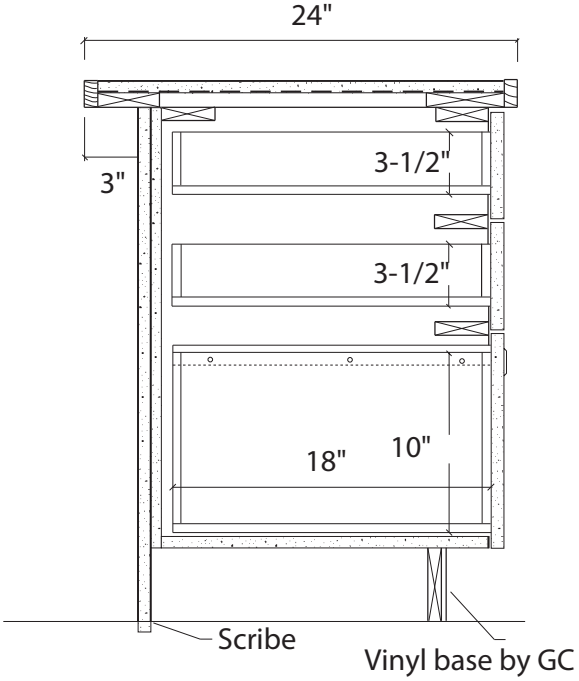
10 - Casework

Reception



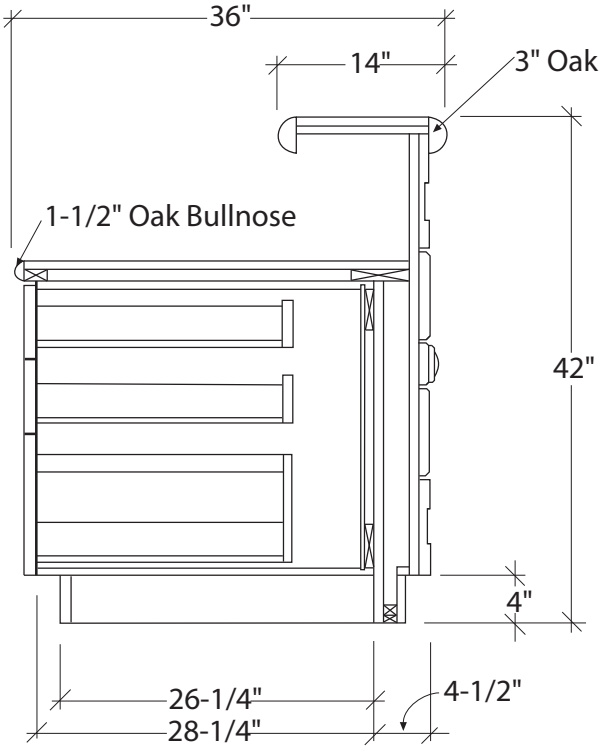


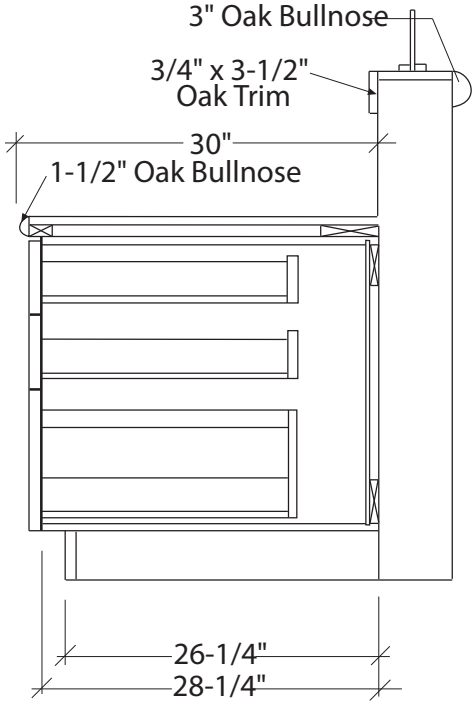


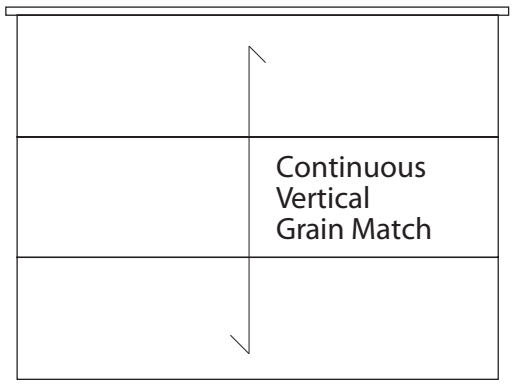


10 - Casework

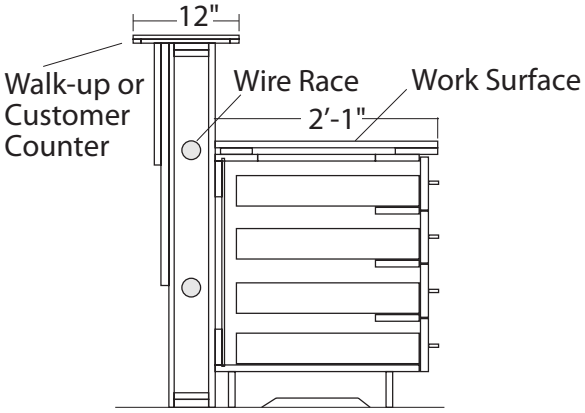
Reception







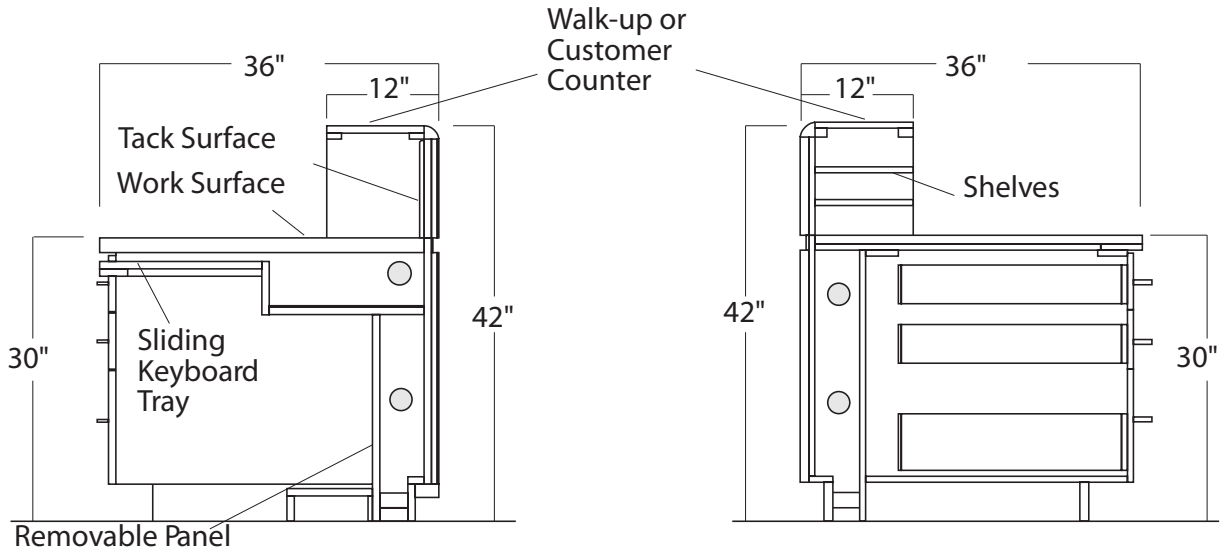
Front Elev. - Small Reception Desk w/ Drawers

