Architectural Woodwork Standards

MILLWORK

SECTION 6
### COMPLIANCE REQUIREMENTS

**GENERAL**

- Basic Considerations .......................................................... 145
- Grades .................................................................................. 145
- Economy ............................................................................... 145
- Custom .................................................................................. 145
- Premium .................................................................................. 145
- Contract Documents .............................................................. 145
- Acceptable Compliance Requirements ................................... 145
- Aesthetics Compliance Requirements ..................................... 145
- Exposed Surfaces ................................................................. 145
- Semi-Exposed Surfaces .......................................................... 145
- Concealed Surfaces .............................................................. 145
- Prevent Telegraphing ............................................................ 145
- Industry Practices ................................................................. 145
- Structural Members ............................................................. 145
- Flame Spread Rated Wood Door Frames .............................. 145
- Wall, Ceiling and/or Opening Variations ............................... 145
- Priming .................................................................................. 145
- Radius Moldings .................................................................... 146
- Method of Fabrication ........................................................... 146

**PRODUCT**

- Scope .................................................................................. 147
- Typical Inclusions ............................................................... 147
- Typical Exclusions ............................................................... 147
- Default Stipulation .............................................................. 148
- Rules .................................................................................... 148
- Errata .................................................................................... 148
- Basic Rules ............................................................................. 148
- Aesthetics .............................................................................. 148
- Woodwork ........................................................................... 148
- Lumber .................................................................................. 148
- Sheet Products ....................................................................... 148
- Exposed Surfaces ................................................................. 148
- Semi-Exposed Surfaces .......................................................... 148
- Concealed Surfaces .............................................................. 148
- Standing and Running Trim ................................................... 148
- Structural Members ............................................................. 145
- Exposed Surfaces ................................................................. 148
- Transparent Finish .............................................................. 150
- For Transparent Finish ........................................................ 150
- Opaque Finish ....................................................................... 150
- Exposed Surfaces ................................................................. 150
- Semi-Exposed Surfaces .......................................................... 151
- Concealed Surfaces .............................................................. 151
- Door and Window Frames .................................................... 151
- Sash ...................................................................................... 151
- Blinds and Shutters ............................................................. 152
- Screens .................................................................................. 152
- Closet and Utility Shelving .................................................... 152
- Glass ...................................................................................... 153
- Factory Finishing ................................................................. 153
- Machining Rules ................................................................. 153
- Exposed Surfaces ................................................................. 153
- Smoothness .......................................................................... 153
- HPDL, PVC, and Prefinished Wood ...................................... 153
- Trim ...................................................................................... 154
- Solid Machined and Block Laminated .................................... 154
- Intersections .......................................................................... 154
- Dadoes ................................................................................... 154
- Standing and Running Trim ................................................... 154
# Section 6
## Millwork

### Table of Contents

**Compliance Requirements** (continued)

**Product** (continued)

**Rules** (continued)

**Machining Rules** (continued)
- Window Frames ........................................ 154
- Sash ......................................................... 154
- Screens ..................................................... 154
- Blinds and Shutters .................................. 155
- Ornamental Woodwork ................................ 155

**Assembly Rules** .......................................... 155

**Joints at Assembled Woodwork** ....................... 155
- Flushness Test D ........................................ 155
- Gap Test A .................................................. 156
- Gap Test B .................................................. 156
- Gap Test C .................................................. 156

**Flatness or Warp Test E** ................................. 156

**Applied Moldings** ........................................ 156

**Miter Joints and Caps** .................................... 156

**Stile and Rail Assemblies** ............................... 156

**Sheet Products** ........................................... 156

**Built up Items** ............................................. 156

**Standing and Running Trim** ......................... 157

**Door Frames** .............................................. 157

**Window Frames** .......................................... 157

**Sash** ......................................................... 158

**Blinds and Shutters** .................................... 158

**Screens** ....................................................... 158

**Ornamental Millwork** .................................... 158

**Miscellaneous Millwork** ............................... 159

**Installation**

- Care, Storage and Building Conditions .......... 160
- Contractor is Responsible for ...................... 160
- Installer is Responsible for ......................... 160
- Rules .......................................................... 160
- Errata .......................................................... 160
- Basic Rules .................................................. 161
- Aesthetics ..................................................... 161
- Transparent Finished .................................... 161

