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Construction Methods in Wood Boatbuilding

Introduction

Although epoxy systems are excellent glues with excellent properties - highly adhesive, tough, waterproof, gap filling, non-shrink, solvent-free and chemical resistant - they are sometimes not the most suitable glues to use. This is particularly true in boatbuilding, where some construction methods, which were developed before the advent of modern glue technology, cannot take advantage of epoxy's high properties and ease of handling. These are generally the "traditional" types of construction which actually rely on movement of the wood during swelling to form a watertight rigid structure. However, many construction methods can take advantage of the properties of epoxies and indeed, some traditional forms of construction can be modified slightly so that they can also benefit.

The following reviews the range of hull construction methods used in wood boatbuilding today and indicates where epoxy adhesives can be used.

Traditional Lapstrake

No adhesives are used in the 'shell' but they can be used to construct the 'backbone' if a laminated structure is used. The close fit planking often relies on moisture to induce the wood to swell and create a waterproof joint. Some builders also use a type of mastic here which ensures a good seal but allows some flexibility.

Traditional Carvel

As above, no adhesives are used in the 'shell' but they could be used to construct the 'backbone'. Using glued laminations of thin wood eliminates the need to use 'grown' timber. The hull planking uses a flexible filler of various types in the seams.

Glued Lapstrake

Planking edges may still be bevelled in the traditional way but they are glued to form a rigid waterproof joint using a thin epoxy adhesive mix. An alternative, simpler form, often found in DIY kits, uses unbevelled planks and employs a thick epoxy filleting mix. Whilst not as visually attractive, this latter method does permit relatively unskilled DIY builders to construct a lapstrake hull very quickly from a kit of parts. Because the hull shell is now a much stiffer structure, much of the framing can be omitted and the close-spaced ribs which characterise the traditional boats can often be omitted altogether. The resulting boats are often up to half the weight of their earlier counterparts and are also much stiffer.

Glued Carvel

Plank edges may be shaped and glued with a thickened epoxy mix, or alternatively the seams of dry fitted planks may be routed later to a constant width and fitted with wooden splines which are glued into place. This latter method is the usual treatment when a traditionally built carvel craft is reconstructed using epoxy adhesives as part of a full restoration programme. Sometimes a thickened epoxy mix is introduced into the seams as an alternative to wooden splines and this seems to be just as effective in fastening the plank edges together. The planking is also glued to the spine and framework, which on new boats is built of laminated hardwood, glued and coated with epoxy.

Strip Planking

This is essentially a modified form of glued carvel construction using a greater number of 'planks', now called 'strips'. The planking is now usually 1 - 2 inches instead of 3 - 4 inches wide. The strip edges may be shaped to fit together by either flat bevelling or machined to form a type of 'ball and socket' joint with the adjacent strip. On larger boats, over 30 ft particularly, the strips are often used unshaped and any irregularity taken up using a thickened epoxy mix. Epoxy is ideally suited to strip planking as the adhesive working time can be easily adjusted to suit the job and the working characteristics of the mix can be altered using different fillers.

Multiple Veneer Construction

The earliest forms did not use adhesive but incorporated a cloth membrane, usually soaked in oil or paint, in between. The veneers were held together with rivets, screws or clenched nails. Epoxy adhesives can be used in the restoration of these hulls by injecting it between the veneer layers.

Cold Moulded Construction

The first cold-moulded hulls commercially produced were derived from wooden aircraft technology developed during World War II. These used phenol-formaldehyde glue and vacuum pressure was employed to hold the veneers together in an autoclave oven. Hulls produced this way have proved extremely durable with a life of over 30 - 40 years. Nowadays no such plant exists and all cold moulded boats are produced on a one-off basis. Glues other than epoxy are still relatively popular but chosen on convenience grounds rather than performance.

Urea-formaldehyde types are viewed as being simpler to use and clean off easily using water. However there are noticeable benefits in terms of hull stiffness using epoxy. This is due mainly to epoxy's good gap filling properties and the resulting continuity of glue line. A contributory reason for the superior stiffness of an epoxy hull is that with other glues moisture is introduced into the veneer during application and by the process of curing.

Plywood Construction

The 'ply-on-frame' building method was developed in the 1950's using mainly urea-formaldehyde adhesives on the then newly-introduced wood medium - plywood. Many boats were designed for this relatively easy form of construction which became popular with professionals and DIY builders. Today ply-on-frame is still used, particularly on small racing dinghy classes designed originally in the 1950's, but with the advent of epoxies, a simpler form

of plywood construction was made possible using a reduced number of stringers or no stringers at all. The new technique relies on cutting the plywood panels to exact size and butt-jointing them. It is common now, in order to increase production efficiency, to place the panels either on the inside or outside of a mould where they are held in place with temporary screws. But sometimes not even a jig is required on the smallest boats. The panels are often simply butt jointed and fastened together using radiused epoxy fillet joints. Bulkheads fitted later running longitudinally and transversely in the hull make up the remaining element of the monocoque structure and these are bonded in using epoxy fillets often reinforced with glass tape.

'Tortured' ply is another method which is ideally suited to using epoxy adhesive. This method involves simply bending thin sheets of plywood to shapes over a jig or within a mould. Commonly used to construct small wooden catamarans the bent plywood becomes highly stressed but is nevertheless efficient in providing stiff and durable hulls.

Guide to Bonding

For full details of the use of SP epoxies in applications such as those described above, this information sheet should be read in conjunction with the SP guide, "Bonding with Epoxy in Wood Construction".

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SP Systems therefore strongly recommend that representative test panels and component sections are built and tested by the user in order to define the best process and materials to use for the desired component. This should be done under conditions as close as possible to those that will be used on the final component.

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