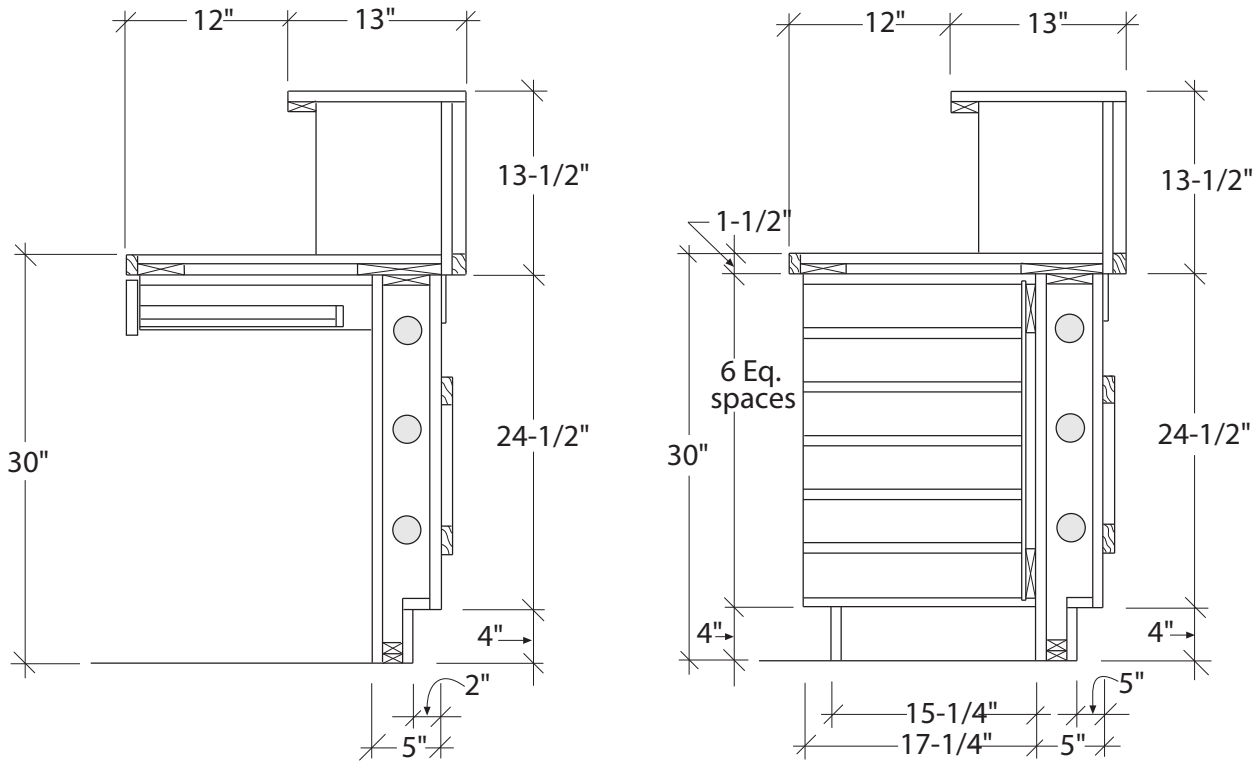


Sect. thru Typ. Drawer
Stack/Reception

10 - Casework

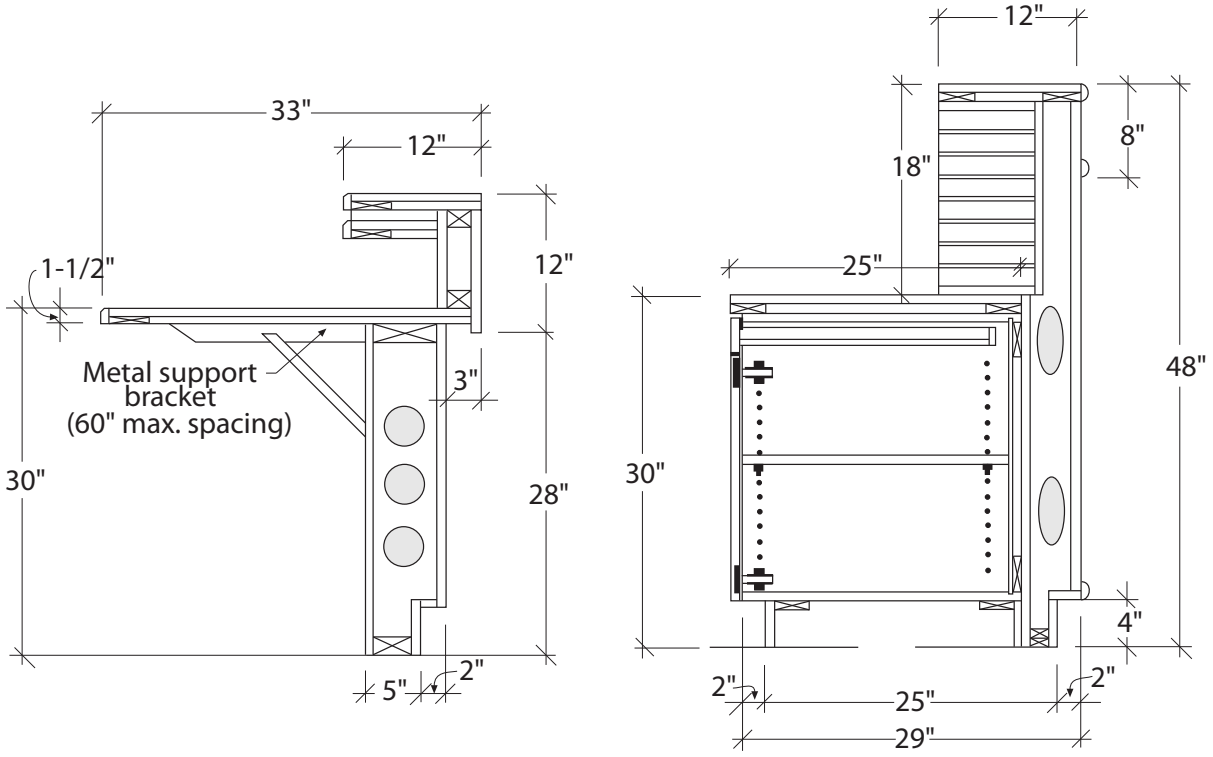
Reception

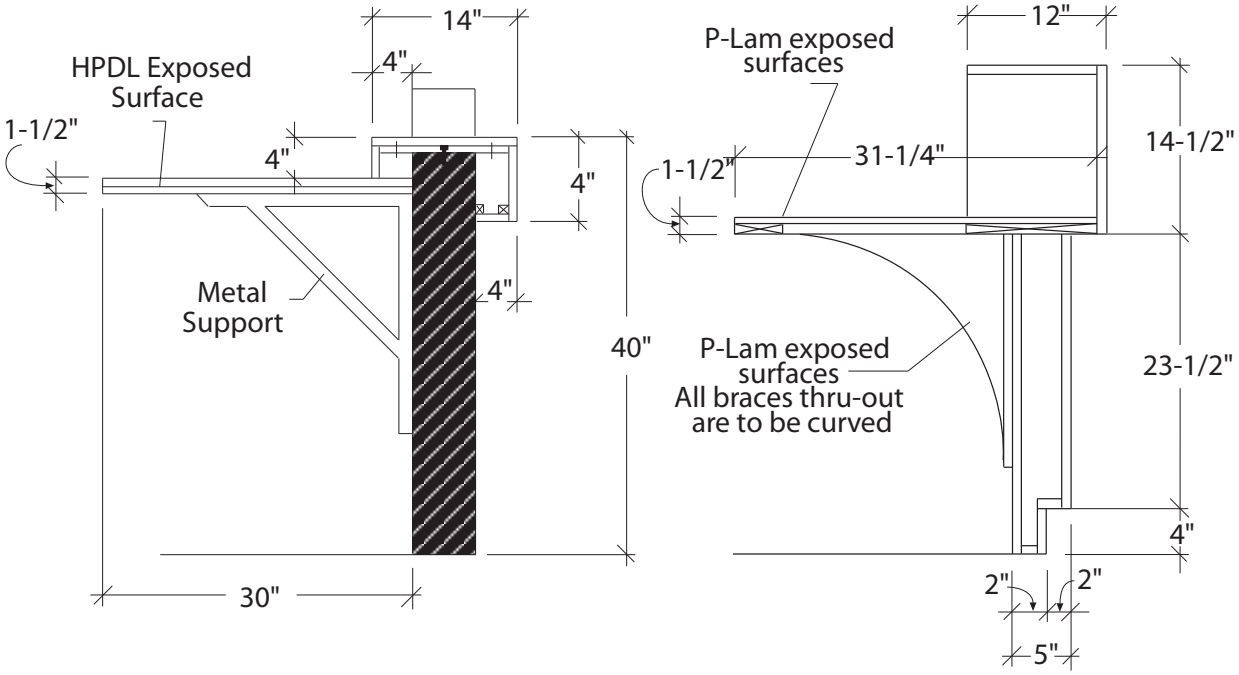




10 - Casework

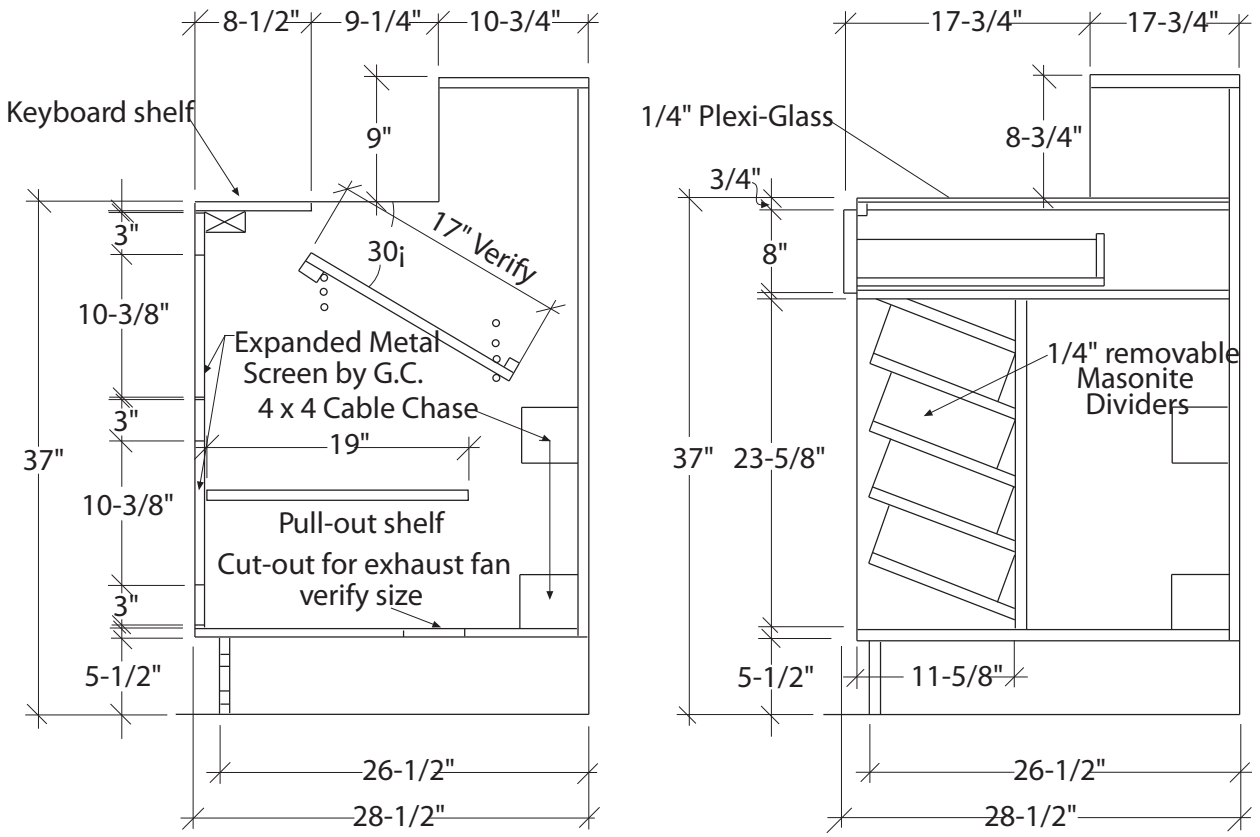
Reception

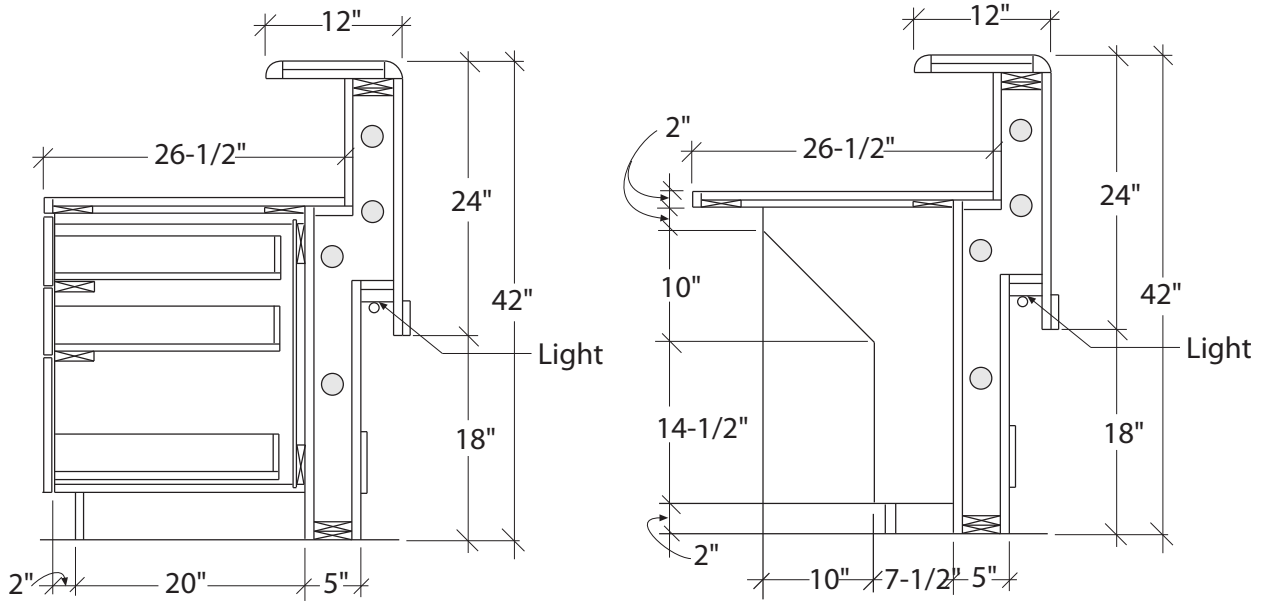




10 - Casework

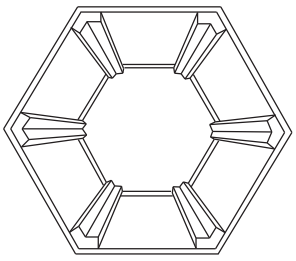
Reception





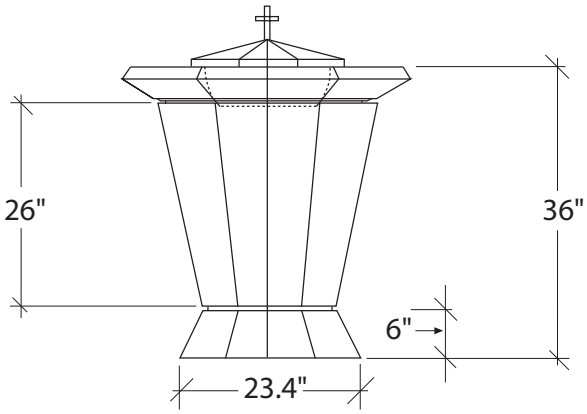
10 - Casework

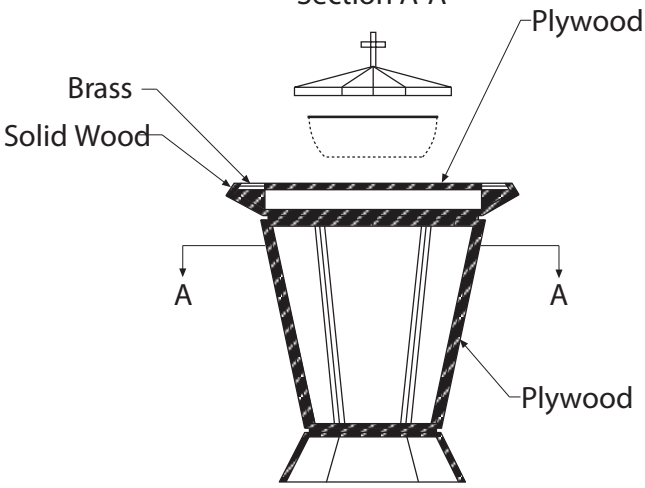
Church Fittings



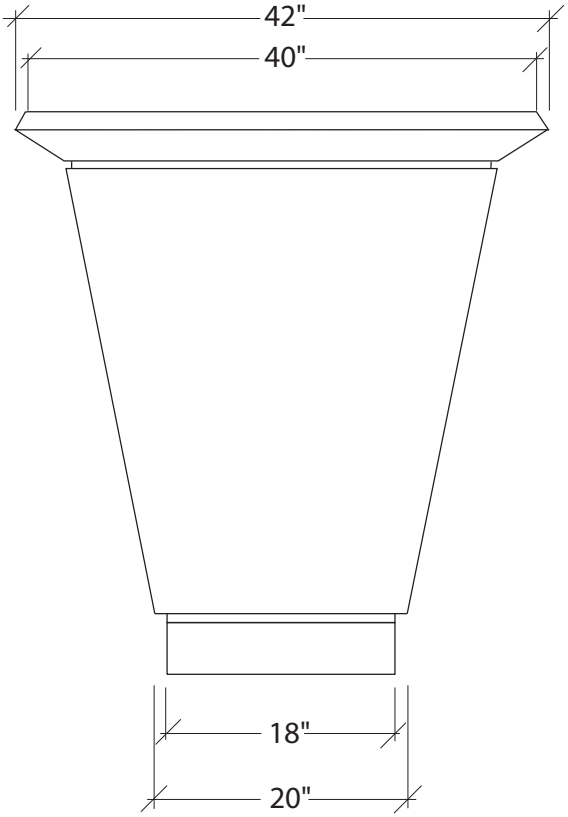
Section A-A

