SOHAM NORTHFIELD WINDMILL

A SUMMARY OF ITS MILLWRIGHTING HISTORY

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27th December 2011

INTRODUCTION

This report attempts a brief snapshot of the mill's history and of significant millwrighting work done on it. I would add that it is a provisional view, since there are gaps in our knowledge, but the basis of the history is as follows. The report should be read in conjunction with Simon Hudson's report on the history of the mill and of personnel concerned with it (Hudson, 2011).

The present owners are Dr and Mrs M. Fussell. [As this report was being finalised news came that Mark Fussell had died on 22nd December 2011.]

LOCATION OF MILL

Soham, East Cambridgeshire District, Ordnance Survey grid reference TL 587 751.

EARLY HISTORY

The mill's early history is important in demonstrating its significance and in explaining important stages in its millwrighting development.

Northfield (or Shade) Windmill is understood to have been built as a fen drainage mill which was later moved to its present site and converted to grind corn (see for example Pevsner, 1970). It is considered to have stood by Soham Mere, near the site of the present day electrically powered pumping station at Mere Engine Farm, TL 570748 (Filby, 2011).

Engines were brought in to drain the mere in the 1830's (Hills, 2003), and this is the period when the windmill became redundant[1]. It was purchased secondhand and moved about 2km up to Soham North Field for conversion to a corn grinding mill, possibly replacing an ageing post mill. It is thought that Hunt Brothers of Soham did the millwrighting, and that William Bullman was milling at the rebuilt windmill in 1834 (Dodd, 1993).[2]

What survives from the fen drainage mill? Almost certainly the smock tower, which was characteristically lightly constructed and has received much strengthening over the years. The cap is

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[1] A gas vacuum engine to Brown's patent was installed at Soham Mere in 1831 to supplement the existing windmill pumps (Hinde, 2006). This engine was given up in 1833 because of problems with the producer gas plant. Reading between the lines the engine's gas consumption was greater than anticipated: the windmills were reprieved for a while. One of the windmills was replaced by 1839 by a 40 horse power steam engine driving a 36ft scoop wheel. The expectation is that this windmill, or one of its sisters, became Northfield Mill, understood to have been in use on its new site in 1834.

[2] It may be noted that this was not an unusual fate for a redundant marsh mill. The only other surviving example in the Fens of a marsh mill converted to a corn windmill is Dyke Mill, Lincolnshire, a smock mill which was originally on Deeping Fen (Hills, 2003). Although Dyke Mill was extremely impressive it is now far less complete than Shade Mill, having lost sails, original cap roof, and much internal machinery.

NB According to Mr Dodd's notes John Dobede had the earlier Shade Mill in 1823-4.

probably similar to the original, but according to Peter Filby (2011) was lost twice during the windmill's life as a commercial corn mill.

What is clear is that Northfield Mill is distinctly different to the other local smock mills, surviving or in the photographic record. The tower is coned much more markedly: a normal corn mill required more space towards the top of the tower for storing corn and for related machinery. A marsh mill could be slimmer towards the top, with a more minimalist cap which need only contain a small brake wheel and waller gear.[3] *It is my opinion that Northfield Windmill is the only surviving mill which presents the general appearance of a medium sized Cambridgeshire fenland drainage mill of the Soham district .*

The cap frame is to an unusual Cambridgeshire pattern, still surviving at Soham Downfield and at Burwell mills. The cap is built up around the sprattle beam[4], with short sheers running forwards to support the weather beam and sails and two others running aft to support the tail beams and fan stage. This unusual design is thought to have developed from marsh mills winded by a tail pole, triangulated from the ends of an elongated sprattle and from the rear of the cap. This cap frame design has a tendency to weakness in old age, but evidently served well enough for a long time at Northfield. Its use lends further if not conclusive support to the tradition that Northfield Mill was originally a marsh mill[5].

