Historic England

Textile Mills

Introduction to Heritage Assets

Summary

Historic England's 'Introductions to Heritage Assets' (IHAs) are intended to provide accessible, authoritative, illustrated summaries of what is known about specific types of archaeological site, building, landscape or marine asset. Typically, they address subjects that lack such a summary, as a result of either a huge volume of available literature or lack of written work. Most often it is the latter, and many IHAs bring understanding of sites or building types that are neglected or poorly understood. Many of these are what might be thought of as 'new heritage', dating to the second half of the 20th century.

The textile industry formed a crucial element of England's economic base from the medieval period onwards, whilst the mechanisation of the production processes and the introduction of the factory-based system in the 18th and 19th centuries resulted in distinctive types of vernacular and industrial buildings, townscapes and landscapes across the country. The commanding architecture of textile mills has become a key characteristic of industrial towns, imparting a powerful sense of place that in some cases has been enhanced by appropriate adaptation of redundant buildings for new uses, creatively adapting to the challenges that often need to be addressed when securing the long-term future of these monumental structures in a post-industrial age.

Front cover: Lister's Mill at Manningham, Bradford built in 1873 for Samuel Cunliffe Lister, later Lord Marham. He commissioned Andrews and Pepper as architects who produced a boldly modelled Italianate design with a unique campanile chimney stack 250 ft high. [Missing Pieces Project: Contributor Rachel Pechey © Historic England Archive]

This document has been written by Ian Miller, University of Salford. It is one of a series of Introductions to Heritage Assets (IHAs) which provide summaries of particular building types and other categories, which can be found at the web page below:

HistoricEngland.org.uk/listing/selection-criteria/ihas/

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Contents

1 Introduction

English textile goods were made from either wool or flax until the later 17th century, when colourful cotton calico started to be imported from South Asia. The sale of this popular and cheap cloth was banned in England in the early 18th century to protect the interests of woollen and linen manufacturers, unintentionally creating an indigenous cotton industry.

Increasing demand for cloth during the 18th century was met by a series of mechanical solutions to large-scale production. Rows of domestic workshops were built in increasing numbers in many parts of the country, typically with hand-powered machinery on the top floor and living accommodation beneath. Some evolved into 'proto-factories' by combining the workshop space along the row for more machinery, as textile production expanded beyond a cottage industry.

Industrial-scale output was achieved by expansion into powered textile mills. These were intended primarily to house a specific range of processes required to produce yarn and cloth from natural fibres using mechanical power, and the array of different building forms that survive across much of the country reflects the varying requirements of the industry's many specialised branches.

These included mills for processing flax, silk, worsted and jute, as well as related functions such as calico printing works and dyeworks, although the manufacture of cotton and woollen goods dominated the English factory-based textile industry after the mid 19th century.

Many mill complexes comprised a suite of separate buildings, each designed to fulfil the requirements of different stages in the manufacturing process. Notwithstanding the emergence of the mill architect as a specialised profession in the mid-19th century, many of these buildings were of functional, or restrained, design reflecting an over-riding need to ensure the efficient arrangement of processes, machinery and power systems.

The first textile mills were designed for silk throwing and were established on the River Derwent in Derbyshire in the early 18th century. Thomas Lombe's silk mill of 1721 provided a basic model for the multi-storey cotton and woollen mills that became prevalent along watercourses across England from the 1770s onwards.

Derbyshire, Nottinghamshire, Lancashire, Yorkshire and Gloucestershire emerged as key nuclei for the fledgling industry for reasons variously including proximity to ports and access to raw materials. These early mills frequently occupied sites on the main streams in the middle and upper reaches of valleys, most suited to waterpower, with space for ancillary buildings and expansion.

The application of steam power to the industry in the final years of the 18th century led to the birth of the urban textile mill, resulting in the rapid industrial growth of towns across the manufacturing belt of Lancashire, Yorkshire, East Cheshire and North Derbyshire given convenient proximity to the coal fields. The size and complexity of textile mills increased sharply during the second half of the 19th century in response to technological developments in structural engineering and the machinery employed in the mills.

Figure 1: The mid 19th century Dean Clough Mills (Grade II) in Halifax, West Yorkshire, was once the world's largest carpet factory, but has since been transformed into a nationally renowned centre for business, leisure and the arts. [DP087831]

The separation of the weaving processes from yarn spinning led to the appearance of the single-storey weaving shed, with a distinctive north-light roof, that dominated townscapes across Pennine Lancashire and West Yorkshire by the late 19th century. The buildings that ultimately served the textile-finishing trades of bleaching, dyeing and printing also employed north-light sheds amongst a variety of one-and-a-half and two-storey buildings, although these works rarely conformed to a standard layout.

The industry's most visually imposing building type, however, is the multi-storey spinning mill, where natural fibres underwent a series of processes on different floors to produce yarn. The initial processes of scutching and carding, which disentangled, cleaned and intermixed the natural fibres to produce a continuous web, were usually carried out on the ground floor. The resulting 'sliver' of fibres was condensed and strengthened in different machines to produce a 'roving', which was passed to the upper floors in the mill for spinning into yarn.

Surviving mill sites make an important contribution to the historic character of their locale, in both rural and urban environments. Some mills have been converted very successfully for various commercial, cultural and residential uses. This includes the Grade II-listed Dean Clough Mills in Halifax, one of the first successful conversions involving the reuse of a substantial former textile mill complex and recognised as a model for effective urban regeneration.