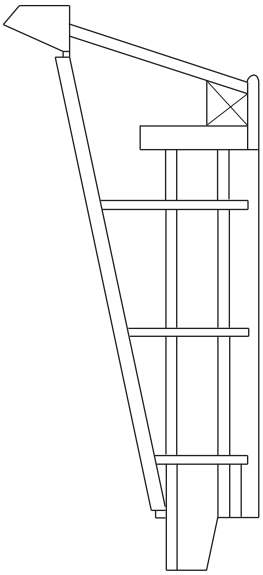
Baptismal Font





Vertical Section

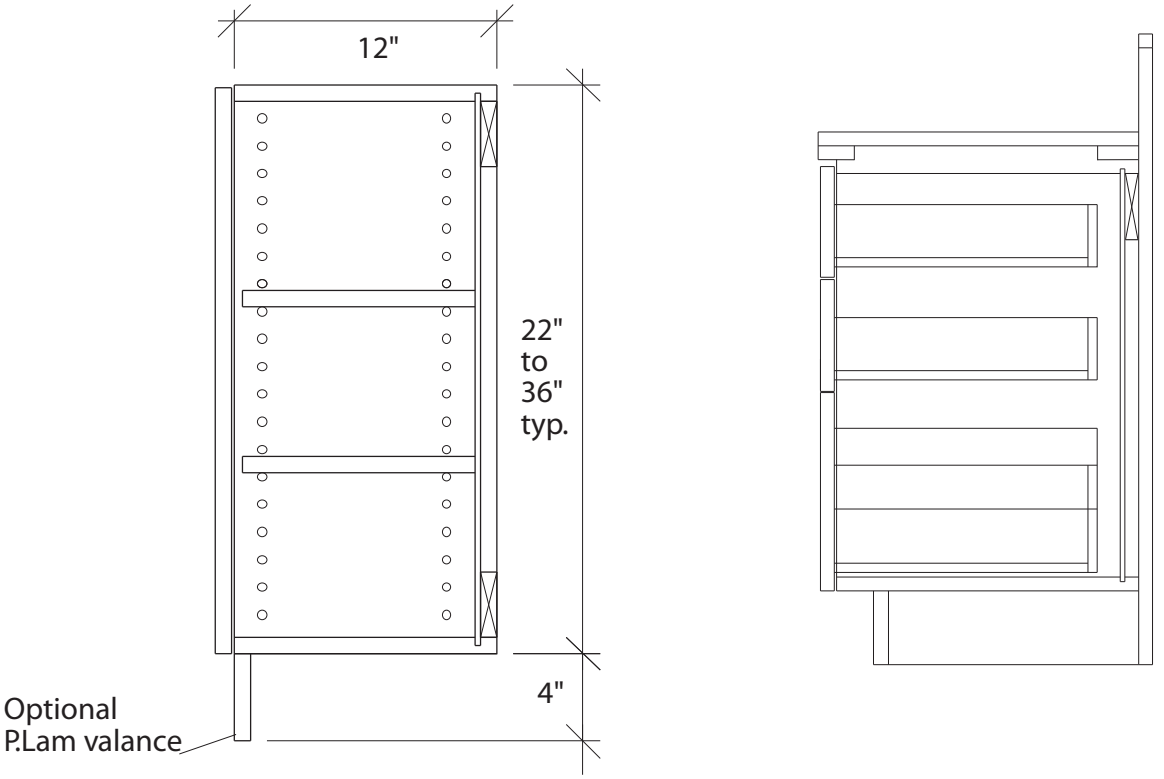


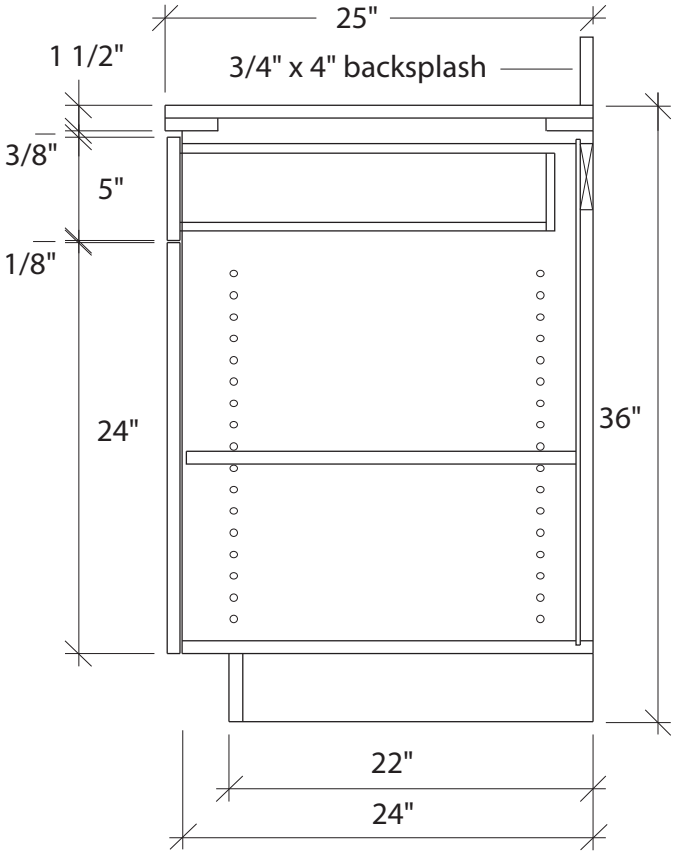


Lectern

10 - Casework

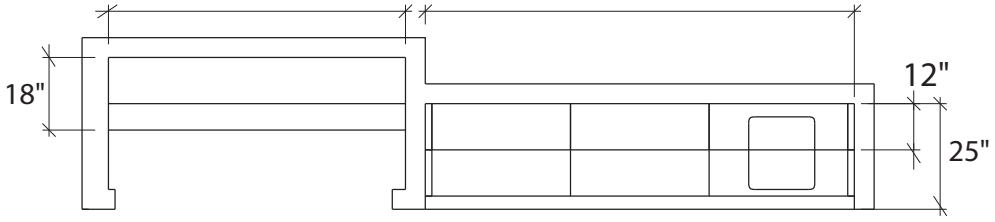
Basic Cabinetry

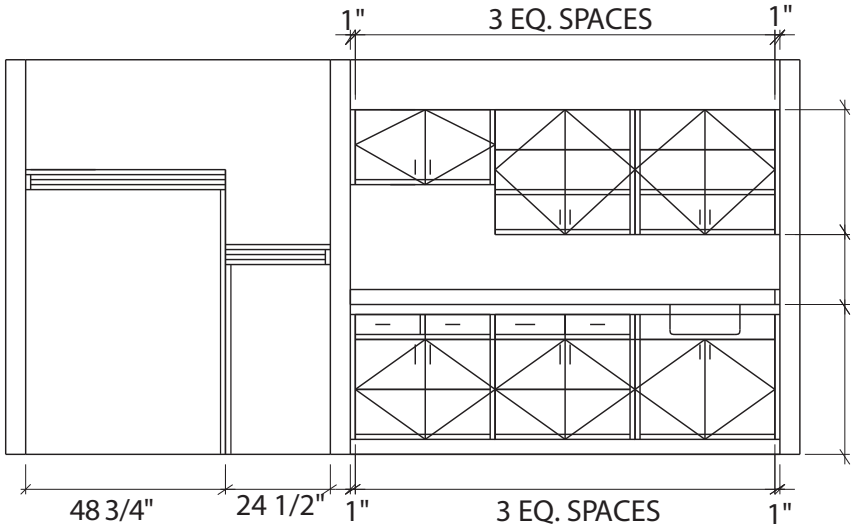


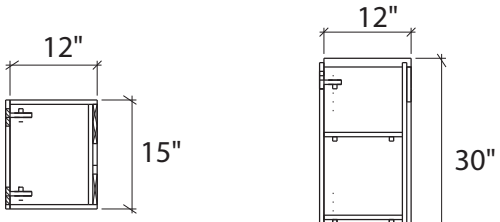


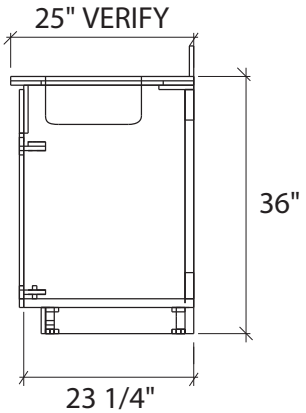
10 - Casework

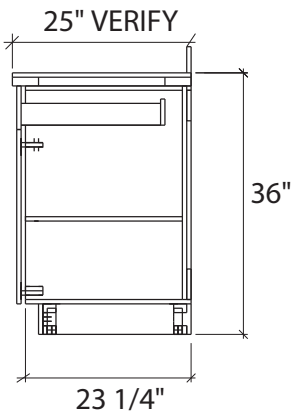
Basic Cabinetry









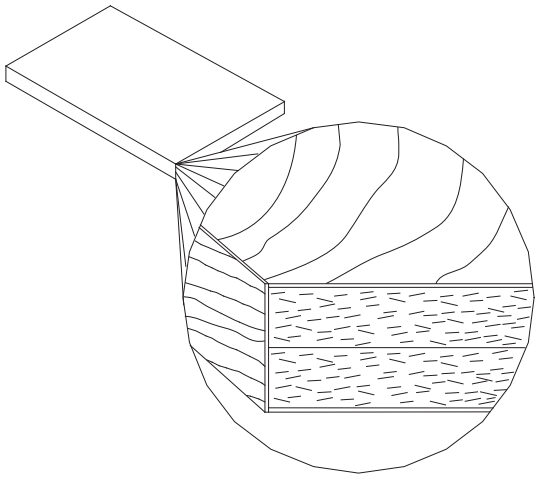


11
Countertops

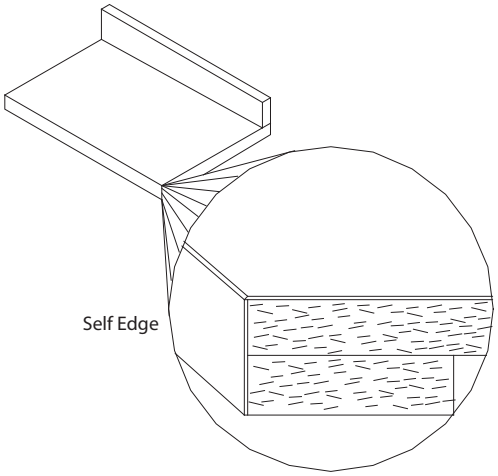
11 - Countertops

