The Importance of the Broads Drainage Mills.

Although windmills had been in use for grinding corn since the 12th century, it is believed that windmills for land drainage were introduced in the late 16th century by Dutch engineers, employed to drain the Fens and other marshy areas. These mills would have been timber structures, turned to face the wind manually, and equipped with framed sails spread by hand with canvas, according to the strength of the wind.

The machinery, made mostly of wood, consisted of toothed and pegged wheels meshing to transmit power from the sails to a scoop-wheel which revolved in a wood-lined channel. This “water-wheel-in-reverse” scooped up water from the dykes to the higher level of the river from whence it could drain away to the sea. These simple mills needed constant attention to keep them facing the wind, the “mill-man” also having to adjust the canvas on the sails so that they turned at the right speed.

Hundreds, if not thousands of these mills were built to drain the Fens of Norfolk, Suffolk, Cambridgeshire and Lincolnshire. Not one survives complete today because steam pumps were built to replace them, and alterations to the watercourses and peat shrinkage led to their total elimination apart from one or two stumps.

The early Broads mills would have been similar to those of the Fens. They would have been “hollow post” mills like Clayrack or Upton, or smock mills like Herringfleet. The latter mill is the only full-size smock drainage mill remaining in England, and the Broads is the only area where historic drainage by wind power can be studied in this country.

In Holland, hundreds of drainage mills can be seen today, but they remained almost unchanged in design over the centuries. English millwrights, however, developed highly efficient labour saving improvements in the 18th and 19th centuries using spin-off technology from the Industrial Revolution. This resulted in advanced and attractive designs that could compete with steam engines on economic grounds. It is significant that the last Broads windmills were built as late as 1912. Wooden “smock” towers were abandoned in favour of brick, except for small mills like the “skeleton” mills, unique to the Broads.

In the Broads, peat thickness was much less than in the Fens, so the land did not sink enough to leave the windmills high and dry. In addition, the land was only required for grazing, so the draining was not deep, and some residual moisture was beneficial. Steam engines often supplemented the Broads windmills, but they were costly to operate and required a long “start-up” process.

The first major improvement was the fantail, patented by Edmund Lee of Wigan in 1745. The patent states that “In Draining or Forcing water out of lowlands, this Machine is peculiarly usefull, as it Requires no Sort of attendance, being so Contriv’d as to keep the Sails Constantly in the Eye of the Wind.”

The second significant invention was the “patent” windmill sail in 1807. Instead of spreading cloth on the sails, light hinged shutters were provided which could be opened and closed simultaneously to adjust sail area. They were self-regulating and could “make the most possible of weak winds and never exceed a proper velocity in the strongest.” They were “found extremely useful in the draining of marshes, as they may be left at work night and day, perfectly safe without any person to attend them.”

The inventor of the patent sail was a Norfolk man, William Cubitt of Bacton Wood Mills, North Walsham. The first mill to have them was a large corn smock mill at Stalham, and they soon became very popular for all sorts of windmills. Cubitt went on to become a celebrated civil engineer, and was knighted in 1851 for his services to the Great Exhibition.

By coincidence, a new type of rotary pump was displayed at the Great Exhibition by J.S. Appold, which was to benefit the Broads mills. His “turbine pump” was mounted on a vertical shaft, and ran faster than a scoop wheel, lifting half as much water again. This improved pump was fitted to many existing mills as well as new ones, again keeping the windmills competitive.

Within the mills, the transmission shafts and gears were refined from timber to cast-iron. Cycloidal profiles for gear teeth were introduced following work on gearing by French mathematicians and astronomers Girard Desargues, Philippe de la Hire and Charles Camus during the 17th and 18th centuries. Thus coarse wooden pegs were superseded by finely-pitched teeth of iron or wood, profiled to a hairsbreadth for smooth, efficient operation.

Despite all this development, some of the older “simple” mills were still retained in use until the end, and worked alongside the more advanced versions. In a few cases, old-style mills were built late because they were cheaper to build and maintain. It all depended on the landowner.

As a result, today it is possible to take a trip through the history of mechanical engineering by studying the remaining Broads windmills, a unique educational experience.

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