The Archaeology of 20th Century Factory Management: Four Factories on the Team Valley Trading Estate

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Abstract

This paper seeks to determine whether changes in factory management during the mid-20th century can be archaeologically recognised.[ii] The 20th century witnessed significant changes in management practice which are understood historically. In order to examine the archaeological record of these changes archaeological and historical research was carried out on four factories on the Team Valley Trading Estate (TVTE) built between 1938 and 1939. It was possible to detect elements of planning for efficiency of movement and process both in the offices and the factory floor. Similarly, division of labour between workers of different status and gender were also evident. Such differences in status were not only part of practical organisation but were marked symbolically. In addition, it was possible to show that though aesthetic considerations were important in factory design during the period 1930-1970; they became less significant subsequently as factories themselves ceased to be marketing tools.

Introduction

The 20th century, especially the period after the First World War, witnessed important changes in business management in the United Kingdom. Many businesses adopted practices developed by government departments during the war while international competition increased. To some extent manufacturing led the way in management innovation from the inter-war period to the 1960s.[1] This was especially true of the newer industries such as mass-produced clothing, chemicals and consumer goods.[2] The mid-20th century saw the transition from traditional business structures controlled by owner-managers in which decisions were made on the basis of experience and rule of thumb towards a version of Scientific Management, which had been developed in the US during the late-19th and early 20th centuries.[3] Fundamentally, Scientific Management is an attempt to optimise processes for efficiency to increase productivity. In theory increased productivity allows higher wages.[4] In practice this resulted in control of production processes being moved from skilled workers on the shop floor to process engineers in offices.[5] Consequently, management became more professionalised, the proportion administrative staff in businesses increased and a distinct group of knowledge workers developed.[6] There are some parallels between this process and that by which capitalists took greater control of production during the origin of the factory itself from the eighteenth-nineteenth century. It has been shown that the structures of early factories were used to enforce this control.[7] As will be shown below, there are similarities between the methods used in the earlier and later periods but also important differences.

British industrialists were sceptical of some of the ideological elements of Scientific Management but did adopt much of it pragmatically.[8] This scepticism may have led to an early interest in 'human relations' theory which critiqued the Scientific Management principle that workers were solely motivated by wages and shifted emphasis towards such factors as fatigue and satisfaction, and away from a purely mechanical conception of tasks.[9] Human relations and Scientific Management are not however exclusive of one another. Human relations utilised key Scientific Management techniques like time and motion study,[10] and solidified managerial control of production processes against calls

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[ii] The structures examined here provide evidence for the period from the late 1930s to approximately the 1990s.

by workers for more democratic decision making.[11] In addition welfare capitalism was still common though in decline during the interwar period.[12]

Concurrently, consumer goods became economically important and novel methods for marketing them were developed. This led to the growth of trading estates throughout the country; especially in the south.[13] Typically this production took place in factories comprising a two-storey office block façade in front of a single-storey factory.[14]

The Team Valley Case Study

This paper examines the archaeological record of these changes via four factories on the TVTE, Gateshead, England (Fig. 1). The TVTE was a government response to the Great Depression under the Special Areas Act (1934). The Commissioner for Special Areas of England and Wales (CSAEW) persuaded Col. K.C. Appleyard and other north-eastern industrialists to form a company to develop a trading estate in the North-East Special Area financed by loans from CSAEW.[15] The company, North-Eastern Trading Estates (NETE), was formed and a site selected in 1936. By 1937 factories were opening.[16]

The main purpose of the TVTE was to end the regional economic dependence on heavy industries which were susceptible to cyclical downturns. This dependence caused the Great Depression to have a severe and prolonged effect in north-east England and other industrial regions.[17] The scheme was inspired by private trading estates such as Slough near London.[18] The success of TVTE led to two further estates: one sponsored by CASEW at Treforest, South Wales and another by the Commissioner for Special Areas of Scotland at Hillingdon, Glasgow.[19]

NETE employed Prof W.G. Holford as consulting architect. Holford was a Modernist and later became involved in town planning. He developed an idealistic social and aesthetic vision for TVTE. Holford was responsible for planning the layout of the estate, details like lighting standards, regulation such as the approval of signage and brick colours, and standard factory types upon which local architects based particular factories.[20]

Since TVTE was built *de novo*, and was self-consciously progressive, its factories should reflect contemporary trends in management and organisation. On the other hand, the fact that many factories were built speculatively rather than for a particular firm means that a greater level of flexibility was required than usual in the 1930s.

Methods and the Factories

The work presented here is based on historical and archaeological study of four factories at TVTE. The factories represent the three types of 'standard' factory (i.e. those built without a particular tenant in mind) and one 'bespoke' factory designed to the specification of an incoming tenant. The factories will be referred to by the numbers given to them by NETE: I60, K51, L50 and L92.

K51 was a medium size (8000 square foot) standard factory built in 1938. It was first occupied by a clothing manufacturer called Tevaclo.[21] This firm was owned by German refugees who were interned at the start of the Second World War.[22] The factory was then sublet to John Barran and Sons,[23] who were clothing manufacturers from Leeds but with extensive facilities elsewhere at TVTE.[24] Barran's occupied the factory until the 1960s. In recent years it has passed through a number of occupiers and was empty when surveyed.

L50 was also a standard factory, but of the largest size (22,000 square foot). It was built in 1938 and was soon occupied by Sigmund Pumps who had other factories on the opposite side of Kingsway.[25]

In 1944 Miroslav Sigmund helped Czechoslovak refugees establish the Bren Manufacturing Company Limited in L50 who then occupied it through the remainder of the War.[26] After the War it had several different occupants until Alsco Cardboard Boxes moved into it in the early 1970s having expanded from L92 next door. Alsco purchased the unit from NETE. Their successor, Rosewood Packaging, still occupies the building.

L92 is next to L50, and was built specifically for Sigmund Pumps to expand into after receiving a contract for Air Raid Precautions equipment in 1939.[27] As the factory was needed urgently its plan was adapted from that of L50. Sigmund occupied the factory until it moved to new premises elsewhere on TVTE in 1949. Alsco Cardboard Boxes then moved in, and in the 1960s, purchased it from NETE.

I60 is quite different to the other three. It is the smallest type of standard factory (6000 square feet). It was designed to be divided into up to four 1500 square foot units. Some 6000 square foot factories were occupied by one tenant alone but most were divided. I60 was initially divided into four units which were let as 'nursery' factories. Nursery factories were intended to encourage new businesses to form or to allow existing businesses to test the north-east area. They were let at a rent of £1 per week, well below market prices, for periods of two years. It was hoped that after the two years a business would wish to expand by taking a larger factory at an economic rent.[28] Such schemes were not unique to the TVTE and were tried on other industrial estates.[29]

Historical research utilised the papers of NETE and the Gateshead County Borough building control plans.[30] All surviving building control plans of each factory were examined to date changes and to reveal aspects of the building which have been removed by later development. The records of NETE were used to determine when factories changed hands and the business of the occupants. This primarily depended on lists of leases sealed between board meetings.[31] In addition, a small archive of material relating to Sigmund Pumps was consulted.[32]

Surveys were made of all four buildings. A thorough photographic survey was made conforming to level three of the Historic England guidelines.[33] In two units, I60 and K51 measurements were taken using tape measures to allow the construction of scale plans of the factories. The current occupation of L50 and L92 prevented a full set of measurements being made, so copies of the building control plans were annotated to record differences between them and the extant building. Measurements of features not shown on the building control plans were taken using hand tapes and a Leica Disto Basic Electronic Distance Meter, again allowing the construction of scale plans.

Results

K51, L50 and L92 are similar to one another as they are all clerestory-lit aisled buildings with two-storey office blocks at the front. They are therefore very different from I60 which is entirely single-storey and not aisled. Because of these similarities K51, L50 and L92 will be considered together before I60 is discussed. All three of these factories reflect the organisation of processes and workers in the factory.

Factory floor

Our understanding of processes on the factory floor is limited significantly by the absence of original plant or indications of where it stood. In the absence of plant, the positions of sliding doors or roller-shutters provide the best evidence for process engineering. In K51 both doors were in the east side of the factory, one at the north end immediately behind the office block and one in the second bay from the south end (Fig. 2). This suggests that the architect imagined raw materials would enter at

one end of the factory, pass through a number of processes, and leave as finished goods through the opposite end. The arrangement at L50 is similar. One door, marked 'dispatch', is in the east end of the factory, and another slightly smaller one, marked 'goods entrance', is located in the south-west corner behind the office block (Fig. 3). In both cases, because K51 and L50 are standard factories, this must represent how the architect imagined industrialists would want to arrange their production processes. L92, which was built to Sigmund Pumps' specification, is a little different. The doors are still at opposite ends of the factory but there are three. One is at the north-west corner one in the north-east and the other in the south-west (Fig. 4). The eastern doors are near to a series of gullies probably used for testing pumps and so were probably for dispatch. The western door is opposite a sliding door in L50 which was occupied by Sigmund. It is likely that this means that pumps were partially made in L50 and then moved into L92 where they were completed, tested, and dispatched from the doors in the eastern end of L92.

The locations of sliding doors were often changed, presumably reflecting changes in processes. L50 is a particularly good example, with a sequence of alterations reflecting changing owners and processes. The first changes to the door locations were made when Bren took the factory in 1944. Building control plans show that the sliding door in the south-west was blocked and two large doors opened beside one another in the northern wall.[34] Reception and dispatch stores were made in the aisle behind these doors. This means that goods must have entered in the northern end, progressed through the factory before returning to where they started for dispatch. The blocking of the southern sliding door broke the link between factories L50 and L92 which were now used by different companies. A drawing of the Sigmund Pumps factories made during or shortly after the Second World War shows a fence between the western ends of L92 and L50 which would have made it impossible for Bren to use this door for dispatch.[35]

Some undocumented changes were made to the factory doors after 1944. Between the 1940s and 1970s a large breach, controlled by either a sliding door or roller-shutter, was made in the south wall. A pair of swing doors were created within the window next to this sliding door/roller-shutter (Fig. 5). The bricks used to make this door are similar in colour to those of the earliest fabric and similar to those used in 1944 so it is likely that this door was made closer to the 1940s than the 1970s. Both doors have ramps suggesting that trollies were being used for materials handling.

1972 building control plans show that one of the large 1944 doors was enlarged further and made into a sliding door and a new sliding door created where the 1944 works' entrance had been.[36] The new sliding door in the south elevation and the rear sliding door were blocked using a similar brick to those used in 1971 changes to the lavatories suggesting that these were blocked in the early 1970s. In both cases swing doors were inserted, one a fire exit and the other providing a route to L92. Another roller-shutter was made in the southern elevation directly opposite an L92 roller-shutter (Fig. 6). The combination of this pair of roller-shutters and the pedestrian route between the factories via the blocked sliding door is convenient for the use of forklift trucks and may have been created specifically for them (Fig. 6).