Numerous textile mill sites, however, face an uncertain future, due to redundancy, vacancy, under-use and partial demolition, exacerbated by a lack of maintenance and investment since the collapse of England's textile industry in the second half of the 20th century. However, mills can accommodate new and exciting uses, attract investment in area wide regeneration, create jobs and host the homes and businesses of the future. They can play a positive role in place shaping providing inspiring places for people to live, work and relax.

Note: Imperial measurements have largely been used in this document, as these were employed in designing the buildings originally.

2 Historical

Background

The earliest textile mills in England were erected on the River Derwent in Derbyshire for silk throwing, the first being established by Thomas Cotchett in 1702. Thomas Lombe completed a larger silk mill adjacent to that of Cotchett's in 1721 and, at five-storeys high, 110ft long and 40ft wide, with the machinery powered by a waterwheel it provided a basic model for the mills introduced some 50 years later by Richard Arkwright to house his patent machinery for the carding and spinning of cotton.

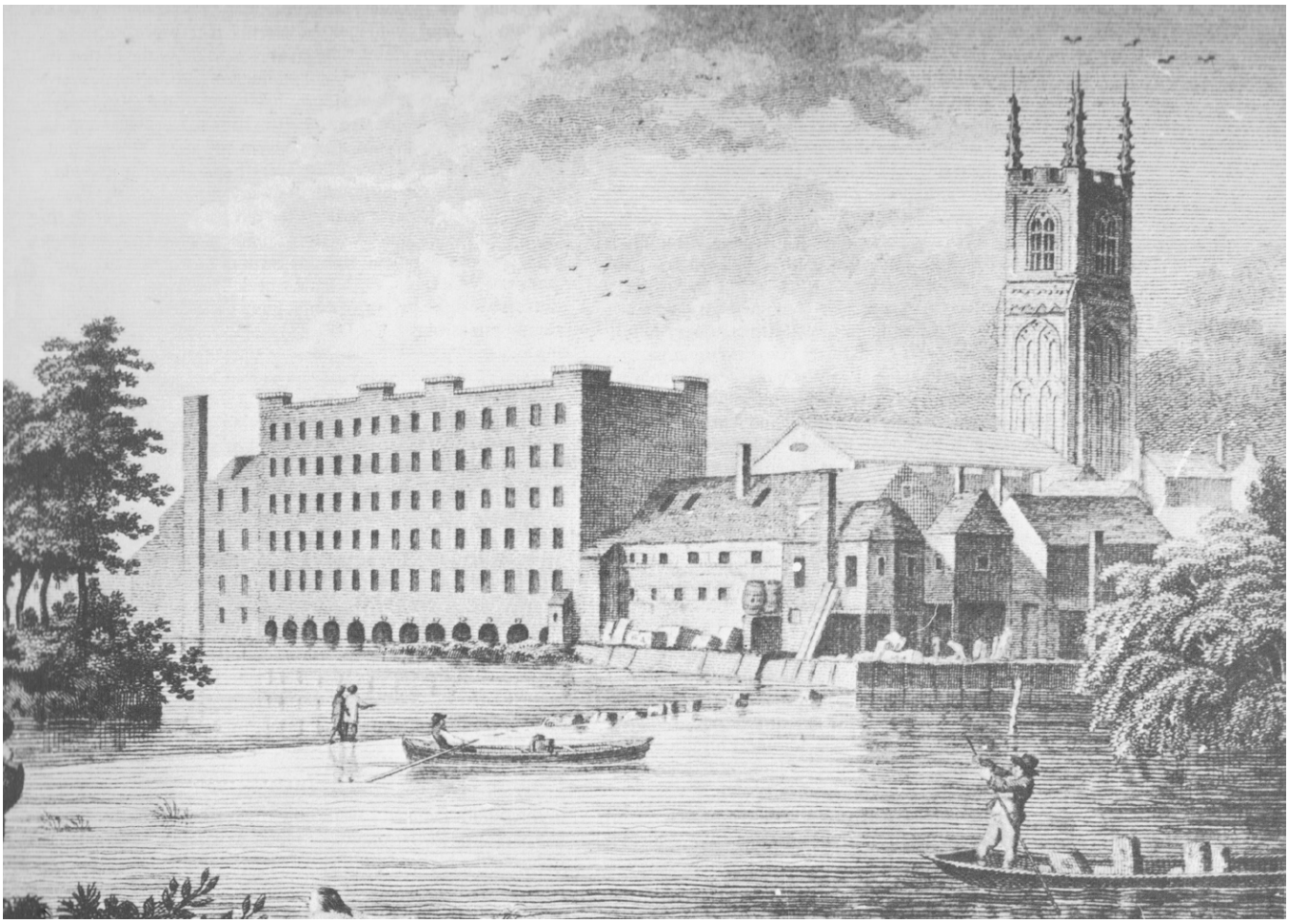

Figure 2: Thomas Lombe's five-storey silk mill on the River Derwent in Derby, shown in an engraving of 1793, set the standard for the first generation of water-powered textile mills in the 18th century. [Public Domain]

Figure 3: Cromford Mills, Derbyshire, was Richard Arkwright's first mill complex. It is now part of the Derwent Valley Mills World Heritage Site with the mill also Grade I listed. [DP169105]

Initially, Arkwright experimented with his patent machinery in a horse-powered mill in Nottingham and went on to build a water-powered mill at Cromford on the River Derwent in 1771. Widely acknowledged to be the world's first cotton factory, this five-storey mill was imitated across the country by other pioneers of the cotton industry and, by 1784, there were an estimated 143 mills of the same principle in operation.