**Repairs** ......................................................... 161

**Installer Modifications** ................................. 161

**Woodwork** .................................................. 161

**These Standards** .......................................... 161

**Gaps Tests I** ............................................. 161

**Flushness Tests J** ........................................ 162

**Fastening and Fasteners** ............................... 162

**Glue** .......................................................... 162

**Equipment Cutouts** ...................................... 163

**Hardware** .................................................... 163

**Areas of Installation** ...................................... 163

**First Class Workmanship** ............................ 163

**Product Specific Rules** ................................. 163

**Standing and Running Trim** ......................... 163

**Closet Rods** ............................................... 163

**Door & Window Frames** ............................... 163

**Blinds and Shutters** .................................... 163

**Screens** ....................................................... 163

**Ornamental Millwork** .................................... 163

**Tests**

- Basic Considerations .................................... 164
- Fabricated and Installed ............................... 164
- Smoothness ............................................... 164
- KCPI ........................................................... 164
- Sanding ...................................................... 164
- Gaps, Flushness, Flatness and Alignment ........ 164
- Illustrations ............................................... 165
Guide Specifications

Are available through the Sponsor Associations in interactive digital format including unique and individual quality control options.

The Guide Specifications are located at:

Architectural Woodwork Institute (AWI)
www.awinet.org

Architectural Woodwork Manufacturers Association of Canada (AWMAC)
http://awmac.com/aws-guide-specifications

Woodwork Institute (WI)
www.woodworkinstitute.com/publications/aws_guide_specs.asp
**SECTION 6**
Millwork

**Introductory Information**

**Introduction**

Section 6 includes information on standing & running trim, door frames, window frames, sashes, blinds & shutters, screens, ornamental & miscellaneous millwork composed of solid wood and/or sheet products and their related parts.

Quality assurance can be achieved by adherence to the AWS and will provide the owner a quality product at competitive pricing. Use of a qualified Sponsor Member firm to provide your woodwork will help ensure the manufacturer’s understanding of the quality level required. Illustrations in this Section are not intended to be all inclusive. Other engineered solutions are acceptable. In the absence of specifications; methods of fabrication are the manufacturer’s choice. The design professional, by specifying compliance to the AWS increases the probability of receiving the product quality expected.

**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.

**Molded Surfaces:**

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

**Smoothness of Flat and Molded Surfaces**

Planers and Molders: The smoothness of surfaces which have been machine planed or molded 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.
EXAMPLES OF STANDING AND RUNNING TRIM AND RAIL PARTS

1. Spindle or Baluster (see Section 7)
2. Crown Running Trim
3. Crown Running Trim
4. Handrail
5. Base Combination (Cove, board, shoe) Running Trim
6. Window Casing Standing Trim
7. Wall Molding Combination (Cove, board, cove) Standing Trim
8. Chair Rail Combination (Cap, cove & rail) Running Trim
9. Newel Post (see Section 7)

Figure: 6-004
EXAMPLES OF STANDING and RUNNING TRIM

1 Cornice
2 Chair Rail
3 3-piece Base
4 Casing
5 Panel Molding
EXAMPLES OF STANDING and RUNNING TRIM and RAIL

1 Skylight Cornice
2 Crown
3 Panel Molding
4 Handrail

Figure: 6-006
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 core, the architectural manufacturer can use several methods to fabricate radius moldings. Moldings applied to radii can be segmented, (typically only by direct specification) bent or steam bent, laminated and formed, preshaped, or machined to the radius. Manufacturers will fabricate the moldings in the longest practical lengths, with the purpose of minimizing the field joints.

- **Solid Machined** (Illustration A) woodwork typically starts with a large, often glued up piece of material, from which several nested pieces can be machined. Characteristically, this method limits the length of pieces that can be developed without a joint. It also yields a piece of material with the grain straight on the face, not following the curve. Profiles with a flat face can be machined from sheet products with an edgeband applied, yielding larger pieces with more consistent grain.

- **Core Veneered** (Illustration B) woodwork consists of core machined from lumber or panel product to which finish material is laminated as an exposed face. This technique is limited to certain profiles; however, it offers the ability to minimize glue joints and control grain directions.

- **Laminated Plies** (Illustration C) woodwork consists of thin, bendable plies of lumber in a form that will hold its shape without having to be secured to another surface. The curved piece can 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.