L92 saw fewer changes. The sliding door in the southern side was replaced with a window and a new one created at the rear. After 1949 the sliding door in the north-west corner was blocked and a new one made one bay to the east. This allowed the front end of the factory to be fenced off creating a barrier between the entrance and the area used by forklifts (Fig. 6). The sliding door in the north-east corner remains but is not currently used and was probably disused when the roller-shutters were installed between the 1970s and 1990s as it retains its sliding door (Fig. 6).

The sliding door locations in K51 changed even less often. Between 1959 and 1967 a room, probably a store for goods awaiting dispatch, was built around the southernmost of the two sliding doors. In 1967 K51 was empty but had probably been a clothing factory fairly recently because 1969 Ordnance Survey plans mark it as such. More recently a sliding door has been opened in the north-east corner of the factory extension close to the existing sliding door, and the one at the front has been blocked in.

Taken together these changes to the positions of doors and their location in the original factories suggest that care was taken in designing process flows, despite the difficulty of many of the factories being built to standard plans. The relationship between process and the locations of doors is strengthened by the fact that door locations often changed at the same time as occupants, especially where the new firm was in a different industry to the outgoing one. At L50 changes were made when it went from being part of a pump factory to other light engineering, and again when it became a cardboard box factory in the 1970s. Similarly, L92 changed little under Sigmund Pumps but changes occurred when Alsco moved in. At K51 no changes were made while it was a clothing factory but did occur after Barran's left.

Offices

Just as the factory floor seems to have been arranged rationally to accommodate efficient production so offices were built and re-built to optimise administration.

Initially in L50 the 'General Office' on the ground-floor had doors directly onto the factory floor, timekeeper's booth and entrance hall. It is likely that the administrative functions associated with the management of the factory workforce were carried out in this office and that the doors provided convenient access to places where staff in the General Office often needed to go (Fig. 3). The arrangement of the offices on the first-floor is less clearly rational with three offices arranged along a corridor with both staff and private (by 1944 male and female) lavatories at the end (Fig. 7). It is likely that this is a result of the architect wishing to provide a flexible arrangement in this standard factory.

At L92 a general office occupied the same position as that in L50, but had a store in place of the timekeeper's office. Like that in L50, this space had a door onto the factory floor and probably fulfilled similar functions to its counterpart in L50. At some point after 1949 the 'Works Office' was moved into the old 'Workmen's Rest Room', which likewise had direct access to the factory floor (Fig. 4). Upstairs, the fact that the factory was built specifically for Sigmund allowed the offices to be built to suit their needs. For instance, the manager's office was given a door directly into the secretary's office, and into a private lavatory. Similarly, the women's lavatory was placed next to the 'General Office' presumably because it was expected that most of the clerical staff would be female (Fig. 8).

At K51 the upstairs offices were originally arranged along a corridor as in L50 and L92 (Fig. 9). Before 1967 doors were made between three of the offices and between the end offices and the stairwell. This would have made interaction between people in the offices more efficient (Fig. 10). Less can be discerned about the offices on the ground-floor. They were not originally planned by the architect; their arrangement being left to the occupant. Before 1959 the end of the factory had been walled off but it is unclear if this was for offices or for storage and rest rooms, certainly in 1946 part of this space had been a rest room, first aid area and workshop, and the whole area was a store in 1967.[37] After 1967, the area to the west of the entrance hall became a works' office by the addition of a hatch and the opening of a door into the stairwell allowing easy access between the factory floor

and upstairs offices (Fig. 11). The door handle here is of the 'Georgian' type which was made between the 1970s and 1990s.

Consequently, it appears that offices were designed and redesigned to improve administrative efficiency; thus, applying the same mindset to administration as to production as administrative activities came to be more closely associated with the management of the factory floor. Such careful planning of space around production and administrative processes could have led to inflexibility and potentially rendered it difficult for NETE to re-let its factories if tenants left. However, the way in which the factories were constructed mitigates against this. The steel frame means that none of the brickwork is structural and so doors and windows can be moved or created almost at will. The aisled plan of the factories is amenable to easy but impermanent division using studwork but can be also used as a single large area. It is likely that this is intentional and a result of NETE's needs but would also have allowed the occupying firms a flexibility not usually provided by 1930s factories.[38] As most structural changes are however related to changes in occupation it seems that this was not taken advantage of to any great extent. This is perhaps unsurprising as flexibility in production processes is a recent management concept associated with late 20th century just-in-time methods.

Division of labour and status

The factories were, however, not only structured by pragmatic concerns; they also reflected, and would have reinforced, differences in status between employees within the firm. Concern for status and hierarchy however are not a separate domain to efficient layout, as hierarchy was an important management tool.

The clearest division is that between factory workers and the clerical and managerial staff. In most factories these groups had separate entrances. In some cases, the entrance for the factory workers included facilities like timeclocks to monitor their arrival and departure. The most complex example was at L50. Originally the workers entered through a door in the south-west corner, past the timeclock, and proceeded through another door into the factory (Fig. 3). On leaving the workers went through a door on the other side of the timeclock, past the pay window and timekeeper's desk and exited via the door through which the entered. The exit and entry routes were separated by a rail which may have allowed one shift to leave while another entered. Clerical staff and management used the main entrance which gave access to the stairs and the ground-floor office, and which received architectural treatment. This was replaced by an equally elaborate arrangement in 1944 when the works' entrance was moved to the middle of the northern wall (Fig. 12). In this arrangement workers entered through a door immediately opposite a 'Gateman's Office' and then went either to the right into the 'Gents' Cloakroom' or left into the 'Ladies' Cloakroom'; they then entered the factory from doors in the far end of the cloakrooms.

At L92 there was also a workers' entrance though it was less elaborate than at L50 and did not include a timeclock, timekeeper's desk or pay window. Presumably the differences were at the request of Sigmund Pumps. Again, clerical and management staff would have entered through the main entrance which provided direct access to the ground-floor office and first-floor and which received architectural treatment (Fig. 13). This arrangement was later changed, probably when the current break room was made. This breakroom has an external door but as the, probably contemporary, locker area is reached more directly via the main entrance it is likely that at this time workers entered through the entrance hall (Fig 6). These changes were made during the 1960s on the basis of electrical and fire suppressing plant in the break room.

At K51 the distinction is less clear though it is likely that workers entered through the sliding door at the north-east corner of the factory, if this sliding door was like those which survive on other units it would have had a swing door within it for pedestrians (Fig. 2). Again, management staff would have entered through the main entrance which provided direct access to the stairs. It is not clear when, if at all, this arrangement was changed as a 1990s or later uPVC door currently occupies the space of the sliding door and may have been a workers' entrance.

Workers on the factory floor were also subject to greater levels of surveillance than those in the offices. We have seen that, at L92, factory workers were monitored leaving and arriving at the factory. At both L92 and L50 the ground-floor offices had easy access to the factory floor to allow efficient oversight of activity there. In neither case were such formal monitoring systems in place for workers in the offices. Surveillance is less obvious at K51, though this may be because we know less about the ground-floor offices. Certainly, when an office was created on the ground-floor between the 1970s and 1990s a system for monitoring activity on the factory floor was put in place via a hatch and door (Fig. 11).

Often different floor treatments were used in factory and office areas. The difference is most marked at L92 where the factory floor, workers' entrance and main entrance hall had concrete floors. The porter's office, general office and area behind the timekeeper's desk were shaded yellow on the building control plan, as were the first-floor offices (Fig. 3). The plan does not state what type of floor treatment the shading indicates but comparison with other TVTE building control plans suggests that it represents parquet in the ground-floor offices. At L92 concrete was used for the whole ground-floor including the entrance hall and offices. It is possible that this was a time-saving measure as the factory was built unusually quickly.[39]

At K51 parquet flooring was specified for the entrance hall alone while the rest of the factory including the optional office space next to the entrance hall had a concrete floor (Fig. 2). In practice the floor to the east of the entrance hall was boarded apart from a concrete slab for the lavatory, presumably because this area was to be an office. It has since had carpet laid in half and linoleum tiles in the remainder which recently formed a kitchen. The area to the west of the entrance hall was floored with concrete as this was used for a workshop, and the factory workers' rest and first aid room (Fig. 2). The differences in floor treatment continued when offices were made in the western aisle and floored with carpet and linoleum tiles. Similarly, when an office was created, in the area that had originally been the workshop, carpet was laid. Differences in floor treatment were probably for practical reasons, as the factory floor would receive more wear and dirt than that of the offices, while dirt from factory processes would enter areas used by factory workers like rest rooms. The different floor treatments do however correlate with parts of the factory used by different sections of the workforce, and must have served to reinforce status along with other indications such as the use of different entrances.

Lavatories were also used to mark status in clearer and more nuanced ways. All the factories had different lavatories for factory and office workers (Figs. 2, 3, 4, 7, 8 and 9). In some instances, there was also a private lavatory for the manager. At L92 this could only be accessed from the manager's office. At L50 the first-floor lavatories were marked 'private' and 'staff' but could both be accessed from the corridor. It is likely that this was a compromise so the lavatories could be male and female if there was no manager on site, as they in fact were in 1944 (Fig.8). At K51 there were originally only male and female lavatories on both floors. After 1967 a private lavatory was added within one of the first-floor offices (Fig. 14). This has since been converted to a shower. Separate rest rooms were also provided for factory and office workers at L92, though those for the office workers were removed when an open-plan office was created recently leaving one restroom for all staff.

In practice the difference in status between the factory and office workers was often one of gender, though this differed between industries. L92 was built as a light engineering factory and expected an all-male factory workforce. Consequently, only male lavatories and restrooms were provided on the factory floor. On the first-floor there were both male and female lavatories and restrooms because the management and clerical staff would be mixed. The women's lavatory and rest room were beside the general office at the southern end of the corridor. In contrast the men's restroom and lavatory were quite distant from one another and so less convenient for their users. This is probably because it was assumed that the workers in the general office would be largely female. The men's lavatory was next to the General Manager's office at the north end of the offices. Although the, probably male, manager had a private lavatory it is possible that this end of the corridor became a specifically male/managerial area in contrast to the female/clerical space at the southern end (Fig. 8). The gendered nature of space changed somewhat in the period following the Second World War. In 1949 Alsco built a female lavatory block on the factory floor and so probably had a mixed factory workforce. Nonetheless, only one rest room was provided for them. Likewise, the removal of the first-floor rest rooms discussed above in terms of status reduced the gendering of the building's space.

At the two standard factories examined gender distinctions were initially less clear because the architects had to provide for the needs of any possible workforce. Originally, L50 had male and female lavatories on the factory floor and the possibility of male and female lavatories on the first-floor too (Fig. 3). It is possible that the labelling of the upstairs lavatories as private and staff indicated that the architect imagined a female clerical staff and male manager. By 1943 the factory floor was more clearly gendered as the male and female lavatories were joined together to provide a single lavatory for the factory workforce. In 1943 this was female but may have been male before the War as Sigmund Pumps used an all-male factory workforce in L92. When Bren took L50 in 1944 it installed male lavatories on the ground-floor and so must have had a mixed factory staff (Fig. 12). Bren did not provide restrooms but did install a single canteen for its whole staff (Fig. 12).