A burst of new water-powered cotton mills following the expiry of Arkwright's patents raised the number to at least 208 by 1787, with the majority being established in Derbyshire, Nottinghamshire, Cheshire and the Pennine river valleys of Lancashire and Yorkshire. In most cases, the design of these new industrial structures conformed to a functional tradition, with little concession to architectural elaboration.

The rapid growth of the cotton industry occurred in tandem with the appearance of multi-storey mills to serve other branches of the industry, including wool and worsted, silk, and flax for the linen trade. Some parts of the country specialised in processing particular

fibres, reflecting local access to raw materials whether farmed, grown or shipped into ports. Gloucestershire, for instance, emerged as an important centre for the woollen industry, together with Yorkshire and Leicestershire; the latter supplying yarn to the burgeoning East Midlands hosiery industry. By the early 19th century, Leeds had developed as a locus for flax spinning, together with Lancaster and Kirkham in Lancashire, which supplied linen to the sailcloth industry. Silk was produced mechanically in many parts of the country, although Macclesfield and Congleton in East Cheshire had become leading centres by the end of the 18th century.

The application of steam power to drive textile machinery was achieved successfully in 1786 at Robinson's cotton mills in Papplewick, Nottinghamshire. This technological breakthrough enabled mills to be built independent of a riverside location and, coupled with the widespread introduction of canals to deliver coal to the steam plant, signalled the birth of the urban textile mill. By 1800, a wave of these new mills to produce cotton, woollen, flax and silk yarn had been established in towns where there were limited opportunities to utilise waterpower, such as Manchester, Preston, Bolton and Leeds.

Typically, this new type of mill comprised at least one multi-storey spinning block, with the steam plant housed either internally or attached externally, together with the ubiquitous tall chimney. The spinning floors were frequently served by a suite of ancillary buildings for the primary processing and preparation of raw materials, warehousing, and office accommodation. Gas retorts were added to many mill complexes in the early 19th century to provide lighting inside the buildings, which had hitherto been illuminated by candles.

Many early textile mills were destroyed by accidental fires, not least arising from the use of candles, leading to attempts to build a 'fireproof' structure. Experiments focused on replacing structural timbers with cast-iron beams and supporting columns, separated by low brick vaults. Sand, brick rubble, or sometimes the process waste from iron foundries and blast furnaces was laid over the vaults to level the flagstone or tiled floor.

This revolutionary design was first used in 1797 at Charles Bage's steam-powered Shrewsbury Flaxmill Maltings (originally Ditherington Flax Mill before conversion to a maltings in the late 19th century) providing a template for modern high-rise buildings. Designed to produce linen thread from flax, its size mirrored Arkwright's cotton mills, measuring 174ft long (18 bays), 36ft wide and five-storeys high. Belper North Mill in Derbyshire, built by William Strutt in 1804 and now part of the Derwent Valley Mills World Heritage Site, provides another fine example of an early 'fireproof' mill. Other technological innovations applied to structural engineering, machinery and power plant enabled larger mills to be built by the mid-19th century.

The introduction of a successful powered loom during the 1820s led to the appearance of the single-storey weaving shed, with a distinctive north-light glazed roof and often occupying a significant area of the mill complex. Weaving sheds began to be added to cotton and woollen mills across Lancashire and Yorkshire in the 1830s, creating 'integrated' spinning and weaving mill complexes. Integrated sites were the most numerous mill type in Yorkshire by the 1870s.

The second half of the century saw increased specialisation, particularly in the cotton and woollen branches of the industry. One result by the end of the century was the prevalence of weaving mills that characterised the industrial landscape of Pennine Lancashire, centred on Burnley, 'the weaving capital of the world'. Much of the yarn required by these weaving mills was spun in South East Lancashire, with Oldham becoming

Figure 4: The innovative structure at Shrewsbury Flaxmill Maltings, subject to a transformative Historic England conservation project, employed cruciform cast-iron columns, inverted Y-section beams and wrought iron ties. The open-headed columns forming the central row were designed to house a rotating shaft that supplied power to the machinery. Shrewsbury Flaxmill Maltings is afforded statutory protection as a Grade I-listed building, illustrating ground-breaking advances in structural design. [DP325212]

the world's most prodigious centre for cotton spinning by the 1880s. Lancashire dominated the cotton industry by the 20th century, reaching its maximum productive capacity in 1926, with mills in Oldham alone boasting a combined total of 17,700,000 spindles.

However, in the 20th century the industry stood at the edge of the precipice of a terminal decline. A combination of trade depression, coal shortages, the General Strike and financial tightening meant that mills began reducing their output from 1927. A short boom period began in 1945 as a result of shortages caused by the war, but after 1952 British cotton textiles faced intense competition from manufacturers in the Far East. This poor trading situation, coupled with the widespread manufacture of man-made fibres, led to the rapid collapse of the British textile industry.

Figure 5: A view across the weaving looms at Queen Street Mill in Harle Syke, Burnley. The exceptional historical interest in the mill, derived not least from the survival of the steam engine that still powers the original working machinery, is reflected in its Grade I listed building status.
[© Oxford Archaeology Ltd]

3 Development of the building type

The textile industry spawned several distinct building types, which evolved from 18th-century origins to fully developed forms in the early 20th century.

