Alexandra Road Estate Heating Infrastructure

Technical Report | Feb 2020

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Executive summary

The heating network at Alexandra Road Estate is failing and in urgent need of repair.

In August 2019 Camden Council brought together a team to carry out a qualitative and quantitative review of the current heating infrastructure and evaluate which areas could be retained and re-used and which areas would require replacement and/or repair. This included a review of the heritage, visual, mechanical, technical and practical implications.

Through collaborative investigations, reviews and testing Levitt Bernstein, Max Fordham and BYA have been able to determine the condition of: the heating plant; distribution pipework; heating coils, tails and valves; and hot water cylinders. The aim was to take a balanced view on how best to ensure the dwellings receive adequate heat for the next 40 years.

The investigation has concluded that the patching up of the distribution pipework is no longer enough. To make the system fit for purpose again it must now be replaced.

As a consequence, the embedded heating coils have been reviewed, to determine if they can be reconnected to the new distribution pipework. Investigations included pressure testing and a review of the practicalities of locating heating coil tails and valves. The exercise concluded that it is not practical, economical, feasible or energy efficient to continue to use the heating coils. The heating coils must now be abandoned and new heating emitters investigated.

A consultation event was held with the Tenants and Residents Association where the findings were explained. The residents were generally pleased with the thoroughness and way the investigations were conducted, and supported the findings.

Camden Council and the design team can now use the findings of this study to move forward with a planning application and listed building consent to provide new estate distribution pipework.

Following this we will begin to design and consult with residents on heating emitter options to determine the best route to heating homes.

1.0 Introduction

1.1 Purpose of this report

This report has been produced by Levitt Bernstein, on behalf of London Borough of Camden, to provide a technical review of the current heating infrastructure at the Alexandra Road Estate.

Through collaborative investigations, reviews and testing we set out to determine the working condition of: the heating plant; distribution pipework; heating coils, tails and valves; and hot water cylinders.

This is to allow us to take a balanced view on how best to ensure the dwellings receive adequate heat for the next 40 years.

1.2 The team

London Borough of Camden
Argyle Street
London
WC1H 8NJ

The London Borough of Camden have commissioned the technical study and will be implementing the outcomes.

Architect
Levitt Bernstein Associates
Thane Studios
2-4 Thane Villas
London
N7 7PA

Levitt Bernstein have been tasked with co-ordinating and reporting the outcomes of the study, with an in-depth understanding of the historic importance of the works.

Building Services Engineer
Butler & Young Associates (BYA)
1st Floor 54-62 Station Road East
Oxted Surrey
RH8 0PG

BYA are coordinating the building services design for the upgrades to the heat network.

Independent Building Services Consultant
Max Fordham LLP
42-43 Gloucester Crescent
London
NW1 7PE

As part of the original design team, Max Fordham have been invited to provide expert advice on the design of the original heating system, its likely longevity and their best judgement opinion on the future of the heating.

Figure 1.0 - Alexandra Road Estate

2.0 Location, context and existing site

2.1 Architectural history

Designed in 1968 and built between 1972 and 1978 by the London Borough of Camden Architects Department, Alexandra Road Estate is one of the most ambitious examples of the innovative new social housing emerging from the Department at this time, and of new housing in Britain. Its architect was Neave Brown.

Camden was formed in 1965 from the London Boroughs of Hampstead, Holborn and St Pancras and was one of the largest, wealthiest and most ambitious of the new London Boroughs. The architect's department under the leadership of Sidney Cook was, like all local authorities, under great pressure to build large amounts of housing. Camden developed low rise, high density schemes to meet this demand rather than the system built high rise schemes adopted by many other local authorities. The Estate was seen as an opportunity to improve a whole area by the inclusion of a public park and the provision of social buildings such as the community centre, shops and special needs school.

The street is the dominant element in the design and seen as a modern translation of the traditional London Street, where the sum of the whole exceeds the individual parts in creating a meaningful urban space. All dwellings are entered directly from the streets, which are freed of traffic by the parking garage provided at low level.

The estate can be seen as one of the most successful examples of the segregation of traffic and the pedestrian, and it remains a successful social space.

The linear stepped section was influenced by work developed by Leslie Martin - an idea also developed by Denys Lasdun at the University of East Anglia (1962-68) and by Patrick Hodgkinson at the Brunswick Centre in Bloomsbury (1967-72). At Alexandra Road the stepped section enabled all dwellings to have a sunny outdoor space and was further utilised to shield the estate from the noise of the railway line to the north. Alexandra Road Estate also represents a development of Neave Brown's earlier work for housing societies, undertaken while he was in private practice, at Winscombe Street and Fleet Road. Though on a much smaller scale, these too were essays in high-density developments of stacked dwellings and the considered sequencing of spaces moving from public and semi-public to private and semi-private.

The construction of the Estate is of white board marked concrete with areas of self-coloured render. The predominant materials are light in colour with contrasting joinery, inside and out. Concrete forms the large, complex section, and the areas of self-coloured render is a reference to the Regency terrace. At Alexandra Road the quality and detailing of the materials is high. The care devoted to the internal fittings was perhaps unique amongst local authority departments at this time.

The quality and importance of the estate has been widely recognised both in England and abroad. It is a powerful icon of the optimism and idealism that underpinned post-war public sector architecture. It continues to be regularly visited by architectural students and practitioners.

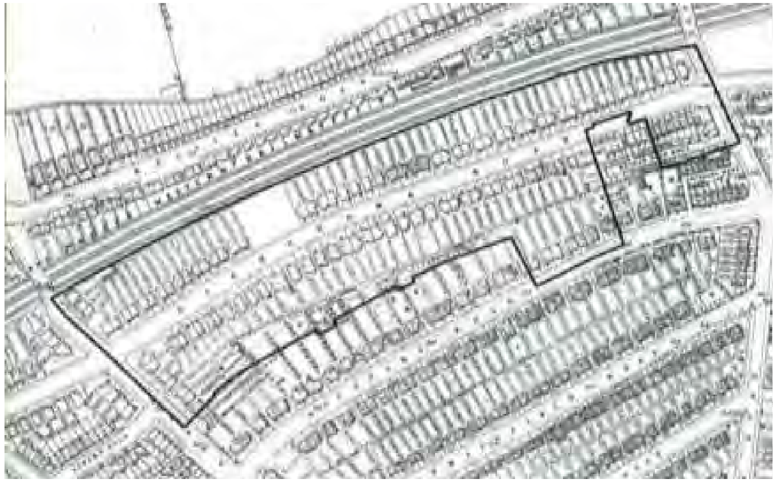


Figure 2.0 - Ordnance survey 1871

Figure 2.1 - Ordnance survey 1965

Figure 2.2 - Block A South elevation

Figure 2.3 - Aerial view of Rowley Way and Langtry walk under construction

2.2 Building services history

Not only did the architecture showcase innovation but so did the building services design . Max Fordham's original heating design included steel pipe coils cast into concrete party separating walls fed by hot water from the district boiler house.

The response to the heating was borne out of the unique architecture, which has few windows with high cills and a desire to avoid radiators obstructing the wall surfaces. The choice of pipe coils set into the walls came about as a cost advantage over underfloor heating and radiator options.

The heated walls are built from concrete containing limestone aggregate. Extra reinforcement was necessary to control tension caused by the increased temperature at the centre of the wall. The reinforcement was formed in two layers instead of one in the centre plane of the wall. Gable ends of each block are cast in two panels, separated by an expansion joint to allow for movement of the inner panel containing the heating coil and also to provide insulation.

The heating coil pipes were made of steel, as copper tends to corrode. They were prefabricated off site in sizes suitable for transportation and welded on site.

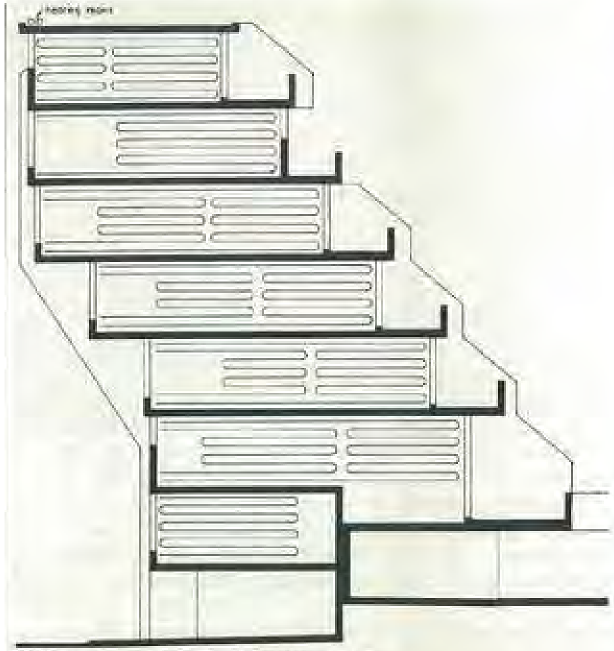
The design of the heating system was primarily required to meet three main criteria:

1. Installation of a heating system which did not obstruct the walls in order to avoid the obstruction caused to furniture positions.
2. Design a form of heating that would avoid the likelihood of condensation in dwellings by being cheap to run. Initially it was felt acceptable to sacrifice some measure of individual tenant control to achieve this. This was later revisited with some tenant control provided.
3. The soundproofing of the rear of Block A and the likelihood that the windows would remain closed, led to the need for mechanical ventilation to the rooms at the rear facing the railway.

Detailed investigations found that satisfactory conditions could be achieved by heating alternate party separating walls instead of every wall. The heated walls were designed to have a surface temperature of 38°C. The need for tenant control was overcome by installing small fans with heater batteries and using a weather compensator in the boiler house for the heating coils. The heater battery was designed so that it could be by-passed in summer to allow incoming fresh air to be either be hot or cold.

Each housing block was designed to have separate temperature control. The response of the pipework was quick to warm but the concrete was known to be slower. The fan heaters were designed to deal with this time lag.

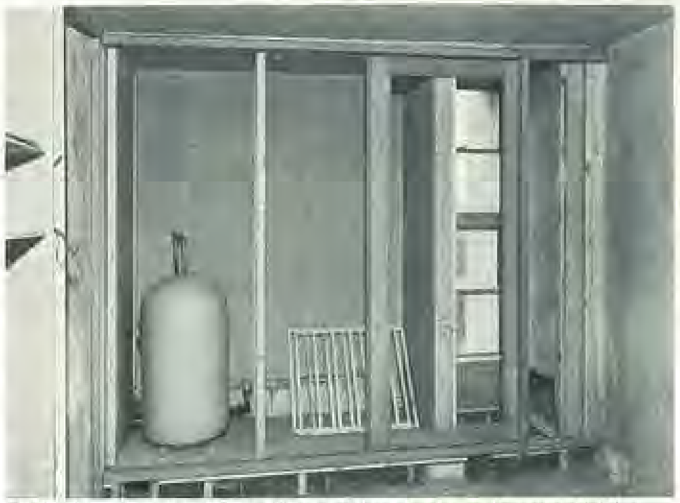
Domestic hot water was provided to each home as part of the communal heat network and stored hot water cylinders.



Q *Arrangement of cast-in heating coils.*

3 *The prefabricated heating coils are stacked ready for placing in the cross walls.*

4 *The heating coil can just be detected between the two skins of reinforcement.*



5 *Cupboard unit against the wall beside the railway provides additional sound resistance. The calorifier acts as a heat exchanger for domestic hot water. Under the cupboard is the fresh air inlet convector with a long shunt duct to reduce noise from outside. The window reveal covered by a sliding glass door acts as a deep double glazed unit. Note the tapering scribed timber at high level due to tolerance difficulties.*

Figure 2.4 - Extract from The Architects Journal 1976

2.3 Site Listing

As the conservation area covers land which was redeveloped by one landowner, the council, over a relatively short time span in the 1970s, the character of the area is homogeneous.

The estate has a strong geometric quality, orthogonal arrangements being varied by the use of bold chamfers, in both plan and section. Use is made in all the blocks of stepped and overhanging sections.

Throughout the estate, play is made of changes of levels with associated ramps, stairs and light wells.

Much of the estate is constructed of fair-faced, white concrete with chamfered arises. Careful attention was given to the detail and execution of the board-marking and day-work joints. The north face of A block, the south face of B block and both faces of C block are of self-coloured render.

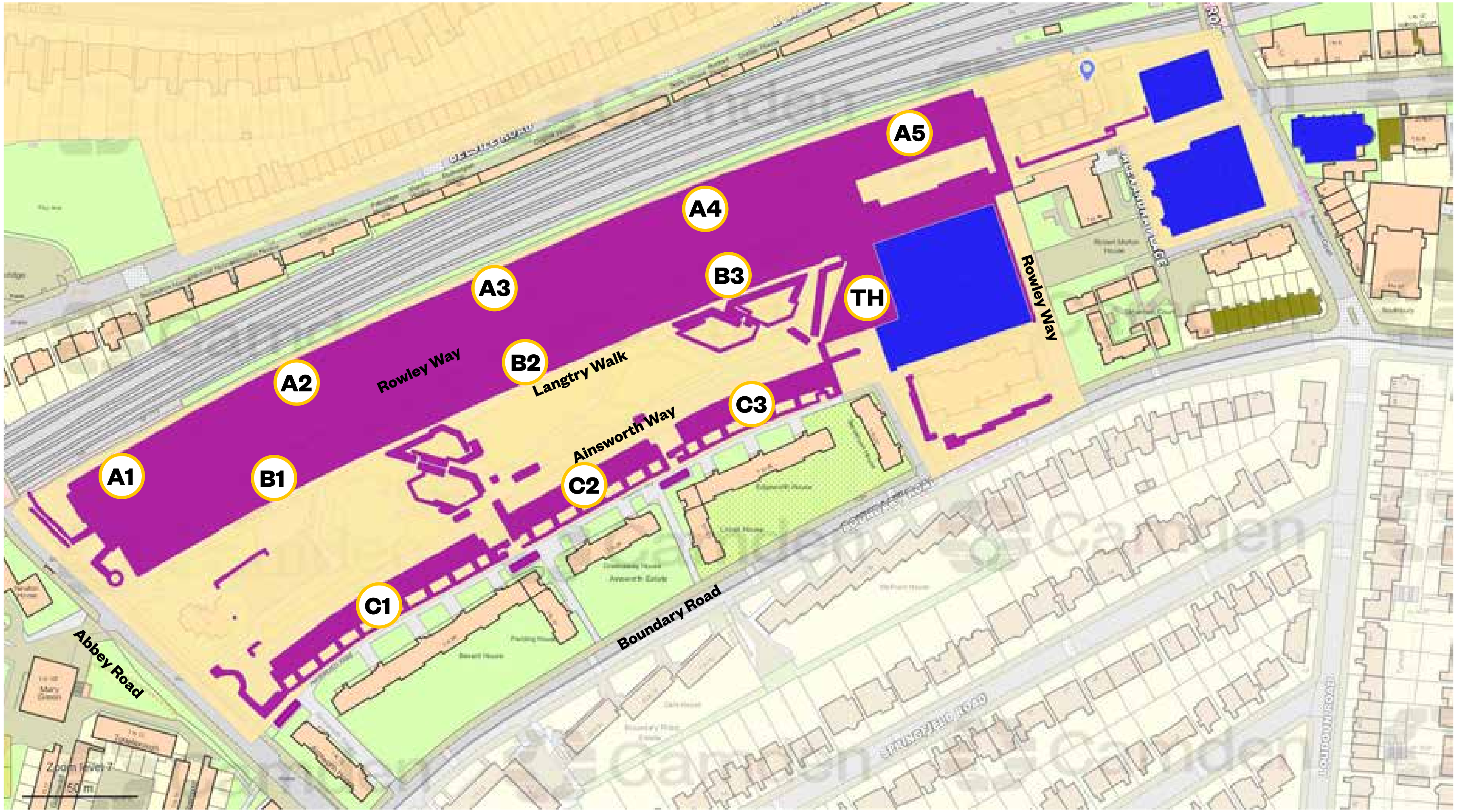


Figure 2.5 - Conservation Plan

Key

- Grade II* Listed
- Grade II Listed
- Alexandra Rd Estate Conservation Area
- A3 Housing block number
- TH Tennant's Hall

2.4 Location

The Alexandra Road Estate is bounded by, Loudoun Road on the east, on the south by Boundary Road, Abbey Road on the west, and by the West Coast Main Line to the north. Block A follows the geometry of the tracks and is organised in the form of a ziggurat, stepping down in height towards the central pedestrian street, Rowley Way. Block B, a lower, 4-storey block runs along the other side of a Rowley Way. Block C runs east-west along the southern edge of the site, sitting parallel to another public walkway.

Block B, the lower 4-storey building along Rowley Way contains maisonettes with shared access, terraces, and gardens over-looking the park at the rear. Maisonettes also occupy the top two levels of Block A opposite, with entrance from a walkway on the 7th floor that runs the entire length of the structure. Dwellings in the lower floor in this block are entered from open stairs serving two dwellings per floor. The flat roofs of the stepped elevation provide private outdoor areas for every home.

There are a number of different dwelling types, all sharing a similar approach and a number of key features. The high density of the estate led to tight interior layouts, mitigated by open plan elements. Sliding doors and glazed partitions allow flexible arrangements, with the potential for views and light to pass through each dwelling.