At K51 the factory was initially designed under the assumption that the factory workers would probably be male. However, as it was occupied by clothing manufacturers, the factory floor quickly became a female space. As originally designed the factory was to have a female lavatory on the east with one cubicle and a male lavatory with two cubicles and a urinal on the west. The door of the female lavatory opened into the office space whereas the male lavatory was accessed from the factory space, indicating where the architect expected different genders to work (Fig. 2). This plan changed before the factory was built so that the female lavatory would be on the west and the male on the east. In this arrangement the male lavatory had one cubicle and a urinal but had extra windows to allow four extra cubicles to be added later. These do not appear on any architect's plan but are part of the original build (Fig. 15). The door of the western lavatory still opened onto the office space. It is not clear whether the door of the eastern lavatory was built as originally planned as a plan of 1958 shows it orientated towards the factory floor while one of 1967 shows it oriented towards the office space: it is not clear whether the 1958 plan is simply wrong or if the position of the door was moved (Fig. 2). By 1946 the urinal in the western lavatory block was boxed in to make the lavatory female. The occupant of the factory had built a workshop and restroom on this side of the factory in such a way that the lavatory was accessed directly from the factory floor despite the position of its door (Fig. 2). It is likely that this was done because the factory staff was largely female so the occupier preferred to enlarge the female lavatories. The female lavatories were enlarged by two cubicles in 1946 (Fig. 2), providing significantly more female lavatory accommodation, indicating a female workforce overseen by a few male foremen. Further lavatories were added when the factory was extended in 1958. They are not marked female but did not have a urinal (Fig. 11).

Between 1958 and 1967 the male lavatories were demolished and two further cubicles added to the female lavatories. This may mean that the male lavatories were actually being used as female and that the two extra female cubicles were a replacement for the two lost when the male lavatories were removed (Fig. 11). If so the factory workforce, both workers and overseers, was all-female by the late 1960s. Consequently, at K51 the factory floor was mainly a female space while the first-floor offices were more mixed.

The Factory as Publicity

The factories also show attention to aesthetics, probably resulting from a concern with the overall visual impression given by TVTE and the use of factories in publicity by individual firms.[40]

NETE and Holford were keen that the Estate looked pleasant, partly to attract tenants, but mainly so that it would project an image of healthy modernity that contrasted with the stereotypical northern industrial district:

> "[I]t is pleasant…to compare the airy, well lighted factories surrounded with roads and backing on to the open spaces with a factory situated in the heart of a residential area with no space, little light and congested conditions" (Appleyard in a speech given in Berlin 24 November 1938).[41]

Modernist architecture expressed this particularly well. The neat, plain appearance of the factories gave an impression of order and was deliberately different to the more haphazard and highly decorated factories around London which Holford disliked:

> "There is seldom any fear, in industrial design and planning, of excessive conformity and monotony…The difficulty is usually in the opposite direction, as the Great West Road amply demonstrates."[42]

Despite an attempt to break with the Great West Road façadism, the façades of TVTE factories are perhaps their most aesthetically important part. In contrast to the factory space the façade office blocks disguise the steel-frame structure and so appear more conventional. While they did not receive the level of decoration that factories such as the Firestone works at Brentford did, the factory doorways were monumental. Of the three examined here only L92 retains its 1939 entrance which has decorative details and planters (Fig. 13). Architects' plans show that both K51 and L50 originally had decorative entrances. The visual impact of the façade remained important into the 1970s. The façade at K51 was rebuilt in 1967 and that at L50 twice, once before 1971 and again in 1971. The first rebuilding of the L50 entrance has left no archaeological trace but architect's drawings show that it removed the steps and canopy. This may have coincided with the extension of the first floor, in which the visual impression was considered as the bricks used on the front elevation were very closely matched to the existing fabric (Fig. 16). The final rebuilding of the K51 and L50 entrances were similar in many ways. Both extended the external entranceway to make it wider than the entrance hall behind and used dark brown brick pillars to support a canopy (Fig. 16). Both were carried out by English Industrial Estates (the successor of NETE) and probably when the factories were empty in order to modernise them to make them more appealing to prospective tenants.

The modernist values evoked by the factories would have reflected on the occupier who could place signage on the façade. The offices also provided facilities to receive visitors and so played an active part in marketing. L50 was originally provided with a porter's office with enquiries hatch to the north of the main entrance (Fig. 3). Opposite this was a room constructed of glass panels marked

'reception'. This has no door into the ground-floor office; only one into the entrance hall, so it is possible that it actually functioned as a waiting room for people visiting staff in the first-floor offices. The facilities at L92 were similar but the enquiry hatch was in the general office and the reception room had a door into the general office as well as the entrance hall (Fig. 4). K51 also had an enquiry office with hatch (Fig. 2). This function continued to be important in the post-war period, though it is notable that Bren removed the reception from L50 in 1944 probably because wartime conditions did not require it. After the War, however, visitor facilities continued to be developed. Prior to 1949 a showroom with counter was created on the ground-floor of L92. The rebuilding of the entrance of L50 in 1971 created a new reception as did that of the K51 entrance in 1967. More recently these facilities have been removed or become disused. At K51 the reception was probably removed when the ground-floor office was created between the 1970s and 1990s. In L50 the reception was made into a cupboard. It is likely that this represents the decreasing importance of the factory in publicity and corporate identity, so clients or stakeholders were met elsewhere.

I60: Nursery Factories

The four units of I60, particularly units-b-d, were very different from the three factories discussed above. All four units shared a heating system, but were otherwise self-contained. Each had a separate mains electricity supply, a pair of lavatory cubicles and a sliding door (Fig. 17).

The single door, and indeed the lack of space, meant that these units did not allow such careful planning of processes as did the larger standard factories. It was probably expected that production would be more artisanal in the nursery factories. In contrast to the larger factories, units I60b-d also provided no means for marking status as there was only one entrance to each, no offices and only one male and one female lavatory for the whole staff. The position of doors and windows leave little scope for dividing the area with studwork as in the larger factories (Fig. 17). Arguably, complex management hierarchies and detailed process engineering would be less important on such a small scale. These units also provided less opportunity for publicity as they had no reception facilities and nowhere to place signage. Units-b-d did not front onto main estate roads, only onto a service road, their entrances did not receive architectural treatment, and indeed the separate units are not clearly differentiated externally. The units were originally used as separate factories; being let to Colmore Adhesives (I60b), Alsco Cardboard Boxes (I60c) and Chemika (I60d).[43] However, Colmore Adhesives soon moved to larger premises allowing Alsco to occupy units-b and -c. This would have given them two sliding doors possibly allowing one to be used for reception and the other for dispatch (Fig. 17). Units-b and -c were separated again during the War but by the 1950s were being used together as a bakery.[44]

Unit-a is different and does offer some of the same facilities as the larger factories. It is separated from the other units by a brick wall. This is original as the concrete floor was laid after it was built. There is no evidence for similar walls having been made between the other three units which were probably separated with studwork. The door currently in the wall is not original and the fact that pipes once ran along the whole length of the wall means that it is unlikely that there was originally any door at all. This wall would have made Unit-a quieter than the other three and would have excluded dust or smells from the neighbouring factories. Unit-a also has space for offices, though at the expense of factory floor area. The office space has a lower ceiling than the factory and was intended as offices by the architect.[45] The division of this space was left to the tenant. Currently the space is divided into two offices, one slightly larger than the other with a small corridor between (Fig. 17). Possible 1930s door hardware on the western office suggest that this was the original arrangement. The smaller office had a large window into the factory allowing surveillance of the factory workers by management. It was possible to use the offices to express status as they were

accessed from the front door while the factory was accessed from the sliding door (Fig. 17). The main entrance and offices also permitted the factory to be used for marketing. The larger of the two offices originally had an enquiries hatch so visitors could be received. The main entrance received architectural treatment, faced one of the main estate roads, and would have provided space for signage. The tenants paid an extra half-crown per week for this unit.[46]

All four units were joined between 1953 and 1969. By the 1960s the factory was being used as a warehouse by Loblite, manufacturers of electrical switchgear, who had other premises at TVTE.[47] Some physical changes to the factory certainly post-date this amalgamation and probably result from it. The sliding doors in units-a and -c have been blocked. As the same brick was used for both it is likely that this happened at the same time. This left one door at each end of the larger part of the factory, possibly meaning that one was for reception and one for dispatch. A door was made in the wall of unit-a allowing direct access between unit-a and the rest of the factory. As unit-a no longer had a sliding door it probably served a particular function (Fig. 17). Part of unit-d was also walled off with studwork (Fig. 17). As this does not separate the whole unit it must post-date the joining of the entire factory. It contains a sliding door, so this area may have been a store for either materials or goods ready for dispatch, though the stud wall prevents half of the sliding door from being opened (Fig. 17). The joining of the four units has allowed some of the lavatories to be converted to other uses, though much of this seems to have happened recently judging from the equipment installed. One pair has been made into a kitchen, pantry and boiler room to replace the now defunct communal heating system and the other housed a compressor and air-receiver. The lavatories in units-a and -c were kept allowing separate lavatories for office and factory staff. The window between the unit-a office and the factory floor has also been covered with textured glass increasing privacy in this office but reducing the surveillance of factory staff. In the larger area a very recent supervisor's office has been created, increasing surveillance in this area.

So, as four separate units I60 provided very different accommodation to the other factories, though some attempt to reproduce their facilities was made in Unit-a from the beginning and in the factory as a whole after the units were joined.

Conclusions

We have seen that many aspects of the businesses which occupied TVTE factories can be read from their physical structure. These reflect the more formalised methods of management and process engineering which became important in the United Kingdom between the wars and grew in importance subsequently. We have also seen that an interest in efficiency was applied to the design of both offices and factory floor. This is consistent with the idea of a pragmatic interest in efficiency that we would expect given the historical evidence for British industrialists' engagement with scientific management.[48] However, the arrangement of buildings for production efficiency was nothing new in the 20th century. Eighteenth century factories were often designed for efficiency including the La Saline saltworks of the early 18th century and Boulton and Watt's Soho Foundry.[49] The latter may have influenced the 1760s Etruria potworks which utilised the division of processes for efficiency and which set the standard for Staffordshire potworks.[50] However, factories of the 18th and early 19th centuries do not appear to show the same concern for the *optimisation* of efficiency of movement revealed here by the quite small adjustments made to, for instance, the position of sliding doors. Similarly, while some 18th and 19th century factories display some concern for efficient movement many were quite haphazard especially where processes were mechanised over a long period of time as in the ceramic and boot and shoe industries.[51] Closer parallels to the TVTE factories are found from the 1880s onwards. In the ceramics industry a linear plan was developed from the late 1880s based on multiple parallel ranges, possibly in response to foreign competition.[52] The

single-storey shoe and boot works which developed in Nottinghamshire from the 1880s are even closer to the TVTE factories. These were single-storey sheds fronted by two-storey office blocks permitting a flexible factory floor space where a logical process flow could be accommodated.[53] This style was introduced from the US in the face of foreign competition. These developments are contemporary to the origin of Scientific Management in the US, notably through the work of Frederick Winslow Taylor. If the optimisation of efficiency in TVTE factories was inspired by Scientific Management, as is almost certain given the historical evidence for its adoption by this period, then the similar evidence from 1880s factories suggests that Scientific Management was being adopted by British manufacturers earlier than business historians have typically thought. The fact that the introduction of more efficient factories seems to have been a response to American competition supports this. Additionally, this may suggest that industrialists were beginning to optimise production efficiency in practice and that Scientific Management theorists like Taylor described and elaborated behaviours already developed in practice. This reflects recent theories of innovation in which theory and practice are seen to inform one another.[54]

Scientific Management relied upon hierarchies of staff within the firm and divisions of labour between different workers and often on gender lines. The factories studied here clearly reflect this, with assumptions about the gender of different groups of the workforce being revealed by lavatory provision. This varied between industries and was significantly disrupted by the Second World War. Various strategies were used to mark status including the provision of separate lavatories, rest rooms and entrances for different groups of workers. Again, this is consistent with the notion that increased managerial control of production led to increasing managerial professionalisation and status.[55] It is possible that the absence of such features in three of the four nursery factories means that such formal methods of management were considered unnecessary in very small businesses, though it is interesting that in Unit-a attempts were made to duplicate the marketing and status facilities on a small scale.

