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Plywood - a long history and strong future

Design for mass production is integrally connected to the development of new technologies in production processes and materials. Composite materials can give designers the opportunity to ‘design’ the material in addition to the end product. One such composite, plywood, is as relevant today as it was one hundred years ago.

Kate Bissett Johnson with advice from Juel Briggs, of Briggs Veneers Pty Ltd, looks at the technology of plywood and veneers while Simon Jackson reflects on its history.

Most histories of veneering begin by acknowledging the first documented practice in about 1500 BC by the Egyptians. There is also archaeological evidence that the ancient Chinese, Greeks and Romans used plywood and decorative veneering prior to the birth of Christ.

The Dutch commenced the use of what was called “oyster” veneers in the 17th century. By the 18th century Thomas Sheraton and Thomas Chippendale were producing high quality veneered furniture. They enriched domestic furniture with the complex decorative surface patterns of precious woods glued onto a solid wood substrate. The piano industry in Europe and America in the early 19th century was a huge consumer of decorative veneer. It was during this time that machines for mass production of thin timber veneers were patented. Each subsequent age and design movement has had its own preferences as to colour, figuring, grain and wood-type. For example, the designers of the arts and crafts movement favoured veneers of oak, walnut and mahogany for their design objects. But it was the designers of the Art Deco period who were perhaps the most prolific users, specifying panels of veneer for walls in restaurants, shops, offices, banks, public buildings, facias of cars, train carriages and ship interiors.

Plywood development has a shorter history than the history of veneering and is often the substrate under the higher quality decorative veneered products. Mass produced furniture and wall panelling started to be produced in the 1920’s, surface veneered from species such as European and American Oak. By the 1930s in Europe, Alvar Aalto and Bruno Mathsson were laminating and forming plywood sheets into organic and complex curves. The celebrated Eames’ LCM chair of 1946 (and its imitators internationally and in Australia) was inspired by experiments making moulded splints for war-wounded human limbs. During World War II (1939 – 1945) a notable wartime plywood design object was the de Havilland Mosquito bomber which was manufactured in Britain, Canada and Australia. This aircraft was made of plywood because it was light and strong and because de Havilland had previously built many of their aircraft out of this material. Also, suitable tradesmen were available, such as those who had worked on pianos, cabinets and furniture generally. The wings and fuselage of the plane were constructed from double plywood skins on the top and single underneath resulting in a design that was light, strong and fast. Minor repairs were also very easy to undertake using simple carpentry skills.

In peacetime around the world, the birth of the consumer society saw a demand for manufactured goods. Up until the 1960s, the substrate of furniture pieces such as stereogram cabinets and TV cabinets was mostly plywood. After this time the baseboard for the decorative veneer was more likely to be particle board and then in late 1980s, MDF.
Wood, imperialism, economics, engineering and aesthetics

While an Australian design presence was limited internationally prior to WWII, some Australian raw materials were highly sought after. For example, in the 1930s and 1940s, British furniture constructed from three Queensland woods – Queensland Walnut, Queensland Maple and Silky Oak featured prominently in publications such as The Studio. It is also possible to read into the popularity of Australian veneers abroad an expression of British imperialism, and also of economic, engineering and aesthetic factors. Many British financial interests in Australia at the time were located on the land with British owners of large agricultural and sheep stations. It is therefore not surprising that at trade shows and international expositions abroad, and in official government buildings (such as Australia House on The Strand in London), Australian woods were favoured. They acted as reminders that Australia was often thought of as “Britain’s Farm”, supplier of raw goods to Empire. French designers of furniture and public buildings similarly drew upon raw materials from the rich forests of their African colonies. Conversely, Australian woods could also offer an expression of Australian national identity abroad. For example at the 1937 Exposition Universelle in Paris, a large display of Australian woods and other raw materials presented a self-image of “abundance” to the rest of the world.

Just as importantly, when Australian veneers were chosen it was because of their strength, aesthetic features and because of economic reasons. For instance, Coachwood was the major species in used in the plywood of the Mosquito bomber because of its strength, light weight, durability, workability and stability under moisture content change. Queensland Walnut was chosen as a decorative veneer because its colour and appearance in quarter-cut was very fashionable (just as Quarter-cut Walnut has recently been very popular). Silky Oak was chosen because of its attractive colour and unique flecked grain. One other major reason that Australian veneers were popular was because they would have been very price competitive compared to British and European species such as English Oak. Fashions for wood veneers are constantly changing.