The proximate relationship of public and private is eased by porches, decks and planting. Finishes are restrained, white paint contrasting with stained timber and brown tiling. Internally, simple joinery shelves and cupboards are formed from plywood, while the stairs are a more developed piece of joinery work. In the kitchens, concrete worktops form a striking, almost sculptural element. These are tiled, as are the walls, forming a very deliberate composition.

Figure 2.6 - Site photos

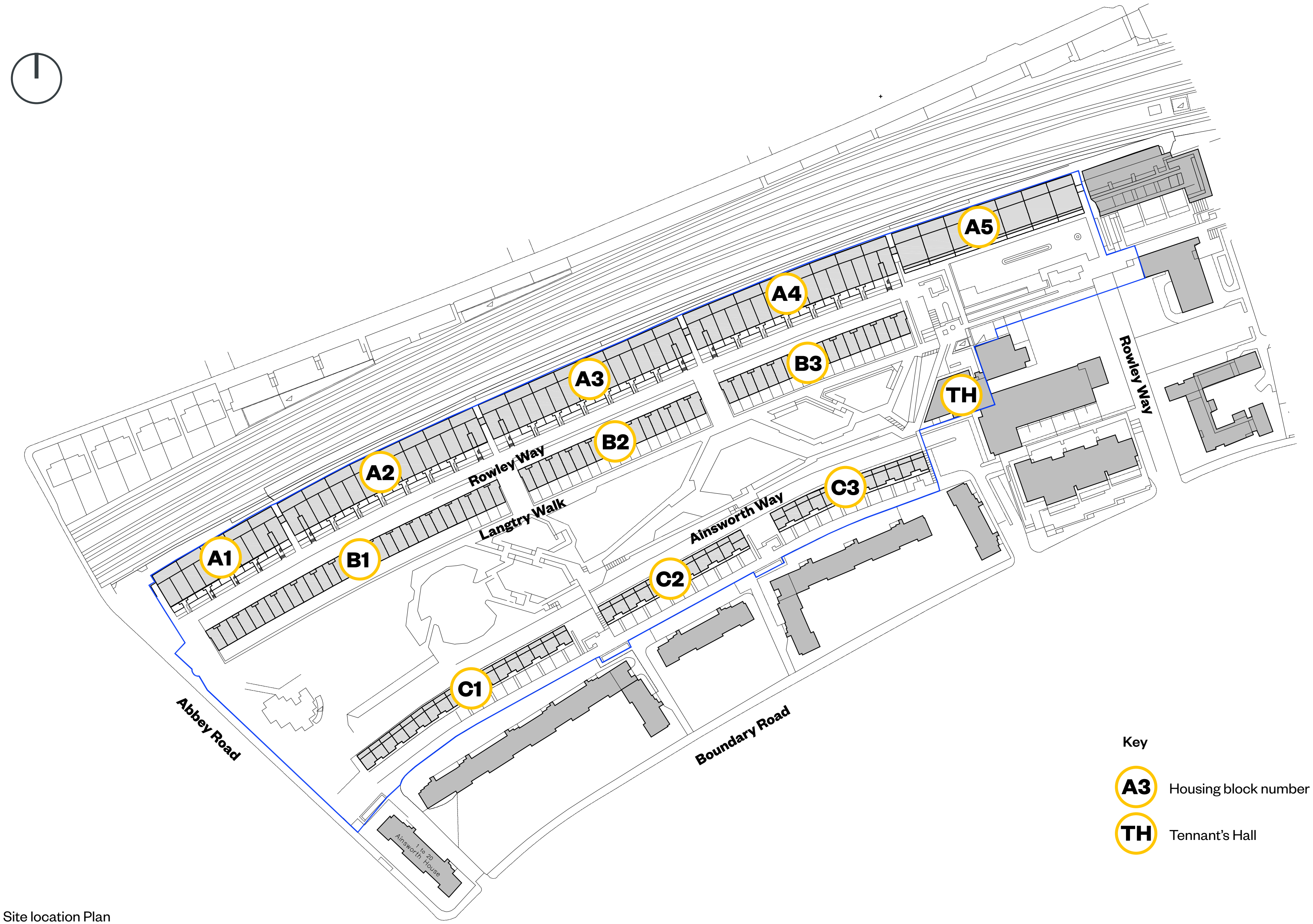
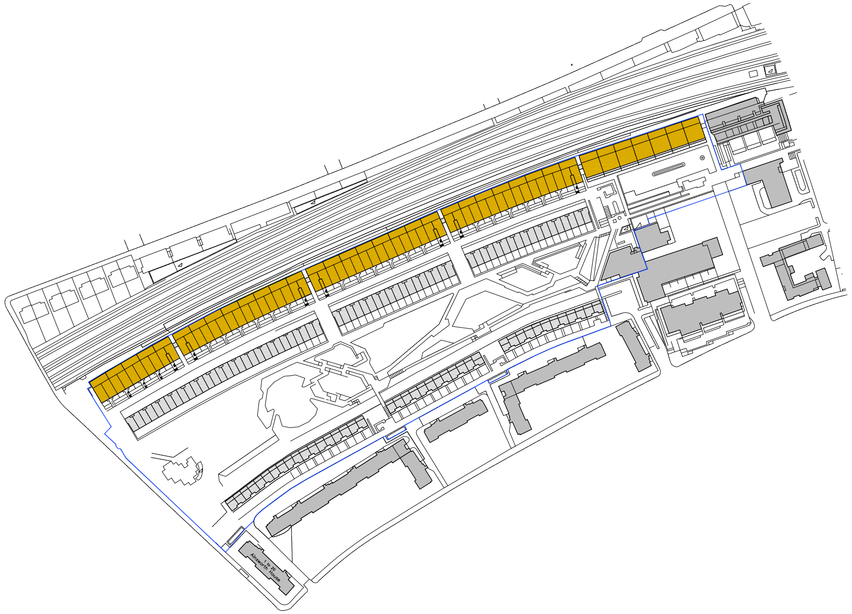


Figure 2.7 - Site location Plan

2.5 Block A



Block A is the tallest (7-storeys plus basement parking) and backs on to the railway to the north of the Estate, presenting a mostly solid elevation with relatively small double-glazed aluminium windows. The south facing aspect is more open and steps down to Rowley Way, which is paved with red brick and lined with trees. The curved sweep of Block A is punctuated by the recessed glazed lift enclosures. which restricts access for maintenance and repair.

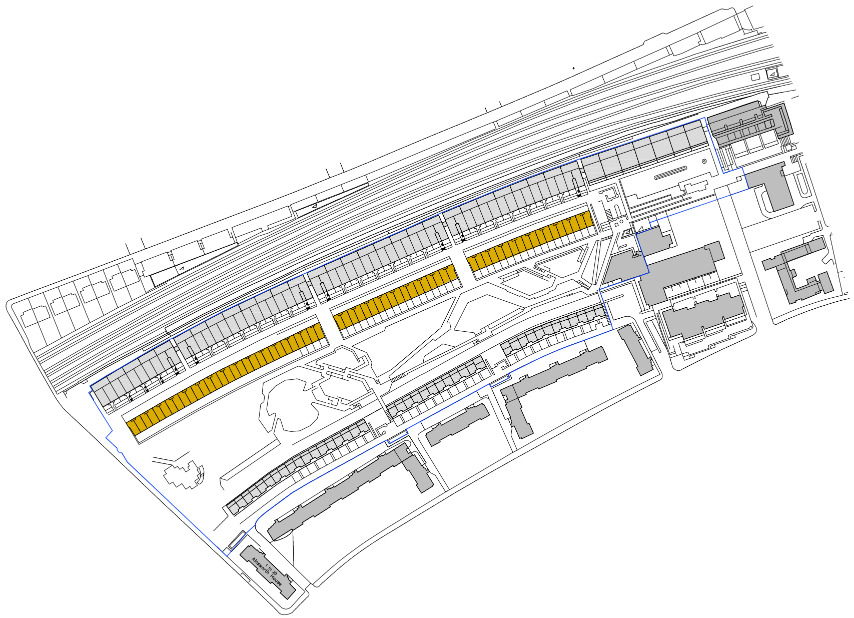
Figure 2.8 - Rowley Way between Block A and Block B

Figure 2.9 - Rear of Block A

Figure 2.10 - Rowley Way front of Block B

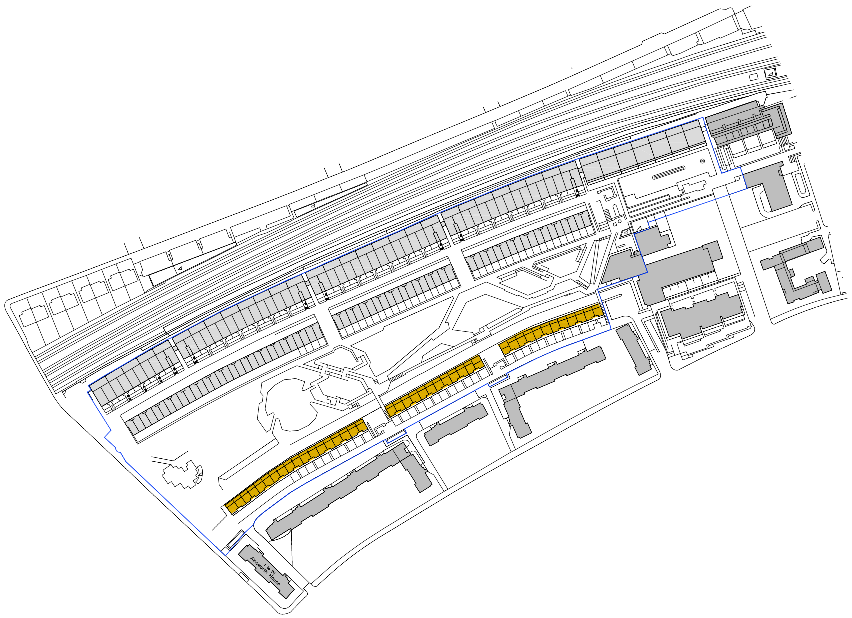
Figure 2.11 - Rear of Block B

2.6 Block B



Block B on the opposite side of Rowley Way is lower (4-storeys) but also stepped in a manner similar to Block A. Each flat or maisonette is provided with its own terrace/garden area with integral in-situ concrete planters. Both Blocks A and B sit on a concrete deck. A parking garage is placed beneath Block A and Rowley Way as a response to requirement of the original brief to provide sufficient parking spaces for residents of the new estate and the existing Ainsworth Estate. The south elevation of Block B is of plain render and is not stepped. A broad band of landscaped lawns, enclosed play areas and integral seating, stretches two-thirds of the length of the site from Abbey Road in the west to the Tenants' Hall in the east and separates Blocks B and C.

2.7 Block C



Block C is a lower, modified form of Block B, and consists of three-storey town houses. Parking is provided at lower ground level reached by one of the estate roads entered from Boundary Road. The gardens of Block C face south but are rather overshadowed by the neighbouring blocks of the earlier Ainsworth Estate.

Figure 2.12 - Block C facing Ainsworth Way

Figure 2.13 - Block C under the pedestrian bridge

2.8 Accommodation schedule

The estate blocks are designated as follows;

The 520 dwellings comprise of a mix of flats and maisonettes

Block A1
8 x 3 bed
10 x 2 bed
32 x 1 bed

Block A2, A3 & A4 (each)
12 x 3 bed
16 x 2 bed
52 x 1 bed

Block A5
14 x 2 bed
42 x 1 bed

Block B1
30 x 3 bed
30 x 2 bed

Block B2 & B3
18 x 3 bed
18 x 2bed

Block C1
18 x 4 bed

Block C2
12 x 4 bed

Block C3
12 x 4 bed

2.9 Tenants and leaseholders

At the time of writing this report there are 111 leaseholders on site with the remaining apartments owned by Camden Council.

At any one time there are a number of void units which allow trials and maintenance work to be carried out.

2.10 Heating and hot water installations on site

The majority of homes have their heating and hot water supplied by the communal heat network. In these instances space heating is provided by the original wall coils and hot water is supplied to the hot water cylinders.

In some cases the heating and/or hot water has failed and been replaced. The complete picture of homes using alternative heating or hot water is unknown, however the following information was made available:

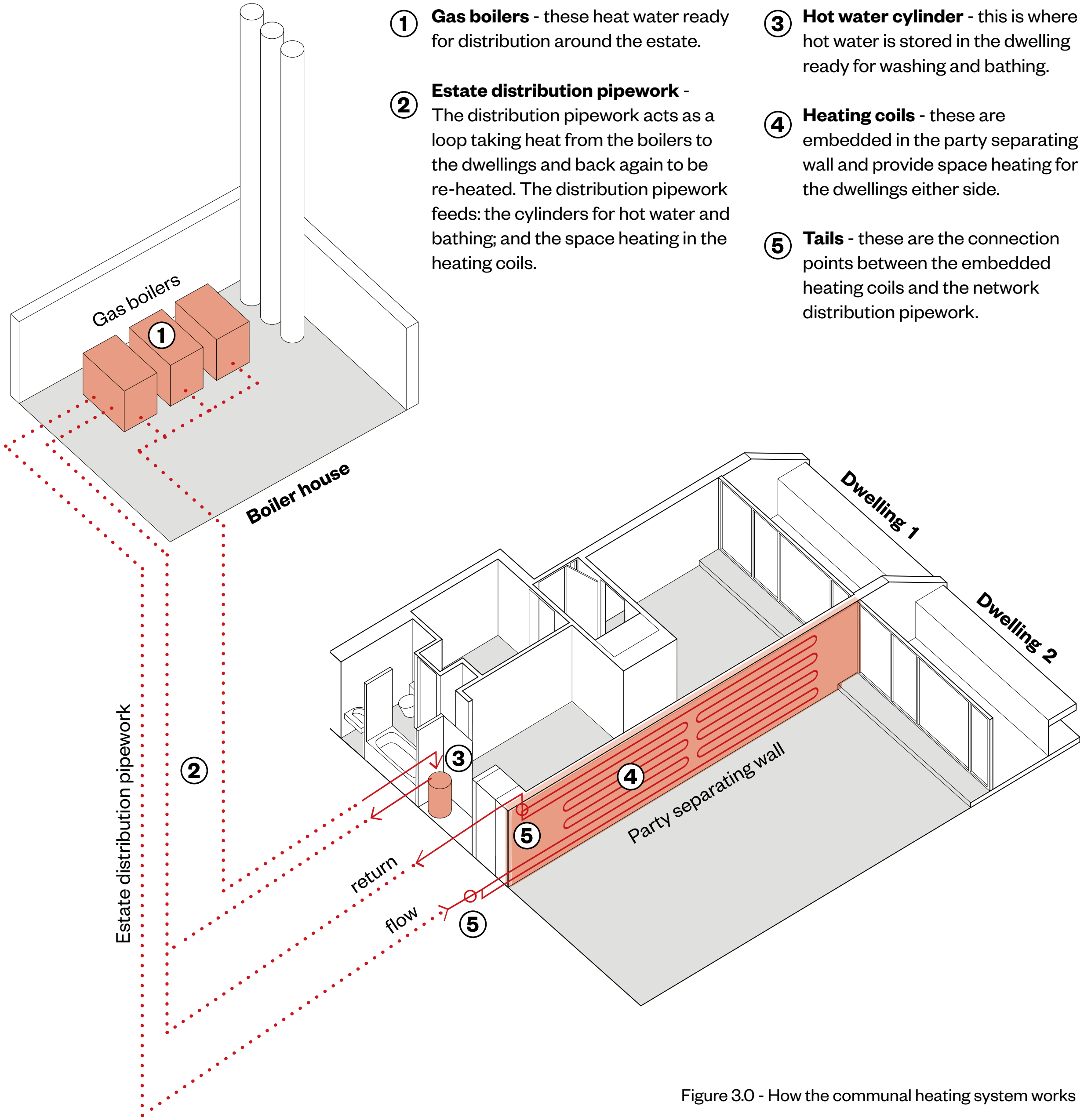
- 54 tenant properties are known to have had their hot water cylinder converted to electrical immersion. There is likely to be more than this, however the full number is unknown.
- Some homes no longer receive heat from the communal heat network. At least three properties are known to have individual gas boilers (two tenants and one leaseholder).
- In some homes where heat no longer reaches the heating coils in dwellings due to a failure, radiators have been provided as an alternative heating source. The number of homes using radiators is unknown.

3.0 How the communal heating system works

Plant distribution
Heating and hot water is supplied to the Alexandra Road Estate via a communal heat network. Three gas boilers in the boiler house heat water which is pumped around the estate in communal heat network pipes. This provides heating and hot water to each dwelling.

Hot water
Hot water for washing and bathing enters homes and apartments and supplies a hot water cylinder within the apartment. This cylinder is often located in a cupboard or under stairs. It stores hot water all year round ready for use.

Heating
Heating to homes and apartments is provided by steel pipe heating coils embedded into the party separating concrete wall between dwellings. This provides a shared source of heat between neighbouring dwellings. The heat network is connected to the heating coils via tail connections. The heating coils are supplied with heat between October and May to keep dwellings warm.



① **Gas boilers** - these heat water ready for distribution around the estate.

