

DESIGN STATEMENT: Sweeps for Meopham Windmill

Meopham Windmill, Wrotham Road, Meopham Green, Kent, DA13 0QA
Gravesham Borough

List entry

NGR: TQ 63947 65183
List entry no: 1054722
Grade: II*
Date first listed: 22nd August 1952

List description

TQ 66 NW 4/100

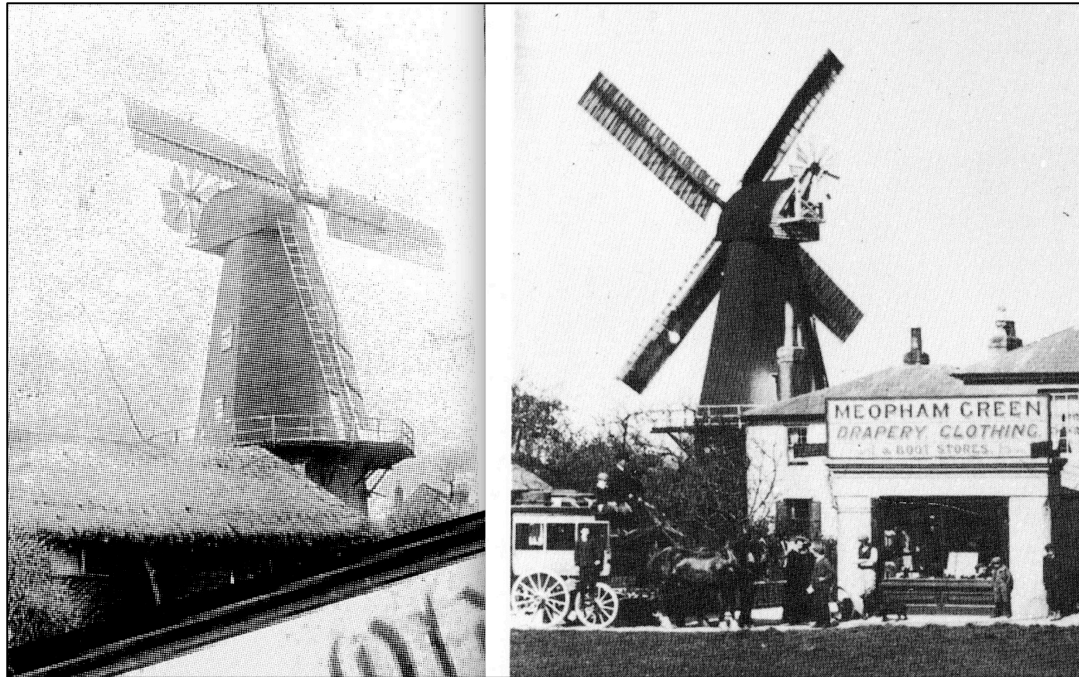
*MEOPHAM WROTHAM ROAD (west side)
Meopham Windmill 22.8.52 II* 1801 built by the
brothers Killick. Smock mill. Lower two storeys
red brick, upper three storeys weatherboarded.*

Introduction

This document follows on from the Heritage Statement which provides historical and technological background to the windmill as it currently stands.

It contains a reasoned proposal to modify the existing arrangement of four patent sweeps, substituting one pair for a set of common (canvas-covered) sweeps.

This 'hybrid' arrangement was formerly fitted to the mill and is shown in several historic photos taken prior to 1906 (Figures 1a and 1b).



Figures 1a & 1b: Meopham Mill, photographed before 1906, showing both common and shuttered sweeps.

1. Historical background to the design of Meopham Mill's sweeps

The common sweeps

The list description above includes an often-misquoted construction date for the mill of 1801. The mill was not in fact built until 1819 (Carley 1993).

When originally constructed, Meopham Mill would have carried four sweeps of an early pattern. These comprised open lattice frameworks that had to be manually spread with sheets of canvas in order to catch the wind.

A version of this design, known as the 'common sail' (or sweep), would have been fitted to the first windmills to exist in Britain. Introduced in the 1180s, these small medieval novelties are depicted in numerous illuminated manuscript illustrations (Figure 2).

At some mills, such as Ash Mill near Sandwich (Figure 3), common sails remained in use well into the 20th century, and many restored windmills of all types are fitted with them.



Figure 2: A 14th century post mill depicted in the Luttrell Psalter, showing 'common' sweeps spread with canvas.



Figure 3: The post mill at Ash, Kent, fitted with the typical combination of a pair of common sweeps and a pair of shuttered sweeps.

Because its sweeps were not long enough to be reached from ground level, Meopham Mill was fitted with a wide external platform at second floor level, known as the reefing stage (Figure 4). Due to the mill's height, this feature would have been part of the 1819 construction. Although the stage has been replicated in new timber, it accurately reflects the form and proportions of the original.

From the reefing stage, the ends of the mill's sweeps could be accessed in order to spread canvas across them. In order for the outer ends of the sweeps to pass inside the safety handrail of the stage, a wide platform was required (Figure 5).