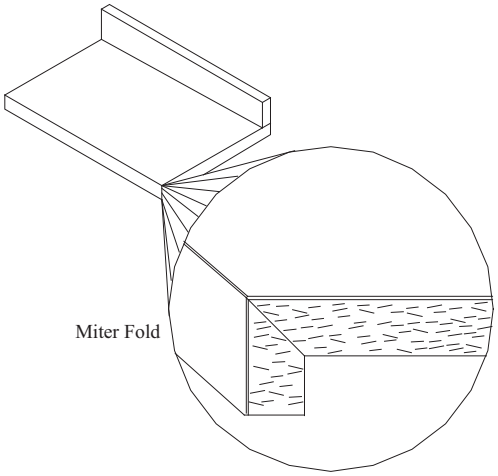
Typical Countertop Configurations:

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.

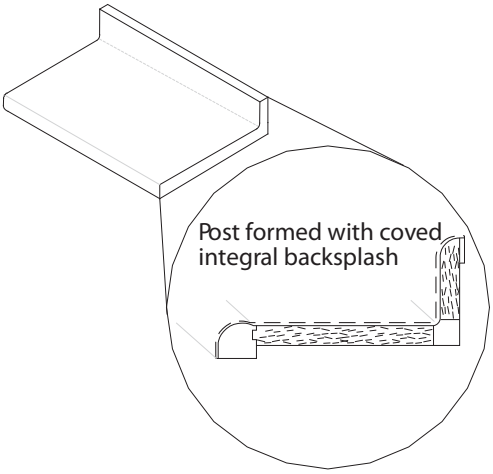


B. High Pressure Decorative Laminate (HPDL) Tops - This type of top consists of plastic laminate over a stable substrate, self edge banded or with an applied decorative edge of another material as specified.

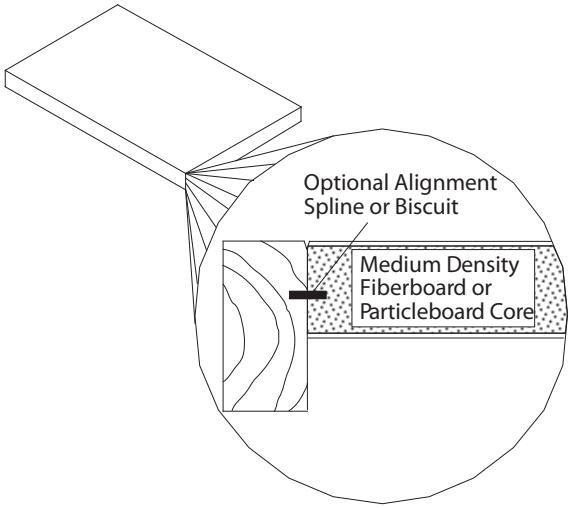




C. Post-formed High Pressure Decorative Laminated Tops - This type of top consists of plastic laminate formed with heat and pressure over a stable substrate and must be specified.