② **Estate distribution pipework** - The distribution pipework acts as a loop taking heat from the boilers to the dwellings and back again to be re-heated. The distribution pipework feeds: the cylinders for hot water and bathing; and the space heating in the heating coils.

③ **Hot water cylinder** - this is where hot water is stored in the dwelling ready for washing and bathing.

④ **Heating coils** - these are embedded in the party separating wall and provide space heating for the dwellings either side.

⑤ **Tails** - these are the connection points between the embedded heating coils and the network distribution pipework.

Figure 3.0 - How the communal heating system works

3.1 Boiler house

The boiler house contains three Hoval Max-3 2200 2.5Mw gas boilers which were installed in 2014 to replace the three Allen Ygnis AY4208 dual fuel boilers (Natural gas and 35 second oil). This was to reduce breakdowns and improve their efficiency.

When the boilers were replaced the three iconic original steel flues were also replaced with insulated twin wall stainless steel stacks clad in aluminium.

As noted in the Building Services Engineer Journal from April 1978 (Appendix X) and the NIFE's Report from 2008 (Appendix X) the system was designed to operate at the following temperatures:

- Primary hot water flow temperature - 115°C
- Primary hot water return temperature -85°C
- Variable heating flow temperature - 82/60°C
- Variable heating return temperature - Variable

In 2008 the system was found to be operating at slightly lower temperatures due to problems on the system. However, the temperatures and pressure may be increased during the winter.

A new plate heat exchanger was also installed to separate the poor water quality in the existing network from damaging the new boilers.

A side stream filtration system has been fitted on the distribution side of the plates to attempt to clean the water in the network.

The boiler plant operates 24 hours a day, 7 days a week and 52 weeks a year to provide domestic hot water. Between the months of October and May the boiler plant also serves the space heating across the estate.

Figure 3.1 - Gas boilers in the boiler house

Figure 3.2 - Gas boiler flues rising from the boiler house

3.2 Distribution of heat on-site

The heat from the boilers is distributed across the estate to serve the space heating and domestic hot water requirements. The distribution pipework acts as a loop, taking heat from the boilers to the dwellings and back again to be re-heated. The estate distribution pipework feeds the cylinders for hot water and bathing, and the space heating through the heating coils.

The network pipework coming from the boiler to the dwellings is called the 'flow' and the pipework returning to the boilers to be re-heated is called the 'return'.

Heat was originally served via a three pipe system (variable temperature pipe for heating, constant temperature pipe for DHW, and a common return pipe). Camden introduced a fourth pipe for constant temperature hot water (blocks A1 to A5), this provided additional hot water to those homes not receiving enough. The three pipe system still remains on blocks B1-B3 and C1-C3. Figure 3.5 shows the four pipe system..

The heat network currently serves these areas:

- Rowley way (Block A)
- Langtry Walk (Block B)
- Ainsworth Way (Block C)
- Council offices
- Youth centre
- Tenants Hall
- Loudoun Road Workshops and flats
- Alexandra Place

Ainsworth Estate is not planned to be on this communal heat network.

Block A

Heat distribution exits the boiler room and runs on the underside of the pedestrian bridge towards the Estate Office. They enter the Estate Office at high level then run to the rear, rise up the existing lift shaft and onto the roof of blocks A1 to A5. The pipes then run horizontally along the roof of block A (figure 3.3). The heating drops in concealed risers to the rear of the properties where it connects to the heating coils in party walls. The domestic hot water drops, via the rooftop cold water tank pods, in risers in the centre of apartments to feed the cylinders in pairs of flats on either side of the separating party wall (each riser serving 10 apartments).

Block B

Heat distribution pipework runs at lower ground through the rear of the garages level to serve block B (figure 3.4). It rises up under the entrance stairs of the dwellings and in to a pair of ground floor maisonettes where it distributes to the pair of maisonettes above.

Block C

Heat distribution pipework leaves the boiler house from the rear and travels underground to the garages in block C. In a similar fashion to block B it is run at the rear of the garages. Each pair of town-house is served via an internal riser.

Figure 3.3 - Roof of block A showing distribution pipework and blue cold water tank pods

Figure 3.4 - Garage under block B showing distribution pipework along the back wall

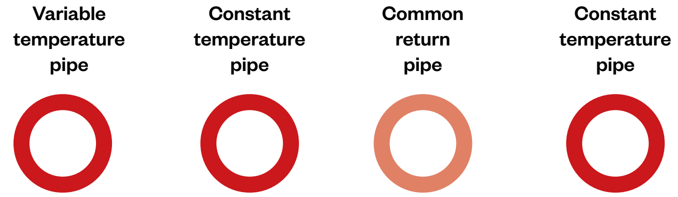


Figure 3.5 - Four pipe system diagram

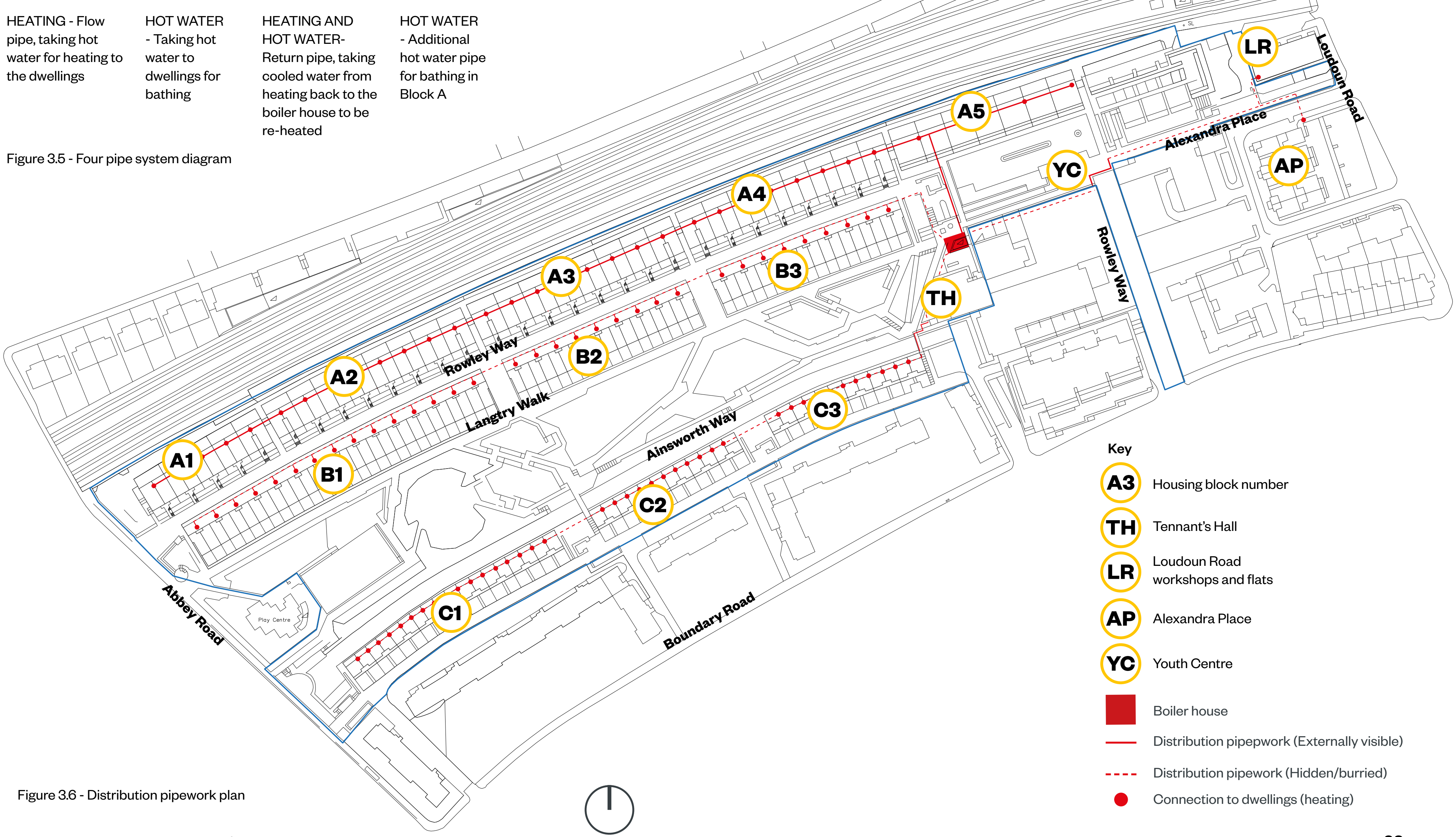


Figure 3.6 - Distribution pipework plan

3.3 Heating and hot water in the homes

Heating coils
Original steel pipe coils are embedded within the concrete party walls which provide joint radiant heating to each flat either side of the party separating walls. The radiant heating was designed to cater for the fabric proportion of the heat loss.

The heated walls were designed to have a surface temperature of 38°C and have been observed to still operate at this temperature. Figure 3.7 shows the recorded temperature of the wall in winter of 2019, seen through a thermal imaging camera.

Due to the shared nature of the heated walls there is no control available to residents to turn their heating up or down.

Tails
The tails are the connection point between the embedded heating coils and the distribution pipework. These are located on either side of the separating heated wall. To access these the concrete walls would need to be broken open on both sides of the wall. These would only need to be accessed in the event of a failure or leak, or if the replacement distribution pipework needed to be re-connected to the coils.

Valves
Valves are required to locally shut-off the heat to the coils. This allows for maintenance and repair of the distribution pipework and/or the heated coil. In block A one set of valves to isolate a heating coil are located on one side of the wall at low level in a riser . The second set of valves are located on the other side of the wall in the flat above. This is problematic for maintenance teams when attempting to shut off or fix a leak in the distribution pipework or heating coil.

Fan heaters
A concealed fan coil/warm air unit once provided heat for topping-up purposes to bring the ambient air temperature up to around 21°C. This was to provide heat to cover the ventilation loss. Fresh outside air was to be brought into the fan coil unit where a damper is fitted such that it can divert fresh air in summer for nominal cooling or via the heating coil to provide heating in winter. These fans provided a form of tenant heating control outside of the heating season and while waiting for the coils to warm up.

The concealed warm air heater has since long been decommissioned due to dirty air being taken from garages at ground levels and blown into homes. All heater fans are now obsolete and in some cases have been removed completely.

Domestic Hot Water
Hot water for bathing enters homes via a hot water cylinder. This stores hot water for instantaneous use around the home.

Some homes have had their cylinder replaced with an electrical immersion cylinder, this is because they were not receiving enough hot water from the heat network.

Figure 3.7 - Thermal image of a heated wall coil in block A , showing a surface temperature of 38°C

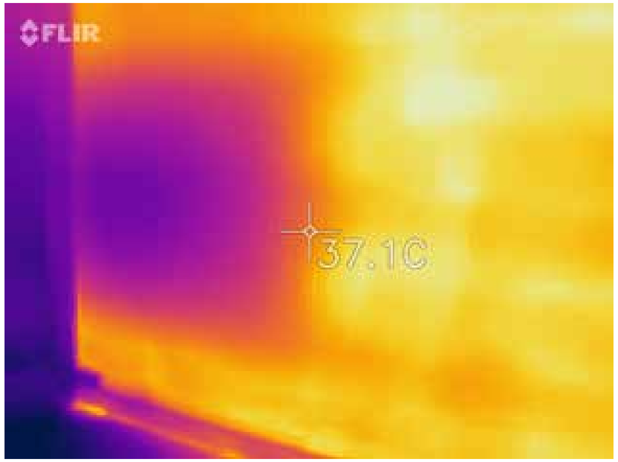
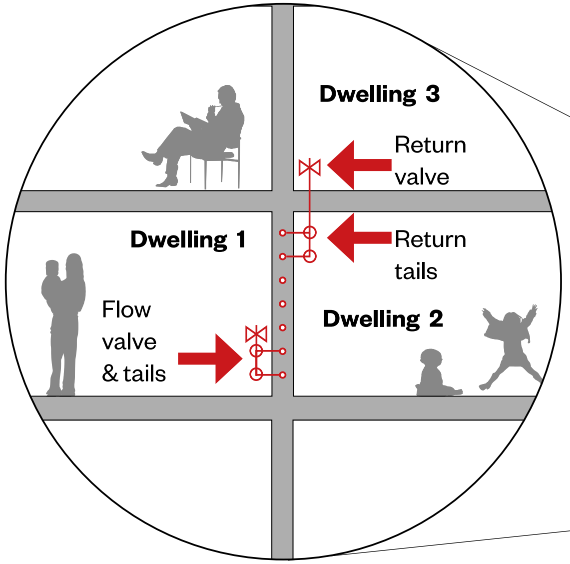


Figure 3.8 - Thermal image of a heated wall coil in block A , showing the link to the tail connections. The cold purple patch shows the unheated area between the tail legs at the top and bottom of the wall.

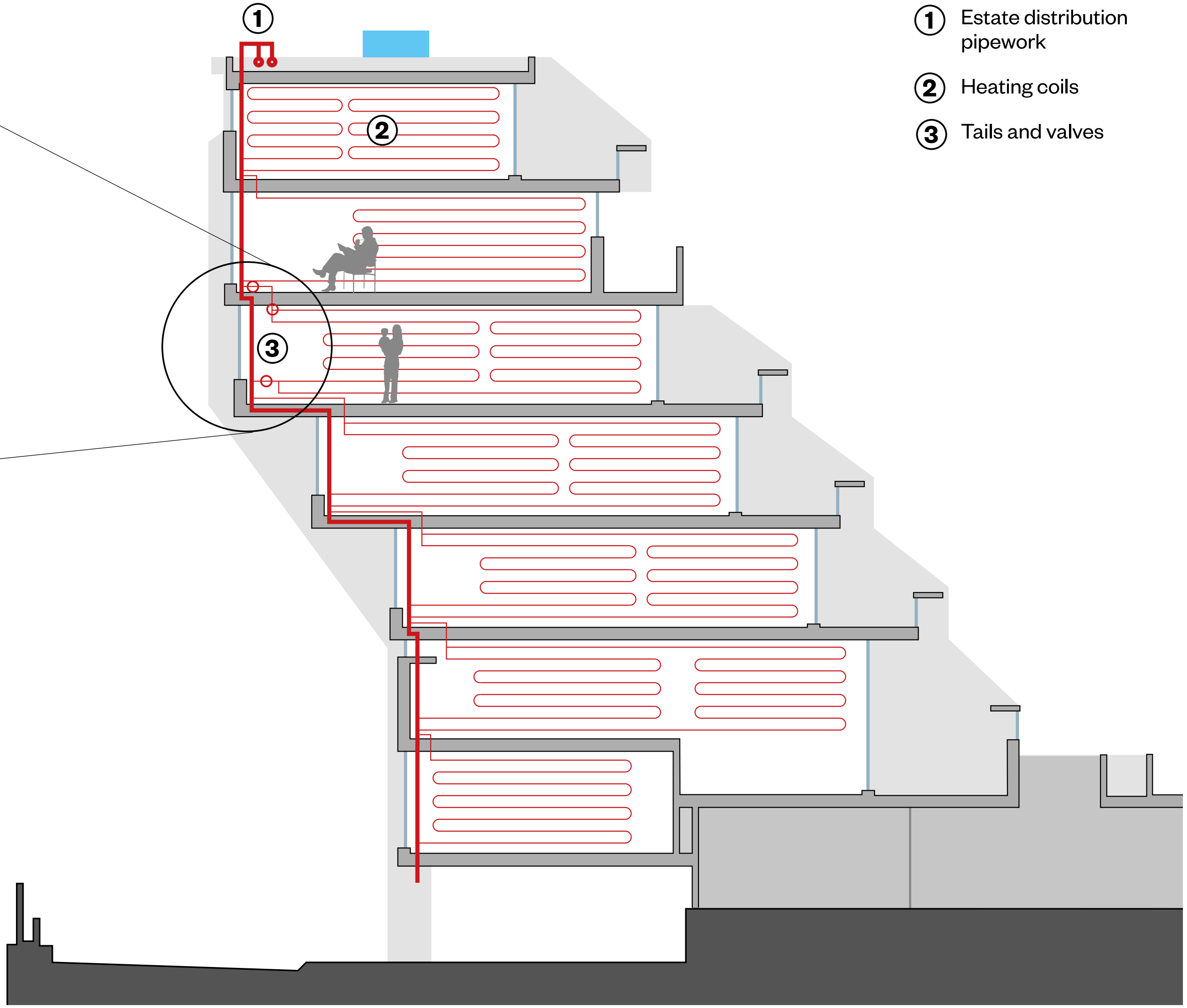
Section through Block A - showing heating coils, tails and valves



3.4 Block A heating

The existing heating estate distribution pipework is routed from the main plant room over to Block A where it runs at roof level. The distribution pipes from the roof drop in internal risers on the north side of block A in every other party wall, where they connect to the heating coils via the tails and valves.