3.1 Spinning Mills

The earliest textile mills housed just one or two stages of the manufacturing processes, producing spun yarn from which cloth could be woven. Cotton mills based on Arkwright's principle involved carding and spinning, and early flax mills contained machinery for the same processes, whilst the earliest worsted mills were designed solely for spinning yarn. These pioneering water-powered mills were typically of a simple form, consistent with a functional tradition, comprising a multi-storey block of a rectangular floor plan, with the efficient arrangement of processes, machinery and power systems being the over-riding consideration in their design. The majority of the early spinning mills were around 30ft wide, frequently over 100ft long and between three- and five-storeys high. Each floor contained wooden boards supported on timber beams, with regularly spaced windows admitting as much natural light to the building as possible.

The application of steam-powered beam engines to the textile industry at the close of the 18th century demanded an adaptation to the established building form, not least to house the steam plant and chimney. The few surviving early steam-powered textile mills typically comprise large, multi-storey, rectangular blocks, often with attached wings to form L- or U-shaped site plans. These mills tended to be wider than their predecessors, but were nevertheless generally narrow in proportion to their length, which was typically between 11 and 20 bays, with bay size being around 8ft. Windows were characteristically small, with ceiling heights of 6-8ft. Mills of this period that utilised the attic space sometimes featured large lunette windows in the gable end walls. Stair towers, frequently external, also became a feature during the early 19th century, together with full-height privy-towers that tended to be slightly smaller in plan than stair towers, and generally without windows.

Some mill complexes comprised three or four multi-storey buildings arranged around an enclosed central yard, providing an element of security. The Murrays' Mills complex of steam-powered cotton mills in Manchester, recently converted to residential use, is of this form.

The technological development of textile machinery during the mid-19th century was a key influence in the evolution of the multi-storey mill. Amongst the most significant developments in spinning machinery was the introduction of the fully self-acting 'mule' (a machine for spinning fibres with limited human operation) to the cotton and woollen branches of the industry around 1825. Brunswick Mill in Manchester, built in c 1840, was one of the largest mule-spinning mills of its time, with a main block, 28 bays in length. In order to accommodate self-acting mules transversely across the spinning rooms, the mill employed improved cast-iron floor beams that provided a width of 52ft.

The design of mills became increasingly more sophisticated during the late Victorian and Edwardian periods, mirroring advances in technology and construction, coupled with the need for increased output and efficiency. Windows became larger as the 19th century progressed, responding to a need for better ventilation as faster machinery generated higher temperatures. Larger windows also allowed natural light to illuminate the central bays of each floor as design improvements enabled the width of mills to be increased.

A construction technique employing brick-vaulted ceilings supported by iron beams and columns was developed, and patented subsequently, by renowned Oldham mill architect Abraham Henthorn Stott in 1871. By the end of the 19th century, concrete floor joists were being used instead of brick arches. The net result was mills of greatly increased width. Despite the use of non-combustible materials, however, destructive fires were still an issue and, from the 1880s, automatic sprinkler systems began to be introduced. Mills of this date often had a flat roof behind a parapet, which allowed rainwater to be collected and used by the sprinkler system.

Mill design frequently became more decorative and ambitious although functionality persisted as an over-riding design consideration. A principal eye-catching feature was a multi-functional tower, which incorporated not only the staircase but toilets and often a water tank for a sprinkler system. The name of the mill was often displayed upon the tower, ensuring it was visible from afar - a characteristic of mills in Lancashire and Greater Manchester.

Despite the primary functional purpose of these sites, architectural display, drawing on the fashionable architectural movements of the period, could be employed to enliven facades, with decorative schemes often used on the more public-facing elements of a mill complex.

The additional investment showed pride, confidence and strengthened the competitive edge. Temple Works (1830s/40s), in Leeds, is a particularly exceptional example using an Egyptian revival design modelled on the classical Temple of Edfu. The mill building at Whitchurch Silk Mill in Hampshire, converted from a water-powered sawmill and furniture factory in the early 19th century, is designed in a restrained classically inspired Georgian idiom and provides another interesting example.

Figure 6: The mill building at Whitchurch Silk Mill (Grade II*) in Hampshire has a classically inspired architectural scheme defined by its decorative pediment. [DP140111]

3.2 Integrated Mills

Large, purpose-built, integrated spinning and weaving mills appeared as a distinct mill type in the 1830s, although only a very few early examples survive intact. The buildings containing these two principal processes were usually interconnected, with spinning organised vertically in a multi-storey block and weaving in an adjacent single-storey shed. On larger sites, the spinning and weaving departments were frequently served by separate engines, with a range of ancillary buildings required for the preparation processes, warehousing and office accommodation.

Figure 7: Tonedale Mills in Wellington Somerset (Grade II*), originating in the late 18th century, is one of the largest textile-manufacturing sites in the south-west. It is a key example of an integrated mill complex, incorporating premises for the full range of wool preparation and yarn spinning processes. It retains buildings for spinning, weaving, cleaning and finishing, as well as warehousing, offices, workshops, and multiple phases of buildings for power generation. [33912_029]

3.3 Weaving Mills

This distinct building type usually comprised two- or three-storey preparation and warehouse blocks, and a single-storey weaving shed with a multi-span, north-light roof. Two- and even three-storey weaving sheds are known to have been built where the space available was limited, although these were very unusual.

The steam-power plant was typically placed adjacent to the weaving shed and reservoirs, or lodges, were built to provide a water supply for the engines and boilers when natural sources were not available. Most weaving mills lacked architectural adornment, other than restrained embellishment of the engine houses, although the fabric of surviving examples can retain significant evidence for advances in the technology of building design, machinery and power-transmission systems.

The early weaving sheds comprised 20ft-wide spans, with transverse bays of 10ft supported on hollow cylindrical columns carrying timber trusses. By the late 19th century, the use of rolled steel joists to carry the roofs allowed for columns to be spaced wider on both axes of the shed, enabling looms to be placed with less interruption by columns.