Northfield Mill is thought to have gone out of use in the 1920's, but was clearly repaired following the loss of one pair of sails in 1928. No doubt the work was done by Hunt Brothers, then the only firm of commercial millwrights in Soham. The mill was set to work on 2 sails, but a significant change to strengthen the weak cap frame was the introduction of 'cantilever trusses', one on each side of the frame. A cantilever truss consisted of an upright post standing on the cap frame in the vicinity of the sprattle beam, and at its top carrying two heavy iron tie rods. The post emerged through the cap roof. The iron rods raked down from the top of the post, one going forwards to the weather beam at the front of the cap frame, the other backwards to the fan stage (see Fig.2). This triangulated structure supported the extremities of the Cap Frame, and was much needed to support the sails, fantail and fan trestle. *Northfield Mill was the only surviving example of this rather notable strengthening system.*

END OF COMMERCIAL WORK

According to Mr William Dodd's notes the mill was last worked in 1941 or 1942, by the Howe family[6]. Local tradition says it was latterly used for manufacturing bone meal (Fussell, 2009). The sail shutters were out and the fan blades removed by 1946.

REPAIRS DURING PRESERVATION

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[3] The waller (or wallower) could be significantly larger than the brake wheel in a drainage mill which drove a big scoop wheel, as for example the very large Harriermeer Mill at Barway near Soham (Allen, 1913). This mill belonged to the Middle Level Commissioners and was working in 1906, but replaced and pulled down soon after. We must assume that Shade's original waller was of similar size to its present one when the mill was rigged up for drainage.

[4] The sprattle beam is a large transverse beam if the cap frame, whose function is to carry the top bearing of the mill's upright drive shaft. The sprattle beam effectively defines the centre of the cap.

[5] Downfield and Burwell mills are intriguing in that they were built new with this unusual and relatively weak design.

[6] Mr Dodd probably made use of Rex Wailes' notes.

1. **1980's: Holding Operation by G.C. Wilson and P. Johnson**

By 1973 the remaining pair of sails was reduced to a broken stock, and the smock tower was in urgent need of strengthening and re-cladding (photo in Smith, 1975). Mr G.C. Wilson of Over Windmill instigated a major project with the then owner Mr P. Johnson to strengthen the smock. In this emergency holding operation beginning in 1984 the old cladding of vertical boards and cover strips was removed, the rather light tower framing was strengthened by plating main beams where needed (not necessarily for the first time) and where the frame was weakest adding additional beams to strengthen the structure. The whole assemblage was further strengthened by cladding the smock in plywood sheets, nailed on to the framing (Fig.1 & 2).[7] Chris Wilson and Pat Johnson completed this work on all six sides of the smock, leaving it with a smooth plywood exterior. They then applied a coat of bituminous felt to weatherproof the smock.[8] This major holding operation ceased before any outer cosmetic cladding was applied.

2. **1990's**

Mr Johnson applied for an English Heritage grant for restoration to working order, with East Cambridgeshire District Council acting as owner's agent for the restoration. Thompson's of Alford were awarded the millwrighting contract.

An important result of the application was that the mill was properly drawn up by East Cambridgeshire DC, providing an important record of the mill in its state immediately pre-restoration.

In the ensuing restoration Chris Wilson's work on the smock was left much as it was, though in retrospect it would have been helpful if the curb at the tower top had been renewed, and the roller track supporting the cap re-set. The old vertical board cladding was not renewed: instead the mill received an outer cladding of horizontal weatherboards, changing the mill's appearance markedly.

The cap was lowered to the ground, and a new cap frame built off-site. The old iron windshaft, brake wheel and most iron fittings were reused, with a new set of sails, fan trestle and fantail blades. The sails were reduced in length, presumably for safety, and were fitted with a one third set of shutters. Unfortunately the cantilever trusses which had done so much to strengthen the old cap were scrapped.

The machinery in the tower, from waller and upright shaft downwards, was left untouched.

Two problems soon manifested themselves.

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[7] This system puts much of the strength of the tower into the plywood skin: effectively a monocoque construction. This system was developed further for use in the restoration of Wicken Corn Windmill, where it was intended to work the mill while retaining as much of the original timber framework as possible.

[8] Mr Dodd suggests that vertical battens were then fitted to the exterior, to support horizontal weatherboards. As a personal view, I regret this: Shade Mill may originally have been fitted with weatherboards, but the earliest photographs show the mill clad in vertical boards. Better to have fitted horizontal or near horizontal battens, which would have facilitated fitting the now very rare vertical boarding in the old style.