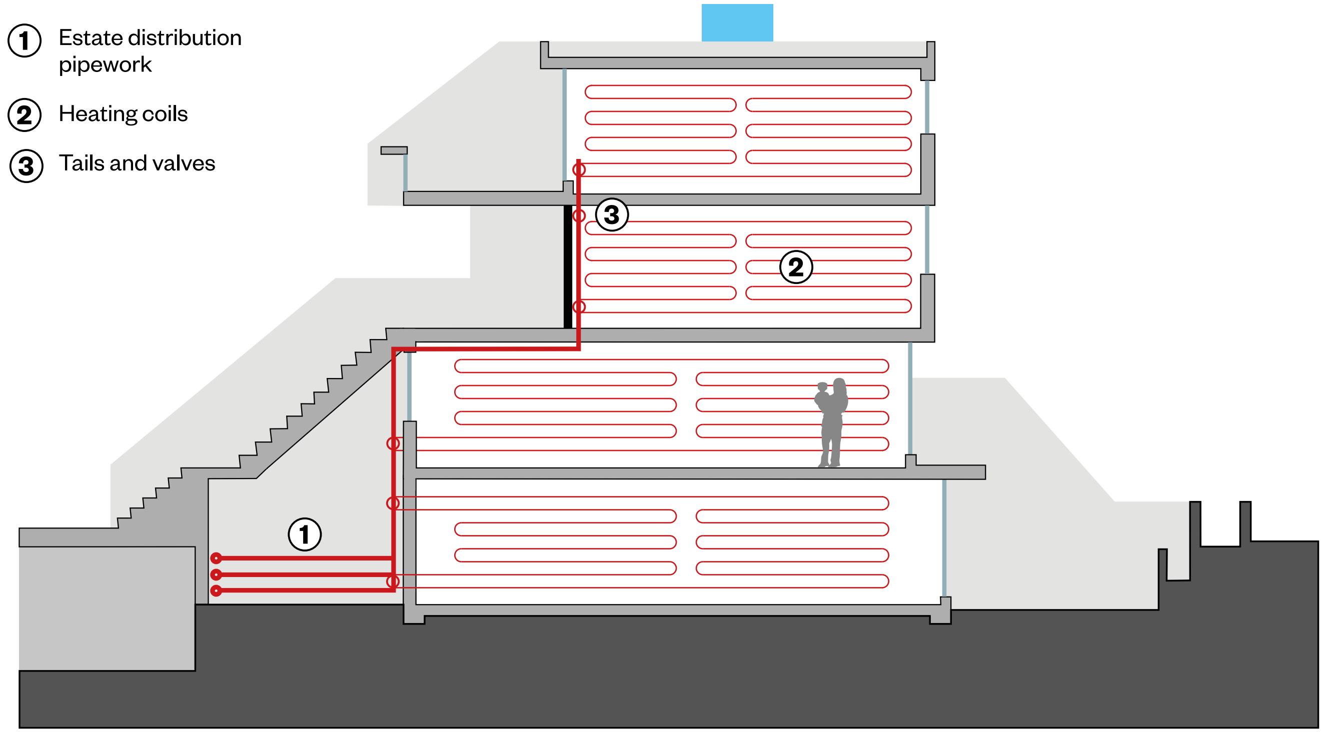
Figure 3.9- Tail connections to the heating coils in Block A



Section through Block A - showing estate distribution pipework, heating coils and tails

3.5 Block B heating

The distribution pipework for block B is routed at parking level below ground. It enters into the ground floor maisonette and routes through the kitchen up into the upper floor maisonette at every other party wall.



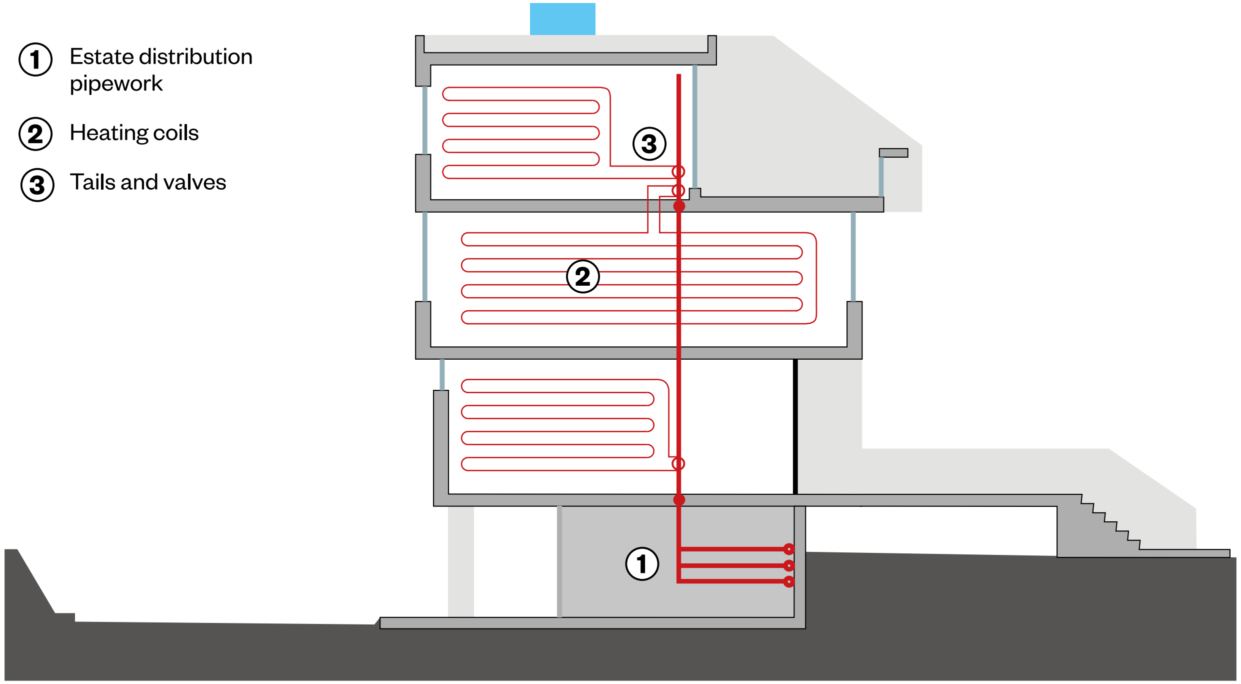
Section through Block B - showing estate distribution pipework, heating coils and tails

Figure 3.10 - Heating coils in Block B

3.6 Block C heating

In Block C, the distribution pipework runs at parking level and up into the dwellings in an internal riser for every other part wall.

Block C has additional complexities, with heating coils on both party walls, as opposed to every other party wall (as in Block A and B). Internal distribution pipework is set into the concrete floors and walls to allow the heating to pass across the dwellings.



Section through Block C - showing estate distribution pipework, heating coils and tails

Figure 3.11 - Heating coils in Block C

4.0 The system as it stands

4.1 The estate distribution pipework is at the end of its life

Estate distribution pipework
The estate distribution pipework is at the end of its working life. For many years the pipework has suffered from extreme corrosion, furring-up and leaks.

The pipework has been continuously patched up over the course of more than 10 years. The upkeep and maintenance is burdensome, costly and unpredictable failures result in sporadic loss of heating and/or hot water for residents.

Many attempts have been made to repair and retain the system over the years. To this end, various alterations have been made to the way the heating and hot water work since the completion of the scheme in 1978. These alterations have been made in response to faults/failures in the system and include:

- Decommissioning of the concealed warm air heater due to dirty air being taken from garages at ground levels and blown into homes. Heater fans are now obsolete.
- Increase in the capacity and temperature of hot water reaching the cylinders and heating coils to ensure all residents receive adequate heat. This makes sure the heat from the boiler house reaches the furthest dwellings on site.
- Minor and major repairs and patching up of the distribution network pipework, heating coils and tails due to corrosion of pipework and valve failures.
- Some dwellings furthest away from the boiler house have been provided with individual gas boilers to ensure they receive enough heat.
- Where heat no longer reaches the heating coils in dwellings due to a failure on the network pipework or with the tails to the heating coils, radiators have been provided as an alternative heating source.
- Where hot water to dwellings has failed an electrical immersion cylinder has been provided to ensure residents still have access to hot water.

The replacement of the boilers has proved a successful intervention, however, the communal heating pipework that supplies heat across the Alexandra Road Estate is now in need of urgent replacement due to extreme corrosion and risk of catastrophic failure.

The photographs opposite demonstrate the condition of the pipework observed during a walk around in 2019.

4.2 Known failures in the system

Camden Council have been monitoring the failures in the system to determine where the problem areas are. The following gives a picture of the failures experienced:

Distribution pipework

- Due to leaks on the network fresh water is regularly introduced, this has been accelerating the deterioration and corrosion of the pipework for the past ten years.
- There is a lot of iron oxide/sludge in the network, although filters have been fitted, this is not enough to deal with the problem.
- There have been pipe bursts in the buried pipework of the network. This causes disruption and is seen as a symptom of the condition of the whole system.
- Isolation valves which would typically assist with maintaining the system when there are leaks are now failing.

Figure 4.0 - Condition of heating pipes located on the roof of Block A

Figure 4.1 - Tail pipe

Figure 4.2 - Corroded pipework

Figure 4.3 - Corroded valve

Figure 4.4 - Corroded pipework section

Tail connect to heating coils
In some units the coils joint/tail between the network and the heating coils has failed. When this has occurred, the coils have typically been isolated and radiators fitted in the affected homes.

Heating coils
Some homes have experienced leaks from the coils. This manifests as damp patches on the party walls. Some larger homes have more than one coil.

Domestic hot water
Some homes have experienced failures in their supply of domestic hot water. Either due to lack of supply from the system, leaks or distribution failure. These homes have been fitted with electrical immersion for hot water supply.

4.3 Lifespan of the system

The system is now 40-50 years old. While some similar embedded heating pipework systems have been known to operate longer than this, sometimes more than 80 years, CIBSE Guide M (Maintenance engineering and management: a guide for designers, maintainers, building owners and operators, and facilities managers. 2nd edition) notes in appendix 13.A1 some indicative life expectancy factors. Its indicates that steel pipework systems (closed) are expected to last 25 years, while radiant hot water heaters are expected to last 20 years.

Therefore, this system has outlived indicative guidance. Given the current condition of the system, if it is to last another 40 years it is in need of significant repair. While guide can be used as an indicator of lifespan, it was determined that the condition of the coils must be proven through testing and observations.

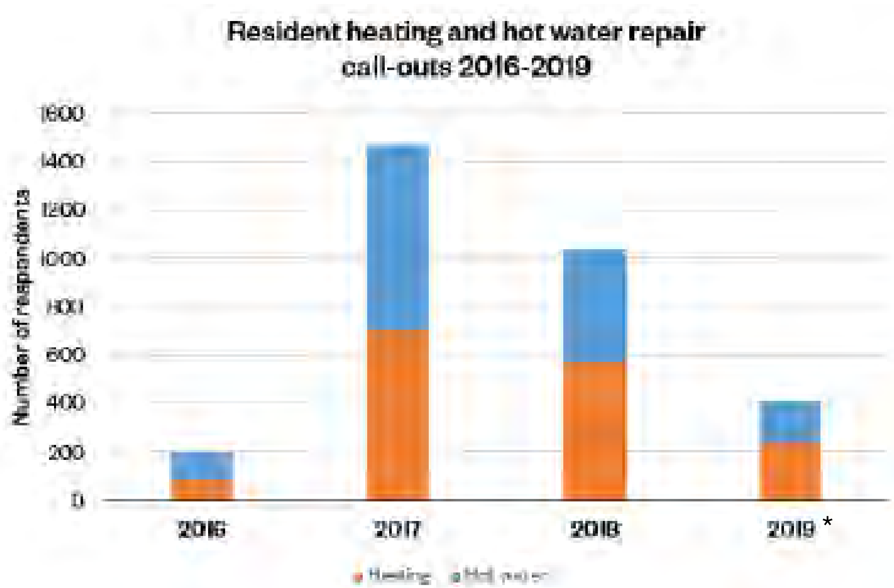
4.4 Repair call-outs 2016-2019

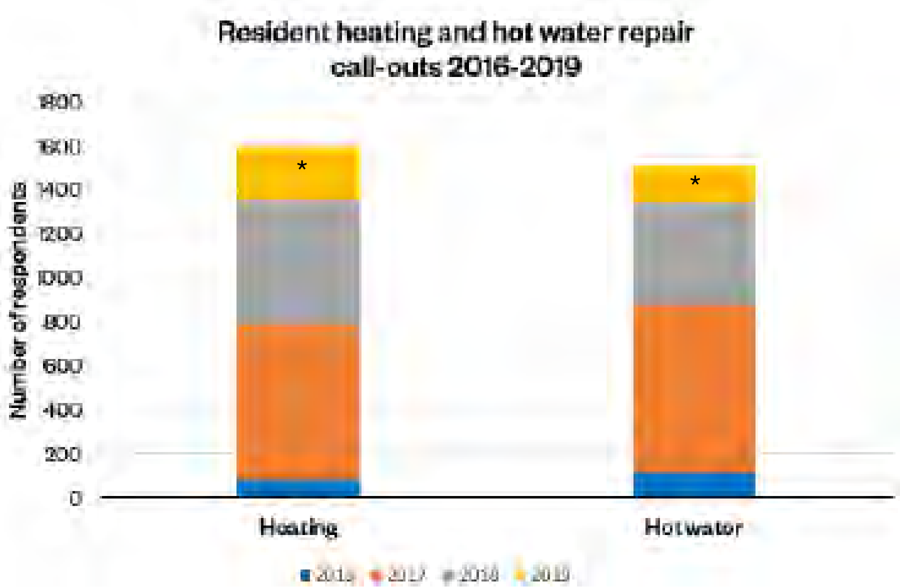
GEM, Camden's Term Maintenance Contractor, has kept a record of the repair call-outs between 2016 and 2019.

The results opposite illustrate the volume of call-outs relating to space heating and/or domestic hot water failure during this period.

It should be noted that the data for 2019 only goes as far as September , this is before the heating was switched back on for winter in October. In addition, this data distinguishes between heating and hot water through the resident's description at the time of their call. There are often misunderstandings as to whether their heating, hot water or both is affected. The frequency of calls means that notes are not always kept as to what action the call-out related to. However, the data is still considered extremely useful as a general picture of the heat network performance.

In 2017 there were over 1,400 call-outs with 1,000 in 2018 across the 520 homes. This highlights the instability of the heat network to provide consistent heating and hot water for residents. It also highlights the urgency of action to reduce the number of failures on the system.





*Data representative only until September 2019, excludes heating 'switch-on' period between October and December 2019

Figure 4.5 - Repair call-out graphs

4.5 Feedback from residents in 2019

In early 2019 Camden Council carried out a letter drop questionnaire to all residents. The questionnaire asked about residents heating at hot water services to determine what services they had in their home, their working condition and any comments/opinions on the systems. This questionnaire was carried out due to a lack of detailed survey information about the heating and hot water supply and distribution in homes.

From 520 properties across blocks A, B, and C (minus void units), 154 residents responded.

The responses provided a snapshot of which heating and hot water systems the residents understood they had.

From the data it is clear that some homes were not sure how the heating was distributed in their homes. This is apparent from the selection of multiple options such as 'space heating from original heating coils' and 'space heating not from original heating coils'. Despite this, the data is considered a useful indicator of a sample set of residents.

The vast majority of residents that responded indicated that they received their 'domestic hot water from the original cylinder' and 'space heating from the original heating coils'.

Residents' comments

The optional comment section of the questionnaire provided an opportunity to understand how the

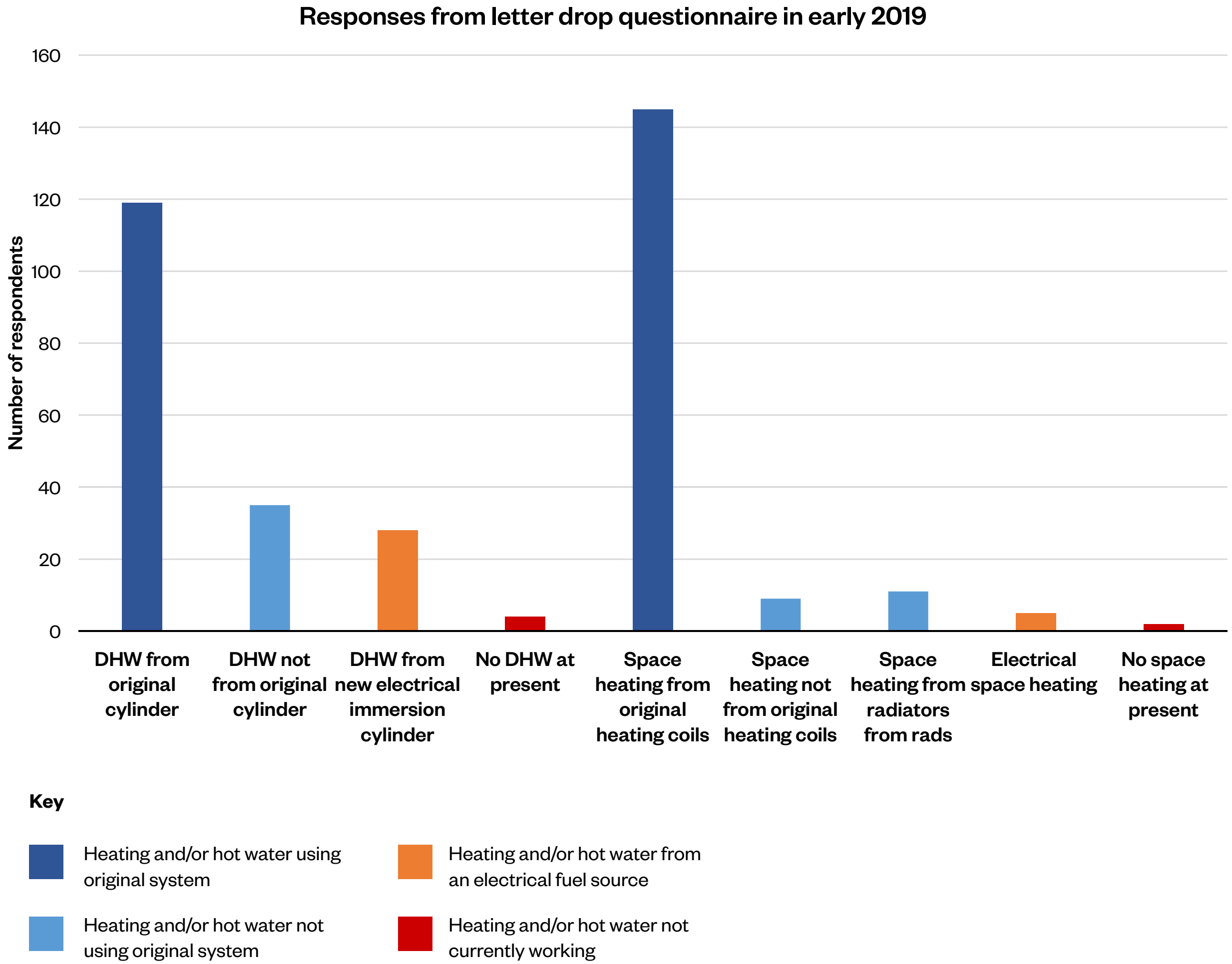


Figure 4.6 - Resident responses to the letter drop

residents found their heating system and hot water supply.