Figure 8: St Mary's Mill (Grade II) in Chalford near Stroud, retains an impressive iron waterwheel, as well as a steam engine. [DP025147]

3.4 Power Plant

Notwithstanding some early and ultimately unsuccessful experimentation with horse and even wind power, the first-generation textile mills in England were water powered and thus built adjacent to watercourses. An unquantified number of existing water-powered sites such as corn and sawmills were remodelled for textile-manufacturing use, although many mills were built on new sites, often remote from established settlements. Small mills of this period tended to have external waterwheels, whilst larger mills often housed the waterwheel internally. Dale End Mill in West Yorkshire, for example, retains a large enclosed waterwheel.

Mills that were established on smaller watercourses were susceptible to stoppages in summer months due to reduced water flow. This issue was addressed by some manufacturers by installing an atmospheric steam engine to maintain the supply to the waterwheel by pumping spent water from the tailrace back to the mill reservoir. An early, and possibly the first, application of this pioneering steam technology to power a cotton mill was achieved by Richard Arkwright, who installed an atmospheric pumping engine at his Wirksworth Mill in Derbyshire in 1780. Many original features survive in this Grade II*-listed mill, known

subsequently as Haarlem Mill and now converted for events use, although there are no visible remains of the pumping-engine system. Physical evidence for this important precursor to driving machinery directly by steam power can now only be obtained via archaeological investigation of early mill sites.

Water-powered mills continued to serve the textile industry through the 19th century, although very few intact examples survive. Notable exceptions with surviving power plant include the late 18th-century mills at Quarry Bank in Cheshire and Helmshore in Lancashire, the early 19th-century St Mary's Mill in Minchinhampton, Gloucestershire, and the Whitchurch Silk Mill in Hampshire. In some cases, it is the surviving elements of the water-management system, such as weirs, races and sluice mechanisms, that provide tangible and often significant evidence for the former use of waterpower.

The early steam-powered textile mills used beam engines, which could be placed either internal or external to the mill. External engine houses were tall buildings, with a narrow rectangular floor plan and often incorporated a characteristic tall, round-headed window set in an end wall. By the mid-19th century, developments in engine technology included the addition of a second cylinder to the standard beam-engine design to provide more power. This required slightly larger engine houses to be built, frequently fitted with a pair of tall round-headed windows.

A significant improvement to the mill's steam plant was the introduction of the double-flue, high-pressure 'Lancashire' boiler in 1844, which led to the increased appearance of external boiler houses. Usually placed adjacent to the engine house, the size of these single-storey buildings was determined by the number of boilers, typically ranging from two to four. The efficiency of the steam-raising plant was improved considerably by the introduction of the economiser in 1845, which utilised hot exhaust gases from the boilers to pre-heat the feed water, thereby reducing the amount of coal needed to raise steam.

A controllable flue and chimney were integral features of the steam-raising plant, and their design was also subject to improvements during the 19th century. Most early steam-powered mills were fitted with square-, or rectangular-, section chimneys that rose for only a few metres above the mill roof, whilst free-standing types of octagonal-section, sometimes mounted on a tall plinth and topped by a corbelled crown, typified mill-chimney design by the mid-19th century. Full height chimneys are functionally and visually very important elements of mill complexes but are now increasingly rare with many having been demolished. Crowns, incorporating an 'oversailer' that ensured smoke was carried away under all wind conditions, are also frequent losses even though they were often important architectural embellishments.

Figure 9: Ham Mill (Grade II), in Thrupp near Stroud, retains an integral, rather than free-standing, chimney complete with an oversailer. [aa017695]

Beam engines began to be superseded by horizontal steam engines in the 1860s, which were frequently placed in large, rectangular engine houses that abutted the multi-storey spinning block. Rope-drive systems were also adopted during the late 19th century, replacing the traditional means of transmitting power from the engine via an upright shaft and bevel gears. These improvements demanded further refinements to textile-mill design, specifically the addition of a rope race to serve each floor of the mill.

Figure 10: Leigh Spinners Mill (Grade II*) in Leigh, near Wigan, includes a rare example of a twin horizontal cross-compound steam engine, nicknamed Mayor and Mayoress, and one of the largest produced by Lancashire firm Yates and Thom. The engine, situated in its original engine house and including the associated rope drum that transferred power to the machinery, has been successfully restored. [DP217593]

Electricity began to be employed as an alternative source of power in English textile mills during the early Edwardian period, with Acme Mills in Pendleton, Greater Manchester, probably being the first to be driven solely by this means in 1905. Each floor of an electrically powered mill was served by a group-drive motor, and these were frequently housed in a full-height external tower as a precaution against the fire risk that this new technology presented. Other infrastructure required for an electric-drive system often included a transformer house to step the voltage from the mains supply down to that required for the machinery and lighting, whilst some mills produced their own electricity using generators driven by steam turbines.

Notwithstanding the advantages of electric drive, however, steam remained the principal source of power until the collapse of the textile industry in the mid-20th century. Tangible evidence of the power systems, ranging from a waterwheel or the steam engine, boilers and chimney to the drive shafts and associated fixtures and fittings, can often be one of the most significant elements of interest in surviving buildings evidencing, for example, technological development and aiding legibility of the process-flow through the mill.

