A survey of Rayne Foundry, The Street, Rayne, Braintree, Essex May 2008

report prepared by
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on behalf of
Knight Developments

CAT project refs.: 08/04c
HEM site code: RARF 08
Braintree Museum accession code: not yet allocated
NGR: TL 7272 2265 (c)

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CAT Report 475
August 2008

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also included:
CD of colour photographs and audio discussion

1 Introduction

This report provides a written and photographic record of a complex of former foundry buildings at Rayne Foundry, The Street, Rayne, Braintree, Essex. It is intended to fulfil a condition of planning permission for demolition and domestic conversion and has been prepared to a brief designed by the Historic Environment Management (HEM) team of Essex County Council (O'Connor 2008) and an associated Written Scheme of Investigation (by the Colchester Archaeological Trust). The written report is accompanied by a CD containing a full photographic record of digital images (index, Appendix 2), but also includes 26 printed photographs of key features (Appendix 1). A further 74 black and white photographs in two packets are in the site archive (index, Appendix 3). Each image is separately described in the written report. The buildings were surveyed during May 2008 when the accompanying photographs were taken. Each of the eighteen buildings within the scheme is identified by a unique number (1-18) as shown on the block plan of the site (Fig 2) and is described in section 4. An account of the iron-casting process, specific to Rayne Foundry, is also included. This account is based primarily on conversations with and insights provided by Mr Jim Gepps, a former employee who worked at Rayne Foundry for 42 years as a purchasing officer, and Messrs Richard Carr and Stanley Paige, formerly of Paxman's of Colchester, during discussions at Rayne Foundry in May 2008. The audio recording of these conversations is included on the accompanying CD. Further information concerning the iron-casting process was derived from *Iron foundries in Essex* (Garwood 1998). A historical account of foundries in Essex by Andrew Phillips is also included.

2 Summary (Fig 1)

Rayne Foundry lies on the north side of the Roman road known as Stane Street – the main route from Colchester to St Albans – today called simply 'The Street' in the centre of Rayne parish. A foundry was in continuous operation at the site from at least as early as the1820s right through to its closure in 2001. Eighteen buildings were recorded in the course of the survey. Little of the early foundry survived, apart from a few external walls to the south and east of the current complex, with the current building dating mostly to the 1930s/1950s. At the time of its closure, the foundry used 20th-century equipment and machinery, and no original fixtures and fittings have survived. The Roper cupola furnace was one of the last remaining examples of its type in the region and, with the closure of Rayne Foundry, the last operational iron foundry in Essex has disappeared.

The site is currently derelict and awaiting demolition prior to redevelopment for housing.

3 Cartographic and documentary survey (Figs 3-6)

Rayne Foundry began in the 1820s as part of an agricultural machinery manufacturer that produced ploughs, amongst other things, supplying the surrounding farms and villages. The emergence of the foundry at this time reflects the on-going Industrial Revolution in Britain that was replacing labour-intensive farming practices with mechanical techniques.

A search of the Essex Historic Environment Record and the Essex Record Office archives produced four maps (Figs 3-6) showing references to an iron foundry on the site. The earliest historical reference to the site appears on the tithe map of 1838 (ERO D/CT 286; Fig 3, circled in red), which records the house, foundry and garden of Edward Goss, of Street Farm. The land to the north later occupied by the foundry is shown as a separate parcel of land. It is interesting to note that the foundry started next door to a smithy, illustrating that the changes in rural life that accompanied the Industrial Revolution co-existed with older, established industries.

In 1881, the first edition Ordnance Survey map (Fig 4) depicts a cluster of buildings lying centrally within the village. By this point, the foundry had started to expand into the northern parcel of land. The central block probably represents the

foundry, with those to the west being used as offices: a manager's house lies to the west and a rural smithy stands to the east (EHER no 15301).

The second edition Ordnance Survey map of 1895 (Fig 5) shows very little change. A small building has been added to the central complex, but except for this it is unchanged.

The third edition Ordnance Survey map of 1921 (Fig 6) also shows little change. Two extensions have been added to the northernmost outbuildings and a separate rectangular structure built just to the north of these.

The earliest non-cartographic reference to Rayne Foundry found in the archives of the Essex Record Office is in an album from records belonging to E H Bentall and Company, Ironfounders and Agricultural Implement Makers of Heybridge, dated to around 1856 (ERO D/F 1/5). This album contains around 750 printed leaflets and pamphlets, most of which are illustrated. Among these is a leaflet that lists 30 implements displayed by Goss and Peene of Rayne Foundry, Essex, at the Royal Agricultural Show held in Chelmsford in 1856. The implements range from ploughs, harvesting equipment, etc, to feed troughs, and are each accompanied by a short description and explanation of use and price.

By the late 19th century, Rayne Foundry appears to have changed ownership. In the 1884-1906 business records of Parmenters, Builders and Contractors of Braintree and Bocking, accounts covering the period 1885-91 list the sale of timber and sawdust to Barnard and Lake of Rayne Foundry, Braintree (ERO D/F 88/1). This is the latest non-cartographic reference to Rayne foundry found at the ERO.

With the probable exceptions of the extreme south-east corner of the foundry and the eastern side of the core shed, nothing of the original foundry complex survived by May 2008. According to the map evidence described above, Rayne Foundry underwent a large rebuilding programme in the early half of the 20th century. New offices were constructed parallel to The Street, and the area between these and the old foundry was roofed over with an internal framework of steel trusses supported on upright steel stanchions. In addition, the foundry expanded into open land to the north, where five large warehouses were constructed along with three Nissen huts. Extra buildings were erected in the main foundry complex as needed, in particular a house for the foundry manager, a finishing shed, and a pattern store. Much of this expansion was linked to the Second World War. During both World Wars, the foundry made hand-grenades and mortar bomb cases, and, at its height during the Second World War, Rayne Foundry employed approximately 120 people, a figure that reflects the labour-intensive manual handling practices of the time. Fifty years ago, approximately three-quarters of Rayne's working population was employed at the site and the foundry was a big part of the community, holding village fêtes on open land to the north of the complex.

As well as producing ironwork, Rayne Foundry also cast in brass (notably replacement cogs for the clock mechanism of Big Ben and pieces for Hampton Court Palace), bronze, gunmetal and, later, aluminium. After the end of the Second World War, machinery manufacture ceased and the whole site was devoted to casting production.

Rayne Foundry downsized in the last quarter of the 20th century; the northern warehouses and properties were sold off and fewer staff employed compared to the numbers employed during the Second World War. The foundry went into receivership and closed on 13th February 2001. Mr Ronald Spencer was the owner for the last 32 years of its existence.

4 Descriptive record (Fig 2)

The eighteen buildings within the development area, numbered 1-18 in Figure 2, are described below. A1 and A2 refer to Appendix 1 and Appendix 2 respectively.

Building 1: main foundry (Fig 2; Plates A1.1, 6-16, 18-20)

Building 1 was the main foundry, incorporating the offices and welfare facilities (staff canteen, kitchen and washrooms), the core shed, moulding floor, furnace, casting floor, and sundry areas. The complex was an amalgamation of the remains of earlier buildings incorporated into a larger, later industrial design and was, in effect, a

series of connected roofs covering different work areas. The complex mostly dates to the 1930s/1950s but incorporated elements that appear on the Ordnance Survey maps of 1881 and 1895 (Figs 4-5). These earlier elements were in the south-east corner of the complex and took the form of external red-brick walls that partially surrounded the moulding floor and the core shed (further discussed below). Apart from these two areas and the offices fronting The Street, the rest of Building 1's walls were a mixture of corrugated plastic or asbestos sheeting attached to upright steel stanchions, which, in turn, supported a framework of iron trusses covered by a roof of corrugated asbestos sheeting.

A single-storey, linear office range of red-brick fronted The Street. The staff canteen was at the west end of this range with four offices between this and the main entrance. To the east of the main entrance were four more offices. Behind this range of offices, separated by a narrow corridor, were the office kitchen and washroom facilities, and two store rooms. The corridor led down three steps into the foundry proper. To the west of this doorway lay the entrances to the foundry washrooms, female to the immediate west and male at the far western end. The female washroom was painted pink with one shower cubicle, a WC and a washbasin; the male washroom had three shower cubicles, a bank of seven washbasins, two WCs and a urinal. Through this to the west was a locker room.

The first part of the complex entered from the offices was the **aluminium foundry**, approximately 26m long by 9m wide. The west and north walls were of corrugated iron sheeting attached to upright steel stanchions that supported a framework of iron trusses covered by corrugated asbestos sheeting. A line of translucent corrugated plastic panels was centrally located in the northern side of the roof. A sliding door in the north wall provided access to an area marked 'Goods in'. The east wall was open to the moulding floor. In the north-east corner was a heat-extractor hood for an aluminium furnace with a trough cut into the concrete floor beneath it. Two smaller furnace troughs were located along the north wall, probably for copper-alloy working. None of the furnaces remained *in situ*. An iron rail was suspended from the roof trusses in front of the main aluminium furnace. This was the overhead monorail metal-handling system that carried molten metal to the casting floor of the aluminium foundry.