- **Block Laminated** (Illustration D) woodwork is made of solid machined pieces, glued up typically in a staggered fashion for width and length. When dealing with some cross sections, it can be advantageous to combine band sawing and laminating; however, it must be limited to certain profiles. It does, however, offer the ability to minimize glue joints, is used in radius jambs and often becomes the core for core veneered woodwork.

- **Kerfed** (Illustration E) woodwork consists of lumber with 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 could result 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 through, and the edge must be concealed.

**Cross Grain** in band sawn or laminated members and edges in veneer laminated members or where multiple layers are exposed by shaping may cause objectionable color variation when finished.

Unless specifically called out, the architectural manufacturer 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. Mockups may be required to visualize the end product.

Chord Segmentation is the process of cutting short lengths of straight molding and joining them around a curved substrate and is NOT permitted unless specified.

Figure: 6-007
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
- Reveal Detail Options
- Pickwick Paneling
- Tongue and Groove “V” Joint
- Beaded Siding
- Rough Sawn w/ Lap Reveal
- Simulated Lap Siding
- Bevel Siding
- Drop/Lap Siding
- Molded Insert
- Beaded Bevel Siding
- Coved Paneling
**SECTION 6**  
Millwork

**BUILT UP MOLDINGS FOR LARGER PROFILES**

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

- **Ceilings** are the most obvious area for “built up” moldings. 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** are 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.

![Diagram of built up moldings and chair rails]

**Figure: 6-009**  
**Figure: 6-010**
• **Fireplaces** highlighted or framed with “built up” moldings is an excellent way to add depth and richness. Below are a few creative but simple to install profile combinations.

• **Doors** and **Windows** are 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.

**DESIGN IDEAS**

Include molding illustrations such as:

• Base and base cap patterns
• Casing patterns
• Panel mold patterns
• Crown mold patterns
• Bed mold patterns
• Handrail patterns
• Chair rail patterns

SECTION 6
Millwork

introductory information

BUILT-UP CORNICE and WALL TRIM EXAMPLES

Example 1
Example 2
Example 3
Example 4
Example 5
Example 6
Example 7
Example 8
Example 9
Example 10
Example 11

Figure: 6-016
introductory information

DOOR FRAME and JAMB EXAMPLES:

1. Split Jamb
2. Single Rabbet
3. Double Rabbet
4. Applied Stop
5. Cased Opening
6. Ploughed-in Stop

WINDOW SASH and FRAME EXAMPLES:

1. Brick Mold
2. Casing
3. Blind Stop
4. Parting Bead
5. Head Jamb
6. Top Rail
7. Fixed

GLAZING EXAMPLES:

1. Single Glaze
2. Double Glazed

THERMAL INTEGRITY:

Wood is a natural insulator that retains heat in winter without a thermal break, resists conductance of cold temperatures 2000 times better than aluminum, and is approximately 30% more thermally efficient than comparable aluminum windows. Wood’s minimal conduction keeps the inside wood surface of windows warm in the winter and cool in the summer.

Performance Testing is applicable only to complete exterior window units and, if required, must be specified and may include all or part of ASTM E 283, Air Infiltration; E 330, Loading; and/or E 547, Water Penetration. ASTM tests must be specified for the current ASTM Grade Level.

Labeled (flame spread-rated) jamb assemblies are typically available in 20-, 45-, 60-, and 90-minute classifications of limited design/species; however, new designs/ratings are in ongoing development. Only firms recognized by applicable code officials are authorized to label a frame assembly. If a label will be required by the applicable code officials, it is the obligation of the design professional to so specify, and the obligation of the manufacturer to assure a properly licensed assembly. These standards do not cover labeled frames.
SECTION 6
Millwork

introductory information

BLINDS and SHUTTERS

• Hardware must be specified, as it dictates the details of construction.

• Manufacturer does not typically supply, machine for, or install operating hardware, locking devices, pulls, lifts, etc.

Typical bead detail examples:

SCREENS:

• Hardware must be specified, as it dictates the details of construction.

• Manufacturer does not typically supply, machine for, or install operating hardware, locking devices, pulls, lifts, etc.

ORNAMENTAL WOODWORK:

Typical Sources of wood ornamentation are either mass-produced or custom carved and tooled.

• Mass-produced product is often limited in available species, sizes, and design, and is often a variety of historical styles, which might lack detail; however, can be appropriate for many applications.