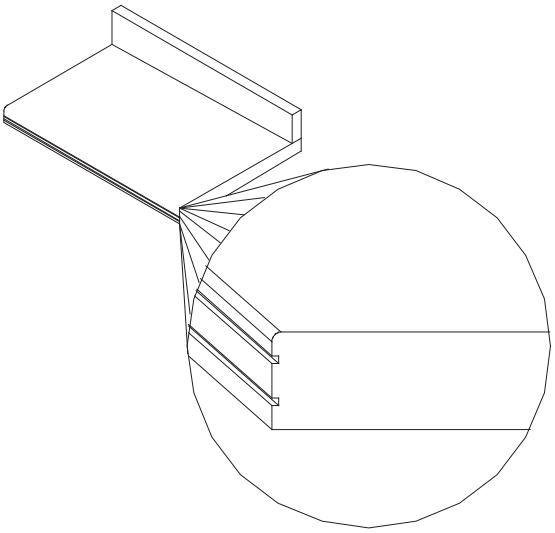


D. Combination Material Tops - This type of top may consist of a mixture of materials, such as wood, high pressure decorative laminate, inlays, etc.

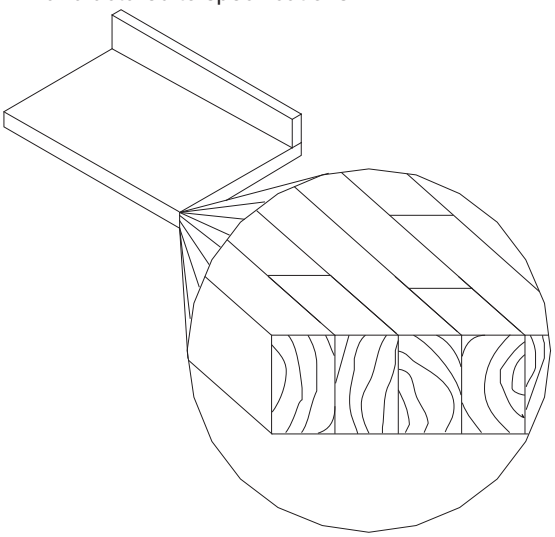


11 - Countertops

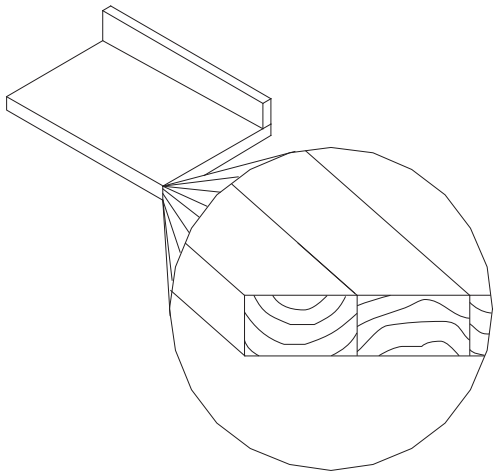
E. Solid Surfacing Materials - This type of top requires special fabrication techniques, depending upon the composition of the product. Many woodworkers fabricate and install the products. Must be specified by brand name and manufacturer.