The use of buildings to control workforces was also nothing new. Markus has shown how principals of institutional architecture were applied to early factories, indeed Jeremy Bentham developed some of his panopticon principles assisting his brother in designing a factory in the Russian Empire.[56] In early factories however, the buildings seem to have driven management practice, as the larger spaces required by machines necessitated new management techniques.[57] This is in contrast to the TVTE evidence where the, now familiar, factory was altered to adapt to management innovation. The comparison is most clearly seen in eighteenth-nineteenth century textile mills the building was also used to control the workforce. This was achieved by the use of a hierarchical layout in which spaces were segregated from one another and accessed only via a unifying space such as a stair tower. The deepest spaces were those used by the workers while overseers' spaces and offices were shallower. This limited encounters between workers.[58] In our factories the space is much more permeable. In direct contrast to the textile mill the manager's offices are usually the deepest space, presumably for privacy. The only strict physical separation is between the office and factory workers, which is usually mediated by a works office with direct access to both. The provision of separate rest rooms for these groups in some factories would have heightened this. It is perhaps significant that this division was often between employees of different genders and may thus have been motivated partly by moral concerns. The control exercised through our 20th century factories was much more visual; the building did not physically limit action but allowed management to observe most parts of the factory. The most senior personnel in contrast enjoyed the most privacy. It would have been very clear to workers that they were observed. This is, perhaps, a more subtle method of control than those of the textile mills. Although owners' offices in textile mills often overlooked the entrance the level of observation seen here seems much greater.[59]

Hierarchies remained important throughout the use of the factories, and some aspects like surveillance of factory workers via supervisors' offices on the factory floor have been developed quite recently as, for instance, in the larger area of I60 or in K51. On the whole however there seems to have been a move towards less clear demarcation of hierarchies since the 1960s as represented by the removal of private lavatories or the provision of a single rest room and entrance for all staff in L92. The features which have been discarded are notably the most purely symbolic markers of status.

Overall, these practices seem to have been maintained into the 1970s at least and have only been abandoned in very recent years. It is possible that this reflects changes in management theory which entered a period of great diversification in the 1980s and 1990s.[60] This was also a period in which family ownership of firms declined in favour of institutional ownership.[61] This is particularly relevant here as many of the firms which occupied the factories in question in the 1930s and in the post-war period were family firms. It is possible that as ownership and management were separated so hierarchies within firms became less strongly marked.

The importance of the factory for marketing purposes in the 1930s is also very clear. All the factories had elaborate main entrances and facilities for receiving visitors including clients. Again, this was absent from three of the four nursery factories suggesting that small businesses were expected to function differently in this respect. This remained significant into the 1970s with the rebuilding of the entrances of K51 and L50 on modern lines in 1967 and 1971 respectively. Similar changes have not been made since the 1970s suggesting that, like some aspects of hierarchy, this has become less significant for TVTE firms in recent years. This is similar in some ways to the use of ornate office spaces for business transactions in 18th century factories.[62] In mills, however, these were often in a separate building while in our factories they adjoin the factory floor, usually with a window into it bringing the factory floor into the 'front-stage' area. This may mean that the factory floor was part of the identity of the firm perhaps because the processes, such as the use of electric power, were cutting-edge.

The clear continuity in the ways in which these factories were used across most of the 20th century followed by a reduction in the marking of status and recent rapid change in the marketing significance of the factory is interesting and does seem to mirror trends in management and marketing nationally. It is, however, difficult with the present dataset to determine the extent to which the presence of the factories on TVTE and the provision of very modern factories influenced participation in these practices. It would be interesting for comparisons to be made with other firms operating in older factories and outside industrial estates during the same period but this lies outside the scope of this paper. The approach taken here should also be applied to late-19th century factories to examine early adoption of Scientific Management in the UK.

Acknowledgements

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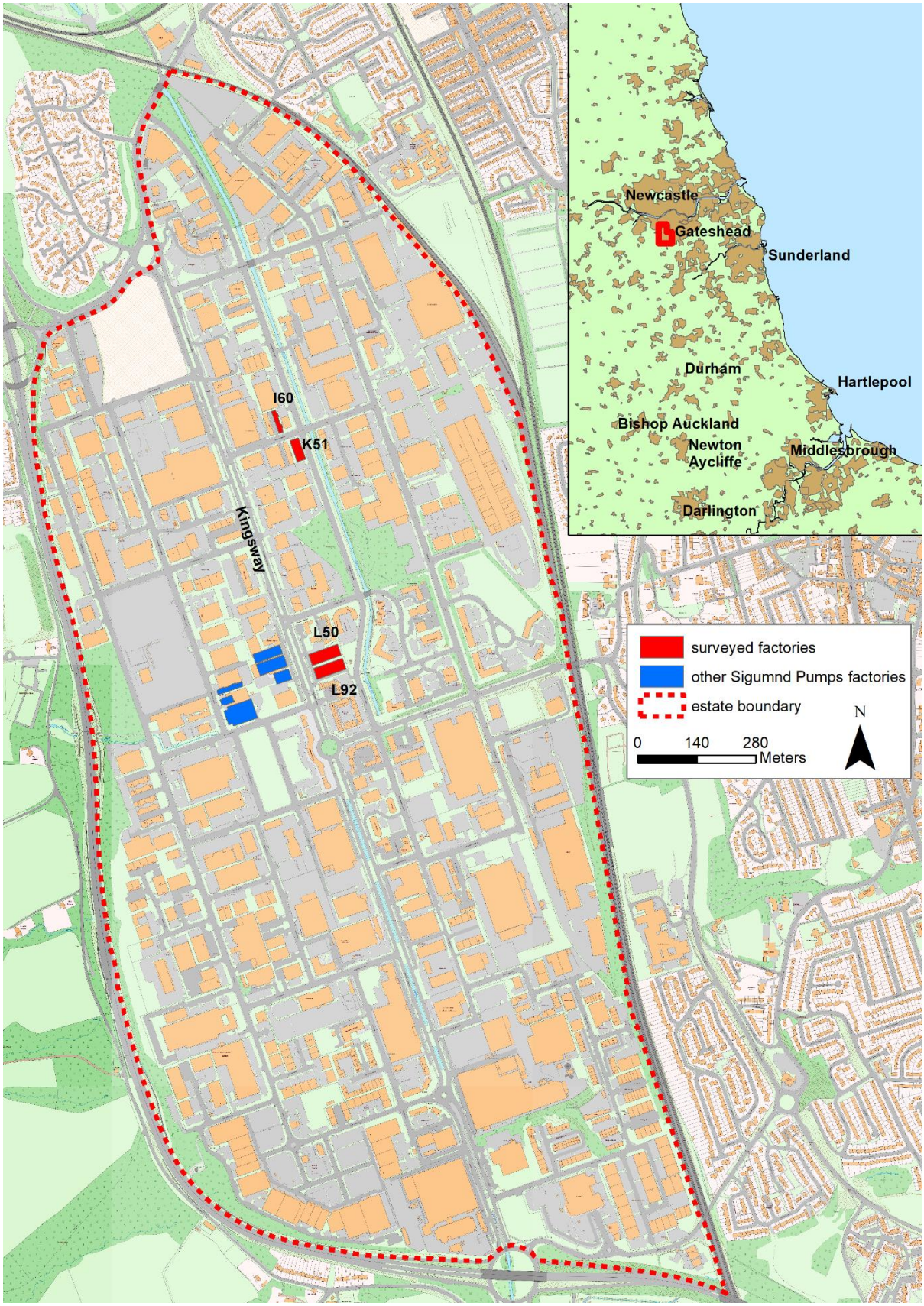
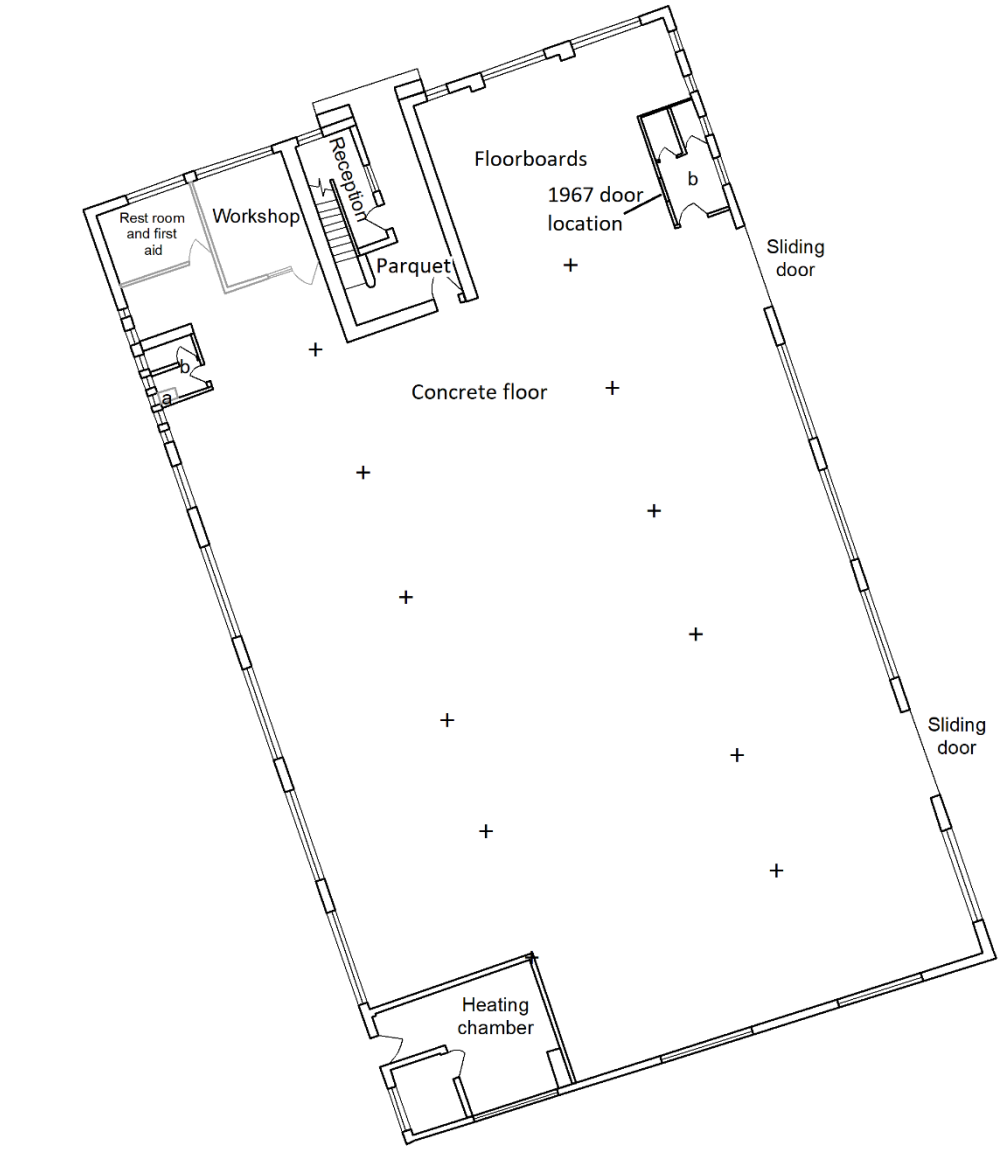


Fig 1 locations of the four factories on the Team Valley Trading Estate. L92 was made to the specification of Sigmund Pumps Limited while the others were standard factories. Ordnance Survey background map © Crown copyright and database rights 2019 Ordnance Survey (100025252).