• Custom carved or tooled work has a special appearance, with depth and clarity or crispness that machine tooling often cannot achieve. There will be slight irregularities because it is done by a skilled artisan; however, this is deemed desirable as it lends character and credence to the work, including tool-marked surface, which can be sanded smooth or left as a texture.
There are four methods of depicting a design in wood:

- **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 incorporated into architectural surroundings.

**Ornamental Woodwork** (continued)

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 manufacturer shall not:

- Provide or prepare for electrical, telephone, mechanical, or plumbing equipment;
- Install woodwork or furnish common in wall 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.

**Fire-Retardant Solid Lumber** may affect the finishes intended to be used on the wood, particularly if transparent finishes are planned. The compatibility of finishes should be tested before they are applied.

**Sources for Wood Ornamentation**

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

- The mass-produced product is often limited in available species, sizes and design, which is often a variety of historic styles which may lack detail, however can be appropriate for many applications. 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.

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

  - When there is a need to replicate missing (hand carved) elements for restoration or renovation.
  - When elements of specified dimensions are required and unavailable otherwise.
  - When a particular wood species is required.
  - When customized logos or lettering is desired.
  - When patterns are required for casting in another material such as plaster, metal, or glass.

  - 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 an 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.

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

- Type of element - molding, capital, bracket, etc.
- 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.

**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...
Working with an Artisan (continued)

• Species of wood and who will supply the "blanks". Finishes (paint grade, gilding, faux finish) should also be discussed.
• Context and/or installed location should be made clear in order to understand lighting and the degree of detail necessary.
• Intended schedule or completion date.
• 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.

What to expect from the carver:
• The carver provides skill and knowledge through experience. The majority of the cost may be in the labor. Carving is a unique product which adds immeasurably to the character and attractiveness of the overall project.
• The carving should closely resemble what is represented in drawings and verbal descriptions.
• 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.
• 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.

DESIGN IDEAS
Includes illustrations of base, picture, casing, panel, crown, bed, handrail and chair rail moldings; along with a large number of historic ornamental woodwork illustrations. These design ideas are not exhaustive and are for the reader to use as a starting guide.

SPECIFY REQUIREMENTS FOR:
• Flame spread ratings or special code compliance.
• Window performance testing and/or labeling and hardware.
• Glass type and thickness.
• Wood species for exterior sash, shutters, or screens and frame parts, exposed, semi-exposed or concealed shall be of any species listed in Section 3, suitable for exterior use as being resistant, moderately resistant, or very resistant.
• Closet and utility shelving shelf size, thickness, and support system needed to meet the load-carrying requirements of the project; otherwise, the minimal requirements of the standards shall prevail. Shelf deflection information can be found in Section 10.
• ADA or barrier-free compliance design and requirements.

RECOMMENDATIONS
• If FIELD FINISHED, include in Division 09 of the specifications:
• BEFORE FINISHING, exposed portions of woodwork shall have handling marks or effects of exposure to moisture, removed with a thorough, final sanding over all surfaces of the exposed portion and shall be cleaned before applying sealer or finish.
• At CONCEALED SURFACES - Architectural woodwork that may be exposed to moisture, such as those adjacent to exterior concrete walls, etc., shall be primed.
• REVIEW the GENERAL portion of Sections 3 and 4 for an overview of the characteristics and the minimum acceptable requirements of lumber and/or sheet products that might be used herein.
• STRUCTURAL MEMBERS, grounds, in wall blocking, backing, furring, brackets, or other anchorage which becomes an integral part of the building's walls, floors, or ceilings, required for the installation of architectural woodwork are not to be furnished or installed by the architectural woodwork manufacturer or installer.
• At WOOD SASH and WINDOWS, the finish coats will be flowed onto the glass area approximately 1/16” (1.6 mm) to properly seal against weather, wind, and rain. It is not recommended to use a razor blade to scrape the glass, as it might break the seal. A broad-blade putty knife is recommended to be used to protect the seal between the glass and the wood members.
• FABRICATION METHODS can affect the final appearance, especially regarding the direction of the grain and the visibility of the glue joints. As a design professional, you may wish to specify the method; however, it is recommended that an architectural woodwork firm be consulted before making a particular selection. Mock-ups may be required to visualize the end product.
The COMPLIANCE portion of this Section has been intentionally excluded to protect our sale of Grade Rules, which allows us to provide these standards free of charge to Design Professionals.