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)

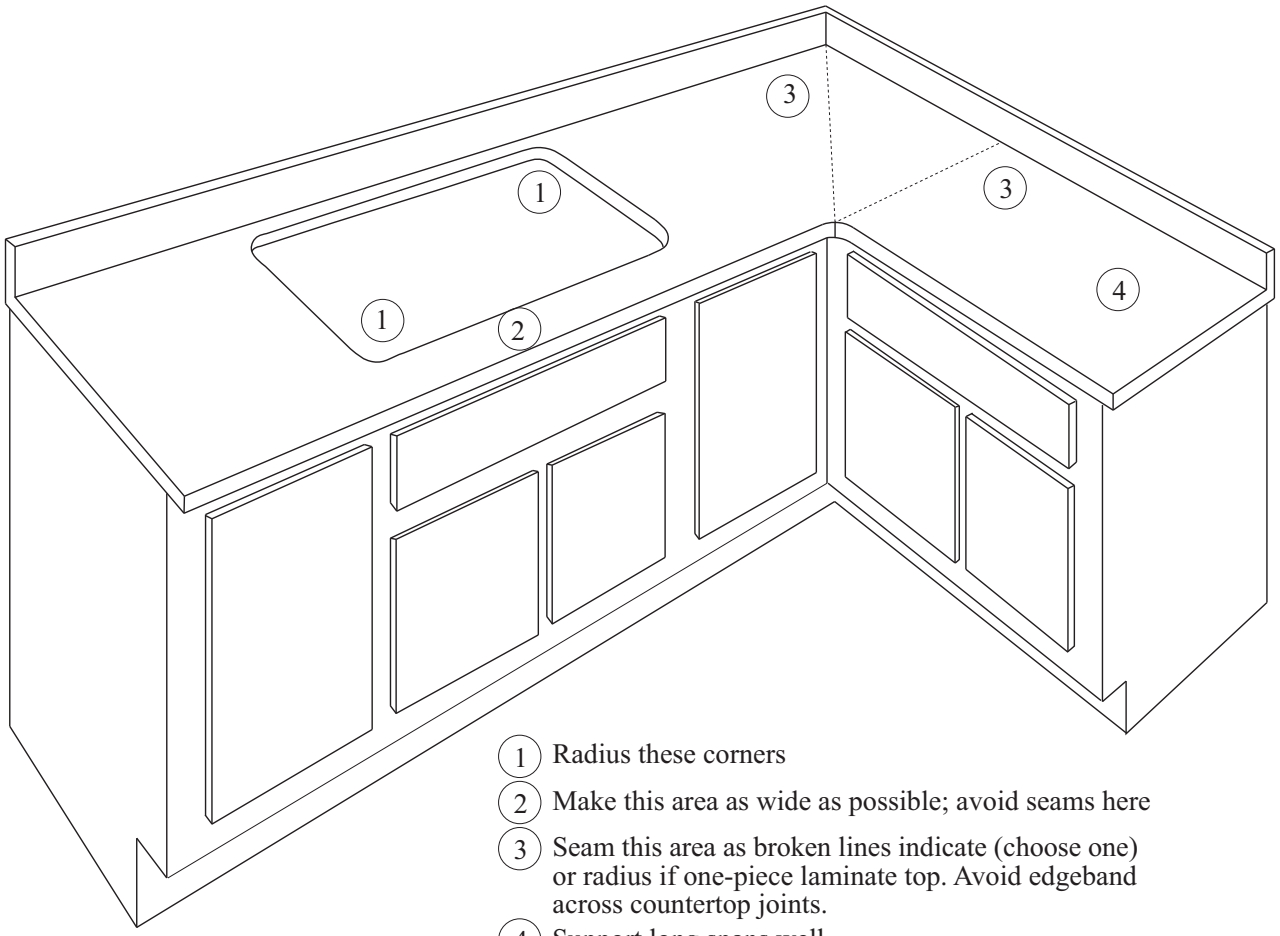
Factory-trimmed sheet edges and saw-cut edges should be routed or filed. Original edges on factory-cut laminates are not finished edges since oversized laminates are supplied to allow for proper fabrication.

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.



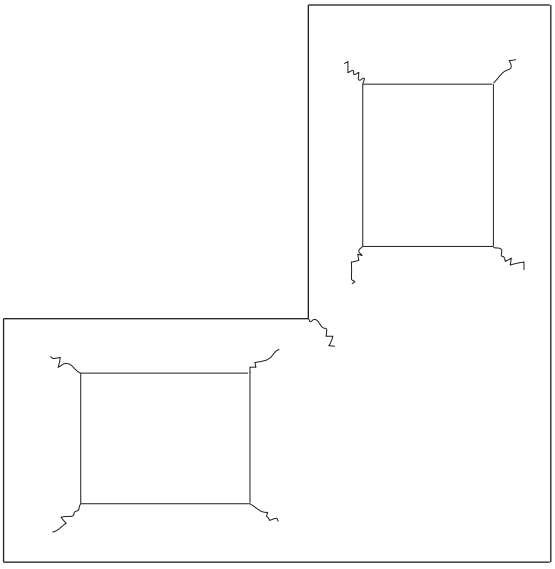
1. Radius these corners
2. Make this area as wide as possible; avoid seams here
3. Seam this area as broken lines indicate (choose one) or radius if one-piece laminate top. Avoid edgeband across countertop joints.
4. Support long spans well

11 - Countertops

Typical Problems - Causes and Prevention

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

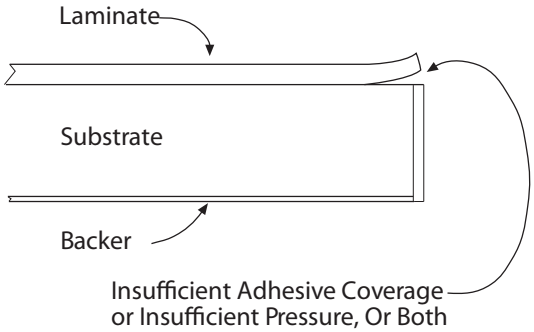
CRACKING of the laminate at corners and around cutouts may be caused by improper conditioning, improper bonding and, sometimes, poor planning, or any combination of these reasons. Cracking may be caused by shrinkage; conditioning helps to prevent it. Rough edges, inside corners that have not been rounded,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



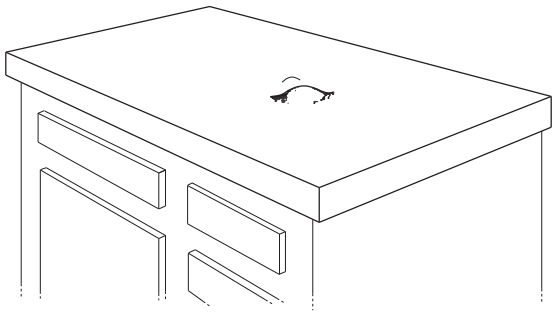
If the seams are properly placed in the layout of the laminate, stresses can be minimized.

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.

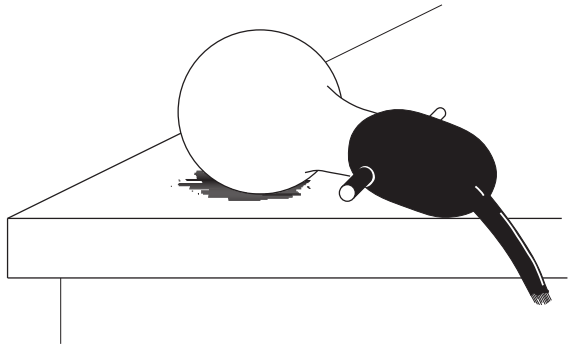


BLISTERING or **BUBBLING** of the laminate surface away from the substrate can be caused by excessive heat, starved glue line, improper conditioning, and inadequate pressure or drying. When contact adhesive is used, the condition can sometimes be corrected by applying heat and pressure. But uniform glue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

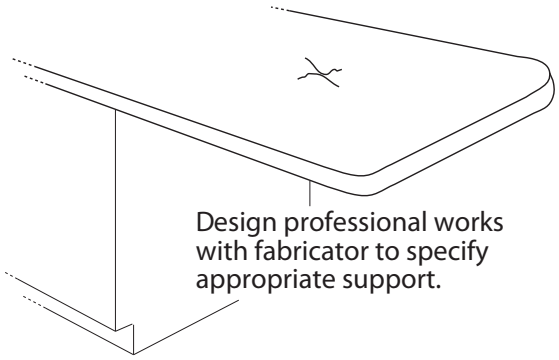


The forming of a blister or bubble over a small area, often accompanied by a darkening of the laminate can be caused by continual exposure to a source of heat. Electrical appliances which produce heat and light bulbs should not be placed in contact with or close proximity to laminate surfaces.