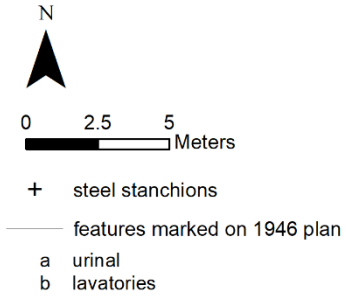


Fig 2 K51 as built based on the 1938 building control plan TWAM CB.GA/BC/plan/NET/52.

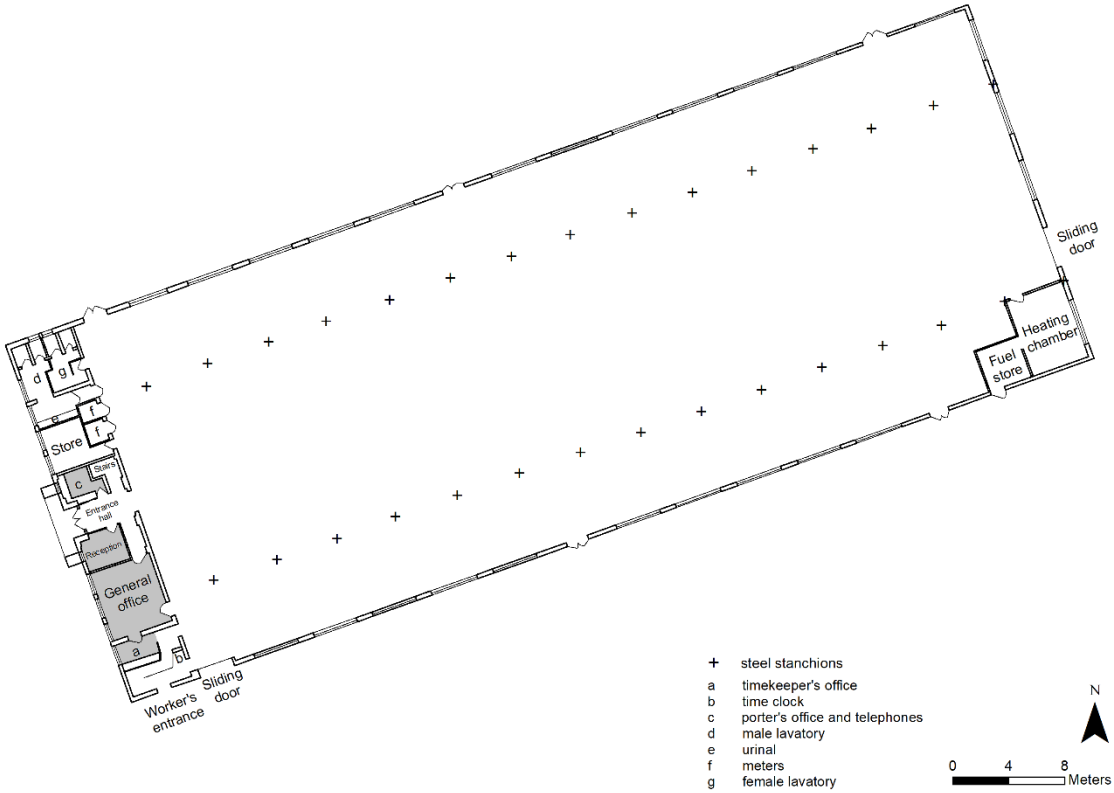


Fig 3 L50 as built based on the 1938 building control plans: TWAM CB.GA/BC/plan/NET/41 and TWAM CB.GA/BC/plan/NET/43. One plan was submitted initially then a second was submitted to extend the factory, both plans were approved at the same time so construction commenced as if the plan were always for the larger building. The areas shaded grey were shaded yellow on the original plan indicating a different floor treatment; probably parquet.

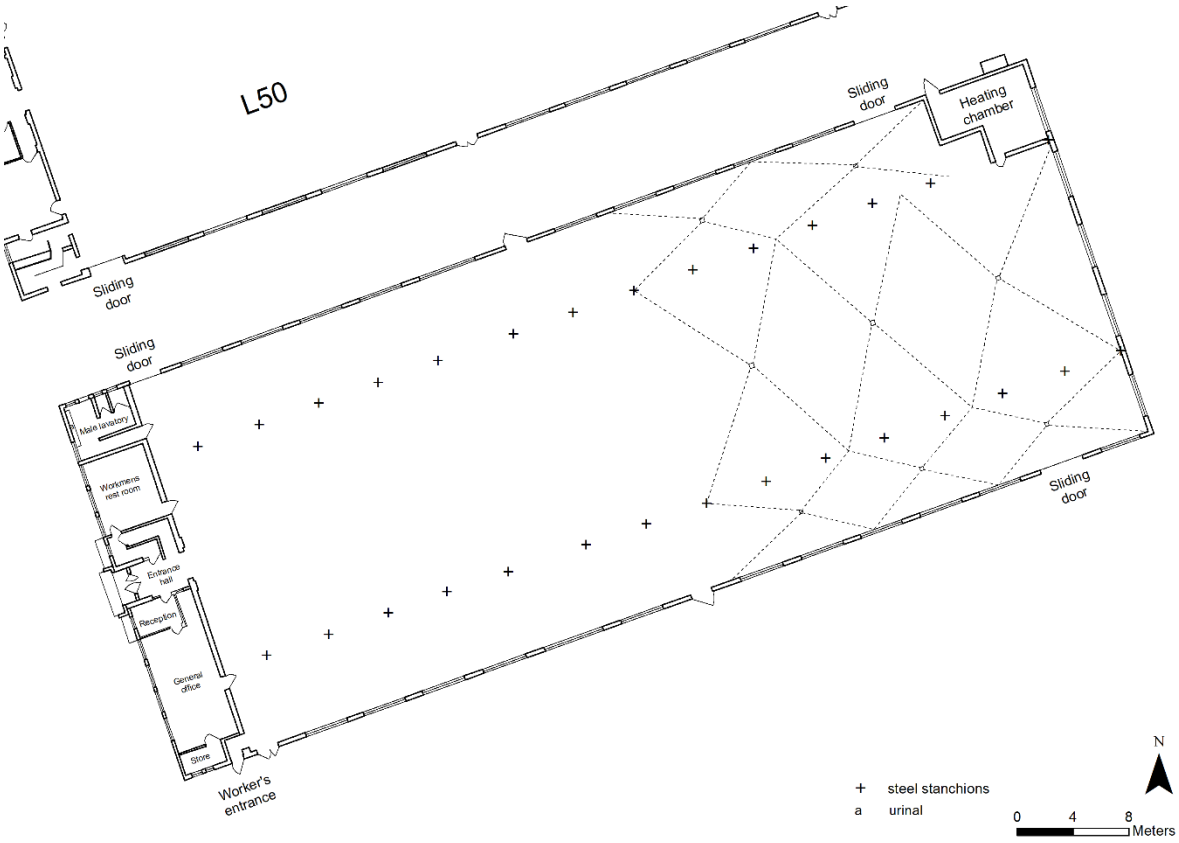


Fig 4 L92 as built based on the building control plan TWAM CB.GA/BC/plan/NET/87.

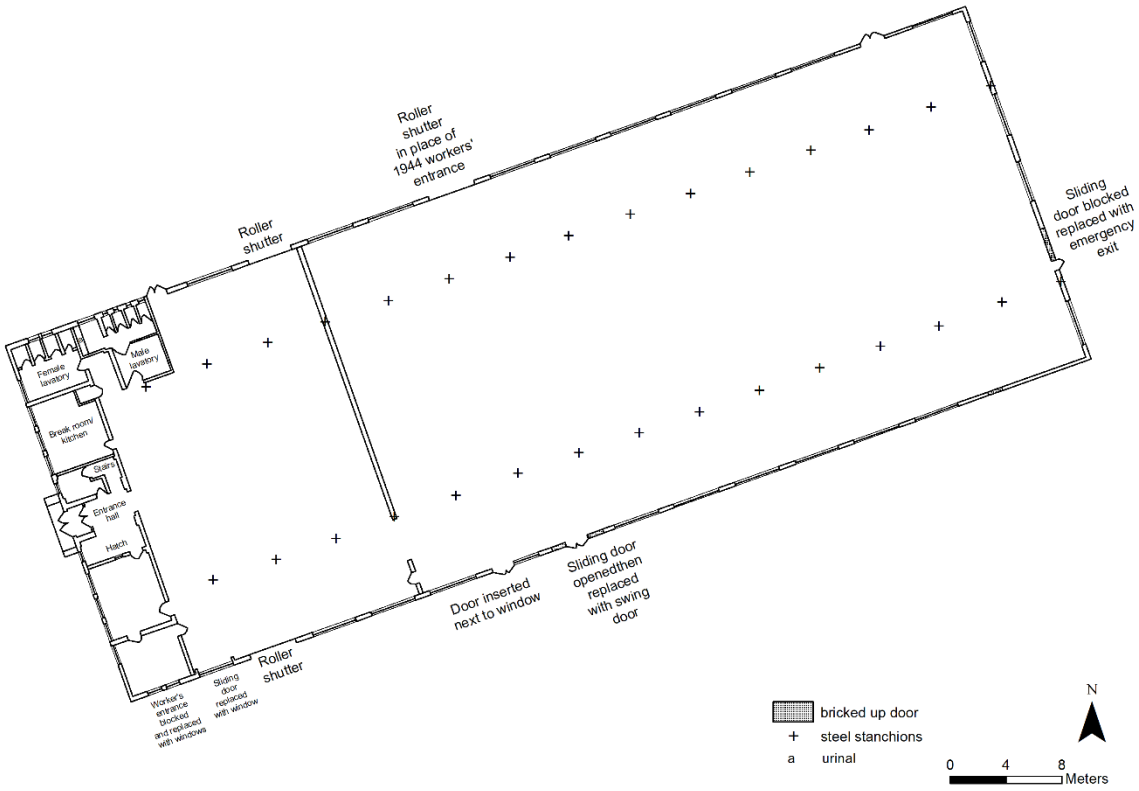


Fig 5 plan of L50 as it is now based on surveys made in December and January 2018/9. The lavatories were not accessible and so are based on building control plan TWAM CB.GA/BC/plan/1971/126.