Through the open east end of the aluminium foundry was the **moulding floor** where the final moulds for the castings were manufactured (Plates A2.40-44). This was one of the older surviving parts of the early foundry, with the east and south walls (approximately 4.7m high) constructed of red brick. The wall to the east of the moulding floor is depicted on the Ordnance Survey map of 1881, as part of a rectangular building aligned roughly north to south. The south wall of this building was separated from The Street by a small structure. By the time of the second edition Ordnance Survey map of 1895, this small building had been removed and the southern wall of the moulding floor extended to The Street frontage. When the foundry was expanded, the west and north walls were removed and replaced by evenly-spaced steel stanchions. A line of evenly-spaced steel stanchions extended north to south down the centre of the moulding floor supporting the double pile roof. This was an unevenly pitched construction of corrugated asbestos sheeting to the east with translucent corrugated plastic panels to the west, a 'saw' design typical of many industrial structures (Plates A2.1, A2.7). The apexes of these had a raised ridgeline with louvred sides for ventilation. At the south end of the moulding floor stood a sand hopper, on the east side of the dividing steel stanchions, whilst, on the west side, large tanks of acid for mixing with the moulding sand once stood.

Two-thirds of the way along on the eastern side of the moulding floor, past two tiers of racking, was the open entrance to the core shed. Immediately to the north of this were a flight of wooden stairs leading up to the pattern loft, a mezzanine floor of lightweight timber construction resting on rolled steel joists (RSJs) supported on upright steel stanchions. Large patterns and some castings were stored here.

An open area between the pattern loft stairs and the core shed contained a red-sand mixing machine and a dust extractor *in situ*. Above the dust extractor was a redundant oil tank. This part of the foundry was constructed of upright steel stanchions with corrugated iron sheeting covering the lower half of the walls and translucent corrugated plastic panels for the upper half. As with the moulding floor,

the roof was of unequal pitch. An opening in the north wall led to the foundry stores (Building 4; Plate A2.30).

The **core shed** on the extreme eastern edge of the complex was a single-storey red-brick building (Plates A2.11-25). Originally this was part of a larger structure extending to the west and was fully enclosed, as depicted on the first edition Ordnance Survey map of 1881. At some point, the entire west wall was removed down to ground-level and replaced with steel stanchions. The remains measured approximately 26m by 7.8m. The roof of corrugated asbestos sheeting was supported on wooden trusses that rested on the brick wall to the east and the steel stanchions to the west. Translucent corrugated plastic panels to light the interior were placed at intervals in the west side of the roof. The interior walls were painted pale yellow with three windows set in the east wall, and a filled-in arch at the eastern end of the north wall. This arch was a redundant feature from an earlier phase of the foundry. Access was through a sliding wooden door in the north wall that led to an extension housing a sand hopper, a redundant sand-mixing machine, and racking for storage. This extension measured 7.6m by 2.5m. It was constructed of corrugated iron sheeting over an iron framework and had a set of outward-opening doors that led to the foundry stores (Building 4).

In the north-west corner of the core shed was a machine for mixing sand and spermalene (a hardening agent), and a bench with patterns, rammers and other materials for making cores. To the east of the shed was a rack of cores waiting to be baked in the large Gibbons Brothers gas-fired oven that was centrally positioned along the east wall of the shed (Plate A1.9). This replaced an oil-fired oven that reportedly once stood in the south-west corner of the shed and had been fuelled by the oil tank in the area to the west.

To the north of the moulding floor, past a deep sump with a metal ladder and another dust collector, was a fire exit. Opposite this was an area where finished and broken moulds were stored in preparation for recycling. North of the fire exit and attached to the exterior of the north-east foundry wall was the furnace. This was a British-made coke-fuelled **Roper cupola furnace**, standing 20m tall, capable of melting up to 18 tonnes of iron per day (Plates A1.12-14). The area to the east of this had an overhead monorail metal-handling system extending across the width of the foundry to the casting floor. Ladles of molten iron attached to hoists were pulled around the monorail by chains and delivered to the casting floor and the awaiting moulds. North of the furnace was a small brick and breezeblock building, housing the electric motor for the furnace air-injection system. In the far north-east corner of Building 1, just inside a large entrance, was an American-made Pangborn shot-blasting machine and two dust extractors (Plates A2.106-114).

The area in front of the furnace was separated from the casting floor by a line of evenly-spaced stanchions that ran down the centre of this area supporting the valley of the double roof. This was of the same design as the moulding floor roof. The casting floor comprised a series of eight sets of parallel rails with four overhead rails along which the molten iron was brought to the moulds (see Fig 7). South of the floor rails there were three extensions to the monorail delivery system but no floor rails. This is where the largest castings were poured. To the north of the casting floor was an open area in front of a set of large sliding doors that led to the grinding shed (Building 5).

South of the casting floor were the stores and goods in areas. These flanked the large folding wooden doors of the foundry's west entrance on the north and south sides respectively. Some moulds on racks were also present in these areas. Immediately to the south-west of this entrance was a pair of sand hoppers.

Building 2: the pattern shop (Fig 2; Plates A1.3-4)

This was a rectangular single-storey red-brick building on the west side of the foundry complex, approximately 20.9m long by 7.35m wide, and painted white inside and out. Entry (at the south-west corner) was through wooden double doors that opened outwards at the south-west corner, with three further points of egress, ie a single wooden door in the exterior wall in the north-west corner that opened outwards, a double iron door opening into Building 3 in the north wall, and a single iron door in the east wall that opened inwards. This last door led to the casting floor

of the main foundry. Three sets of iron-framed windows were situated in the west wall, in-between the two doors. The roof was of corrugated asbestos sheeting, supported by iron trusses (Plate A2.156). Four raised skylights were in the roof at the south end, two on either side of the ridgeline. In between these skylights, translucent plastic was substituted for two of the asbestos panels. Immediately to the north of the southernmost window, the exterior walls rose by approximately five courses of brick and continued at this level through the rear wall of the pattern shop into Building 3. An unbroken line of skylights extended along the centre of the west side of the roof. At the south end of the pattern shop was a modern wall constructed of breezeblocks. This stood slightly lower than the external walls and separated a WC and a small, flat-roofed kitchen from the pattern shop. A single wooden door that opened outwards in the western external wall accessed these areas as well as a door in the south wall that opened inwards from the goods in area. The north wall of the pattern shop was of poured concrete panels that completely filled the area from the ground to the apex of the roof. It is clear that Building 2 did not originally extend as far north as this but was enlarged at some point. Attached to the south wall of the pattern shop were several lockers and shelves that held adhesives and fittings used by the pattern-makers. A few benches remained, along with half-finished patterns, random tools and equipment, but no *in situ* machinery was present.

Building 3 (Fig 2; Plates A2.16-19, 159-164)
This was a rectangular single-storey, red-brick building on the west side of the foundry complex, approximately 15.7m long by 7.35m wide, and painted white inside and out. As has been stated above, originally Building 3 extended further south than its internal dimensions now allow and, at some point, a wooden partition sub-divided what was left into two chambers, leaving approximately two-thirds of its length at the north end of the structure. A double set of wooden doors was cut into the wooden partition separating the two chambers. The northern end of Building 3 was of unpainted breezeblocks possibly indicating a rebuild. Other than the entrance from the pattern shop, access to Building 3 was through a set of double wooden doors in the north wall that opened outwards and through an opening in the east wall that led to the casting floor. The northern chamber was used as a pattern store, whilst the south chamber, adjoining the pattern shop, was used as a timber store. The central part of the roof of Building 3 had a raised ridge with louvred sides for ventilation. Attached to the west wall of Building 3 were two sheds measuring 11m by 3.4m. The northernmost shed was constructed of corrugated iron sheeting attached to an iron frame, whilst the southern shed (constructed as an extension to the other) was a wire cage on two sides with corrugated plastic sheets above and on the roof. These sheds were external chemical stores.

Building 4: the foundry stores (Fig 2; Plates A2.165-168)
Located to the north of the core shed, and opposite the furnace, this was a tall, 28m-long by 3.65m-wide structure, open on the west side, and was the raw materials store for the foundry. The building was constructed from corrugated iron sheeting attached to an iron framework, with a roof of corrugated plastic sheeting, and was divided into six bays, five of equal width with a sixth at the north end being double width. This double-width bay was the coke store for the furnace. Cobblestone-sized pieces of limestone were stored next to this and pig iron was kept in the third bay. Clinker from the furnace was kept in the fourth bay and red moulding sand in the fifth. The sixth bay, closest to the core shed, was for reject castings waiting to be recycled. Iron scrap and automotive scrap for adding to the iron mix was stored opposite Building 4 against the exterior of Building 1.

Building 5: the grinding shed (Fig 2; Plates A2.169-181)
Building 5 was the grinding shed where castings were finished (a process called 'fettling') before being despatched. The grinding shed was 30.7m long by 9.3m wide and was constructed from corrugated iron sheeting attached to an iron framework that was itself attached to a pre-cast concrete frame. The roof was of corrugated asbestos sheeting with clear plastic panels that extended down the middle of the roof on each side of the ridgeline. The building was divided into two chambers, a

main shed taking up four-fifths of the interior with a smaller room at the east end. Access was through a pair of sliding wooden doors (4.3m wide) in the west end wall. There was also a smaller set of sliding wooden doors at the rear of the main shed in the south wall. Several fettling benches and a dust extractor remained *in situ*, and a small shot-blasting machine once stood at the east end of the room. The smaller room at the east end of the building was the foundry maintenance shed and could be accessed from the main chamber or, independently, through an outward-opening iron door in the south wall. Attached to the north side of the main grinding shed entrance was the dipping shed, an open-fronted structure of corrugated iron panels over an iron framework to the north and west. This measured 5.8m by 3.35m and had a sloped roof of corrugated iron sheeting.