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



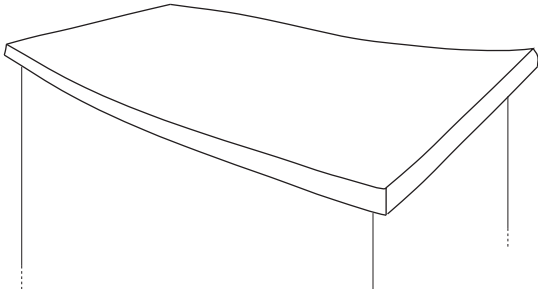
CRACKING of the laminate in the center of the sheet may be caused by flexing of the substrate when it covers a wide span or by spot gluing. Wide spans call for sturdy framework, and special attention should be given to the uniformity of glue lines and gluing pressures. Also, care should be taken to avoid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

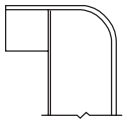
This Section is a sample of design ideas. It makes no pretense of being complete. It's here for the reader to use as a starting place. The exercise of personal creativity is the essence of fine architectural woodworking.

Custom-designed woodwork gives you complete freedom of expression.

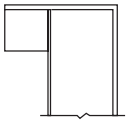
- Design flexibility: The use of custom-designed woodwork in a building allows the design professional freedom of expression while meeting the functional needs of the client. A custom-designed building is enhanced by the use of custom-designed woodwork.
- Cost effective: Custom woodwork does compete 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

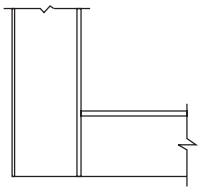
These illlustrations are not intended to be all inclusive. Other engineering solutions may be acceptable. In the absence of specifications, fabrication methods are at the option of the woodwork manufacturer.



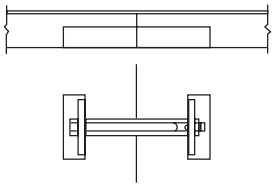
Radiused Top



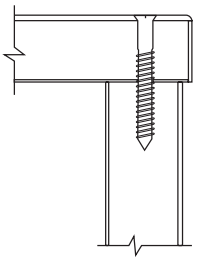
Square Top



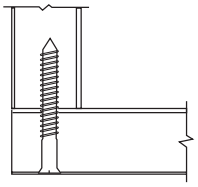
End Splash Joint



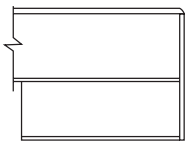
Tight Joint Fastener



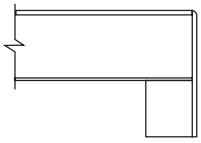
Removable Ledge



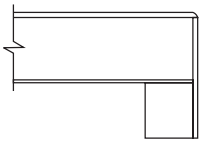
Square Splash Joint



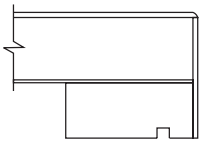
Self Edge w/ Wide Build Up



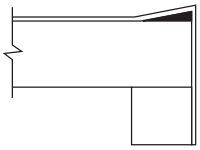
Self Edge Economy



Self Edge Premium/Custom

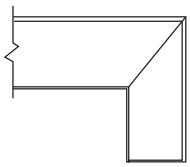


Self Edge w/ Drip Groove Laboratory

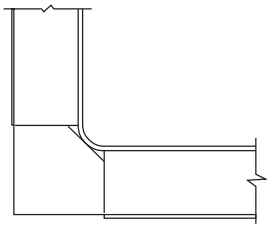


No Drip Self Edge

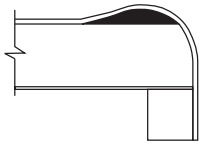
The details below cannot be made on radiused counter tops:



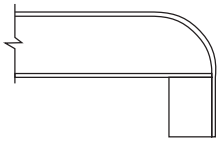
Miter Fold



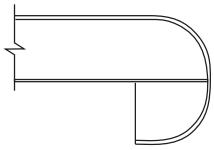
Coved Splash Joint



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.

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Fire-Retardant Ratings

(when specified)

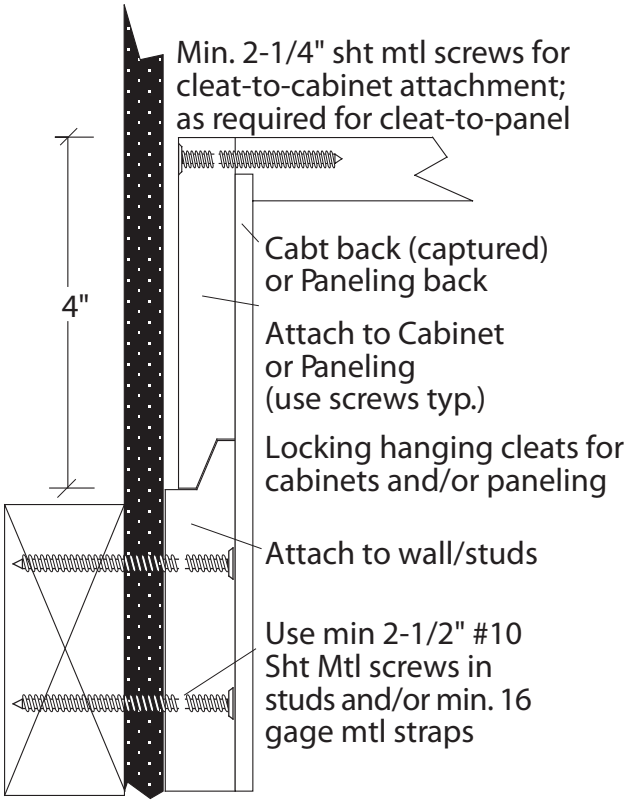
It is the responsibility of the specifier to research local codes and to indicate what fire-retardant rating, if any, is required for the specific items and classifications of the woodwork.

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

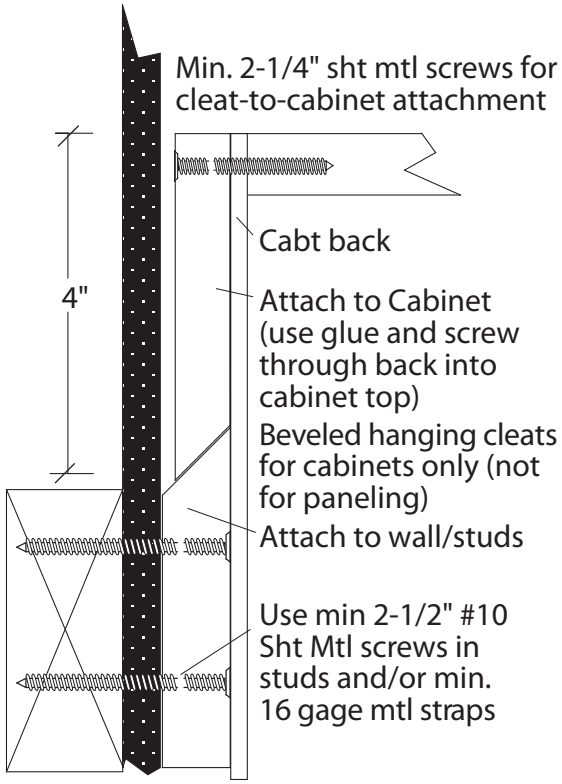
Recommendations which follow

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.