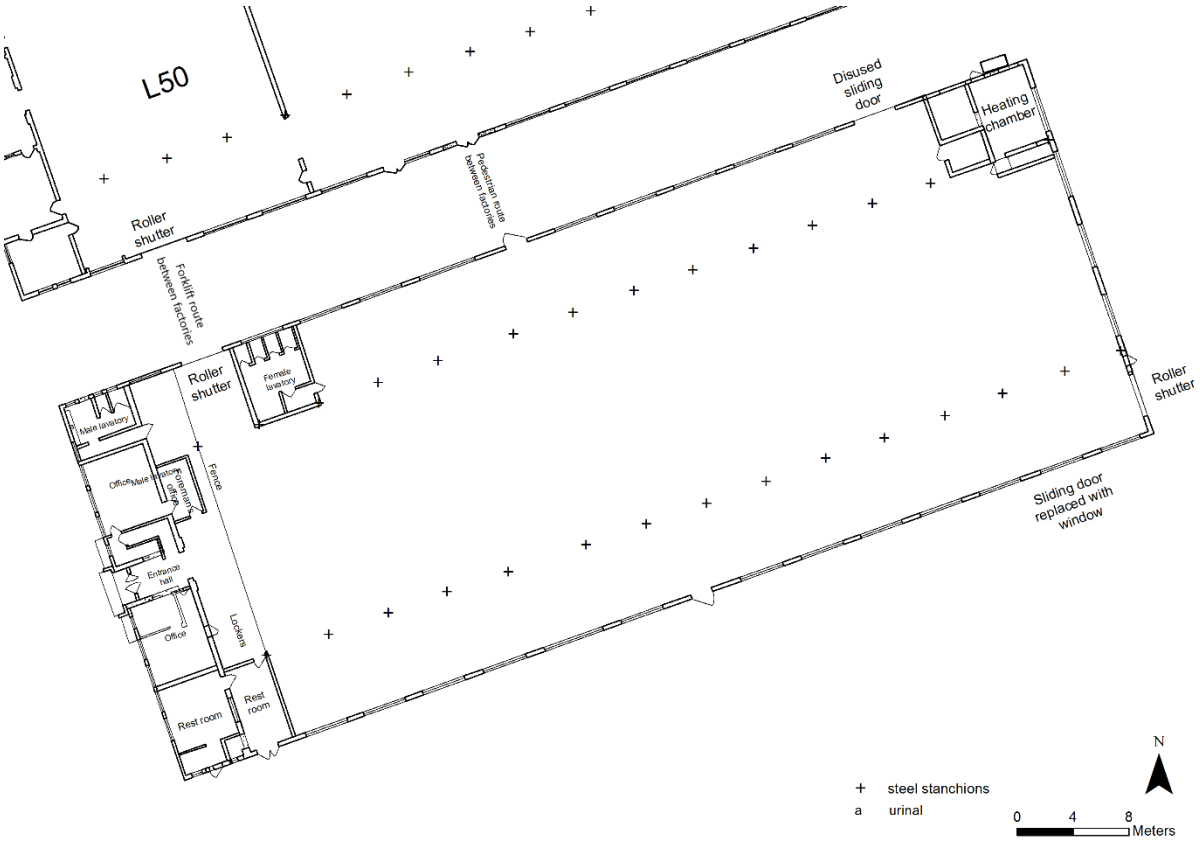


Fig 6 L92 as it is now based on surveys made in December and January 2018/9.

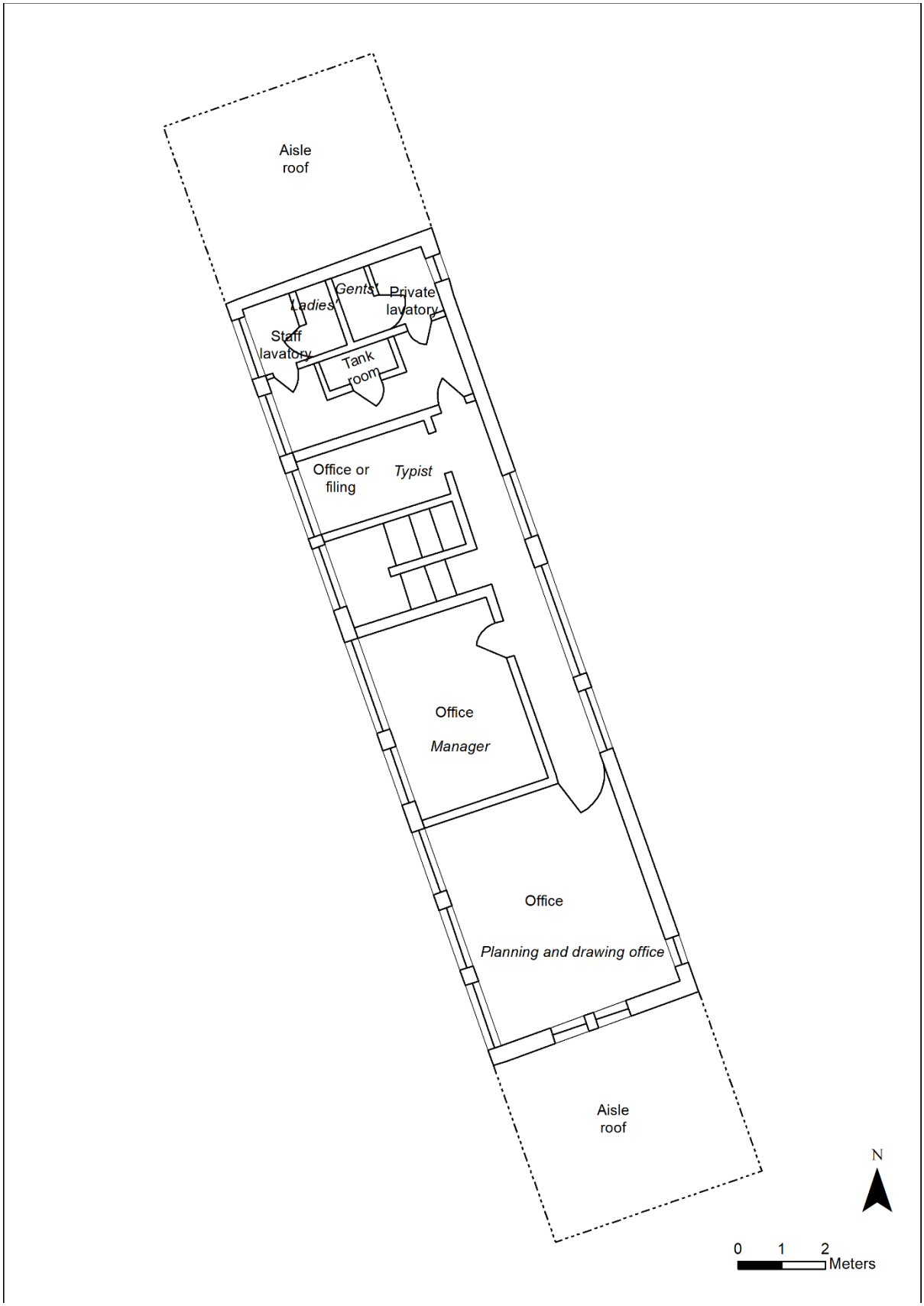


Fig 7 The L50 first-floor offices as built based on building control plan TWAM CB.GA/BC/plan/NET/41.

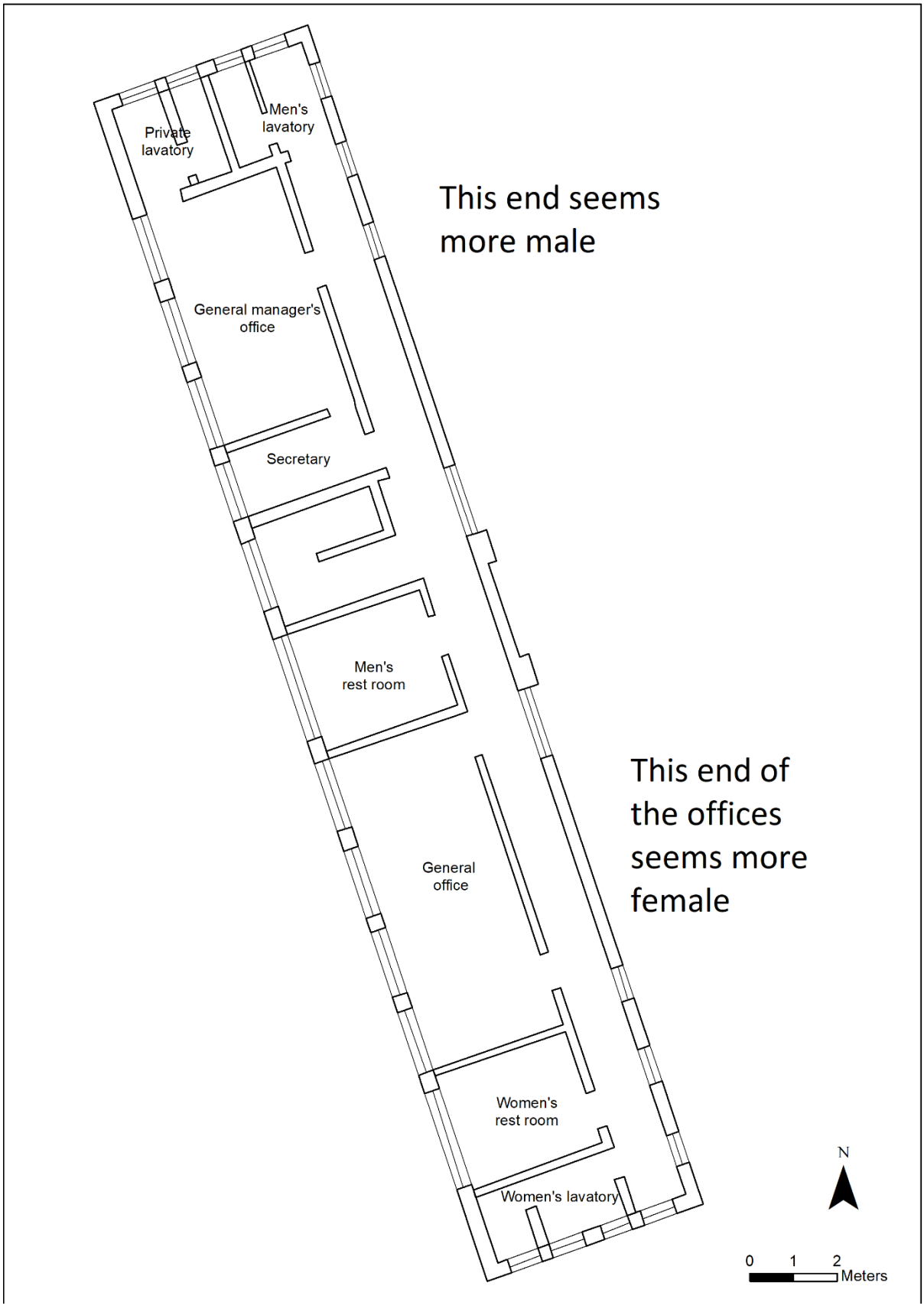


Fig 8 The L92 first-floor offices as built based on building control plan TWAM CB.GA/BC/plan/NET/87.