Building 6: the pattern store (Fig 2; Plates A2.182-185)
Building 6, the main pattern store for Rayne Foundry, was constructed around a pre-cast concrete frame with the north and west walls of breezeblocks, whilst the south and east walls were of corrugated asbestos sheeting. The sloped roof was of corrugated asbestos sheeting with transparent panels set at spaced intervals. Access was through a single sliding wooden door in the east wall and there was a wooden fire exit at the west end of the south wall. The pattern store measured 24.6m by 6.2m and bore the legend 'ATCOST' above the door. The interior was shelved around the walls from floor to ceiling and was full of wooden patterns. It was constructed in the late 1980s.

Building 7 (Fig 2; Plates A2.187-192)
Building 7 was a two-storey brick-built house, with a tiled roof, 10.5m long by 5.6m wide. The doors and windows were single-glazed with metal frames and the house had two chimneys. This used to be the residence of the foundry manager but was later converted into offices and a laboratory for the quality-control testing of the iron produced during the casting process. The interior was judged unsafe to enter and no further comment can be made.

Building 8 (Fig 2; Plates A2.193-194)
Building 8 was a 27.7m-long by 11m-wide structure, on an east-west alignment, to the north-west of the main foundry. A surplus World War One Nissen hut of corrugated iron sheeting over a tubular steel frame was supported on a low brick wall. Access was through a pair of sliding iron doors at the east and west ends. There was no indication as to the purpose of the structure, although it appeared to have been last used as a dog-training arena.

Building 9 (Fig 2; Plates A2.195-197)
Aligned north to south, this was a smaller version of Building 8, 12.4m long by 11m wide, with one entrance in the north end. However, this entrance was a steel roller door rather than a set of sliding doors. Building 9 was last used to house an industrial concern of an unknown nature.

Buildings 10 and 11 (Fig 2; Plates A2.198-219)
Buildings 10 and 11 were separate structures, but, with the dividing wall having been removed, formed a single large roofed unit with two rooflines. Evenly-spaced green-painted steel stanchions supported the junction of the two roofs. Both structures were 39m long with the width of Building 10 being 12.3m and that of Building 11 being 12.8m. The walls were of breezeblocks, painted white on the interior, with the upper half of the south wall of Building 10 glazed along its entire length. A sign saying 'COLOSPERS' was attached to the exterior of these windows. Access to Building 10 was through a centrally-positioned roller door in the west wall. Building 11 had two of these doors positioned in the east and west walls respectively, as well as outward-opening wooden fire doors immediately to the south of each main entrance. The roofs were of corrugated asbestos sheeting supported on iron trusses. A centrally-located line of translucent corrugated plastic panels extended the length of the roof on either side of the ridgeline in both roofs. At the west end of the two buildings was a white-painted, flat-roofed brick structure, 5.7m long by 4.15m wide, that straddled the dividing line of the two buildings. A plywood- and

glass-panelled enclosure was located in the south-west corner of Building 10. This was 13.45m long by 5.45m wide. Presumably both of these internal structures were offices. Positioned on the exterior of the south side of Building 10 was a breezeblock-built washroom, 9.2m long by 3m wide. This facility was divided into two unequal parts. The female toilets to the west were equipped with three WCs and a sanitary incinerator, with two basins and a boiler in the anteroom. The male toilets were equipped with two WCs, a urinal, a single basin and a drinking fountain. A door from the female facilities led into Building 10, and an external door accessed the male toilets. To the east of the washroom was a breezeblock structure, 2.8m wide by 2.7m long, with an open front and an asbestos roof. This was probably for the storage of gas cylinders.

Building 12 (Fig 2; Plates A2.220-222)
This was separated from Building 11 by a breezeblock wall and measured 39m long by 12.3m wide. The north and east walls were brick, whilst the lower half of the west wall was constructed of breezeblocks with the pediment being completely brick-built. The roof was of corrugated asbestos sheeting supported on iron trusses with a line of evenly-spaced translucent corrugated plastic panels extending along the centre of the southern half of the roof. Access was through a centrally-positioned roller door in the west wall with a smaller door immediately to the south, and a large sliding wooden door in the east wall. The white-painted interior was empty apart from two breezeblock toilet cubicles in the north-east corner.

Building 13 (Fig 2; Plates A2.223-225)
Building 13 was entirely brick-built and measured 39m long by 12.3m wide. The roof was of corrugated asbestos sheeting supported on iron trusses with a line of evenly-spaced translucent corrugated plastic panels extending along the centre of the southern half of the roof. Access was through a centrally-positioned roller door in the west wall with a smaller door immediately to the north, and a large sliding wooden door in the east wall (not present at the time of the survey). The white-painted interior was empty apart from two breezeblock toilet cubicles in the south-east corner. The south wall appeared to have filled-in windows facing north, suggesting that Building 13 was of later construction than Building 12.

Building 14 (Fig 2; Plates A2.226-232)
Building 14 measured 39m long by 12.3m wide with north, east and west walls constructed of breezeblocks. The south wall was brick with filled-in windows that faced north, and was originally the exterior of Building 13. The roof, which was approximately 1m higher than those of Buildings 10-13, was of corrugated asbestos sheeting covering a framework of iron trusses with evenly-spaced translucent corrugated plastic panels. The roof was supported on upright steel stanchions that were positioned against the walls. Access was through centrally-positioned roller doors in each end wall, with smaller doors to the immediate north of these. The interior was white-painted with two breezeblock toilet cubicles in the north-east corner. There was a wooden-walled office in the north-west corner. A sign saying ‘CPS Marketing Ltd’ was mounted on the exterior of the west wall.

Building 15 (Fig 2; Plates A2.235-237)
Building 15 was roughly L-shaped, and was attached to the east end of Building 11. It measured 5.8m by 6.65m at its widest point. Building 15 appeared to be brick-built, with a concrete render, but was obscured by vegetation, making a full analysis difficult. A tall, brick chimney protruding from the roof, and large-bore iron ducting attached to various parts of the exterior, suggest that this was a boiler room for Building 11.

Building 16 (Fig 2; Plates A2.238-242)
Building 16 was a surplus World War One Nissen hut of corrugated iron sheeting over a tubular steel frame measuring 11m long by 5.1m wide. The north and south ends were of upright wooden battens, each with an identical door flanked by two windows. The interior was divided into two chambers.

Building 17 (Fig 2; Plate A2.243)
Building 17 was an extension to the east end of the grinding shed (Building 5). It measured 8.4m long by 3.85m wide and was constructed of breezeblocks with a sloped corrugated iron roof. It appears to have been built around a raised oil tank, the legs of which formed the frame supporting the two iron doors that gave access to the structure. This was used as a hydraulic hose store for the foundry.

Building 18 (Fig 2; Plate A2.244)
Standing just to the east of Building 17, this was a 4.3m-long by 3m-wide shed, constructed of galvanised zinc corrugated sheets over an iron framework. There was no indication as to its purpose.

5 The iron foundry process (Fig 8)

This section draws heavily upon *Iron foundries in Essex* (Garwood 1998) and the verbal testimonies given by and discussion with the consultees of the study group.

Patterns for castings arrived at Rayne Foundry either already manufactured or as blueprints that were then fabricated in the pattern shop (Building 2). Patterns were exact wooden replicas of the finished product, around which a mould was formed for casting. Patterns were manufactured slightly over-size to a pre-determined dimension to allow for shrinkage of the casting as it cooled. Five pattern-makers were employed at Rayne Foundry in the last quarter of the 20th century, working the lathes and drills that filled the pattern shop and constructing exact patterns of the items to be cast. Some castings could be very intricate, with multiple chambers and hollows, and so required a core to be placed within the mould. These cores were made in the core shed at the east side of Building 1 from patterns provided by the pattern shop.

Sand from the hopper in the core shed was originally mixed by hand with spermalene, a task that was later mechanised. Eventually a sand and resin/acid mix replaced the sand/spermalene mix. This mix was poured into a pattern to form a core, then rammed hard and removed. Any imperfections that might be passed onto the casting were removed by hand and then the cores were baked in the core oven. This was a large gas-fired industrial oven, 1.9m wide by 1.45m deep by 2.1m high, manufactured by Gibbons Brothers Ltd of Dudley. it was installed at Rayne Foundry in the late 1980s, replacing an older oil-fired model.

When the patterns and cores were ready, they were sent to the moulding floor where the moulds were fabricated. Moulds were made from flasks, a cast iron or steel box in two halves, each with no top or base. The pattern was placed into one half of the flask and wet sand mixed with coal dust or manure (later mixed with resin and acid) was packed around it. This half was then turned over and the other half of the flask placed on top and then the pattern packed with sand on its other side. The pattern was then removed and the mould was ready for pouring. If the casting required a core, then this was held in position in the centre of the mould by supporting arms called 'chaplets'. Once completed, the moulds at Rayne Foundry were moved to the casting floor to await the molten iron.