- Problems of concentricity in combination with the old curb not necessarily being true and level meant that occasionally the cap seized up as the fantail attempted to turn the sails to wind. This eventually led to the breakage of one of the cast iron centring wheels. The wheel was replaced without resolving the underlying engineering problem. It would appear that soon the cast iron bevel pinion on the fantail shaft broke up as well (Fig.5). The fantail was then tied up permanently.

- The weather beam, that is the front main beam of the cap frame, distorted under the weight of the sails. NB The sails, windshaft and brake wheel weigh around 4 tonnes, even in their restored state with shortened sails only partially shuttered[9]. This weight is mostly taken by the weather beam. Here it is important to understand features of this kind of Hunt Brothers cap:

  The windshaft is inclined quite steeply, at around 15° to the horizontal. This requires the head bearing of the sails (neck bearing) to be raised on blocks so that it is considerably above the weather beam. Rising up on either side of the neck bearing are heavy wooden studs, the weather studs. These are tenoned firmly into the weather beam, and act as restraints for the neck bearing assembly, as well as being principal supports for the front portion of the cap roof.

  Any weakness in the front parts of the cap framing will allow the sails to subside over time. A common path for this to happen is that the combined weight of the sails and windshaft forces the neck bearing downwards and forwards, ultimately through distortion of the weather beam. The central part of the weather beam is deformed downwards by the weight, and at the same time twisted forwards.

  This has the important effect of rotating the tops of the weather studs forwards. *The studs are strong, and such movement will inevitably cause the cap roof to fail by forcing the studs through the roof.* At Northfield Mill this problem has manifested itself in two ways:
  - The wooden boarded cap roof has ruptured either side of the weather studs (Fig. 4, 5)
  - The cap roof as a whole has been distorted forwards. This has opened cracks in the roof, and is very noticeable towards the rear where the side fences of the fan stage have detached from the cap roof.

3. **Recent Holding Operations**

   The failure of the cap roof and the ingress of rain over many years is endangering the mill structure. Experienced local windmill repairers: Dave Pearce (Wicken Windmill), Robert Bramley (Haddenham) and Andrew Kite (Downfield Mill) arranged with the owners Dr and Mrs Fussell to carry out emergency holding work voluntarily, pending the hoped for eventual full restoration.

[9] For comparison, at Wicken Corn Windmill the sail assembly weighs some 5¼ tonnes.

The incipient damage to structural timbers and floors resulting from years of weather ingress can be seen in Fig. 8 - 12. White fungus, symptomatic of continuing excessive damp, is apparent on the beams. Considerable efforts were made in September 2010 to stop the holes in the cap roof using commercial builders' adhesive tape 'flash band' (Fig.6,7).[10]

Investigation showed that water was not only entering through holes in the roof. It was also driving in down the striking rod hole along the centre line of the cast iron windshaft (carrying the sails). Some of the water could be ducted away by making and fixing an aluminium chute, which was attached to the windshaft tail beam just below the striking rod outlet. There was just sufficient height available to direct the water outside by taking this chute over the top of the smock tower.

Unfortunately this did not stop striking rod water continuing to wet the structural timbers below. Further investigation showed that the windshaft tail beam is composite, at least in the critical region near its mid-section. Water running through the striking rod hole could seep out between the two timbers of the composite beam, and then drip down into the tower as before. Dealing with this is more easily said than done, because lack of clearance and awkwardly placed components have so far prevented a second direct chute to take this water out of the mill. A temporary arrangement of plastic sheeting funnelled down to a bucket on the bin floor seems to be working, but I would like to make a more workmanlike solution ... this will demand further work, I suggest in early 2012. In the meantime the bucket has to be emptied periodically.

A second major task carried out in September 2010 was to take down the fantail blades and inter-blade tie irons carefully for storage (Fig.13). The full size fantail had been tied up for many years. Bearing in mind the large sails and small cap, and history of cap loss through tail winding, and that the cap will not be able to turn without major restoration of both cap and tower, it was decided with some reluctance to dismantle the fantail. The blades and irons are stored in a large shed nearby on the property. NB We were concerned not only about the possibility of tail winding … this concern could be resolved permanently by fitting restraining dog irons at the rear of the cap to stop the cap lifting … but also about the impact of heavy side gusts on the fixed fantail. The cumulative impact of these gusts over many years could easily rip blades off the fantail.