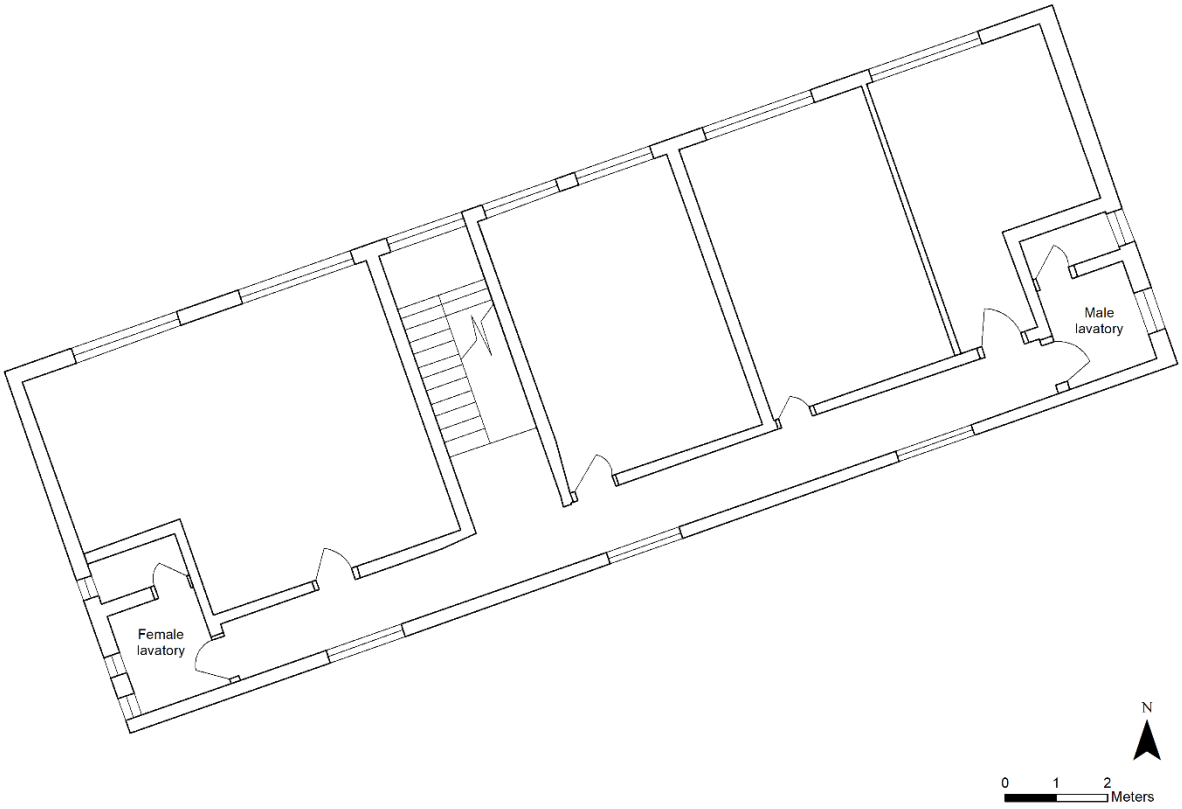


Fig 9 The K51 first-floor offices as built based on the building control plan TWAM CB.GA/BC/plan/NET/52.

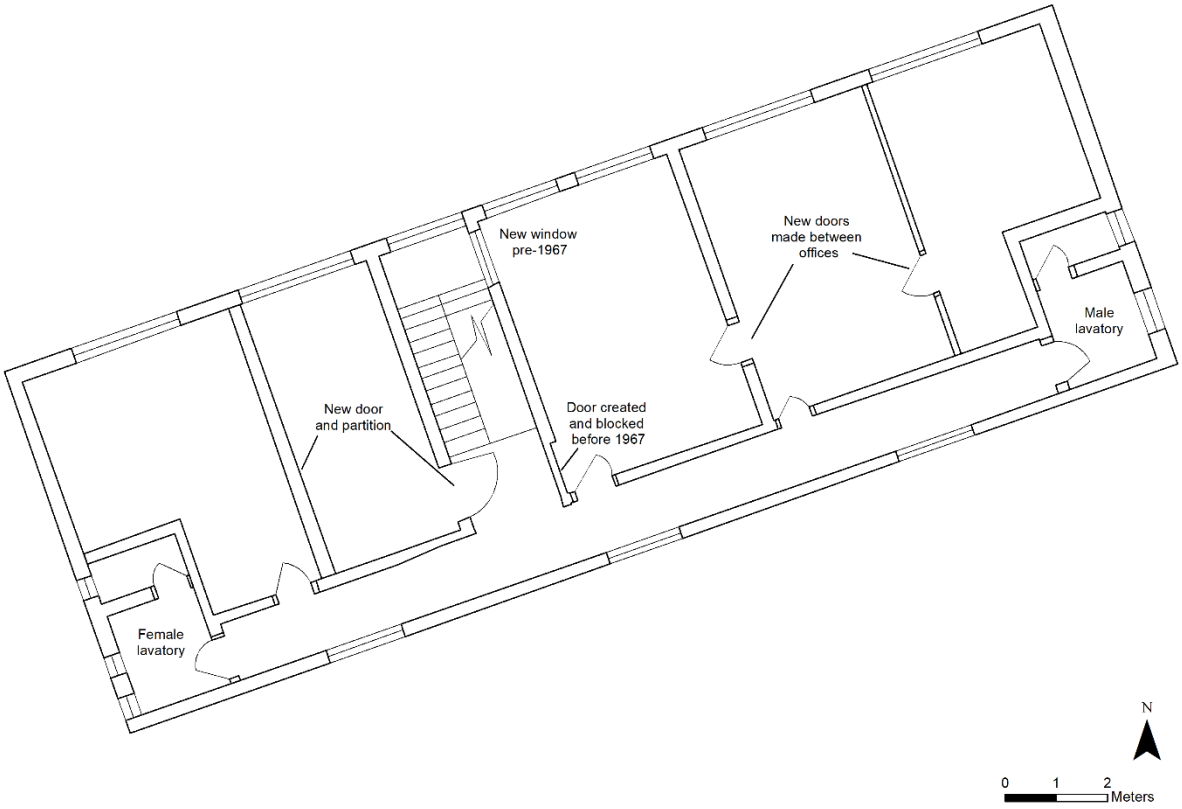


Fig 10 The K51 first-floor offices in 1967 based on building control plan TWAM CB.GA/BC/plan/1967/540.

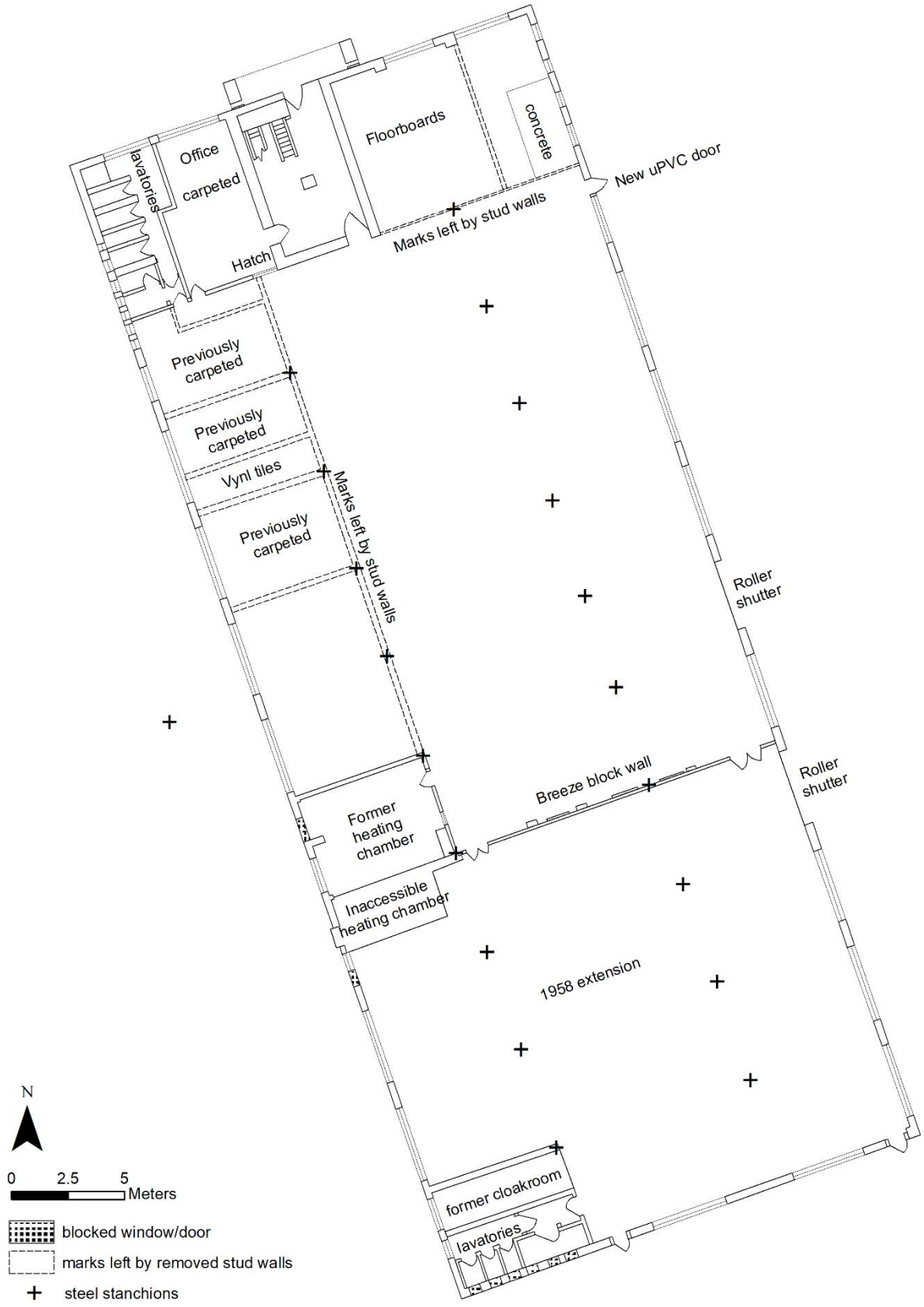


Fig 11 K51 as it is today based on surveys made in May and June 2018.