Rayne Foundry's Roper cupola furnace was moved twice in its history, spending 30 years in its final location. The cupola furnace was a coke-fired furnace charged by an external automatic feed system from a raised platform. A ratio of pig iron to scrap was used, depending on the nature of the casting. Limestone was added to the mix to purify the metal. Air was fed into the furnace from an electrically powered fan. It averaged 2-3 tonnes of coke for a day's firing, usually being fired up at 11 am for a 2 pm pour. The 20m-tall chimney was shrouded in a water jacket to remove fumes and grit.

When the iron was molten and the impurities drawn off, the liquid metal was poured into ladles suspended on hoists. These hoists were moved around the overhead monorail metal-handling system to the casting floor and the waiting moulds by chains pulled by the foundrymen. The ladles could rotate 360 degrees as well as being raised or lowered with the hoists; this allowed the four overhead rails to distribute to twice that number of casting rails. As the molten iron was poured into the moulds, the heat ignited particles of coal dust or manure in the sand, causing

gases which formed a barrier between the sand and the surface of the casting. Once cool, the moulds were broken away from the castings along with any sand cores present. Old moulding sand was recycled for future use by adding it to fresh moulding sand. However, the cores were too solid to be re-used cost-effectively.

Once free of the moulds, the rough castings required finishing. Before a casting was considered finished, excess metal, called 'sprue' and 'moulding flash', had to be removed. Sprues were the passages through which the liquid iron was introduced into the mould. As the mould cooled, this excess material, also referred to as sprue, solidified. Moulding flash was caused by leakage of the liquid iron between the two surfaces of the mould. The removal of sprue and moulding flash was done either by hand in the grinding shed (Building 5), by the process known as fettling, or, for larger castings, in the Pangborn shot blaster. This used WD-30 steel shot to abrade the rough castings. When finished, the castings were generally painted or dipped to prevent rusting, usually with red oxide, although finishes were occasionally carried out in black or battleship grey.

Patterns were not discarded after use, as they were expensive and labour-intensive to make. Instead they were stored for future use.

6 Essex foundries: a historical introduction

by Andrew Phillips
(with technical assistance from Stanley Page and Alex Walford)

Cheap iron (and later steel) was central to what we term, with some oversimplification, the 'Industrial Revolution'. The smelting of iron was famously transformed by Abraham Darby's replacement, notably after 1770, of charcoal by coke (Hyde 1973). By 1790, the blast furnaces of the North and Midlands were able to produce cast iron – pig iron – in sufficient quantities to reduce the unit cost, enabling smaller foundries to cast it into simple items, often in batch numbers, for domestic, industrial and agricultural use: fire grates, machine gears, plough shares.

The growth of small foundries was greatly enhanced by the development of the cupola, a tall, circular furnace where pig iron, coke and limestone (to act as a flux) were fed through an external elevated platform and melted by a blast which usually lasted half a day. The molten iron was then tapped into moulding boxes. These metal, box-like moulds were packed with a fine damp sand (called 'green sand'), which contained a cocktail of additives (including a quantity of horse manure!), and the hollow which the iron was to fill was created by placing a wooden pattern, the shape of the finished product, into each side of the moulding box in turn. Often the pattern itself was in two parts. The sand was packed round the pattern (each half in turn) which was then carefully removed, creating the void which the molten iron was to fill. Heavy items, because of the risk that they would distort the shape in the green sand, were packed round with 'dry' sand which contained an element of clay. Exceptionally large items, too big for any mould box, might be cast into the sand which, many inches deep, covered the floor of the foundry.

Hollow castings required cores which were created by packing an oil-bonded sand inside a 'reverse mould' (often also in two parts). This is then baked in a special oven. The hardened sand core is then located in the mould using 'prints' left by the pattern's imprint, in order to effect a correct alignment. In the late 20th century, an infusion of CO^2 gas replaced this traditional baking. Because metal contracts on cooling, a pattern (and any core) had to be made slightly larger in all its dimensions than the finished product. Pattern-makers worked with specially calibrated rulers whose measurements were proportionately enlarged.

This is, of course, a simplification of what was involved, but highlights the fact that a foundry required firstly the capital to install the cupola and the other specialist equipment, and secondly the skilled workers capable of operating it: making patterns, casting iron and crafting the finished product which usually came from the casting process in a very rough state. Nevertheless, the cupola system, with inevitable improvements over time, proved remarkably long-lived, and still remains at the heart of some foundry operations. Rayne Foundry, for example, was still operating this system when it closed. Indeed, the very specialist nature of foundries

meant that, as Rayne Foundry demonstrates, they tended to have very long lives. The passing of a family dynasty, the bankruptcy of the current incumbent, were only opportunities for ambitious outsiders, quite unable to launch a new foundry, to get themselves a foundry of their own.

We have little clear evidence of the source of raw materials for Essex foundries at this date. Limestone and foundry sand could have come from several sources, but, being a bulk product, a foundry with port or river access would benefit. Coke was generated by gasworks, but, increasingly, specialist foundry coke was imported from the North or South Wales, where its production was often practised by coal merchants. Later railways transformed the scene, though foundries in a position to play the river off against the railway (as at Colchester) were in the strongest position.

Essex 1790-1850: formative years

Given the specialist nature of foundries, it is not surprising that a predominantly agricultural county, as Essex was in 1800, should, for the next 50 years, acquire most of its growing range of cheap iron products via ironmongers, the retailers, rather than ironfounders, the manufacturers (Phillips 1982). By 1820 there were only about seven active foundries in Essex; by 1850 about 25. By this date, advances in the efficiency of the stationary steam engine, the development of specialist engineering machinery and further steep reductions in the cost of pig iron, notably by the transport efficiencies achieved by railways, meant that many establishments still calling themselves 'foundries' were, in practice, general engineering works whose foundry was but one department. Nevertheless a foundry with a workforce of 50 was large.

The first Essex foundry was opened behind Colchester High Street in 1792. Appropriately it was 1926 before it closed, and even then it had a twilight after-life as a car-repair business. The other significant factor is that it was founded by an established ironmonger, Richard Wallis. This is a pattern that was to repeat itself. An ironmonger knew the metal trades, might have the capital to finance a foundry and recruited his specialist staff from an existing foundry, often over quite large distances (Phillips 1982). Wallis's foundry remained unique in Essex for 15 years. This was a long time, particularly when, over 1807-9, foundries were established at Colchester (its second), Chelmsford, Hornchurch, Goldhanger\Maldon and Greenstead Green, all but the last in predictable urban locations. It has been suggested that this reflects a particular economic threshold, possibly the increased availability of scrap iron, which was far cheaper to acquire than the pig iron which mostly arrived by sea (Phillips 1982). Seven years passed before the establishment of a foundry at Coggeshall and, in 1817, a second one at Chelmsford. Thereafter, in our present state of knowledge, there were three established in Essex in the 1820s, nine (including that at Rayne) in the 1830s and five in the 1840s (Booker 1974).

All these foundries began in quite a small way and made their 'bread and butter' in jobbing engineering, casting a wide range of items invariably to meet many customers' requirements. In consequence, almost all were *de facto* general engineering works as well. Nevertheless, from an early date all but the least ambitious sought to reach a wider, even a national market, with a specialist product. So, as early as the 1840s, Wedlake's at Hornchurch and Richard Coleman at Colchester (later Chelmsford) sold and marketed their own agricultural equipment nationally, exhibiting and winning prizes at the annual Royal Agricultural Show. Others pursued this policy by marketing implements developed, even patented, by others. In 1860 Rayne Foundry, always a modest operation, was advertising Goss and Peene's root grater, hardly an item of high technology (*Essex County Standard* 14.11.1860). But it would be misleading to claim, as some have, that agricultural equipment was the sole market for Essex foundries, even though it was important, and even though firms like Bentall's of Heybridge rapidly gained a national reputation for its specialist ploughs. Examination of surviving records of this and other firms shows from an early date an equal business in domestic and structural ironwork (Phillips 1982). The survival today of street furniture carrying the foundries' names is vivid proof of this. Rayne Foundry was still making it when they closed in 2001.

Essex 1850-1960: the foundry century

The century covered by this section could be dubbed the golden age of British

engineering. From 1850 to 1914 the steam engine, advancing its technology at a spectacular rate, was king. Thereafter the emphasis moved to the use of electricity and the internal combustion engine. The development of an extensive railway network in the mid-Victorian period transformed the possibility of the mass marketing of goods. Equally important to export-led Britain was an international network of shipping lines, dominated by British companies. This in turn sustained the captive market of the British Empire as 20th-century protectionism replaced Victorian free trade. All this and the economies of scale led to the development of giant engineering firms, notably manufacturers of steam engines, with workforces measured in thousands and agencies throughout the world. It was their boast (not always justified) that everything manufactured by their company was produced in-house. This required in particular a foundry, a pattern shop and a machine shop to fashion the relatively crude products of the foundry to tolerances of a thousandth of an inch. No longer called foundries, these companies were called initially ironworks, later engineering works. And steel, as much as iron, became the medium of construction.