[10] Recently animals, probably grey squirrels, have damaged the flashband over the roof holes, presumably in the interest of gaining access to the cap. A potential holding operation task for 2012 would be to replace the flashband in these areas by carefully shaped soft aluminium sheet.

DESIRABLE FUTURE WORKS

The most salient millwrighting requirements in any eventual return to going order at Shade Mill can be summarised:

- Rebuild tower curb and roller race, with careful attention to levelness and circularity.
- Check the strength of the smock tower, and take any remedial action necessary.
- Check the bitumastic felt undercoating: water ingress to the tower proper must be prevented.
- Reclad the smock tower with vertical boards, carried on battens designed to allow drainage between the bitumastic felt and external boarding.
- Repair the cap on the ground. Pay particular attention to:
  - The cap circle is to be concentric with the tower curb and of appropriate diameter.
  - Centring wheels are to be correctly placed.
  - The cap frame is to be stronger than in the 1990's restoration. Pay close attention to the pre-1990's restoration drawing. Particularly the Weather Beam is to be of adequate strength and securely fixed.
  - Refit cantilever trusses, as per Hunt's repairs of 1928 onwards.
  - Rebuild the roof.
  - Refit the fantail, repair/renew gears as necessary
- Repair and refit the sails, providing a full set of shutters if the mill is to work.
- Renovate the internal machinery.

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Figures

Photo's by D.L. Pearce unless otherwise attributed

Fig.1 Under restoration, 1984 (a)

(Martin Watts collection)

Fig.2 Under restoration, 1984 (b)

(Martin Watts collection)

Fig.3 Strengthening and re-cladding the smock (G.C. Wilson holding operation): additional framing, and plywood cladding.

Fig.4 Strengthening & Re-cladding the Tower (G.C. Wilson holding operation): plating a cant post and cladding with plywood sheets

Fig.5 Miscellaneous items on one of the millstones, including the broken fantail pinion

Fig.7 Covering large hole caused by roof distortion

Fig.6 Covering gaps in the roof with flash band

Fig.8 Beginnings of fungal attack on beams of hursting near tower top, caused by many years of damp ingress

Fig.9 Fungal attack 2. Other side of hursting beam, and curb

Fig.11 Holding Operation aluminium guttering, instaslly to channel rain water out of cap and over top of Curb

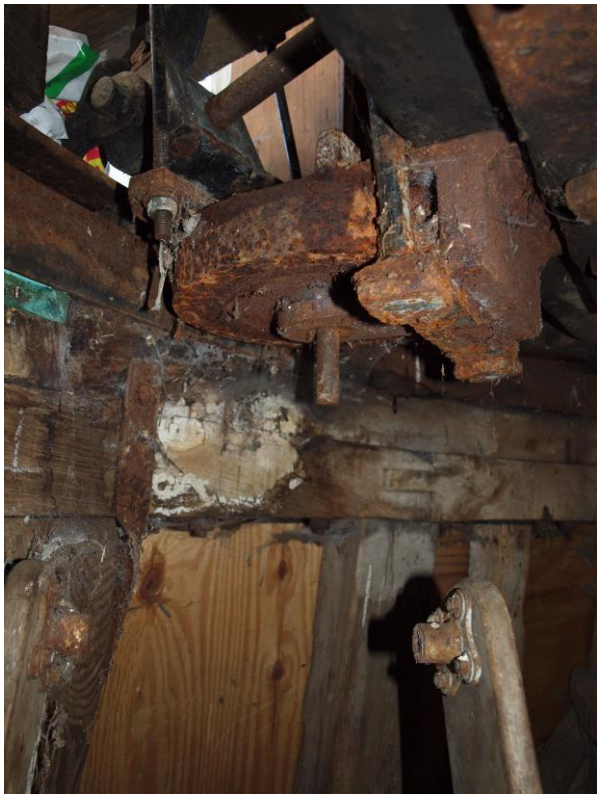

Fig.10 Curb, and pronounced rusting of rear cap Centring Wheel

Fig.12 Damage to Bin Floor, from continual wetting

Fig. 13 Lowering a fan blade for storage (R. Bramley in 'cherry picker, A. Kite on cap)

(Jacqui Ward collection)