The stage also gave access to the brake rope, which was used to start and stop the sweeps. In order to reach each sweep it would have been rotated to its lowest point and the brake temporarily applied so the canvas could be spread out and tied in place.



Figure 4: Meopham Mill's reefing stage at second floor level – a wide wooden platform with a perimeter handrail.



Figure 5: Spreading canvas over a common sweep from the reefing stage at Bursledon Mill, Hampshire.

The patent sweeps

During the later years of the 19th century, technological innovations were being applied to windmills throughout the country to improve their efficiency. This included replacing common sweeps with more expensive but less labour-intensive forms of sweep that made the miller's life easier.

The most heavily favoured design was Cubitt's 'patent' sweep of 1807, which incorporated one or two rows of adjustable shutters. Although in existence at the time of Meopham Mill's construction, the popularity of the design had yet to spread to this area by 1819, so it did not form part of the original concept.

At some time during the 19th century, one pair of commons had been replaced with a pair of patent sweeps (Figures 1a and 1b). This was quite an undertaking, and involved making modifications to the windshaft – the principal iron axle in the cap to which the sweeps were attached.

Some time later, possibly around 1915, a second pair of patent sweeps was fitted to replace the remaining common sweeps. Each pair differed slightly in design, as was quite usual when sweeps were installed at different times. It is possible that the second set of patent sweeps was a second hand pair from another mill.

Once four patent sweeps had been installed, a wide reefing stage was no longer needed to access the tips of the sweeps, as these could be controlled remotely. Unlike at Cranbrook mill, where the original stage was replaced with a narrower one when patent sweeps were retrospectively fitted, the stage at Meopham was retained at its full width.

Further alterations to the sweep arrangement appear to have been made in the 1920s (Figure 7). Their working area was increased by adding extra panels and longer shutters to increase the width of the sweeps. This may have been a last attempt to improve their efficiency, in the belief that increasing the working area would consequently lead to an increase in power.

By 1930, the second pair of sweeps had been removed, and the one remaining pair had been shortened by removing the outer bay of shutters (Figure 8). Soon after this, the use of wind power was discontinued.



Figure 6: c1915. Two pairs of patent sweeps are now fitted. The 'leading side' of each sweep is narrower than the 'driving side', as is usual.



Figure 7: 1920s. The four patent sweeps have been widened so their leading and driving sides are equally wide.



Figure 8: 1930. Two sweeps have been removed and the remaining pair have been slightly shortened.

2. Discussion: reasons for the design changes

It was usual for the design of a windmill's sweeps to be altered over the course of a mill's working life. The main aim of doing so appears to have been to make the operation of the mill less labour intensive. By reducing the time involved in setting up the sweeps for work, the miller would have been free to attend to other tasks.

Compared with a common sail, which was just a simple wooden framework, a shuttered sweep is significantly heavier. A heavier sweep will require more force to move it, and so shuttered sweeps develop much less power in light winds than lighter common sweeps.

To counteract this problem, a pair of common sweeps was often used in combination with a pair of shuttered sweeps – as at Meopham and numerous other Kent windmills. This gave a satisfactory combination of power, from the commons, and self-regulation as well as ease of operation from the shuttered sweeps.

The remote-control of the shuttered sweeps also provided a welcome safety factor, limiting the maximum rotation speed and enabling the mill operator to slow the sweeps down rapidly by fully opening the shutters.

In strong winds, a mill with common sweeps will run faster than one with patent sweeps. Often, the conversion from commons to patents required alteration to the gearing ratio inside the mill, to enable the millstones to run at the same speed when working with slower-running sweeps.

Alterations to the gearing are easier to make at mills of large diameter like Cranbrook, which have more room to accommodate larger gear wheels. Narrower mills like Meopham did not have the space to accommodate new gearing, so the existing layout had to be tolerated when patent sweeps replaced common ones. This may be one of the reasons why Meopham Mill does not appear to have worked satisfactorily with four patent sweeps.

Sweeps that carry shutters – either the patent or the spring-controlled type – contain numerous small metal parts that allow the shutters to open and close. A typical patent sweep at Meopham Mill had two rows of 24 shutters. Every shutter has two hinges, each of which is made of two cast iron components. The weight of a typical shutter at Meopham mill – including its four metal fittings – is 1.5kg.

The addition of a pair of shuttered sweeps to the mill would therefore have increased the weight of the sweep assembly by approximately 144kg. This extra weight required a stronger wind to move it, and this may have been another factor resulting in the reduced efficiency of the mill when patent sweeps replaced common ones.

3. Proposal: reversion to a hybrid arrangement

By the 1920s, shortly before the mill's working life ended, the mill had gained a set of sweeps much larger and heavier than those for which the building was originally designed.

Over successive periods of repair, from the early 1960s onwards, modified versions of the enlarged 1920s patent sweeps were fitted to the mill. When the existing set of replica sweeps was installed in 2003, these were made so large that the outer ends passed within 50mm of the reefing stage handrail – much less than the recommended safe clearance (Figure 9).