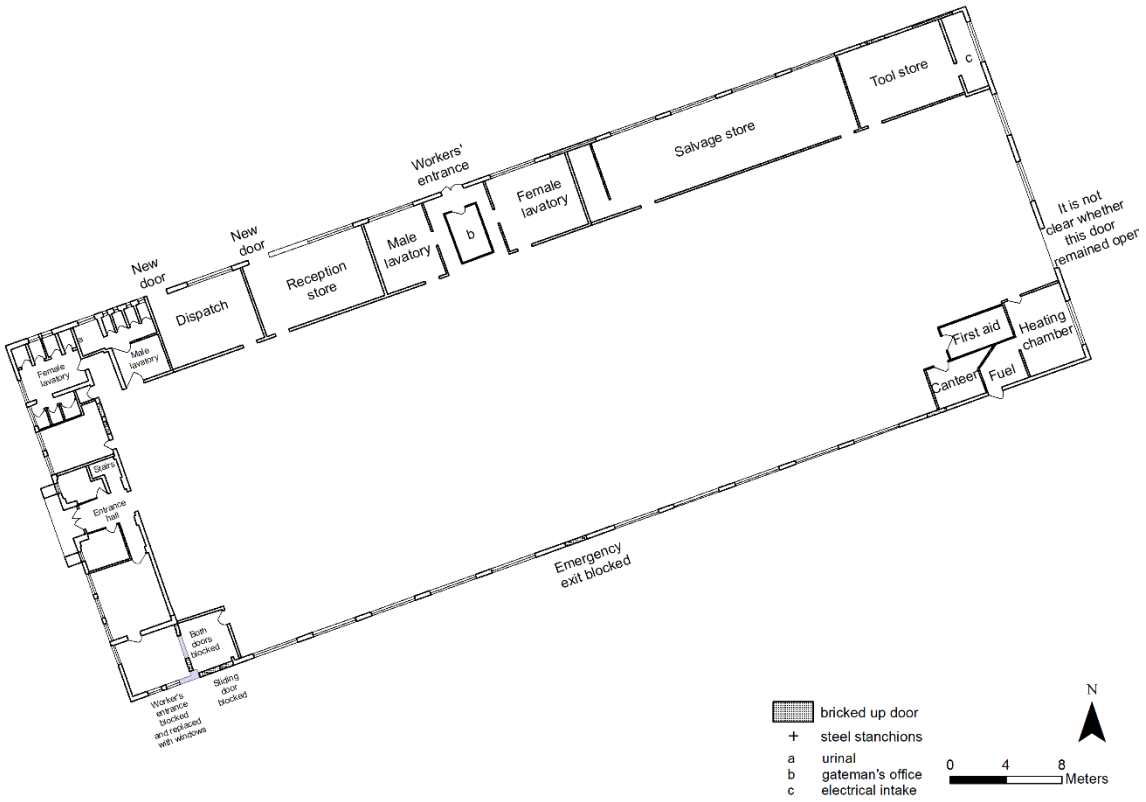


Fig 12 L50 in 1944 based on building control plan TWAM CB.GA/BC/plan/NET/161. This plan was for changes ahead of the Bren Manufacturing Company Limited occupying the factory.

Fig 13 photograph of L92 entrance, apart from the door itself this is the entrance built in 1939. Note the decorative canopy and planters to either side. The sides of the supports of the canopy are decorated with squares in relief.

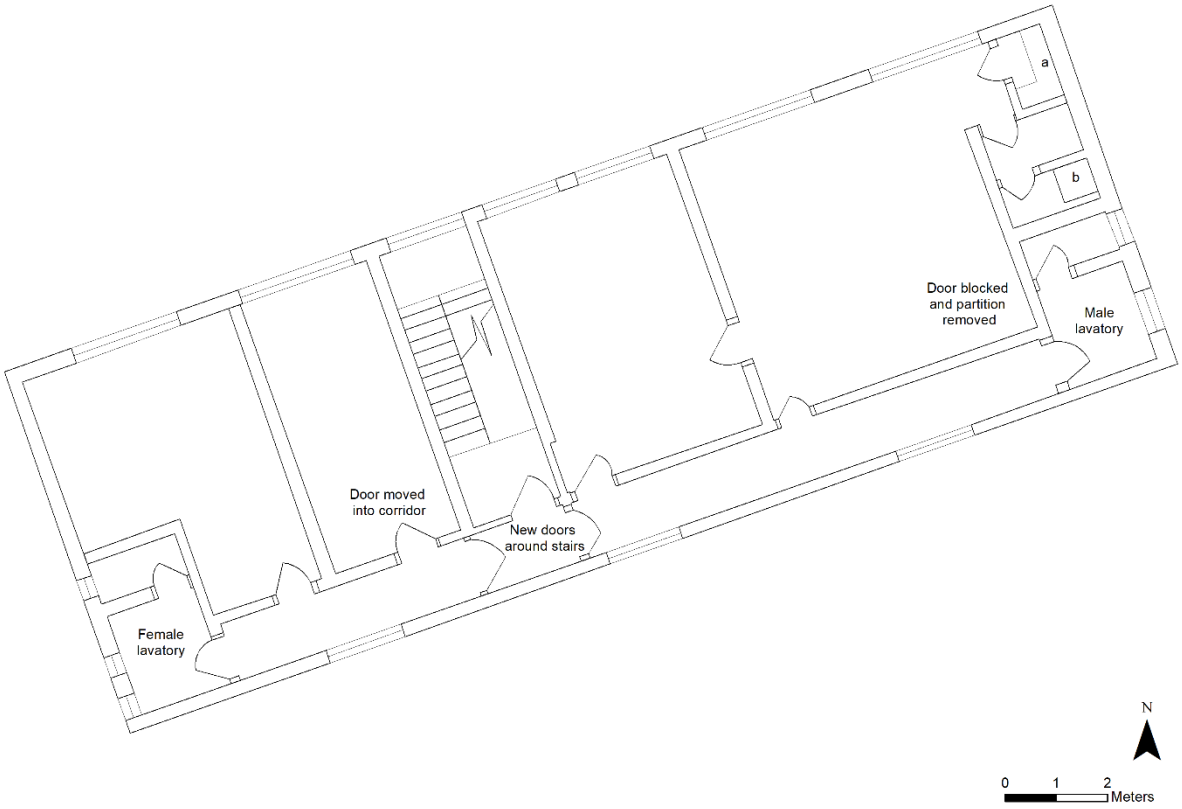


Fig 14 The K51 first-floor offices as they are today based on surveys made in May and June 2018.

Fig 15 The lavatory windows in the west elevation of the office block of K51. Although these differ from the four large windows shown on the building control plan (TWAM CB.GA/BC/plan/NET/52) the surrounding brickwork shows no sign that they were added later and so are probably part of the original build.

Fig 16 The west (front) elevation of L50. The entrance was rebuilt in the early 1970s and prior to this the first-floor was extended to the full length of the frontage. This is not apparent in the brickwork as the colour has been very carefully matched, though there are joints apparent in the concrete lintel above the windows.

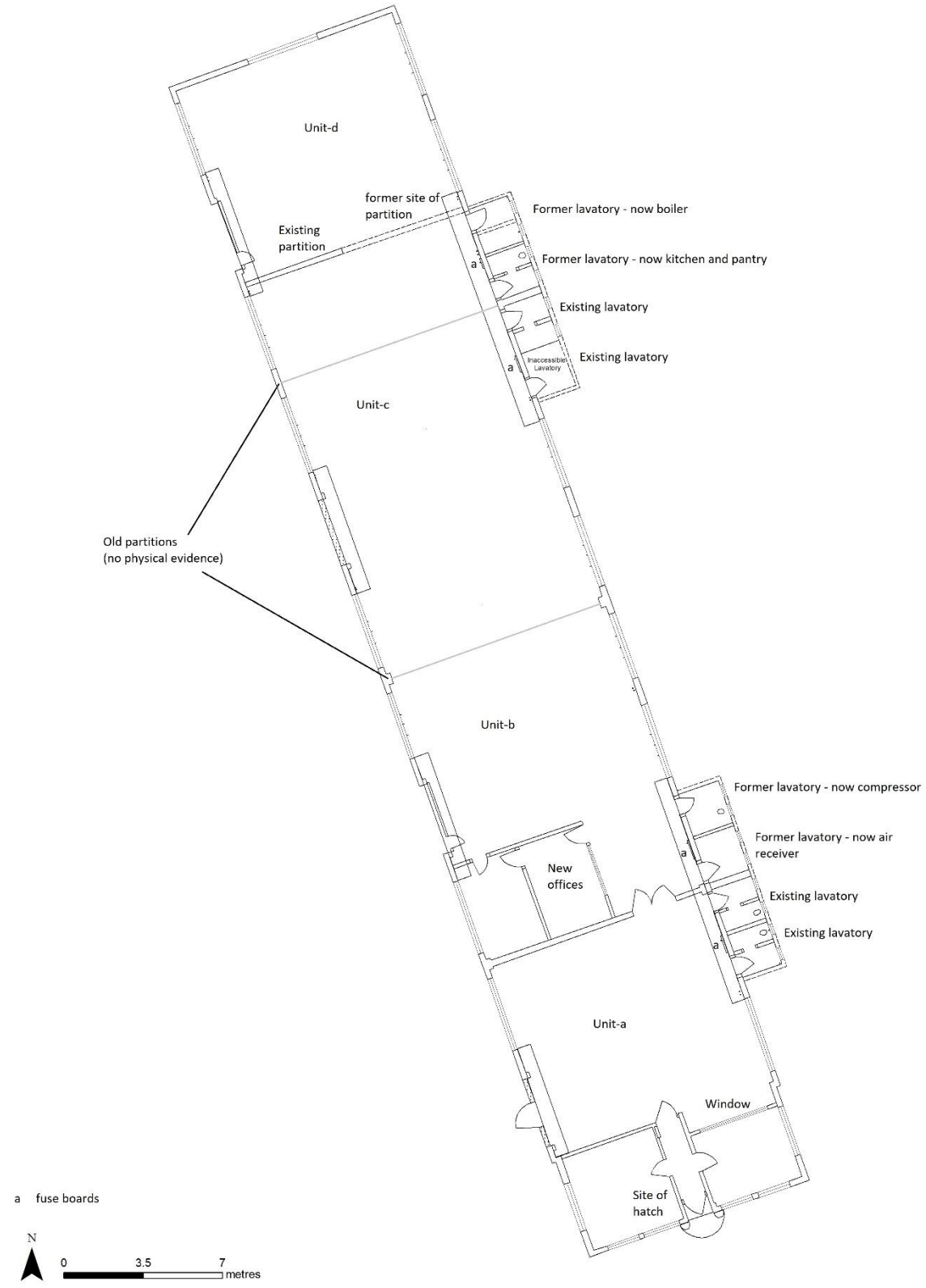


Fig 17 I60 as it is now based on surveys made in May and June 2018.

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