As a vast and multi-phase complex operating from the late 18th to 20th centuries, Tonedale Mills in Somerset, for example, retains evidence for waterpower as well as its subsequent adaptation to steam and electrical power. This includes a waterwheel chamber in the earliest

part of the site, where the wheel was replaced with a turbine in 1904, a beam engine house marking the shift to steam power, and power house complex incorporating a boiler house powered by Lancashire boilers, economiser house, fan engine house and turbine house for electricity generation.

Whilst the historic fabric of a mill can retain visible evidence for the development of its spatial layout, power and transmission systems, circulation patterns and fixtures and fittings (lighting,

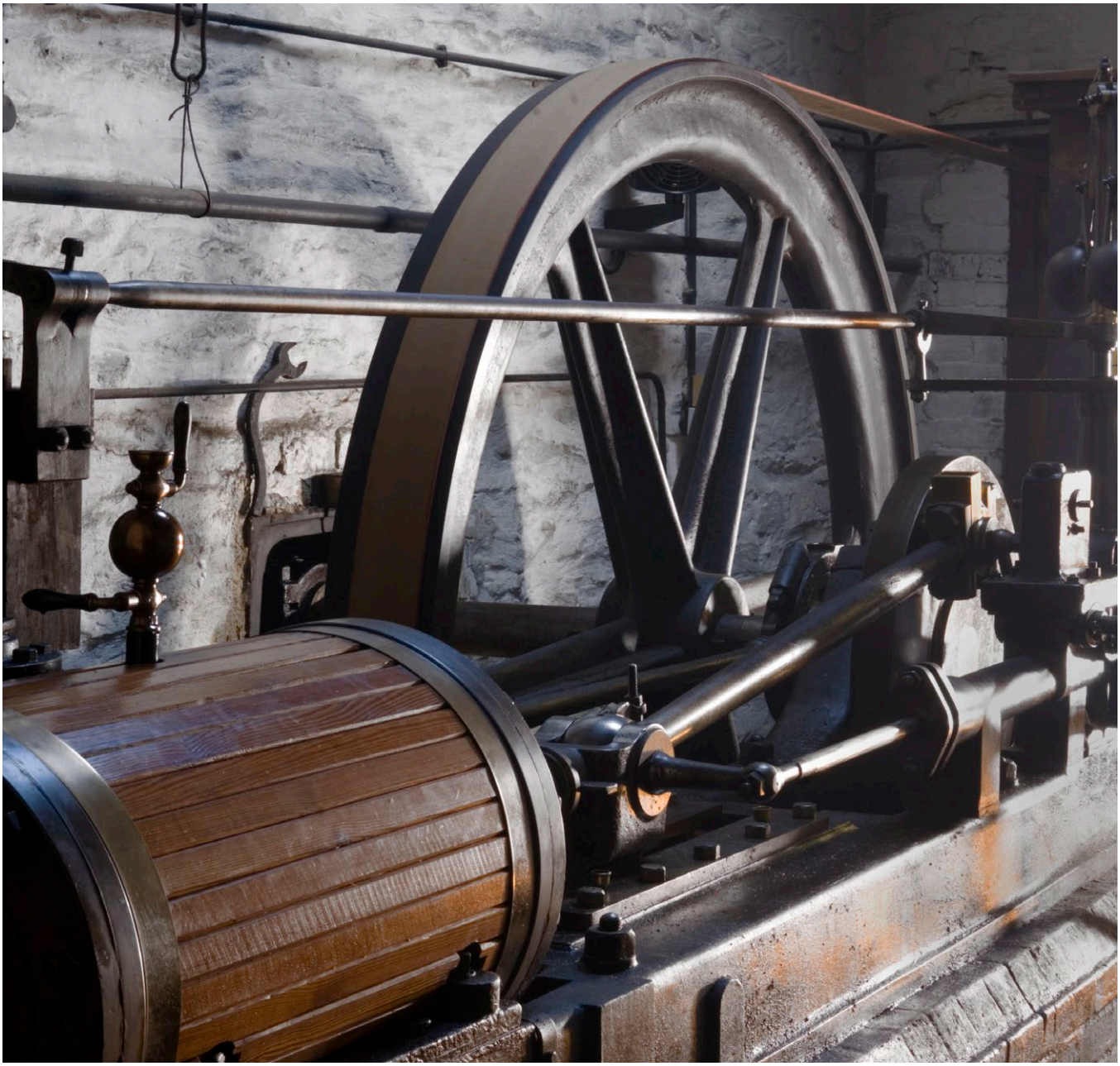

Figure 11: Stott Park Bobbin Mill (scheduled) in Finsthwaite, Cumbria, retains a horizontal steam engine. The mill is a good example of a site that supplied the textile industry providing bobbins and reels for winding yarn or thread. [DP044995]

heating, fire-prevention measures and sanitation systems), textile mills that retain all the component elements of their steam-power plant are increasingly rare, although significant evidence can be gleaned from an examination of the fabric and any associated below-ground remains (both within the buildings and outside). On cleared sites, with no upstanding remains, archaeological investigation is often the only means available to elucidate the structural and technological development of a mill complex and can produce hugely significant results.

Figure 12: The archaeological excavation of Richard Arkwright's Shudehill Mill in 2014-15, Manchester's first steam-powered textile mill, yielded nationally significant information for the sequence of power plant, including physical evidence for a waterwheel pit and an associated steam-powered water-returning system. [© Oxford Archaeology Ltd]

4 Change and the future

The collapse of the British textile industry in the 20th century left many of its historic buildings facing an uncertain future despite their ability to be adapted for other uses. A lack of investment in maintenance, repair and security, as well as economic fluctuation, mean that numerous mill complexes are vulnerable and a significant number have already been demolished, lie vacant or are underused.