Those who made positive comments were generally satisfied with the heating and hot water provision overall.

The negative comments typically related to: feeling too warm in homes when the heating was on; lack of heating control; the high cost of the immersion hot water; and not enough hot water capacity for baths and showers.

There were also indications of misconceptions regarding heating controls, with one resident noting that the neighbours tamper with the controls.

A range of resident quotes have been noted opposite, together with a graph indicating the number of positive and negative comments.

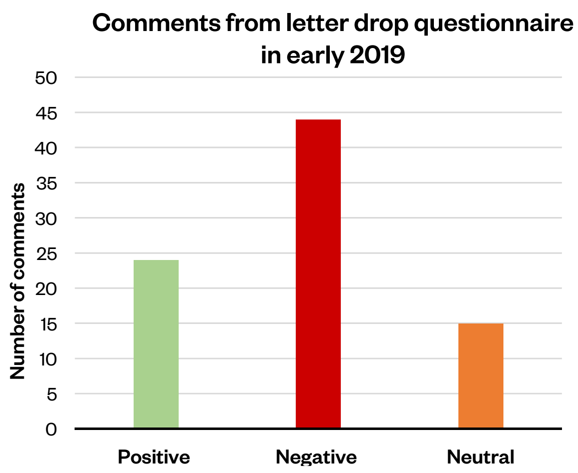


Figure 4.7 - Resident comments to the letter drop

Quotes from residents:

"Hot water is too hot in my flat. Don't like this old system, I can't turn it on or off when I want and the flat is too hot all year long."

"I have lived on the estate since 1978 with no problems with either."

"Too hot, cannot sleep in bedroom"

"Constant leaks have resulted in no hot water and damage to flats (h/w) Heating is sometimes too hot and breaks down. Heating preferences are not catered for. Discreet radiators would make sense and not detract from the overall appearance. Camden should not always go for the cheapest option."

"Problem with the heating is that neighbours tamper with the controls. This was reported to Camden by GEM but no action was taken and I have to pay for electric heaters when outside temperatures fall. Tenants should not be permitted to tamper with a shared system."

"Very good system. Keep it, I like it."

"Never enough hot water to have a bath and water runs cold quickly"

"Heating is either too hot, where it makes it difficult to sleep, or it becomes too cold. It would be more convenient if we had self controlled central heating/ radiators"

"Immersion heater is expensive to run (h/w)"

5.0 Site investigations

5.1 The distribution pipework cannot be replaced in isolation

The replacement of the distribution pipework has a knock on effect for all heat supplied on the estate. The distribution pipework is connected to every working heating coil and hot water cylinder. The corrosion of the pipework has been found across the network, from boiler house to the heating coil tails.

The replacement of the distribution pipework is an opportunity to renew and repair the network for another 40 years operation.

To ensure this outcome, Max Fordham, Levitt Bernstein, and BYA were commissioned by Camden Council to investigate whether:

- the heating coils are in good working order and capable of continued operation for another 40 years if reconnected to the new distribution pipework.
- the viability of reconnecting to the heating coils via their tails given their complex locations.
- the valves are in working order an accessible.

In order to determine this a series of investigations were carried out. This included:

- A visual inspection of the network pipework.
- A visual inspection of the location and condition of a series of heating coil tails and valves.
- Pressure testing a sample set of heating coils to determine if they are in good working condition.

5.2 Findings of site inspection 1

A site inspection was carried out on 17th September 2019. GEM, Camden's Term Maintenance Contractor, took representatives from Max Fordham, BYA, Levitt Bernstein and Camden Council around site to review the condition of the distribution pipework and maintenance activities.

GEM has worked at the Alexandra Road Estate over many years and has knowledge of the heating and pipework system. They have had day to day site experience of operation and the maintenance and replacement activities that have been necessary to sustain the system.

The following areas were inspected:

- Inspection of the pipework previously removed from the heating distribution
- Inspection of riser pipework and embedded coil tails in an under stair service void supplying heat to Block B.
- Inspection of distribution pipework on the roof of Block A.
- Inspection of riser pipework and embedded coil tails in a garage supplying heat to Block C.
- Inspection of riser pipework and embedded coil tails in a void dwelling in Block A.

Summary of findings

The site inspection highlighted the extent of corrosion of the distribution pipework in voids, on roofs and in dwellings. Sections of pipework were removed from site and cut in half to inspect the internal condition of the pipes. It was found that the internal corrosion of the pipework was not extensive. The corrosion appeared to be external.

A number of heating coil tails were inspected in Block B and C. The tails were found not to be externally corroded. However, access was at height and restricted in Block B. Access in Block C was reasonable.

In Block A the connections to the tails showed signs of external corrosion, although the pipe tails appeared to be less affected. Access to the space heating risers was found to be difficult. For regulation and maintenance the breeze block enclosure often needs to be broken out to allow full access. In addition, three dwellings would require simultaneous access to disconnect or isolate a single heating coil. The impracticalities of this were noted.

The photos opposite show some of the access issues and disruption.

The full set of inspection notes have been included Appendix C.

Figure 5.0 - Alexandra Road heating network inspection

Figure 5.1 - Internal distribution - disruptive access

5.3 Observations and opinions following the site inspection

Following the site inspection Max Fordham provided an observations and opinions report. This provided a qualitative analysis and context for the next steps prior to the detailed pressure testing.

Summary of findings
The report highlighted the following:

- The coil tails that were inspected, were on the whole in a reasonable condition externally. Possibly this is because they were horizontal and continuous pipe without joints. There was one exception within Block B where the tail had corroded and failed making repair difficult. That coil has been abandoned.
- The riser pipework and coil connections including isolation valves and fittings are in poor condition having suffered extensive external corrosion and need to be replaced as soon as is possible.
- Existing riser pipework common to groups of dwellings passes through a number of dwellings. In the event of a heating system leak or other maintenance activity access is required to dwellings to identify the location and source of the leak. This makes access for inspection and maintenance difficult and time consuming. It reduces the quality of heating service Camden are able to provide to residents.
- Reuse of the heating coils would require the wall heating coil connections to be reconfigured so that they are within the dwelling. Work to achieve this would require significant intervention within the dwellings to accommodate the new pipework and coil reconfiguration. This would be disruptive to residents.
- Any re-use of the coils could never provide fully independent individual time and temperature control within each dwelling or room (as a more traditional radiator heating system with thermostatic radiator valves and time clock within each dwelling could) as the heat output from the wall is the same for neighbouring dwellings.
- The embedded coils will need replacement at some time. There is a risk that the rate of failure will increase substantially over the next 20 year operational period.
- There is an inefficiency associated with the coils in that heat the party walls that are connected across the thermal line of the building.

In conclusion, the complexities associated with connecting to the coils and the impact on maintenance, repair, service runs and comfort are significant and must form part of the final decision.

The full set of observations and opinions from Max Fordham have been included Appendix D.

5.4 Pressure testing the coils

The site inspection highlighted the problems on the network and access issues, but it did not conclude whether the heating coils could be retained and reconnected to.

On the whole the coil tails observed appeared not to be corroded and therefore, in theory provided a viable connection. There is evidence of some heating coils on site failing and leaking over time, however this appears not to be widespread.

Pressure testing had previously been carried out following instruction from Camden Council in 2010. However, the detail of the results were limited Therefore, it was concluded that a number of coils should be pressure tested to determine if they would be suitable to continue to use following the replacement of the estate distribution pipework.

A pressure test was commissioned and carried out on 21st October 2019. The aim of the work was to explore the integrity of representative embedded coils and the way in which the coils might be inspected, tested and reconfigured if they were to be considered for reuse for space heating in the future.

The test was carried out by GEM with relevant parts of the test observed by a representative from Max Fordham. A void dwelling in Block B was chosen for its good access to the coil connections and to minimise the disruption to residents.

A methodology was agreed and testing commenced.

Summary of findings
All three coils tested in the void unit held the test pressure over the 1 hour period and there were no identified water tightness leaks. It is unlikely the coil pipework had corroded to the extent that the pipework had lost its water tightness integrity. The sampled embedded coils in Block B were found to be in a serviceable condition.

While the test demonstrated the pressure could be held in those coils, it also highlighted that the disassembly process was constrained by the building fabric (eg. pipework was contained adjacent to the front door frame, making for difficult access).

It was determined that for Block A testing will be more disruptive to the dwelling finishes and fabric and would need more to organise and implement. Remedial works to finishes and fabric would then be required after the test. It was concluded that it is not possible to test in void dwellings in Block A as concurrent access is required to three adjacent dwellings.

Block C was not tested.

The full test report and associated methodologies has been included Appendix E.


Figure 5.2 - Alexandra Road heating network inspection

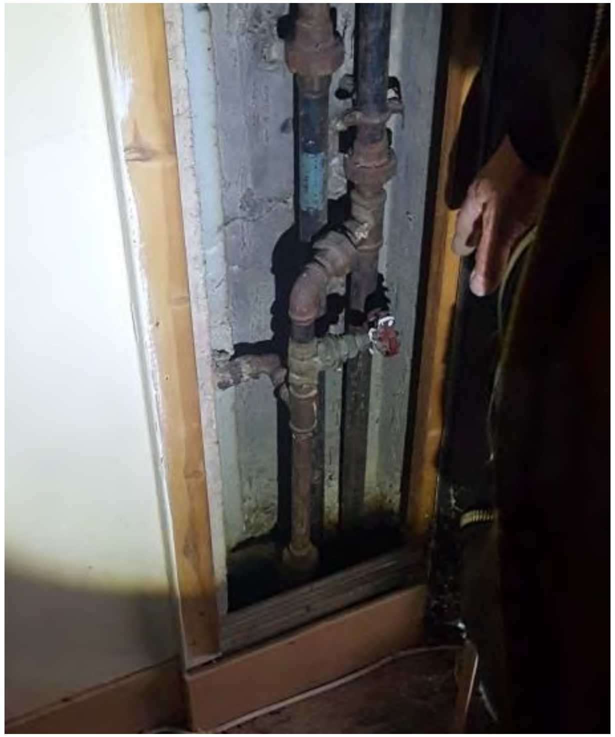


Figure 5.3 - Alexandra Road heating network inspection

6.0 It is no longer possible to use the embedded heating coils

Estate heat distribution pipework
It is clear that the patching up of the distribution pipework is no longer enough. To make the system fit for purpose again it must now be replaced.

Visual inspections by the team and service records have made it clear that the heat distribution pipework is beyond repair and in need of urgent replacement to prevent catastrophic failure. Failure of this pipework could range from the loss of heating and/or hot water to individual dwellings or the whole of the Alexandra Road Estate.

Heating coils
Pressure testing was carried out on a sample set of heating coils in Block B to determine whether the embedded coils were in good working condition and could be re-used. The sample embedded coils in Block B were found to be in serviceable condition. No tests were carried out in Blocks A or C.

Having reviewed the possibility of connecting the replacement distribution pipework to existing heating coils, it was determined that the design and installation of the new pipework would not be guaranteed or insured against failure where it is connected to the existing 40 year old embedded heating coils.

Tail connections to the heating coils
The testing of the heating coils provided the opportunity to review the composition, location, condition/corrosion of the connection tails. It was found that the tails to the coils are not easily accessed or connected to.

The testing revealed that, in Block B, to access the tails to the heating coils, it would be necessary to temporarily remove of the front door of the dwelling and break open of some of the concrete fabric. The condition of the tails varied and therefore were difficult to physically connect to for testing purposes. The testing also necessitated the temporary disconnection of heating to the dwelling below.

While the testing of Block B was found to be challenging, it is noted that Block B is one of the easier blocks to access the tails. The testing of heating coils in Block A and Block C were aborted due to the significant disruption required to residents and the building fabric. To test a single coil in Block A three adjacent dwellings would require parts of their walls and/or floor to broken open simultaneously to access the necessary tails and valves. To test heating coils in Block C there would be significant disruption to walls on multiple stories of each home. From a heritage perspective it is undesirable to damage the building fabric in this way.

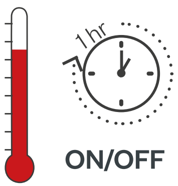
For this reason it was determined that it was not practical nor reasonable to attempt to test the coils in Blocks A and C.

It is not possible to replace the distribution pipework and connect to the existing heating coils
The testing of the heating coils and the subsequent tail location exercise have demonstrated that the site-wide distribution pipework requires renewal and it will be intrusive and disruptive for residents to connect to the heating coils. Therefore, we have concluded that it is necessary to abandon the embedded heating coils and seek an alternative heating system for each dwelling.

A planning application will be submitted for the replacement of the estate heating network. This covers the re-routing of distribution pipework externally and the addition of sub-plant rooms.

7.0 Wider considerations

With the renewal of the distribution network determined necessary and the disconnection of heating coils a consequence, there are a number of wider considerations.



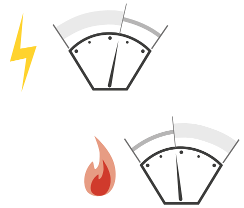
Time, temperature and zoning
Where new heating systems are installed there is the possibility of improvement of individual heating time and temperature control in each dwelling. This is not currently possible while dwellings share a heating coil. If dwellings were to have their own heating system they would each also have the ability to control the temperature and timings in different rooms.

Currently the residents' only option is to open their windows when they are too hot in winter. This is because they are unable to turn the heating system off when they are warm enough. Better occupant controls will result in less heat wastage.

Energy efficiency
A more efficient heating system could be installed than the existing heating coils. Currently the heating coils are run constantly between October and May to guarantee heat for residents. Where individual heating systems are installed residents will be able to turn it on and off to suit each occupancy and comfort levels.

Heating response times
The high thermal mass of the concrete separating party walls means that the heat from the heating coils takes time to heat up and cool down and is not responsive to rapid changes in external temperature. The move away from heating in the walls will eliminate this lag, which was originally dealt with through the fan heaters.

Hot water on-demand
Currently domestic hot water for bathing is stored in the hot water cylinders in homes. This provides a store of hot water for residents to use. When this runs out, due to long showers or multiple baths, residents are required to wait for the hot water to replenish. By removing the hot water cylinder and replacing it with a HIU residents will have hot water on demand.



Metering and billing
Dwellings could be individually metered and billed for the heat used. Currently residents pay a split of the heat bill for all un-metered heat used in Camden - with Alexandra Road Estate the forth largest user of heat per dwelling in the borough of 160 sites. Individual heating systems would allow residents to pay only for what they use.

A heat interface unit (HIU) would be installed in every home, this has two main advantages:

- The HIU contains a heat meter so residents would only be billed for the heat they use.
- It also provides a separation of the hot water between the estate distribution network and the dwelling. Therefore, if there is a problem in the home or on the network the individual dwellings are easily isolated.

The use of a HIU would allow the homes to be compliant with current industry design practice. The Heat Network (Metering and Billing) Regulations 2014 place certain responsibilities on Camden for supplying and charging for heating. It required Camden to install heat meters for each dwelling by 31 December 2016, unless it was deemed to be not technically feasible or cost effective to do so. This assessment has to be repeated every four years. To date there have been valid reasons not to install heat meters on the Alexandra Road Estate due to the impracticalities. However, it is now possible to meet the requirements of the Regulations under the new proposals.

This was not a factor when the estate and the original heating design was conceived.

Camden also use Fairheat District Heating Design Supplement document, which suggests for best practice the design should offer all residents (Tenants and Leaseholders alike) independent, fully controllable, responsive, energy efficient heating and DHWS systems that can be metered and billed at the point of use.