In non-metropolitan Essex, examples of these new companies could be found in Bentall's (workforce 700 by 1914), Hunts of Earls Colne (350), and Crompton's, a pioneer British electrical company (400). The situation in Colchester, the county's largest established town, was particularly interesting. Here Davey, Paxman & Co. (founded 1865, workforce 950 in 1914 and 2,500 in 1960) specialised in high-tech boilers, refrigeration machinery and large stationary steam engines, later diesels; Mumford's (400) in pumps, marine engines and boilers; the Britannia Engineering Company (250) designed and manufactured machine tools, while the High Street foundry, the oldest of all, still jobbed along with its workforce of 50. The significance of this was that none of these Colchester firms competed with one another; indeed, there is good evidence of co-operative market sharing.

Amidst all this change (and 110 years is a long time), surprisingly little changed in the operation of foundries. Perhaps the only universal, apparent change was to drive their blast by electric fans rather than by a steam engine. Including these large companies, Essex still had about 29 foundries in 1900, contracting to about 12 by 1960, and some of these were no longer using cupolas or smelting iron. By the 20th century, specialisation took many forms – Cottis at Epping made lawn mowers, Warner's at Walton-on-the-Naze pumps; Mildmay Ironworks at Burnam-on-Crouch made gramophone turntables; Lake & Elliot at Braintree accessories for cars - but cast iron foundry technology remained much the same (Booker 1974). Thus, for example, Paxman's, which made the very latest high-speed diesel engines, might, during a busy period, subcontract some of their castings to the foundry at Rayne.

An important change in Essex came with the opening in 1931 of Ford's massive works at Dagenham on the Thames, the largest vehicle-manufacturing plant in Britain. This included in its giant complex an authentic iron ore reducing blast furnace, the only one in Essex, working, as was normal, round the clock until maintenance was required. Adjacent were coke furnaces, whose by-product coal gas lit stoves to provide the furnaces with hot blast. In consequence they were able to supply the Essex foundries with both pig iron and foundry coke. Towards the end of this period, oil-fired crucibles for aluminium casting were opened at Witham and Rayne and, in a small way, at Paxman's in Colchester. The latter was a small crucible furnace, but for all critical aluminium castings Paxman's bought in from a large Birmingham company.

Essex 1960-2000: the end of cupola furnaces

These specialist aluminium facilities foreshadow the increasingly sophisticated needs of those engineering businesses surviving the last four decades of the century, which increasingly saw severe contractions in manufacturing industry. As globalisation took its toll, workforces were downsized and firms closed: Bentall's, Maldon Iron Works, Portway's at Halstead and Hunts at Earls Colne. Moreover, technology was finally overtaking cupola furnaces which had always confined themselves to cast iron and, despite some refinements to their capabilities, could not achieve the precise quality of iron that modern engines required. It was a seminal Essex moment when the still mighty firm of Paxman's closed their foundry in 1979,

essentially because it could not produce the spheroidal graphite iron its latest engines required. In retrospect, it was remarkable that it had survived so long. Even Hunt's, before their closure, had installed an electric-induction furnace. Lake & Elliott at Braintree installed reverbatory furnaces to produce the only Essex steel, later converting to an electric arc furnace. Noke's at Halstead built a modern oil-fired crucible furnace for casting aluminium. And that was about it, leaving the 160-year-old Rayne Foundry as a last lone cupola survivor.

A working cupola foundry

The day began at 6 am when labourers knocked any castings remaining from the previous day from their mould or core boxes, brushed off the sand, and sent them to the fettling shop where they were shot-blasted to remove any baked sand and surplus metal before going to the machine shop for machining. The sand from the moulds is put through an aerator and recycled. Meanwhile the moulders can begin preparing their moulds, the patterns required to be cast having all been set out in rows the day before. A special team repairs the cupola after the previous day's work. After yesterday's melt, trap doors at its base had been opened so that the slag and coke cinders could fall to the ground. Now cool, these are removed. This gives access to the inside of the cupola where the linings of the interior walls are patched up with ganister, a heat-resistant brick and clay compound, since the fierce heat of the blast can burn off not only yesterday's ganister but affect the fire bricks behind them too. Eventually the cupola will have to be closed down and the fire bricks replaced. For this reason, larger foundries had a second, back-up cupola. Finally the mouth of the furnace, where the molten iron is to flow down a gully, is also repaired with ganister and a clay 'bot plug' is inserted by a rod to block off the exit. A fire is now lit in the cupola from wood refuse and, when well alight, coke is dropped onto it from the charging platform near the top exterior of the cupola. Latterly this would be lowered via a special drop-bottom bucket followed by the pig iron and limestone. Special grades of pig iron were ordered according to the type of iron required for the current castings. To this a measured quantity of scrap iron was added. This too had to be of the required specification, so it mainly consisted of rejected items made in-house and iron from the automotive industry which was known to be of equivalent quality. Occasionally in-house scrap steel was added to enhance the quality of the iron.

Despite these precautions, there was no real way of knowing the precise make-up of the iron from any melt, a severe limitation of the cupola system as standards became more critical. When the melt was complete, a small sample was often tapped off, cooled and snapped in half, the colour of the cross-section being a good guide to quality. It might also be sent to the in-house laboratory (if there was one) to test, but by then it was too late to change that day's melt or castings. The blast was provided by an electric-driven fan feeding air through the tuyeres, pipes leading down to the furnace. The blast would last from mid morning to mid afternoon, by which time the metal was molten. Occasionally small quantities of nickel might be added as shot. An iron rod would be used to carefully puncture the 'bot plug' and molten iron was tapped into a large ladle. Toxic gases would accompany this process. As metal was needed in controlled amounts, a fresh plug might be re-inserted and removed several times (a hot task). The ladle was carried by overhead crane, tilted by a geared wheel and from its lip fed via a 'cup' into each mould. Smaller moulds were lined up on a roller conveyor belt, ie the moulds were rolled along it; the conveyor belt did not move. With larger moulds, a continuous flow of metal was vital, as was the need to prevent a void developing in it. This was done by a 'feeder' inserted above the heaviest part of the casting as it contracted.

Casting would continue for the rest of the day, the number depending on the size of the majority of castings planned for that day. There could be hundreds. A better measure is that ten tons of molten metal was a standard day's output. Should any hot metal remain, it was fed into the foundry floor as pigs and re-used on subsequent days. The trap doors at the base of the furnace were now released, causing the cinders and flux to fall. It can then be gently hosed down. Despite the hazards – perhaps because of them – serious accidents were rare; long-term respiratory problems were more common. A large foundry and fettling shop, like that at Paxman's, employed over 100 people.

7 Acknowledgements

The Colchester Archaeological Trust would like to thank Knight Developments for commissioning and funding the work.

CAT would also like to thank the members of the study group, Messrs Richard Carr, Jim Gepps, Stanley Paige and Andrew Phillips for their insight and advice into the foundry process.

The project was managed by C Lister and the survey work was carried out by C Lister and A Wightman.

8 References

Booker, J	1974	*Essex and the Industrial Revolution*, ERO, 1-23
Essex County Standard		14.11.1860
Garwood, A	1998	*Iron foundries in Essex*, Essex County Council report
Hyde, C K	1973	'The adoption of coke smelting by the British iron industry 1709-1790', in *Explorations in Economic History*, **10**
O'Connor, T	2008	'Brief for the recording of Rayne Foundry, The Street, Rayne, Braintree, Essex', Essex County Council brief
Phillips, A	1982	'Early Colchester foundries', in *Essex Archaeology and History*, **14**, 102-110

9 Abbreviations and glossary

CAT	Colchester Archaeological Trust
ERO	Essex Record Office
HEM	Historic Environment Management team
NGR	National Grid Reference
RSJ	rolled steel joist

10 Archive deposition

The paper and digital archive is currently held by the Colchester Archaeological Tust at 12 Lexden Road, Colchester, Essex CO3 3NF, but it will be permanently deposited with Braintree Museum (accession code not yet allocated).