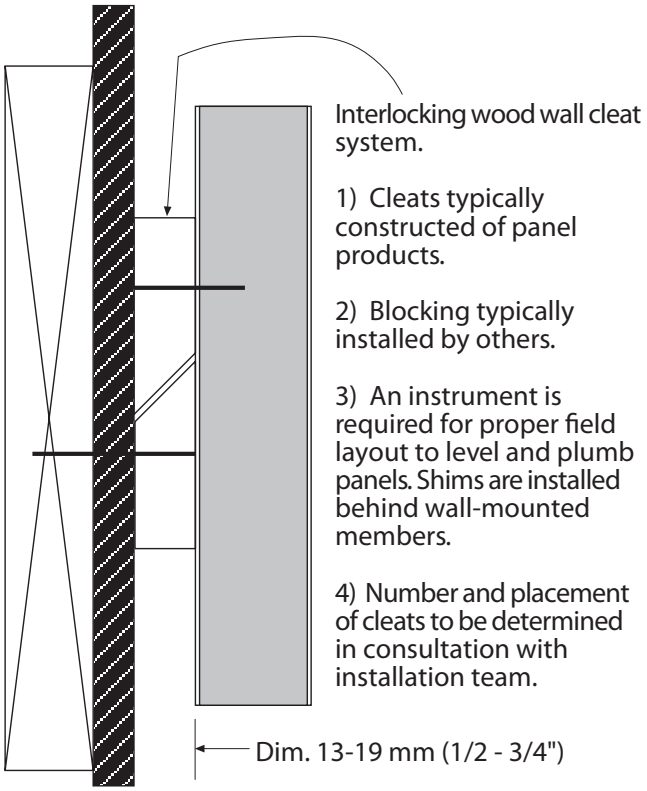
Hanging Cleat Recommendations



CABINET OR PANEL HANGING

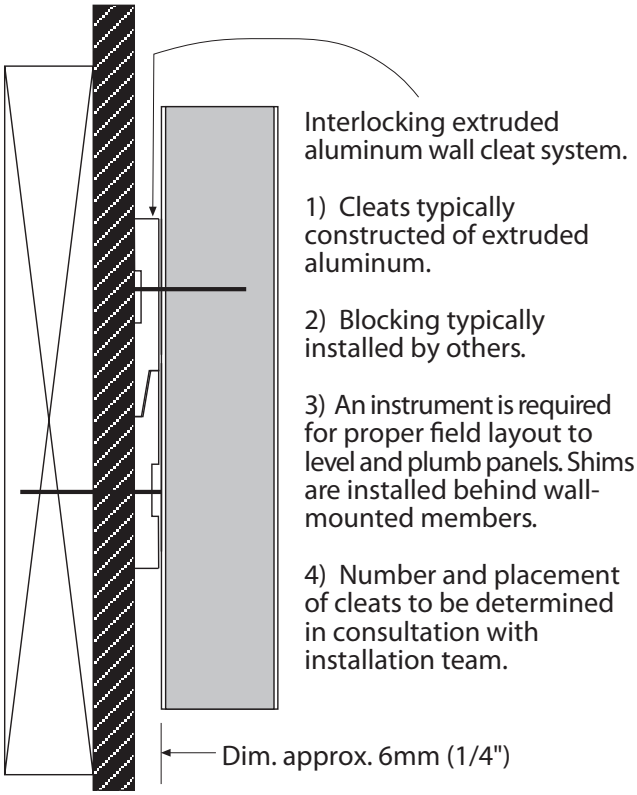


CABINET HANGING



WOOD INTERLOCK

12 - Installation

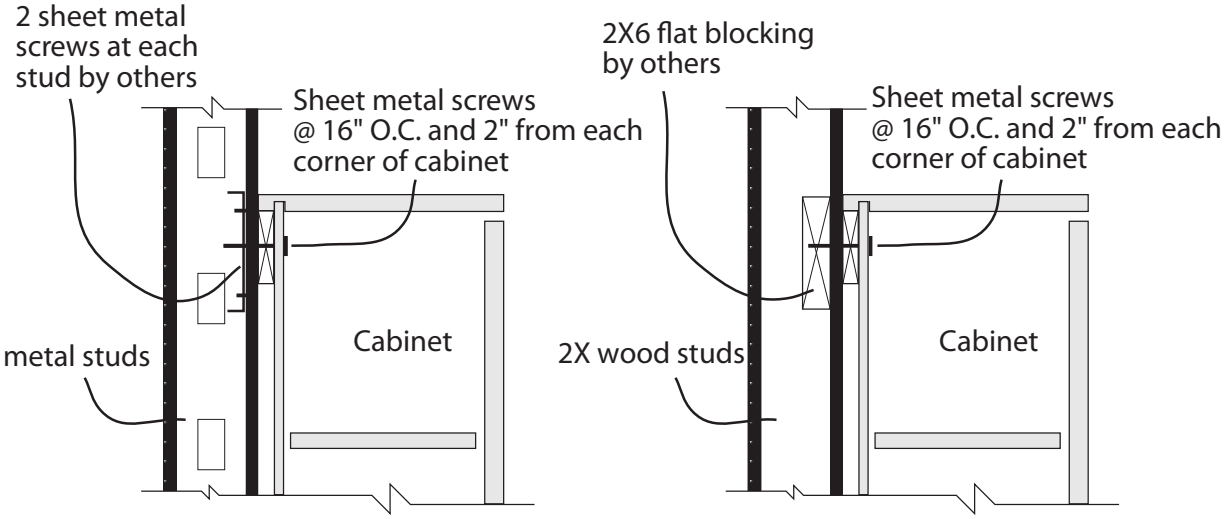


ALUMINUM INTERLOCK

12 - Installation

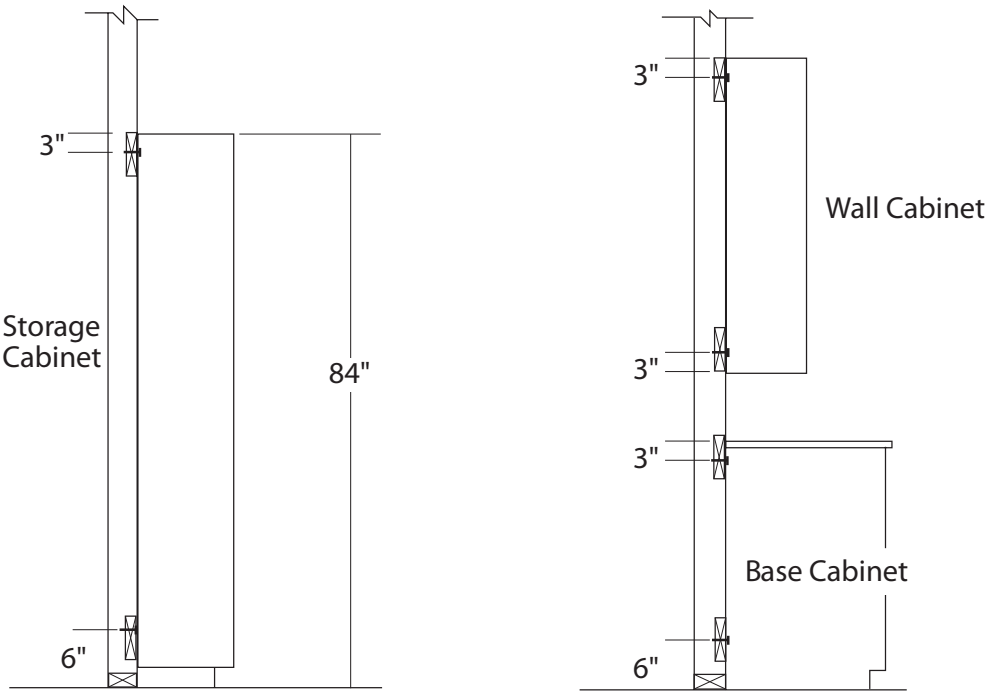
Cabinet Fastening Recommendations

NOTE: These techniques are not approved for seismic areas.



Typical at Metal Stud Walls

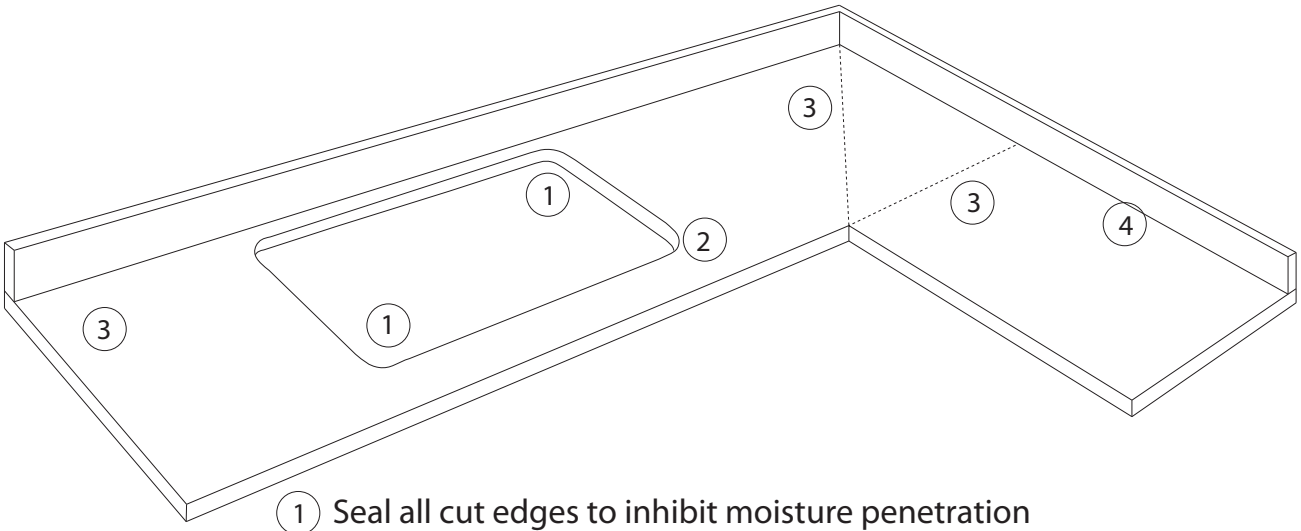
Typical at Wood Stud Walls



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

13
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