Repairs

The renewal of the system will mean repairs and downtime of heating or hot water will be less frequent and limited to a single dwelling, reducing disruption. The heating replacement scheme will aim to relocate common pipework to locations outside dwellings so that it is more readily accessible by maintenance teams and does not disrupt residents. This will also provide fully accessible distribution routes with as much common pipework and fittings readily accessible for inspection, repair or replacement, rather than being buried in walls and floors.

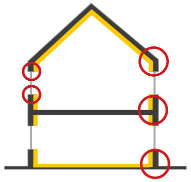
Costs

The costs of the heating system replacements for lease holders and Camden will be fully considered. Both Camden and leaseholders will have a finite budget.

Logistics

To improve cost effectiveness, all homes should be swapped over to the new system together. Therefore, the proposals will investigate running the new distribution pipework concurrently with the existing heating pipes. This will allow for all residents to transition at once.

It would not be practical, energy efficient or cost effective for some dwellings to swap to the new system while others remain on the old.



Fabric efficiency

There is an inefficiency associated with the building fabric and the embedded heating coils. The heated party wall bridges the enclosing thermal envelope allowing heat to transfer though the external concrete wall. When the heating coil is on it increases the loss of heat to the outside.

Levitt Bernstein carried out some initial investigations in to the extent of the heat loss. We found that there was an additional 6°C heat loss from the heated wall when compared to the non-heated separating wall. This is a significant amount of heat loss from the dwellings and highlights the inefficiency of the system.

In the context of the climate emergency it would be best to change the method of heating now to reduce wasted heat.

Appendix F and G details the full findings of the heat loss study.

Fabric improvements

As part of the exercise to replace the heating system Camden Council are also keen to reduce the heat loss from dwellings. This means that homes could have a lower heat demand.

The building currently has minimal thermal insulation and single glazing, typical of its time of construction. This means that heat regularly escapes from walls, floors, roofs and windows. Camden Council are keen to explore where this can be minimised to determine if there are any measures that can be put in place now or in the future.

It is likely that single glazing will be replaced with double glazing as a first step.

It is hoped that possible future improvements to the glazing and fabric would reduce the scale of new heating emitters.

Ventilation

Where the building fabric is improved the background ventilation should also be considered. This is to avoid future problems and unintended consequences.

Heritage

Installation of a heating system is also a complicated issue in practical terms. The flats were not originally designed for an alternative heating system and so anything considered needs to be visually sympathetic.

It is considered that the heating within dwellings should be carefully considered alongside the heritage of the scheme. Listed building consent or an extension to the heritage partnership agreement will be required for the works.

Figure 7.0 - Rear of block A showing the heated party wall from the coils is warmer than the unheated wall

Figure 7.1 - The western end wall of block A illustrating heat loss from the dwellings and significant thermal bridges at the floor and wall junctions.

Figure 7.2 - Eastern end wall of block A illustrating heat loss from the heating coils in the dwellings.

Figure 7.3 - Block A - front facade

Figure 7.4 - Block A - rear facade

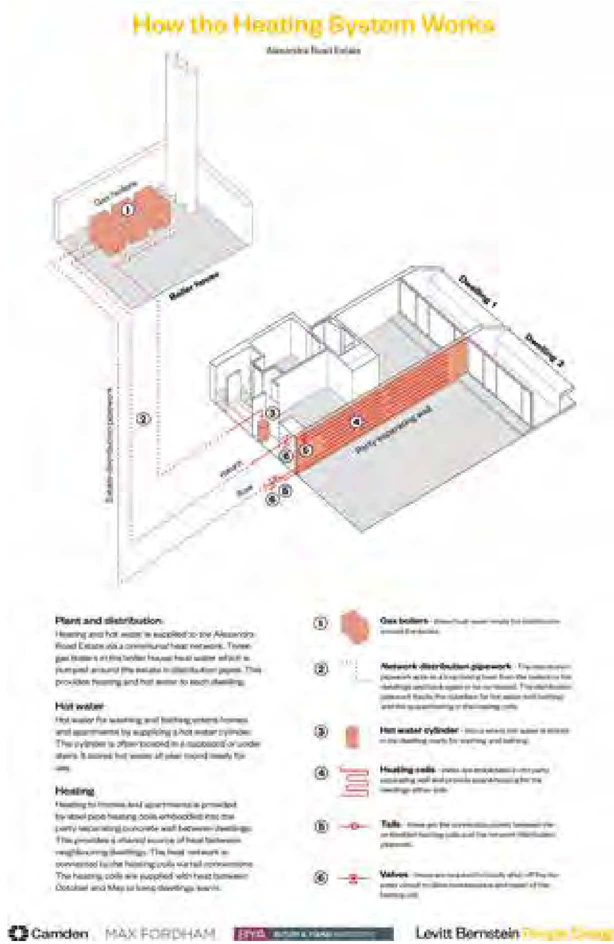
8.0 Resident consultation

Residents consultation 20th November 2019
The Tenants and Residents Association (TRA) were presented the findings of the technical review (consultation boards opposite). This included a description of how the system works together with the issues associated with connecting the new distribution pipework to the heating coils.

The residents were generally pleased with the thoroughness and way the investigations were conducted, and supported the findings.

The residents understood the practical implications of the findings which meant that the heating coils and hot water cylinders in homes could no longer be connected to the estate heat network.

The next steps will seek to find a suitable alternative to the heating coils to distribute heat in the dwellings in future at Alexandra Road Estate. Residents will be consulted on the design and options available.



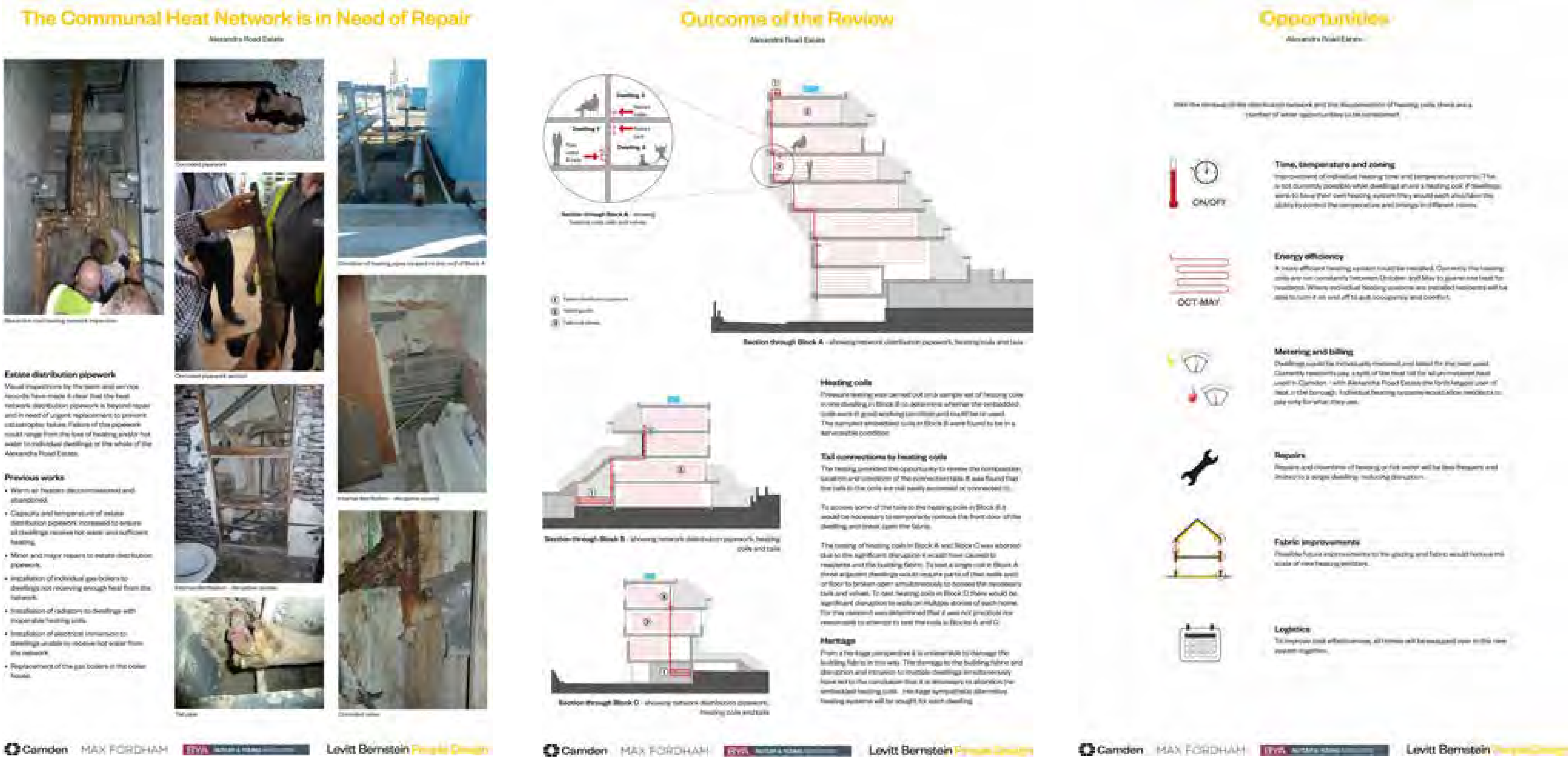


Figure 8.0 - Resident consultation boards

9.0 Outcomes and next steps

This technical investigation sought to review the Alexandra Road Estate heat network. Through collaborative investigations, reviews and testing we have been able to determine the working condition of: the heating plant; distribution pipework; heating coils, tails and valves; and hot water cylinders.

This has allowed us to take a balanced view on how best to ensure the dwellings receive adequate heat for the next 40 years.

This report has reviewed: the history of the site and building services; how the heat network operates; the condition of the system as it stands; and the site investigations carried out to date.

The investigation has concluded that the estate distribution pipework is in desperate need of repair. It is clear that the patching up of the distribution pipework is no longer enough. To make the system fit for purpose again it must now be replaced.

As a consequence of this, the embedded heating coils have been reviewed to determine if they can be reconnected to the new distribution pipework. Investigations concluded that it is not practical, economical, feasible or energy efficient to continue to use the heating coils. The heating coils must now be abandoned and new heating emitters investigated. There are a number of wider considerations as part of the renewal of the distribution pipework and review of the heating emitters, this includes:

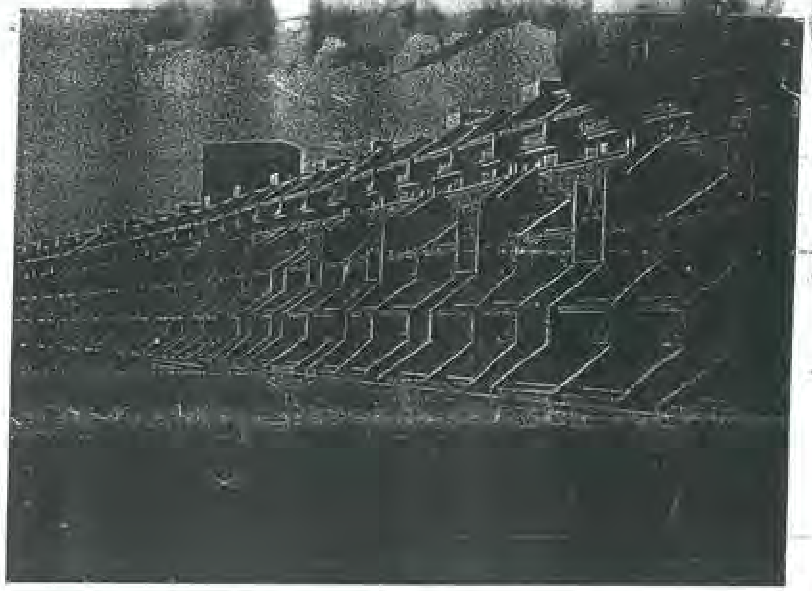
- Time, temperature and zone controls of a new heating system
- Energy efficiency of an upgraded system
- Heating response time
- The availability of domestic hot water on-demand
- Metering and billing of heat
- Future repairs and maintenance of the system
- The need for costs to be reviewed to protect leaseholders and Camden
- The logistics of transferring all residents to a new system
- The efficiency of the building fabric and heat loss through the junction of the heated wall with the external wall.
- The potential for fabric improvements
- Heritage considerations.

The next steps will be to:

- Apply for planning permission and listed building consent to install externally mounted estate distribution pipework and extend plant rooms. This is critical to ensure the works can begin as soon as possible.
- Review the building fabric and glazing to determine if the heat demand of homes can be reduced through an energy efficient building fabric. This should include a long term strategy and menu of options for the continued improvement of the energy efficiency of Alexandra Road Estate.
- Design and consult with residents on heating emitter options to determine the best route to heating homes.

10.0 Appendices

Appendix A - Building Services Journal



RADIANT WALL HEATING FOR FLATS

by Max Fordham, MA, FCIBS* and Helen Ryding BSc, MCIBF

The plans of the flats at Alexandra Road present a special heating problem since few windows had a high cill and the Architect wanted to avoid radiators obstructing the wall surfaces. Compact radiator systems to meet this brief were designed and costed. The alternative of a conventional panel heating system in the floor finish was discarded by the Design Team as being too expensive. A panel system with pipe coils cast into the centre of the concrete floors seemed attractive since it met the design requirement and initial checks suggested it was not too expensive.

Alexandra Road, London NW8 is a high density redevelopment scheme for the London Borough of Camden. It comprises 520 flats, maisonettes and houses, a Special School, a Childrens' Reception Home, a Physically Handicapped Home, a Youth Club, a Building Department Depot as well as a Community Centre, district heating boilerhouse and a public park.

The housing is heated by steel pipe coils cast into concrete tenancy separating walls, and fed by water from the district boiler house. As far as one can tell, this method of heating has not been used before on such a scale, if at all. It was devised because of the particular requirements of the building and also because of its cost advantages over equivalent radiator schemes.

In line with current thinking on controlling ventilation it has mechanical supply ventilation at the rate of 1½ air changes/h to each flat. This solution was originally suggested as part of the acoustic precaution for the long block but was extended to all dwellings after the contractor had been appointed.

Design Brief

Initially, the heating coils were to be used only in one particular block of flats on the site, and the other blocks were to be heated by radiators. This particular block consists of a seven storey slab block, approximately a quarter of a mile long, of identical cross-section along its length (with minor variations at the lowest level), with three different flat or maisonette plans. The block is designed to act as a noise barrier for the rest of the site (the site is bounded by the main line from Euston), and has special acoustic precautions along its back wall.

The design had to meet three main criteria:

(1) The architectural layout with floor to ceiling glazing, meant that suitable radiator positions were difficult

above:
Fig 1—Part of the flats at Alexandra Road

*Max Fordham & Partners, Consulting Engineers.

Fig 1 — Installing the heating coils on site

to find without obstructing the walls, which the architect wished to avoid in order to avoid the obstruction caused to furniture positions.

(2) The brief from the Housing Manager was to design a form of heating which would avoid the likelihood of condensation in dwellings, by being cheap to run. Initially, it was felt acceptable to sacrifice some measure of individual tenant control in order to maintain background heating at all times. (Later this was retracted, and full tenant control was called for.) Later some measure of tenant control was called for and provided.

(3) The soundproofing precautions along the back wall of the building included double glazing, which is intended to be kept closed. This problem and rulings by the District Surveyor in relation to the setback section of the building required the provision of mechanical ventilation to the rooms at the back of the building. This requirement became known after the preliminary design for the heating system had been done.

Reasons for Choosing Scheme

The alternatives considered were: a radiator system using low radiators built into recesses under windows, or running along skirtings; or conventional underfloor panel heating in the screed. Underfloor electric heating was rejected as being too expensive to run. Pipe coils in the screed proved to be more expensive, but led to the investigation of pipe coils cast into the structural floor or walls. This proved to be cheaper but the structural implications of floor panels, necessitated expensive expansion joints every four dwellings. This was avoided by putting the coils in the cross-walls, with the extra advantage that the upper limits to the surface temperature for comfort conditions were higher, and thus a greater output of heat could be achieved. On consideration of the heat losses and which walls to heat, it became clear that satisfactory conditions could be achieved by heating only alternate cross-walls. Detailed investigations were then made, which proved satisfactory. Costs, despite modifications to the structure, were still considerably lower than the radiator scheme.

The needs for full tenant control and for mechanical ventilation became known at about the same time. This problem was solved by designing a small fan and heater battery in their own purpose made casing, to be fitted in each dwelling. The heater battery has a bypass damper so that the incoming fresh air can be either hot or cold, providing control of the heating system for the tenant and satisfying the mechanical ventilation requirement.

The two other housing blocks originally were of concrete block cross wall construction, with radiator heating. Following the request of the contractor to change these two housing blocks to in situ concrete construction, it was decided to change the heating scheme to pipe coils as well. In these two blocks, the dwelling plans necessitated more wall heating, and in the block of houses, both cross walls are heated. These blocks do not have a mechanical ventilation requirement, but the fan convector units have been retained to provide tenant control. This extra cost was set against the saving in changing to pipe coils, and also a saving in changing to concrete construction.