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171 Building 5: grinding shed entrance, view east.
172 Buildings 5 and 17: exterior, view east.
173 Building 5: red oxide dipping shed, view north.
174 Building 5: red oxide dipping shed, view north.
175 Building 5: red oxide dipping tank, view north.
176 Building 5: grinding shed interior, view east.
177 Building 5: grinding shed, dust collector, view north-west.
178 Building 5: grinding shed, fettling benches, view north-east.
179 Building 5: foundry maintenance room at east end of grinding shed, view north-east.
180 Building 5: foundry maintenance room at east end of grinding shed, view north-east.
181 Building 5: foundry maintenance room at east end of grinding shed, view north-west.
182 Building 6: pattern store, view south-west.
183 Building 6: pattern store entrance, view west.
184 Building 6: pattern store, view west.
185 Building 6: pattern store interior, view south-west.
186 Building 7: foundry manager's house with Buildings 1 and 5 to the left and right, respectively, view west.
187 Building 7: foundry manager's house, view west.
188 Building 7: foundry manager's house, view west.
189 Building 7: foundry manager's house, view north-east.
190 Building 7: foundry manager's house with Building 1 and cupola furnace chimney in background, view east.
191 Building 7: foundry manager's house, view north-east.
192 Building 7: foundry manager's house, detail of fireplace, view south-east.
193 Building 8: entrance, view north-west.
194 Building 8: exterior, view east.
195 Building 9: entrance, view south-west.
196 Building 9: entrance, view south-east.
197 Building 9: interior, view south-west.
198 Building 10: exterior, view north.
199 Buildings 11 and 10: exterior, view south-east.
200 Building 10: exterior with washroom to the right, view north-east.
201 Building 10: exterior of washroom, view north-east.
202 Building 10: exterior of washroom, view north-east.
203 Building 10: exterior of washroom, view north-west.
204 Building 10: exterior of overgrown gas cylinder store, view north-west.
205 Building 10: ‘COLOSPERS’ sign, view north.
206 Building 10: female washroom, view south-east.
207 Building 10: interior of washroom, view north-east.
208 Building 10: female washroom, view east.
209 Building 10: female washroom, sanitary incinerator, view north.
210 Building 10: male washroom with drinking fountain, view south-west.
211 Building 10: male washroom urinal, view south-east.
212 Building 10: male washroom basin, view east.
213 Building 10: male washroom toilet, view south-east.
214 Building 10: male washroom, detail of drinking fountain, view south-west.
215 Buildings 10 and 11: office, view west.
216 Buildings 10 and 11, view north-east.
217 Buildings 10 and 11: interior, view south-west.
218 Buildings 10 and 11: interior, view south-west.
219 Building 11: exterior, view north-east.
220 Building 12: exterior, view south-east.

221 Building 12: exterior, view east.
222 Building 12: interior, view east.
223 Building 13: exterior, view north-east.
224 Building 13: interior, view east.
225 Building 13: interior, view west.
226 Building 14: exterior shot, view south-east.
227 Building 14: sign, 'CPS Marketing Ltd', view north-east.
228 Building 14: exterior, view north.
229 Building 14: interior, view east.
230 Building 14: interior, view east.
231 Building 14: interior, view west.
232 Building 14: south wall with bricked-in window, view south-east.
233 Buildings 14-10: exterior, view south-east.
234 Buildings 12-14: exterior, view north-west.
235 Building 15: boiler room, view north-west.
236 Building 15: boiler room, view north-west.
237 Building 15: boiler room, view north-west.
238 Building 16: Nissen hut, view north.
239 Building 16: Nissen hut, view north-west.
240 Building 16: Nissen hut interior, view north-east.
241 Building 16: Nissen hut interior, view south-west.
242 Building 16: Nissen hut interior, view north-west.
243 Building 17: hydraulic hose store with oil tank above, view north-west
244 Building 18: exterior, view north.
245 Discarded suspended ladle.
246 Discarded suspended ladle.
247 Discarded suspended ladle.
248 Pattern.
249 Pattern.
250 Top of cupola chimney stack, as seen from the road, view north-east.
251 General shot of the main foundry complex, view north-east.
252 General shot of the main foundry complex, view south-east.
253 Consultees (from l-r) Mr Jim Gepps, Mr Richard Carr, Mr Stanley Page.

Appendix 3: index of black and white photographs (2 packets)

Note: each photograph has an index number printed on the reverse side.

Packet 1

1003 Buildings 14-10: exterior, view south-east.
1004 Building 16: Nissen hut exterior, view north-west.
1005 Building 5: grinding shed exterior, view north-east.
1006 Building 5: red oxide dipping shed, view north.
1007 Building 5: grinding shed interior, view north-west.
1008 Building 1: cupola furnace chimney, view west.
1009 Building 1: cupola furnace chimney, view west.
1010 Building 1: charge door of cupola furnace, view west.
1011 Building 6: pattern store entrance, view west.
1012 Building 3: external chemical store with Building 1 in the background, view south-east.
1013 Building 3: external chemical store with Building 1 in the background, view south-east.
1014 Building 7: foundry manager's house, view west.
1015 Building 1: Pangborn shot blaster, view north-west.
1016 Building 1: Pangborn shot blaster, interior, view north-west.
1017 Building 1: Roper cupola furnace, view south-east.
1018 Building 1: Roper cupola furnace, view north-east.
1019 Building 1: south end of main foundry, view south.
1020 Building 1: detail of Roper Mark 11 ladle hoist, view south-east.
1021 Building 1: core shed, view north-east.

1022 Building 1: moulding floor, view south-west.
1023 Building 1: moulding floor, view south-west.
1024 Building 1: aluminium foundry, view south-west.
1025 Building 1: overhead monorail metal-handling system, view north-east.
1026 Building 1: casting floor, view north.
1027 Building 1: casting floor, view north.
1028 Building 2: pattern shop interior, view south.
1029 Building 2: pattern shop interior, view south-west.
1030 Building 1: foundry frontage showing main foundry and offices, view north-west.
1031 Building 1: foundry frontage, view north-west.
1032 Building 1: foundry frontage showing main offices, view north-east.
1033 Building 1: water shroud covering cupola chimney, view north-east.
1034 Building 1: water shroud covering cupola chimney, view north-east.
1035 Building 1: cupola furnace chimney, view south-west.
1036 Building 1: automatic lift to charge door of cupola furnace, view south-west.
1037 Building 1: automatic lift to charge door of cupola furnace, view south-west.
1038 Building 1: automatic lift to charge door of cupola furnace, view south-west.
1039 Buildings 1 and 5 with Building 7 in the background, view west.

Packet 2
1040 Building 1: cupola furnace chimney, view south-west.
1041 Discarded suspended ladle.
1042 Building 1: core shed, view north-east.
1043 Building 1: core oven, view east.
1044 Building 1: red sand mixing machine, view south-west.
1045 Building 1: moulding floor sand hopper, view south-west.
1046 Building 1: aluminium foundry, view east.
1047 Building 1: ladle hoists, view north-east.
1048 Building 1: casting floor rails, view north.
1049 Building 1: overhead monorail metal-handling system, view north-east.
1050 Building 1: furnace area, view north-east.
1051 Building 1: Roper furnace, view east.
1052 Building 1: Roper furnace, view east.
1053 Building 1: Roper furnace, view south-east.
1054 Building 1: Pangborn shot blaster, view north-west.
1055 Building 1: Pangborn shot blaster, interior, view north-west.
1056 Building 2: pattern shed, view south.
1057 Buildings 6 and 7: exterior, view west.
1058 Building 5: grinding shed interior showing dust extractor, view north-west.
1059 Buildings 10-14: exterior, view north-east.
1060 Building 9: exterior, view south-west.
1061 Building 16: Nissen hut exterior, view north-west.
1062 Buildings 1 and 3: exterior, view south-east.
1063 Building 3: external chemical store, view south-east.
1064 General shot of the main foundry complex, view south-east.
1065 General shot of the main foundry complex, view north-east.
1066 Building 1: foundry frontage showing main offices, view north-east.
1067 Cupola chimney, view north-west.
1068 Building 1: foundry frontage, view north-west.
1069 General shot of main foundry complex, view north-east.
1070 Building 1: sand hoppers, view east.
1071 Building 1: sand hoppers from below.
1072 Building 1: cores in mould ready for casting.
1073 Building 1: cores in mould ready for casting.
1074 Building 1: ornamental railings pattern, pattern loft.
1075 Building 1: 'WH Smith' pattern, pattern loft.
1076 Survey team in front of main foundry, view south-east.

Fig 1 Site location.