Figure 9: The mill in 2009, with oversized sweeps installed in 2003 (G Woodward).

The operational and design problems associated with the present form of wide patent sweep strongly suggest that a revision of the present design is required. Analysis of the historic photos, summarised above, provides evidence of the smaller size and form of common and patent sweeps that the mill worked with for several decades.

It is therefore proposed to revert to the arrangement of sweeps fitted to the mill during the later years of the 19th century, as shown in Figures 1 and 1a. Common sweeps would have been installed when the mill was built in 1819, and the mill appears to have run very satisfactorily with a pair of each type from some time during the second half of the 19th century until at least 1906, and possibly as late as the 1910s.

After this date, the numerous alterations made to the sweep design suggests that the arrangement of four wide patent sweeps was unsatisfactory in terms of their performance.

Reversion to a pair of each type of sweep has several advantages:

- It will significantly reduce the weight on the historic timber frame of the building's envelope. This will reduce the torsional forces placed on the base frame of the cap roof as it turns to face the wind on top of the smock tower. The result will be that the cap turns more easily and the historic timbers will be placed under less strain, improving their longevity.
- Installation of a pair of common sweeps will allow the wide reefing stage to be used as originally designed. This would be educationally instructive, allowing visitors to understand the pros and cons of the different forms of sweep and how each design is operated.
- In terms of maintenance, the hybrid sweep assembly will be less labour intensive to maintain and will allow operation in lighter winds. Both of these outcomes will result in greater longevity of the sweep components, and will provide the added community benefit of the sweeps being turned on a greater number of days per year.
- The traditional appearance of the windmill, returning it to a form reflective of its last years of commercial prosperity at the turn of the 20th century, will be reconstructed as a result of the proposed alterations to the current sweep design.
- A set of sweeps has a life expectancy of between 20 and 50 years. Any design changes to the sweep assembly should therefore not be viewed as permanent. The current arrangement of four large shuttered sweeps has been well recorded with drawings and photographs, allowing it to be reinstated in future years if desired.

Alternative options are set out below, together with the reasons why they have been discounted.

Option	Likely result
Reconstruct existing sweep arrangement without making any alterations to the remainder of the building.	This option risks the recurrence of operational problems experienced since 2003. These have included problems with the fantail winding gear due to the increased torsional forces, the deflection of the cap frame timbers due to the sweeps' excessive weight and clearance issues at the centre and the tips of the sweeps due to their increased length and width.
Retain existing sweep arrangement and strengthen smock tower and cap roof to better withstand their weight.	There is relatively little additional space inside the mill to strengthen the timber frame. Any additional metal bracketry and fixings would be visually obtrusive and would result in unacceptable alterations to the existing design of the cap and superstructure.
Retain existing sweep arrangement but omit shutters to lighten the assembly.	This is possible but it would preclude the ability of the mill to operate for demonstration in the future.
Install four common sweeps as per the mill's original design of 1819	This would provide a solution to the problems of excessive weight but would make the mill difficult to control in operation, resulting in less frequent operation of the sweeps. It would also result in the loss of the patent sweeps which are a key characteristic of the mill's mechanical development.

4. Materials

The four sweeps are currently carried on two hollow steel stocks. Traditionally, stocks were made of high quality joinery grade softwood, decorated with an appropriate oil-based paint. Steel stocks were installed at a handful of windmills in the 1970s and 80s as an experiment, but most have since been removed after a series of structural failures.

The age of the existing stocks is unknown; they may date from the repair phase of 1979. It is not possible to accurately survey the condition of the interior of the stocks. The rusty exterior gives cause for concern, indicating they are no longer fit for purpose. It is therefore proposed to renew the stocks in solid treated timber.

The timber used for the existing whips is laminated, untreated softwood, and showed decay in several areas when dismantled. It is proposed to renew the whips in traditional solid timber, treated with preservative to provide maximum longevity.

The sweep assembly will be decorated with an appropriate paint system based on linseed oil, a key ingredient of the traditional lead paints used during the mill's commercial life.

5. Conclusions

This document has set out the pattern of development of the sweeps at Meopham Mill over the course of its working life.

It shows that common sweeps were in use at the mill from its construction in 1819 until at least 1906, in conjunction with a pair of patent shuttered sweeps during the late 19th century. The working arrangement of four patent sweeps was relatively short lived, from c1910 until the late 1920s.

The benefits of reverting to the hybrid arrangement of a pair of common and a pair of patent sweeps include a significant weight reduction on the historic timber frame and greater longevity, due to their ability to operate in lighter winds.

Alternative options have been explored and reasons for discounting them are set out above.

Overall, the proposal to revert to a hybrid arrangement is considered by KCC to offer the best combination of historical authenticity and practical benefits - to the building itself and to those tasked with staffing and maintaining it in the future.

The new sweep assembly will be constructed from high quality, historically appropriate materials, using traditional techniques.

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