Investigations of Similar Schemes

Our investigations, and those of BSRIA, produced some theoretical information on wall panel heating, but no information on actual calculations. The wall panels mentioned were usually pipes embedded in plaster. However, considerable practical experience of floor panel heating was provided by Balency Schuhl, a French firm of consulting engineers, who have been responsible for the design and construction of several thousands of dwellings with pipes cast into structural concrete floors. These dwellings have mostly been tower blocks in France, but recently they have collaborated with G. N. Haden on a large housing scheme at Ballymun, in Ireland. A questionnaire was sent to several of the French architects involved. This revealed that there were not problems with cracking concrete or corrosion of the coils, except in one case where the contractor had used accelerators in the concrete. The heating was satisfactory unless water temperatures over 45°C were used, in which case, the tenants tended to complain about the floor temperature affecting their feet. Occasional problems of comfort arose where heating was uneven due to the coil layout not being diffuse enough. In most cases, the circulated water had some form of treatment.

We have based most of the installation procedures on the experience of these French schemes.

Concrete Design

The heated walls are built from concrete containing limestone aggregate. This was chosen by the structural engineer in consultation with the Cement and Concrete Association to reduce the amount of expansion of the walls. Extra reinforcement was necessary to control tension caused by the increased temperature at the centre of the wall, and also to control shrinkage cracks. Gable ends of each block are cast in two panels, separated by an expansion joint to allow for movement of the inner panel containing the heating coil, and also to provide insulation.

Allowance must be made in the thickness of the wall for adequate vibration of the wall, bearing in mind the pipe coil, extra reinforcing steel, and conduits. The reinforcement was formed in two layers instead of one in the centre plane of the wall.

Supply of Heat

Each block, (a quarter of a mile long) is served by three heating mains running in roof ducts or exposed in garages. A weather-compensated flow main provides heating water at flow temperatures ranging between 82 and 60°C for the

Fig 3 — Steel pipe coils in position before casting the concrete

Fig 4 — Close-up of a steel pipe coil

pipe coils, a constant temperature flow main at 115°C provides a primary supply to each dwelling's individual indirect cylinder, and a third pipe provides a joint return for both these systems. Heat is provided by three oil-fired (35 sec gas oil) boilers in the boilerhouse for the site.

Vertical risers for paired stacks of dwellings feed the coils and fan convector units. Water is first fed through the fan convectors and then through the coils. Each pipe coil is valved off from the riser. All pipework in this section is standard steel pipework with screwed joints.

Installation

The pipe coils were manufactured by a specialist manufacturer and delivered to the heating contractor. The services engineers specified that the coils should be sealed and pressurised with compressed air by the heating contractors; the main contractor then took the coils and placed them in position with the wall reinforcement. The concrete was then cast. The pressure in the coil was to be monitored to provide immediate indication if any damage occurred to the coil.

The services engineers advised that the concrete specification be written to exclude the use of additives, particularly calcium or magnesium chloride. If heat were applied to the concrete too soon after casting it could accelerate the rate of hydration and so aggravate the occurrence of shrinkage cracks in concrete and plaster. The mechanical specification limited the rate at which the coil temperature should be raised and called for the plaster to have a minimum of two weeks drying before heat was applied.

These measures should limit corrosion at the outside of the pipes especially as all heated walls are within the weatherproof skin of the building. The corrosion from inside pipes in a closed system is limited by excluding oxygen and keeping the water slightly alkaline.

Fan Convector System

The fan convector itself was a galvanised sheet steel box. The heater battery was designed to heat air to 21°C, using water at 82°C return temperature 66°C. The air quantities were chosen to give 1½ air changes throughout the dwelling and the box has one or two fans, according to the size of the dwelling. A damper is fitted so that air can either be drawn over the heater battery or bypass it for cooling. Fresh air is fed into the fan convector via an acoustic main through builders work, designed to reduce the noise path from the railway. Each fan convector serves two or three rooms in the dwelling. The air is delivered through small metal ducts or builders work to grilles in the skirting. The fan can be switched on from each room served by it, though families will have to agree whether they all want hot or cold air.

Wall Finish

The walls are plastered and painted. The surface temperature is only 38°C, the sort of temperature encountered on chimney breasts, so no special precautions were felt necessary, apart from the procedure for warming up the coils, which should not be going on at the same time as plastering and painting. However because of the limestone aggregate in the walls, it may be necessary to specify plaster.

Automatic Control

Control of the heating is achieved in a number of ways. The basic level of heating provided for all tenants in one block will be set by the water flow temperature, which will be controlled in the boiler house by a weather sensitive compensator, independently for each block, as is normally done for radiator systems.

It was expected that the high thermal storage of the building would prevent sensitive control according to rapidly fluctuating weather conditions. Very rough calculations gave the building a response time of about four hours (compared with 20 minutes for a pulse of water to go round the system). The Meteorological Office were consulted about rapid fluctuations. It was found that changes of 6°C or more, in less than two hours happened very rarely. Changes of 3°C in less than two hours downwards are very infrequent, but changes upwards happen about 10 times a year, usually in spring. In view of this, the need for short term weather forecasts and prewarming of the walls, in advance of a sudden cold spell, were not felt to be necessary. Sudden falls in temperature were moderate enough to be dealt with, either directly by the walls: the room temperature falling in response to the falling outside temperature, would increase the temperature difference between the wall and room air, automatically increasing the wall output by radiation and convection; or by the fan convector, which, already supplied with hotter water from the boiler house could provide an immediate response.

Sudden rises in temperature would be dealt with in the reverse way: directly by the wall output dropping in response to the reduced temperature difference between the wall and the room; and indirectly, by bringing relatively cold fresh air from outside, through the fan convector, bypassing the heater battery. Control of the heating coils directly by the tenant, is not feasible for two reasons. In the first place the coils often serve two dwellings one on either side of the wall. In the second place, shutting off water to one coil would upset the balancing, and interfere with the heating produced by coils in other parts of the walls.

Architect: Neave Brown
Consulting Engineers: Max Fordham & Partners
Heating Contractor: Drake & Scull Engineering Ltd

Appendix B - NIFES Consulting Report

NIFES CONSULTING GROUP

COMMERCIAL IN CONFIDENCE

OPTIONS APPRAISAL

Of

HEATING SERVICES

At

ALEXANDRA ROAD ESTATE

For

LONDON BOROUGH OF CAMDEN

on behalf of

London Borough of Camden
Capital Investment Group
33-35 Jamestown Road
London NW1 7DB

Prepared by: Chris Palmer
Date: 02 July 2009
Ref: DES204/LBC/Alexandra Report/CPP/Final

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CONTENTS

1 SUMMARY

1.1 Conclusions

The conclusion of the report is that the implementation of **Option 1B** without Heat Meters would offer the best long-term solution as reflected in the lowest Whole Life Cycle Cost over a 30 year period.

The existing heating systems in some case do not meet current day standards. Optional enhancements for replacement of the individual heating systems are discussed within this report and priced accordingly.

Individual user controls would be provided for the heating system in a similar way as domestic boilers, giving residents flexibility and controllability in use.

The installation of such a system would provide good reliable services with a typical life span of 30 years and reduced year on year capital and maintenance costs.

All options discussed are subject to Listed Building and Planning Consent

1.2 Recommendations

It is recommended that **Option 1B** be implemented as this is the most beneficial to London Borough of Camden and residents. It would also provide a reliable, controllable and energy-efficient system that would last at least 30 years, with boiler plant and pipe work replacement at year 25 and also in comparison with regular planned preventative maintenance.

Option 1B offers the lowest whole life cycle costs over a 30-year period.

For budget purposes a sum of **£7,500,000** should be allowed to implement Option 1B which includes external services tubes to the rear of Block A.

This figure excludes professional fees and VAT but includes Contingency sums and Provisional Sums.

2 SUMMARY ON WHICH RECOMMENDATION IS BASED

2.1 Introduction

NIFES Consulting Group was appointed by the London Borough of Camden to carry out this project in accordance with the terms and conditions of our proposal to provide Mechanical and Electrical Consultancy Services Term Commission dated 26 June 2002.

The project for includes an Options Appraisal for the replacement of heating and hot water services at the Alexandra and Ainsworth Estate, London, NW8, and is for Housing Blocks A, B and C only.

A survey was undertaken over a period of time focusing on communal areas and a sample selection of dwellings.

It is understood that the purpose for undertaking the options appraisal survey is due to complaints received from residents with regard to ineffectiveness of the heating system. Also Camden's Planned Maintenance Group identified that the existing heating pipe work and boilers was in a very poor state and likely to fail.

The content of the report is based on Camden's "Heating Policy (1st revision 11-10-06) which states that Camden will; *"Undertake "whole life cost" option appraisal when considering improvements to whole block heating. The selected option will be determined by the least negative Net Present Value (NPV). Where the NPV of one or more options are within 5% of the lowest option, the recommendation shall be determined using economic, social and environmental impact assessment."*

The estimated life cycle costs are based on a period of 30 years and a discount rate of 3.5% and take into account all installation costs and likely repairs and maintenance costs based on the current term maintenance contractor rates.

The expected running costs due to gas and electrical consumption has been factored into the net present value costs assuming gas price annual inflation rate of 3%.

The aim of the report is to: -

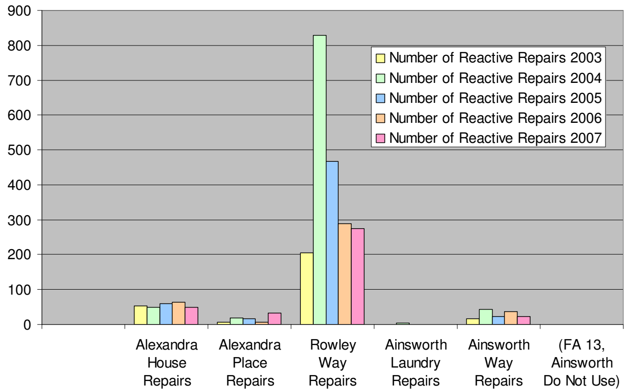
- Carry out an options appraisal providing net present value costs over a 30-year period based on capital cost, repair, maintenance and fuel costs.
- Make a recommendation as to which option should provide the best long-term benefits.
- Review repairs records to try and ascertain some history and nature of complaints and comments are made in this respect.

2.2 Reactive Repairs

2.2.1 Summary of Repairs

Repair by Block	Reactive Repairs 2003	Reactive Repairs 2004	Reactive Repairs 2005	Reactive Repairs 2006	Reactive Repairs 2007	Total
Alexandra House	54	49	60	64	50	**277**
Alexandra Place	7	19	16	7	33	**82**
Rowley Way	205	829	467	290	275	**2066**
Ainsworth Laundry	0	4	1	0	1	**6**
Ainsworth Way	17	43	23	37	23	**143**
Total	**283**	**944**	**567**	**398**	**382**	**2574**

The chart below shows the number and type of repair since 2003.



From records viewed the current Maintenance Contract equates to £75,704 per Annum.

In addition to this works and repairs have been undertaken that fall outside the Maintenance Contract between 2003 and 2007 summarised as follows: -

Item	Remedial Work Cost
Ad-hoc Repairs	20,433
Replacement DHWS Cylinders	47,063
Replacement of Riser Block A	35,000
Distribution re-configuration Block A	292,400
Total	**394,896**

In simple terms the above costs indicate that almost £79,000 per annum has been spent on the system repairs over and above the Annual Maintenance costs over the last 5 years.

In summary the overall repair and maintenance cost over the last 5 years was £774,016 or £154,803 per annum or £298 per dwelling per annum and represents an ongoing burden to Camden.

2.2.2 Summary of Events by Block

The following summary of events just relates to those blocks associated with this scheme, these being Rowley Way and Ainsworth Way.

Item	Description	Block A	Block B	Block C	Total
DH	Defective heating	312	237	31	**580**
DHW	Defective hot water	901	267	77	**1245**
DHHW	Defective heating and hot water	88	43	14	**145**
DR	Defective radiator	17	2	4	**23**
DCW	Defective cold water	4	0	1	**5**
L?	Leak somewhere	11	3	1	**15**
LHP	Leaking heating pipe	75	19	8	**102**
LHW	Leaking hot water	0	1	2	**3**
DT	Defective thermostat	5	1	1	**7**
PPM	Routine PPM	9	2	2	**13**
V	Replace valves	6	3	2	**11**
RC	Replace cylinder	40	5	0	**45**
U	Unknown	8	0	0	**8**
Total		**1476**	**583**	**143**	**2202**

Of all the 2202 events listed since 2003, the largest numbers of repairs are associated with heating, hot water and leaking pipes (2072).

Given the number of defect events this suggests that reliability is becoming worse due to the age of the system and suggests a case for renewal.

Given the number of leak events, especially heating pipes, it suggests that the system infrastructure is becoming fragile due to the age of the system and suggests a case for renewal.

Given the number of combined defective heating and hot water events it suggests that such events occurred at the same time and it can therefore be assumed that this was attributed to main plant failure.

2.3 Options Considered

The following options have been considered for whole life cycle costs analysis:

Option 1A: Complete Replacement With Heat Meters

Complete removal and replacement of communal heating and hot water system (with hydraulic boards and heat meters in dwellings) with new external service tubes to block A.

Option 1A: Complete Replacement Without Heat Meters

Complete removal and replacement of communal heating and hot water system (with hydraulic boards but without heat meters) with new external service tubes to block A.

Option 2: Domestic Condensing Boilers

Complete removal of communal heating and hot water system and replacement with domestic condensing boilers (with new external service tubes to block A).

Option 3: Domestic Combination Boilers

Complete removal of communal heating and hot water system and replacement with domestic condensing combination boilers (with new external service tubes to block A).

Option 4: All Electric Heating

Complete removal of communal heating and hot water system and replacement with all electric heating and hot water (with new external service tubes to block A).

Option 5: Retain and Repair Existing Radiant Heating System

Retain and repair existing embedded radiant and warm air system and replacement hot water system, but retaining the communal boiler plant until replacement is due (with service tubes to block A). Assumed boiler replacement within 5 years.

Option 6: Replace Radiant Heating System

Complete removal and replacement of communal radiant heating (wall or ceiling panels) and hot water systems (with new external service tubes to block A).

Option 7: Underfloor Communal Heating

Complete removal of communal heating and hot water system and replacement with underfloor heating and hot water cylinders (with new external service tubes to block A.).

Option 8: Underfloor Electric Heating

Complete removal of communal heating and hot water system and replacement with all electric underfloor heating with hot water system (with new external service tubes to block A).

2.4 Cost Information

The estimated life cycle costs are based on a period of 30 years and a discount rate of 3.5% and take into account all installation costs and likely repairs and maintenance costs, based on the current term maintenance contractor rates. The expected running costs due to gas and electrical consumption has been factored in to the net present value costs. The fuel inflation rate has been based on 3%.

The costs presented are those expected to be returned under a competitive tender basis although these would need to be reviewed over time.

Preliminaries costs, provisional sums and contingency are included or excluded where indicated in the costs tables or schedules. All costs presented exclude VAT.