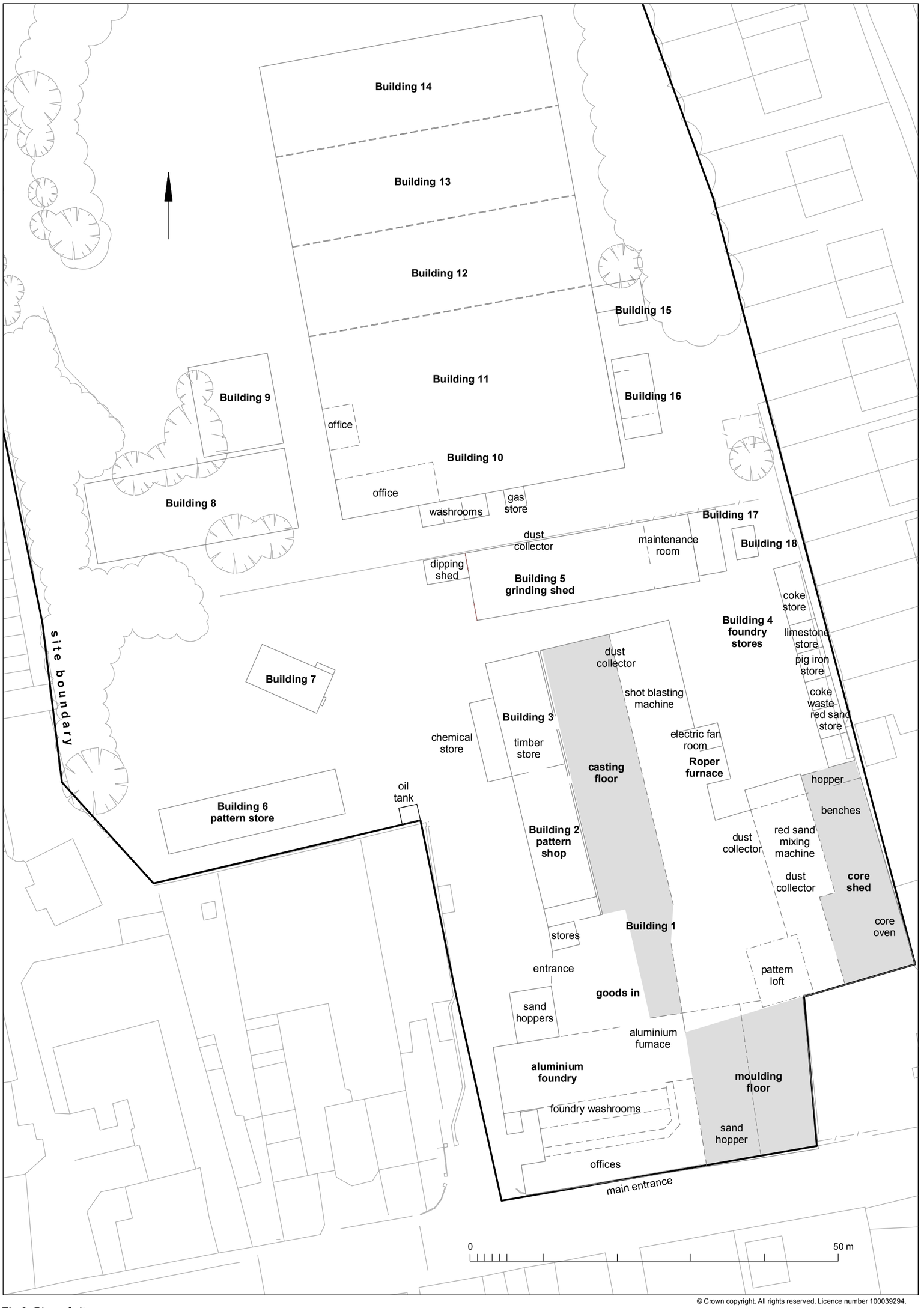

Fig 2 Plan of site.

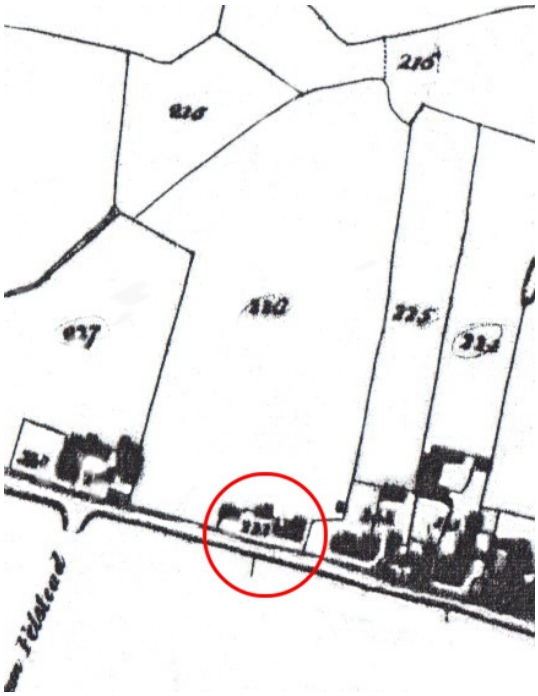

Fig 3 Plan of Rayne Foundry as shown on the tithe map of 1838 (ERO D/CT 286).

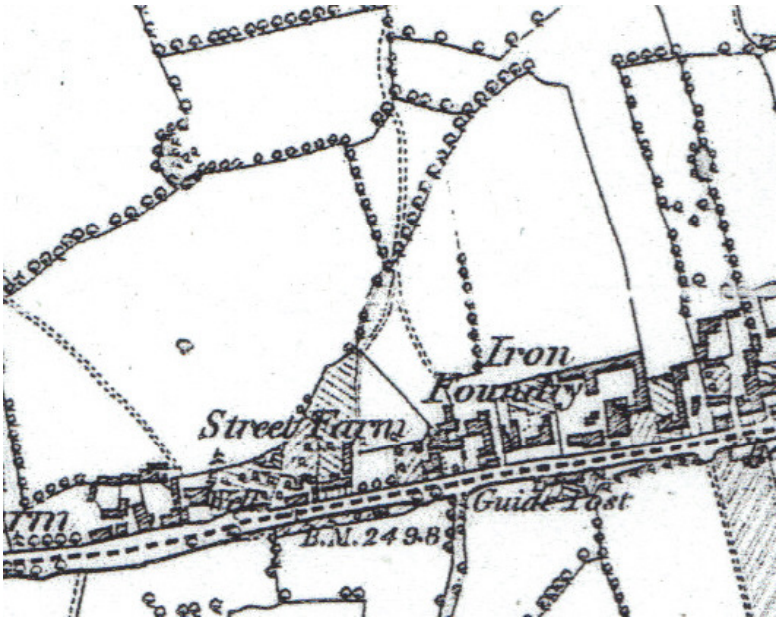

Fig 4 Plan of Rayne Foundry as shown on the first edition Ordnance Survey map of 1881.

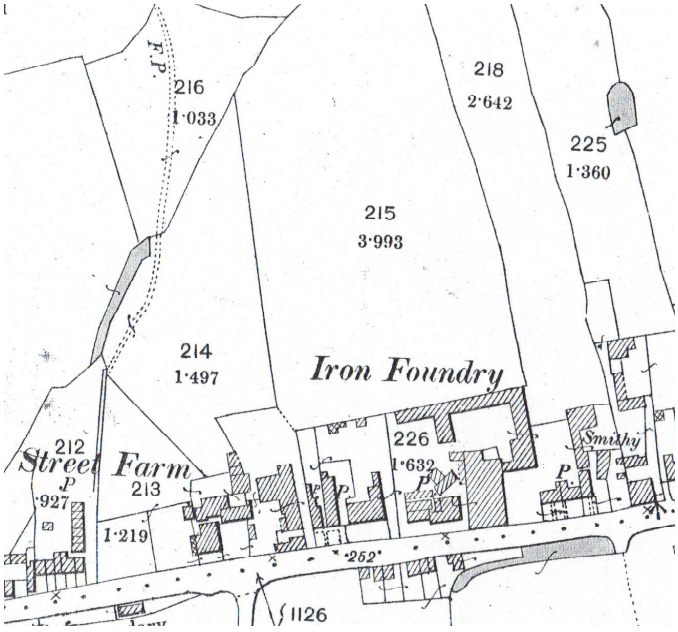

Fig 5 Plan of Rayne Foundry as shown on the second edition Ordnance Survey map of 1895.

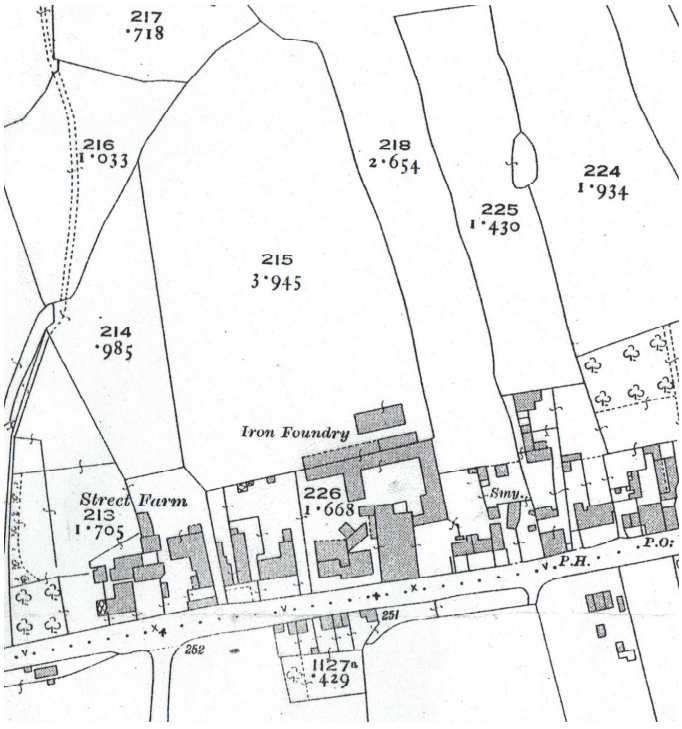

Fig 6 Plan of Rayne Foundry as shown on the third edition Ordnance Survey map of 1921.