Despite this, these assets are increasingly gaining exciting new futures as homes, offices, businesses, as well as cultural and community spaces, having a transformative impact on their areas. The themes of risk and renewal are discussed in research published on behalf of Historic England: Engines of Prosperity, expanded in Driving Northern Growth through repurposing historic mills.

More information on the transformative potential of textile mill regeneration can be found on Historic England's 'Mills of the North' webpages.

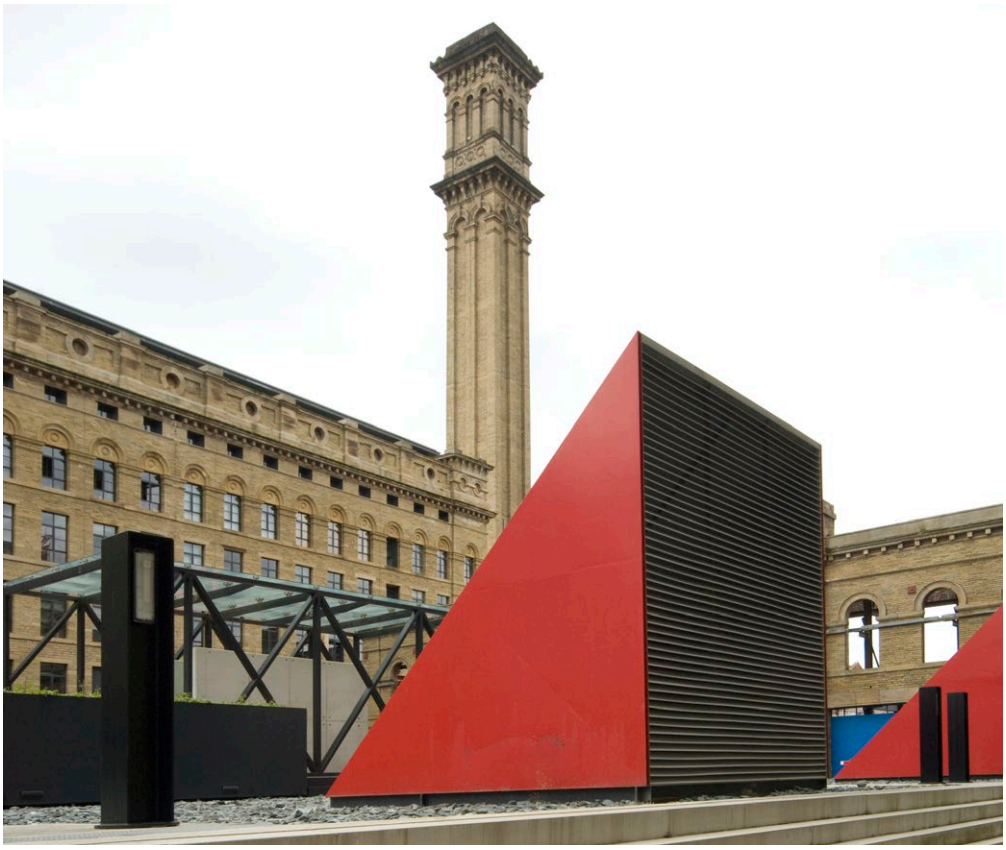

Figure 13: Lister's Mill at Manningham, Bradford built in 1873, is now being converted into residential apartments and ground-floor commercial units. [dp071762]

5 Further reading

There is a huge volume of published work relating to the textile industry and its buildings.

The development of textile mills as a building type was examined in depth during three large-scale surveys that were initiated by the former Royal Commission on the Historical Monuments of England (RCHME) in the 1980s. These were carried out in West Yorkshire, Greater Manchester and East Cheshire, and aimed to produce as full a record as possible of the buildings of the textile industry, and to examine the importance of mills in the architectural heritage of the region. The results obtained from these strategic surveys were published as three separate volumes: M Williams with DA Farnie, ***Cotton Mills in Greater Manchester*** (1992), C Giles and IH Goodall, ***Yorkshire Textile Mills 1770–1930*** (1992), and A Calladine and J Fricker, ***East Cheshire Textile Mills*** (1993).

Building on this work, Historic England commissioned Buildings at Risk surveys for each Local Authority area within West Yorkshire (surveys published 2019, summary report published 2019), Greater Manchester (surveys, summary and heritage audit published 2017) and Lancashire (rapid survey published 2010, full surveys published 2012 with a summary published 2018).

Historic England has also commissioned and published ***Engines of Prosperity***, accessible for free on our website, which explores a series of case studies and themes for mill regeneration in West Yorkshire (published 2016) and the North West (published 2017). These two volumes highlight the scale of the opportunity and explore a wide range of best-practice precedents from recent mill-conversion projects. This builds on an important study of weaving mills carried out in Pennine Lancashire, which culminated in the production of ***Northern Lights: Finding a Future for the Weaving Sheds of Pennine Lancashire*** (2010). The information in Engines of Prosperity has been renewed and refreshed in ***Driving Northern Growth through repurposing historic mills*** (2021).

Several detailed studies examining textile mills in individual towns or areas have also been published. In Greater Manchester works include JH Longworth, ***The Cotton Mills of Bolton 1780-1985*** (1987), D Gurr and J Hunt, ***The Cotton Mills of Oldham*** (1998), as well as I Miller and

C Wild, *A & G Murray and the Cotton Mills of Ancoats* (2007). English Heritage published a further study on the Ancoats area of Manchester, *Ancoats: Cradle of Industrialisation* (2011).