Technology

Natural materials, like wood, due to their cellular structure are not always consistent in either their performance or properties. Solid timber objects or furniture need to be designed to allow for the timber’s absorption of moisture and corresponding expansion and contraction of various parts. Composite materials such as plywood, however, expand considerably less than solid timber, a definite advantage for functional objects and, of course, mass production.

The category of wood composite materials to which plywood belongs (plywood being a collection of veneers adhered together) is rapidly expanding. Fibreboard, Strand Board, Chipboard (properly known as Particleboard), Medium Density Fibreboard (MDF as it is more commonly known) are all wood plastic/resin composites, the wood being utilised as either flour, fibre, chips or solid timber (as is the case with Blockboard which is solid timber pieces laminated together). These composites produce an end product that makes the best use of the properties of both wood and plastic thus overcoming the variations and ‘movement’ of the natural timber material.

A veneer is thin sheet of wood. Decorative veneer in Australia is usually 0.6mm but in parts of Asia it can be as thin as 0.2mm and is produced by peeling or slicing thin layers of material from the log. Veneer patterns are created through peeling and
slicing in different ways, such as crown-cutting or quarter-cutting. Veneers are described by both species and method of cutting.

Although veneers are initially more expensive to produce than solid timber lengths, once converted into furniture they have several benefits. Rare or expensive woods can be used over cheaper substrates thereby minimizing their consumption, strength to weight ratios can be optimised, the number of parts minimised and the assembly simplified.

Plywood is constructed by gluing together a series of thicker veneers with the grain of each layer of veneer laid up at right angles to one preceding it. This results in a final board that has near uniform strength in both directions. Plywood is usually constructed of odd numbers of sheets of veneers and is reportedly the best man made composite wood material for bending and forming. It can be manipulated into curved forms through cold forming, laying up or laminating or by hot pressing/moulding facilitating the production of two way compound curves.

The species, grain direction, temperature and moisture content of the plywood determine the minimum bending radii, while the thickness of the plywood also is a major factor. The selection of the best bending process is dependant upon the radius of the curvature required, the grain direction relative the axis of bending, the thickness of the plywood, the type of application, the stresses that will be placed on the final bent product, the species and the arrangement of the plies within the panel.

Cold bends generally result in larger radii and the best results are obtained when the axis of the bend is perpendicular to the grain. Hardwoods can be bent to smaller radii than softwoods. Adding moisture to timber plasticises the wood, increasing the moisture content resulting in smaller radii. Drying the wood in the bent position causes less spring back after bending.

Heating and steaming also increases the plastic properties of the wood for better bending results. Heated wood can only be stretched a small amount before tearing but conversely can be compressed a relatively large amount without fracturing. Technology driven companies in Europe are currently developing bending processes using compressed solid timber lengths, changing their cellular structure through compression so that the parts can subsequently be bent in 3 dimensions.

Alternatively plywood can be impregnated with chemicals or bonded to other materials to change its physical properties. The “Less” Stacking side chair and Stool, designed by Marco Ferreri in 1993 and produced by BPA International out of Italy, converts a veneer to an upholstery by adhering polyurethane foam at high temperature under the softwood face veneer, the final 'wood' upholstery having a soft feel.

In terms of green design, plywood makes the best use of wood resources by using the best quality veneers only for the external visual surfaces. Water based glues can be used. One of the real green issues with plywood apart from the use of sustainable timber resources is the specification of an environmentally sensitive protective coating that will perform both visually and physically to enhance the appearance of the face veneer.

Wood Plastic Composites (WPC) are plastic materials “filled” with wood fibre, waste wood products or chips to add strength. Whilst they may be up to 70% wood either as fibre or wood flour, they really perform more as a plastic, as they can be moulded
in pretty much the same way as traditional plastic materials, most commonly they are extruded.

Wood Plastic Composites do have several positive properties. They make use of relatively plentiful raw materials and can be produced from recycled wood and plastic products and can in themselves be reground and recycled. They are available in a broad range of colours and finishes and can be easily fabricated using traditional wood working machinery. WPCs offer an attractive alternative to solid timber and plywood for the right applications.

Wood composites, whether making use of veneers or fibres, encourage the designer to ‘design’ the material while the potential for unique and manufacturable design expressions is endless. Whether they should be considered and valued as wood or plastic is up for debate, however applications to both the furniture and construction industries can only continue grow as worldwide forest resources dwindle.

* Briggs Veneer is one of the oldest Australian plywood and veneer manufacturers and merchants. The Briggs Group of companies have been continuously involved in the milling and marketing of sawn timber products for over 90 years and manufacturing veneers since 1933.