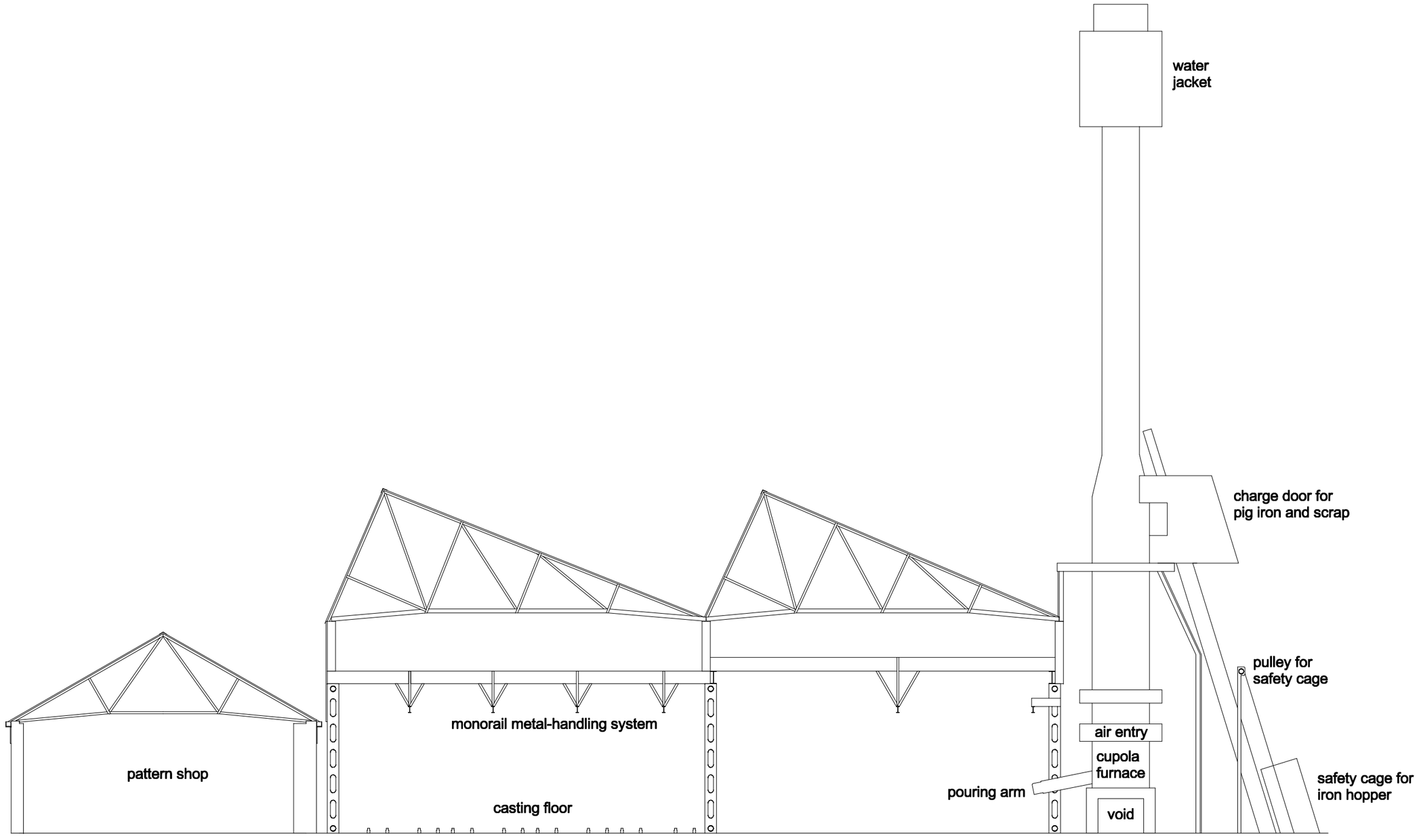

Fig 7 Cross-section of Rayne Foundry.

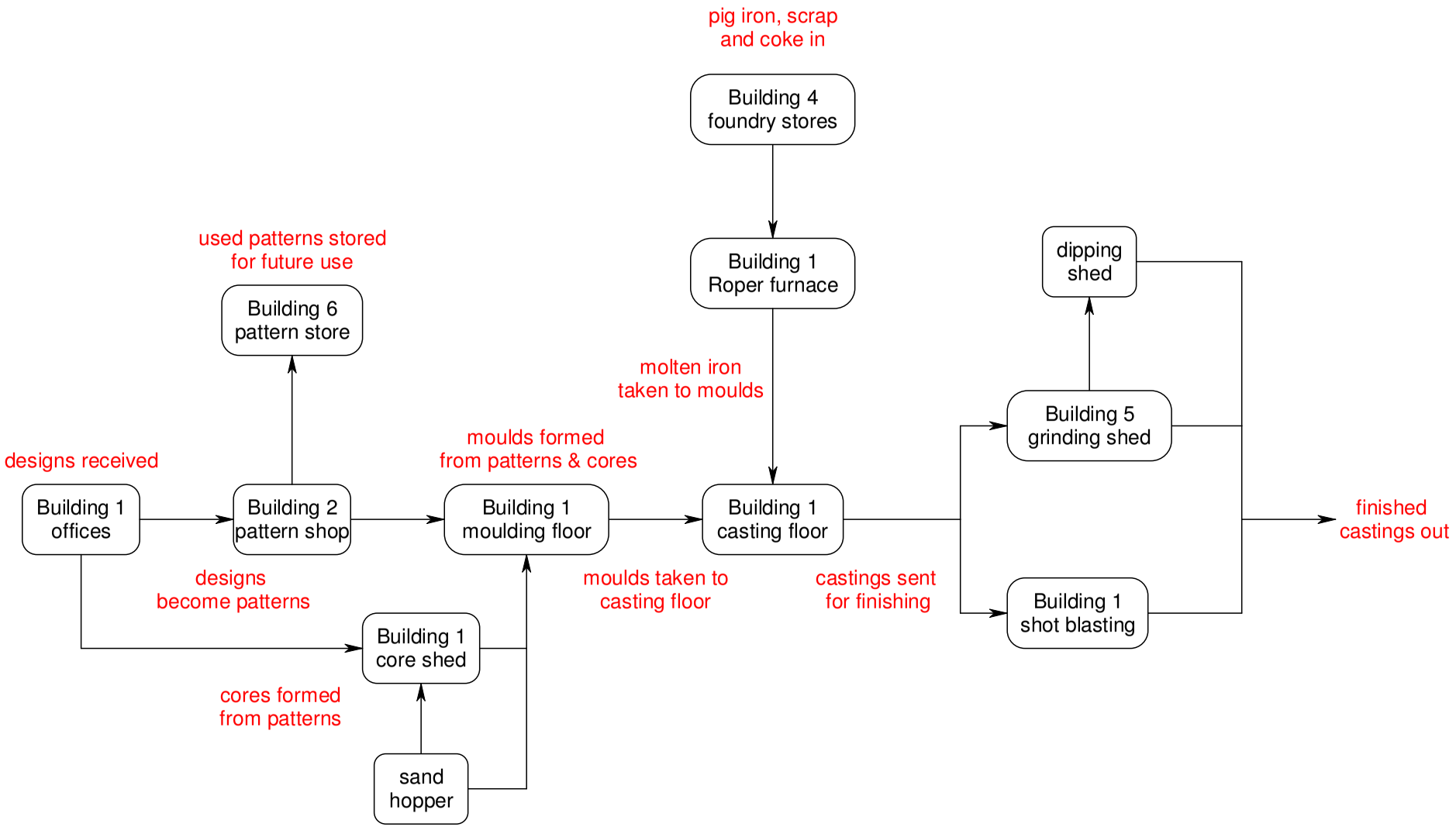

Fig 8 Flow diagram showing the iron foundry process.

Essex Historic Environment Record/
Essex Archaeology and History

Summary sheet

Site address: Rayne Foundry, The Street, Rayne, Braintree, Essex	
Parish: Rayne	***District:*** Braintree
NGR: TL 7272 2265 (centre)	***Site code:*** RARF 08
Type of work: Photographic survey	***Site director/group:*** Colchester Archaeological Trust
Date of work: May 2008	***Size of area investigated:*** 1.7ha
Location of finds/curating museum: Braintree Museum	***Funding source:*** Developer
Further seasons anticipated? No	***Related EHER nos:*** 15301
Final report: CAT Report 475 and summary in *EAH*	
Periods represented: 19th- and 20th-century industrial structures	
Summary of fieldwork results: *This report provides a written and photographic record of a complex of former foundry buildings at Rayne Foundry, The Street, Rayne, Braintree, Essex. It is intended to fulfil a condition of planning permission for demolition and domestic conversion and has been prepared to a brief designed by the Historic Environment Management (HEM) team of Essex County Council (O'Connor 2008) and an associated Written Scheme of Investigation (by CAT). The written report is accompanied by a CD containing a full photographic record of digital images (index, Appendix 2), but also includes 26 printed photographs of key features (Appendix 1). A further 74 black and white photographs in two packets are in the site archive (index, Appendix 3). Each image is separately described in the written report. The buildings were surveyed during May 2008 when the accompanying photographs were taken. Each of the eighteen buildings within the scheme is identified by a unique number (1-18) as shown on the block plan of the site (Fig 2) and is described in section 4. An account of the iron-casting process, specific to Rayne Foundry, is also included. This account is based primarily on conversations with and insights provided by Mr Jim Gepps, a former employee who worked at Rayne Foundry for 42 years as a purchasing officer, and Messrs Richard Carr and Stanley Paige, formerly of Paxman's of Colchester, during discussions at Rayne Foundry in May 2008. The audio recording of these conversations is included on the accompanying CD. Further information concerning the iron-casting process was derived from* Iron foundries in Essex *(Garwood 1998). A historical account of foundries in Essex by Andrew Phillips is also included.*	
Previous summaries/reports: None	
Keywords: foundry, iron, casting	***Significance:*** **
Author of summary: Chris Lister	***Date of summary:*** August 2008