Similarly, in Pennine Lancashire, English Heritage published a key thematic study of mills in the Borough of Pendle, *Pendle Textile Mills* (Simon Taylor 2000), with a more In-depth study on the town of Nelson by Nicola Wray, *By Industry and Integrity: Nelson a Late 19th century Industrial Town* (2001). More broadly, A Phelps, RA Gregory and I Miller, *The Textile Mills of Lancashire: The Legacy*, was published in 2018 for Historic England.

In Yorkshire, an English Heritage study explored the area of Manningham, Bradford (Simon Taylor and Kathryn Gibson, *Manningham: Character and Diversity in a Bradford Suburb* (2010)). Further work includes G Ingle, *Yorkshire Cotton* (1997) as well as a study of the model town of Saltaire in N Jackson, J Lintobon and B Staples, *Saltaire: The Making of a Model Town* (2010).

Outside of the north of England, key publications include M Williams, *Textile Mills of Southwest England* (2013), and C Giles and M Williams, *Ditherington Mill and the Industrial Revolution* (2015).

A comprehensive and accessible account of the early water-powered cotton mills in the north of England is provided by C Aspin, *The Water-Spinners: A New Look at the Early Cotton Trade* (2003), and O Ashmore, *The Industrial Archaeology of Lancashire* (1969), is also a useful introduction to the subject. An account of one of the most prominent firms of mill architects is provided by RN Holden, *Stott & Sons: Architects of the Lancashire Cotton Mill* (1998), and G Shackleton, *The Textile Mills of Pendle and their Steam Engines* (2006) gives a comprehensive account of the steam plant used in the Pennine Lancashire cotton industry. A study of the weaving sector, and the development of weaving sheds is provided by RN Holden, *Manufacturing the Cloth of the World: Weaving Mills in Lancashire* (2017).

Timeline:

1690s	Earliest documented spinning of cotton in England.
1702	Thomas Cotchett built the first silk factory on the River Derwent in Derbyshire, although this was unsuccessful commercially.
1718-21	Thomas Lombe erected a five-storey silk mill adjacent to Cotchett's mill on the River Derwent to become the first successful textile factory.
1733	John Kay introduced the flying shuttle, vastly increasing the output of woven cloth and increasing the demand on spinners to produce yarn.
1764	Robert Peel commences mechanised calico printing on an industrial scale at Brookside Mill in Oswaldtwistle, Lancashire.
1764	James Hargreaves invents the spinning jenny, the first machine to spin more than one yarn at a time thereby allowing the output of the spinners to be increased.
1769	Richard Arkwright patented his spinning machine that became known as the 'water frame', as it was the first spinning machine to be water powered.
1771	Richard Arkwright established the world's first successful cotton-spinning mill at Cromford.
1775	Richard Arkwright secured a patent for his rotary carding machine that transformed raw cotton into a lap that was suitable for spinning. This enabled the entire process of producing spun yarn from raw cotton to be mechanised, signalling the birth of the modern factory system, and led Arkwright to embark on a great burst of mill-building activity.
1779	Samuel Crompton invented the spinning mule, which combined the best properties of the spinning jenny and the water frame to spin strong but fine yarn that was suitable for warp or weft.
1780	Richard Arkwright employed an atmospheric steam-powered pumping engine at his Wirksworth Mill in Derbyshire to return water from the waterwheel tailrace up to the mill reservoir during periods of reduced flow in the River Ecclesbourne.
1781-83	Richard Arkwright built a mill remote from a watercourse at Shudehill in Manchester, which he attempted to power solely by a steam engine. This was unsuccessful, although the mill was set to work with a waterwheel that was supplied with water by a steam-powered pumping engine.
1782	James Watt patented his 'sun and planet' gear, which enabled him to achieve rotary motion from his steam engines.

1785	Edmund Cartwright patented the first power loom, although this was not commercially successful.
1786	James Watt patented his parallel motion, which guided the piston rod in a straight line using a linkage of bars and enabled the smooth power delivery that was necessary to prevent the thread snapping during the spinning process.
1786	G & J Robinson became the first cotton spinners to install a rotative steam engine, supplied by Boulton & Watt, in their Papplewick Mill in Nottinghamshire.
1797	Ditherington Flax Mill became the first iron-framed ‘fireproof’ textile mill in the world.
1799	Charles Tennant patents bleaching powder, enabling the finishing branch of the textile industry to become a factory-based process.
1813	William Horrocks improves the power loom to create a commercially viable alternative to hand-loom weaving.
1820s	Powered spinning machinery adopted by the woollen industry.
1825	Robert Roberts patents a self-acting or automatic spinning mule.
1830s	Single-storey weaving sheds added to spinning mills to create integrated textile-manufacturing sites.
1844	The twin-flued Lancashire boiler developed in Manchester by William Fairbairn as a more efficient alternative to the types of boilers used in textile mills.
1860s	Horizontal steam engines begin to supersede vertical engines in new textile mills.
1905	Acme Mills in Lancashire became the first textile mill to be powered solely by electricity.
1929	Formation of the Lancashire Cotton Corporation, which embarked upon a programme of rationalisation of cotton-spinning mills in consequence of a shrinking market.
1936	Cotton Spinning Act designed to reduce capacity by levying all employers and compensating those who agreed to break up machinery.
1940s-50	Polyester, acrylic and other artificial fibres introduced.
2016	Tower Mill in Dukinfield reopened after a multi-million pound restoration, representing a return of commercial cotton spinning to North West England.

6 Where to get advice

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