TALKING TIMBER

WOOD AND WIND TURBINES

***Martin Ansell** discusses the application of wood in the construction of modern wind turbines and the environmental advantages of selecting wood*

Modern multi-megawatt wind turbines are mostly horizontal axis machines with the generator set mounted on a steel tower. The aerofoil turbine blades are usually manufactured from glass- or carbon fibre-reinforced plastic (GFRP or CFRP) with the rotor hub connected horizontally to the generator. Wind speeds increase with height above the ground and the power generated is proportional to the swept area of the blades. Hence, tall towers and long blades maximise power output.

Wind turbines are intended to have a design life of approximately 25 years. There are now approximately 2,000 wind farms in the UK with about 1,500 located onshore and 500 offshore. Turbine blades experience aerodynamic and gravitational loads which result in progressive fatigue damage, so blades must be replaced well before catastrophic failure is a possibility. Fibre-reinforced plastics (FRPs) are difficult to recycle, and blades are often buried in landfill sites. Recycling options include chemical methods such as depolymerization and pyrolysis to produce the basic constituents of polymers, fuels and fertilisers. Alternatively, the FRPs can be ground up or shredded and used as fillers and reinforcements for concrete and asphalt. Both options are complex and expensive.

An alternative approach is to manufacture turbine blades and towers from wood, which is more recyclable. In the last two years Voodin blades (https://voodin-blades.com) have been manufactured in Germany from laminated veneer lumber, manufactured by Stora Enso from birch veneer sourced in Finland. To date 19.3m blades have been installed on a wind turbine and 50m-plus blades for a 4.2MW turbine are being developed with Senvion of India (https://www.senvion.in). The Swedish company Modvion (https://modvion.com) manufactures laminated wood wind turbine towers, which are delivered to site in sections. In 2024 a Vestas V90-2.0MW wind turbine with a Modvion tower was installed in Sweden. The tower is 105m tall and the total height of the wind turbine is 150m including blades. Heavy steel towers are usually shipped by road as single welded units whilst shorter laminated wood sections can be assembled on site.

In the 1980s Jim Platts and Mark Hancock at Gifford Technology, Southampton developed laminated wood turbine blades using rotary peeled African mahogany (Khaya ivorensis) veneer. The blades were vacuum bagged in two half blade moulds and bonded together with an internal shear web. The bonded wood technology was developed originally for boatbuilding by Gougeon Brothers in the US using the WEST epoxy system for bonding veneers. Concurrently, a long-term fatigue testing programme, funded by the UK government and the EU, was carried out by the author at the University of Bath to generate comprehensive fatigue design data for wood laminates under cyclic and complex loads.

Gifford Technology expertise was subsequently transferred to several companies, including the Wind Energy Group (Taylor Woodrow) in a series of takeovers and became the property of Aerolaminates who manufactured laminated wood-epoxy wind turbine blades on the Isle of Wight. In 1998, following the takeover of Aerolaminates, NEG Micon built a new facility for the manufacture of hybrid laminated wood/carbon fibre-reinforced hybrid blades and in 2003 developed a commercial blade for a 110m diameter rotor for multi-megawatt turbines. However, as blade diameters and turbine capacities increased, aerodynamic and gravity loads also increased. As a result, companies such as Vestas in Sweden took advantage of the high stiffness and strength of CFRP to manufacture blades and used balsa wood as a core material to space the skins and resist shear loads. ■

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Below:
Wind Energy Group wind turbines in California erected in 1986 (MS-2) and 1988 (MS-3) with wood/epoxy blades

Wood Technology Group

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