2.5 Summary of Capital Scheme Costs

OPTION	DESCRIPTION	COST £
1A	Communal 2-Pipe Heating with Heat Meters	6,374,686
1B	Communal 2-Pipe Heating without Heat Meters	5,916,436
1C	Communal 3-Pipe Heating with Heat Meters	6,689,660
1D	Communal 3-Pipe Heating without Heat Meters	6,533,960
2	Domestic Condensing Boilers	7,241,025
3	Domestic Combi Boilers	8,112,637
4	Electric Heating	5,658,841
5	Retain and Repair Communal Heating	4,797,632
6	Replacement Radiant Heating	6,697,729
7	Communal Underfloor Heating	9,442,323
8	Electric Underfloor Heating	5,841,434

2.5.1 Initial Capital and Whole Life Cost Summary

The net present value of whole life cycle costs for combined capital, maintenance, and fuel costs for all options is indicated in the table below: -

Option	COSTS TO LEASEHOLDERS AND CAMDEN			NPV WHOLE LIFE CYCLE COSTINGS						
	Capital Cost if Capital Scheme	Leasehold Charge		Capital Cost if Capital Scheme	Leasehold Charge		Capital Cost if Capital Scheme	Leasehold Charge		Capital Cost if Capital Scheme
	£	£		£	£		£	£		£
1A	6,420,511	1,323,071	1A	6,420,511	1,323,071	1A	6,420,511	1,323,071	1A	6,420,511
1B	5,916,436	1,219,196	1B	5,916,436	1,219,196	1B	5,916,436	1,219,196	1B	5,916,436
1C	7,266,395	1,497,381	1C	7,266,395	1,497,381	1C	7,266,395	1,497,381	1C	7,266,395
1D	6,533,960	1,346,449	1D	6,533,960	1,346,449	1D	6,533,960	1,346,449	1D	6,533,960
2	7,241,025	1,492,153	2	7,241,025	1,492,153	2	7,241,025	1,492,153	2	7,241,025
3	8,112,637	1,671,766	3	8,112,637	1,671,766	3	8,112,637	1,671,766	3	8,112,637
4	5,658,841	1,166,114	4	5,658,841	1,166,114	4	5,658,841	1,166,114	4	5,658,841
5	4,797,632	988,645	5	4,797,632	988,645	5	4,797,632	988,645	5	4,797,632
6	6,697,729	1,380,197	6	6,697,729	1,380,197	6	6,697,729	1,380,197	6	6,697,729

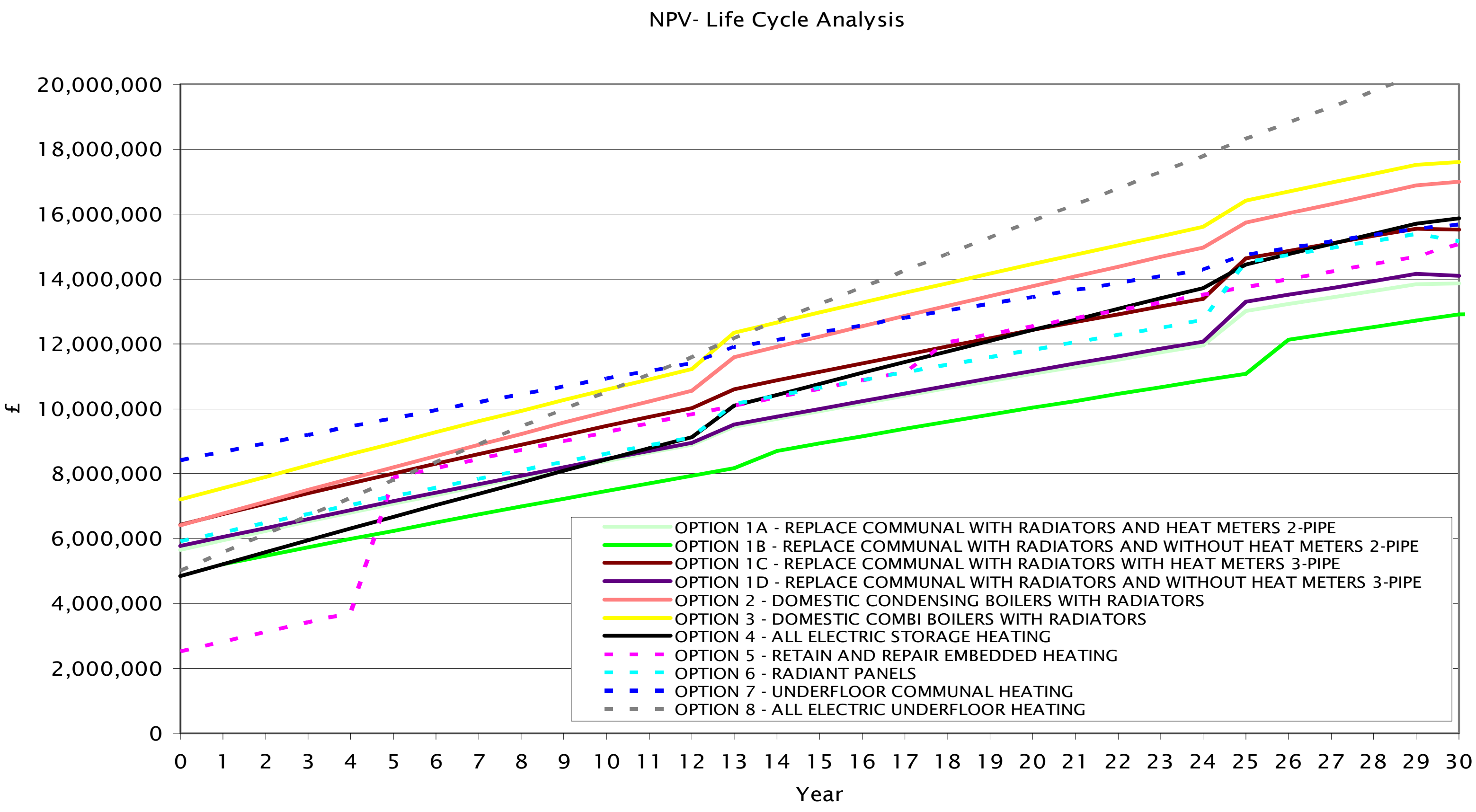
Based on the above total NPV for capital cost, maintenance and fuel the best option would be **Option 1B** for Complete Replacement of Communal Heating/Hot Water System without Heat Meters due to the lowest capital investment, maintenance and fuel cost. Leasehold charge assumes 93 Leasehold dwellings. The leasehold charges are approximate only as NIFES Consulting Group are not authorised to calculate such charges.

For clarity the Scheme Capital Costs differs from the Capital Cost for NPV purposes. This is because the scheme costs would normally include provisional sums and contingencies and if these were included as part of the appraisal, those options with a higher cost would attract higher contingencies and in turn provide a wider differential of cost between options.

The chart below indicates the results graphically.

2.5.2 NPV Chart for Whole Life Cycle Costs

The following chart shows "at a glance" a comparison of whole life cycle costs for all options over a 30-year period. It can be seen that Option 1B indicates the lowest Whole Life Cycle Cost over a 30 year period.


NPV- Life Cycle Analysis
20,000,000
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
£
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Year
OPTION 1A - REPLACE COMMUNAL WITH RADIATORS AND HEAT METERS 2-PIPE
OPTION 1B - REPLACE COMMUNAL WITH RADIATORS AND WITHOUT HEAT METERS 2-PIPE
OPTION 1C - REPLACE COMMUNAL WITH RADIATORS WITH HEAT METERS 3-PIPE
OPTION 1D - REPLACE COMMUNAL WITH RADIATORS AND WITHOUT HEAT METERS 3-PIPE
OPTION 2 - DOMESTIC CONDENSING BOILERS WITH RADIATORS
OPTION 3 - DOMESTIC COMBI BOILERS WITH RADIATORS
OPTION 4 - ALL ELECTRIC STORAGE HEATING
OPTION 5 - RETAIN AND REPAIR EMBEDDED HEATING
OPTION 6 - RADIANT PANELS
OPTION 7 - UNDERFLOOR COMMUNAL HEATING
OPTION 8 - ALL ELECTRIC UNDERFLOOR HEATING

2.6 Energy Consumption

Due to the diverse usage of hot water the energy consumption for hot water is taken as the same with the exception of Option 3 for combination boiler where this would consume approximately 10% less than the other options as it would be heated as and when required.

The estimated annual energy consumptions are tabled below. Due to the various options/types of heating discussed each option would attract different annual energy consumption. For the purposes of the energy calculations it is considered that communal heating boilers would be more efficient than domestic boilers, as communal boilers have reduced cycling. However, communal systems do have additional pipe heat losses due to the length of pipe work to get to each dwelling.

Nevertheless taking into account an allowance for behaviour patterns with residents on flat rate week heating costs the communal energy costs are considered higher than domestic boilers.

The existing energy consumption is 12,302,376kwh per annum.

Option	Heating, kWh	HWS, kWh	Total kWh	% Saving
1A	8,107,391	1,036,588	9,143,979	26%
1B	8,624,884	1,151,765	9,776,649	21%
1C	8,713,761	1,227,539	9,941,300	19%
1D	9,269,959	1,363,932	10,633,891	14%
2	6,886,614	1,515,480	7,872,161	32%
3	6,508,229	1,363,932	7,872,161	36%
4	6,057,090	1,515,480	7,572,570	38%
5	10,087,584	1,599,673	11,687,257	5%
6	9,583,205	1,151,765	10,734,969	13%
7	8,624,884	1,151,765	9,776,649	21%
8	7,106,986	1,515,480	8,622,466	30%

This data is based on theoretical calculations and the energy data listed may increase or decrease as the occupancy patterns and residents' particular comfort levels are so varied. Nevertheless if the occupancy patterns are different to that indicated the fuel consumption for each option would follow a similar trend.

2.7 Environmental Benefits

The implementation of Option 3 for domestic combination boilers would provide the best environmental solution due to the greatest saving in **CO_2**. However, this does not provide the best option in terms of Whole Life Cycle Cost.

Option	kg CO_2 emissions	% Savings	CO_2 Saving kg per Annum
1A	1,776,675	26%	613,676
1B	1,899,603	21%	490,749
1C	1,931,595	19%	458,757
1D	2,066,165	14%	324,187
2	1,632,527	32%	757,825
3	1,529,561	36%	860,791
4	3,256,205	-36%	(865,853)
5	2,270,834	5%	119,518
6	2,085,805	13%	304,547
7	1,899,603	21%	490,749
8	3,707,660	-55%	(1,317,309)

Retention of communal heating will enable future installation of, or connection to, combined heat and power which is the best solution in Camden for delivering carbon reduction.

2.8 Heat Metering

Heat metering has been discussed by Camden many times and considerable benefits can be achieved. The advantage of heat metering means that residents would pay for what they use. A disadvantage is that the meters have to be read manually, by hard wiring, digital signal or radio signals, and then the bill has to be produced and managed. The raising of bills and collection of payment can be labour intensive.

As an alternative to this prepayment heat meters are available whereby a smart card is credited and the resident simply inserts it into the meter. Such an option may be suitable for most but vulnerable residents may be at risk during cold periods if for instance the card "ran out" of funds. Heat metering issues will be discussed later in this report.

2.9 Social Cost and Benefits

In terms of basic weekly running costs the following table indicates the estimated weekly fuel costs for each type of dwelling based on 16 hours per day operation.

The first row reflects actual Camden heating and hot water charges for the year 2007/2008.

Option	Bed-sit	1-Bed	2-Bed	3-Bed	4-Bed	5-Bed
2007/2008 (H/HW) Charges	7.03	9.30	14.10	15.89	17.58	20.15
1A	5.73	4.47	9.63	9.98	13.76	13.76
1B	4.55	4.55	9.81	10.16	14.01	14.01
1C	4.86	4.86	10.47	10.85	14.96	14.96
1D	4.95	4.95	10.67	11.05	15.24	15.24
2	6.84	6.84	14.74	15.26	21.05	21.05
3	6.49	6.49	13.97	14.47	19.96	19.96
4	8.12	8.12	17.50	18.12	25.00	25.00
5	5.44	5.44	11.72	12.14	16.75	16.75
6	5.00	5.00	10.77	11.15	15.38	15.38
7	4.55	4.55	9.81	10.16	14.01	14.01
8	12.74	12.74	27.44	28.42	39.20	39.20

Option 1A, B, C, D, 5, 6 and 7 reflects the predicted fuel cost that Camden may pay based on calculation methodology on fuel demand for the new system.

Option 2 and 3 costs for individual boilers represent the cost to the residents via their own gas meter and supply agreement.

2.10 Energy Tariffs

The running costs include for the estimated consumption of natural gas for both Domestic British Gas and Camden Communal Tariffs. The running costs are based on costs and annual percentage increase of 3% per annum. The tariffs used to calculate the heating charges for all options are indicated in the full report.

2.11 Gas Supply

For the purposes of options 2 and 3 of this report, costs have been included to replace the underground gas mains and above ground lateral mains.

2.12 Further Items for Consideration

Benefits in terms of fuel savings for electricity and gas may be applicable by the inclusion of a combined heat and power unit whereby electricity is generated at site level and the by-product - heat - is utilised to supplement the boiler plant.

Although CHP technology is not considered part of this report and would be the subject of a further Options Appraisal to investigate combining other communal heating sites in the area, outline calculations have been undertaken and are summarised as follows: -

Size of Unit	Capital Cost £	Potential Benefit Per Annum £	Payback years
519 Dwelling 600kWe	750,000	191,000	9.8
699 Dwelling 600kWe	750,000	252,000	6.0
699 Dwelling 836kWe	786,000	262,330	7.4

The above assumes heat can be utilised and excess electrical energy can be exported.

3 CLIENT BRIEF

3.1 General

London Borough of Camden commissioned this report to undertake a survey of the existing services at Alexandra Road Estate.

The main purpose for undertaking the report was due to complaints received from residents with regard to ineffectiveness and interruptions to service of the heating system.

As such the intention was to produce a report on selected options to enable costs to be presented and decisions made on options to implement for "Raising the Standard".

The brief advised by Capital Projects was to inspect the following services: -

- Central plant room
- A selection of dwellings
- Heating distribution mains

In additional the following items would be covered: -

- Recommendations and various methodologies of dealing with any issues discovered during the surveys
- Liaison with Planned Maintenance Group to obtain more detailed and historical information of the heating and water supply services.
- Liaison with Camden's Energy Department with regard to fuel usage and tariffs.
- Undertake outline calculations for Combined Heat and Power (CHP).

The cost appraisal takes the form of estimated capital costs, running costs and life cycle costs.

The estimated capital costs include for supply and installation of all equipment, associated electrical and builders works and contractors costs.

4 DATA

4.1 General

The following data has been used to form the calculations of the report.

4.2 Energy Tariffs

The running costs include for the estimated consumption of natural gas for both Domestic British Gas and Camden Communal Tariffs. The running costs are based on costs and annual percentage increase of 3% per annum. The Tariffs used for the appraisal are as follows: -

Tariff	**Night Tariff Pence per kWh**	**Tier 1 pence per kWh**	**Tier 2 pence per kWh**	**Flat Rate pence per kWh**
British Gas	-	5.207*	2.941**	-
Camden Gas	-	-	-	2.048
Electricity	2.726+++	27.131+	13.080++	

4.2.1 Gas

*Tier 1 tariff cost based on first 1,143kWh consumption per quarter. Equivalent cost is **£238:06** (which is equivalent to £4:60 per week) for the first 4,572kWh consumed annually.

**Tier 2 tariff costs based on consumption after the first 1,143kWh consumption per quarter used up to a maximum of 73,288kWh consumed per quarter.

The fuel cost under option 1A includes VAT at 5%, which Camden would have to charge to residents with a metered supply.

4.2.2 Electricity

+Tier 1 tariff cost based on first 900kWh consumption per quarter. Equivalent cost is **£244:18** per annum (which is equivalent to £4:70 per week) for the first 900kWh consumed annually.

++Tier 2 tariff costs based on consumption after the first 900kWh consumption per quarter used.

+++The night tariff would apply to the majority of energy consumption due to energising the electric storage heaters overnight.

However, a 5% proportion of daytime electricity has been included for daytime boosting.

4.2.3 Heat Meters Reading and Billing Cost

The annual regular billing check per dwelling not including collection of money or debt risk is indicated as £60.

4.3 Life Cycle Costs

The life cycle costs include all installation, maintenance, replacement and fuel costs for a 30 year period.

The life cycle costs are based on a discount rate of 3.5% per annum.

The repair costs are embedded in the comprehensive Term Maintenance Contract so periodic repairs are not included.

It has been assumed that boilers for communal heating option would be replaced at year 25 of the appraisal; and for individual domestic heating options at year 13 and 25.

For domestic and communal systems the appraisal includes radiator replacement at years 13 and 25.

4.4 Maintenance Costs

For communal and domestic systems the maintenance cost per dwelling has been based on the following: -

Option	Maintenance Cost £ per Dwelling per Annum
Communal	140
Domestic System Boilers	150
Domestic Combi Boilers	160
All Electric Systems	50

4.5 Combined Heat and Power

4.5.1 General

Combined heat and power, whereby electricity is generated and the bi-product (heat) is recovered does not form part of this appraisal.

However, should a communal heating system be considered the communal systems discussed in the appraisal would allow future insertion of CHP with reduced disruption via suitably positioned valved connections into the heating system.

Nevertheless, a brief overview of CHP has been undertaken which has produced the following results. The first is based on a unit installed to serve Blocks A, B and C. The second is based on extending the communal system to the Ainsworth Estate.

This review has been carried out based on the following assumptions of numbers of dwellings, heat and power loads, and energy costs. The capital costs are budget numbers for typical community heating schemes involving Reciprocating Engine CHP plant.

Parameter	Value
Nos of Dwellings	519 and 699 totals
Annual Assumed Electrical Load per Dwelling	4,200 kWh
Annual Assumed Gas Fuel Load per Dwelling	27,127 kWh
Gas Price	£25.00/MWh
Electricity Price	£115.50/MWh
Assumed Export Electrical Price	£34.65/MWh (30% of market price above)

4.5.2 519 Dwelling Total – 600kWe CHP Plant

For the 519 dwelling option, the assumed CHP plant is a 600kWe electrical generation unit. The plant output is led by the available heat load, on the assumption that excess power generation can be exported.

The benefits and costs of this option are outlined in the table below.

Parameter	Value
Budget Capital Cost	£885,000 inc VAT
Annual Maintenance Charge	£20,900
Annual Total Tenant Benefit	£191,340 (31.7% current costs)
Carbon Dioxide Emissions Annual Saving	1,305 tCO_2
Payback	**9.8 years**
IRR	8.8%
NPV @3.50%	£344,000

4.5.3 699 Dwelling Total – 600kWe CHP Plant

For the 699 dwelling option, the first assumed CHP plant is a 600kWe electrical generation unit. The plant output is led by the available heat load, on the assumption that excess power generation can be exported.

The benefits and costs of this option are outlined in the table below.

Parameter	Value
Budget Capital Cost	£885,000 inc VAT
Annual Maintenance Charge	£20,900
Annual Total Tenant Benefit	£252,960 (31.1% current costs)
Carbon Dioxide Emissions Annual Saving	1,320 tCO2
Payback	**6.0 years**
IRR	17.4%
NPV @3.50%	£995,000

4.5.4 699 Dwelling Total – 836kWe CHP Plant

For the 699 dwelling option, the second assumed CHP plant is an 836kWe electrical generation unit. The plant output is led by the available heat load, on the assumption that excess power generation can be exported.

The benefits and costs of this option are outlined in the table below.

Parameter	Value
Budget Capital Cost	£925,000 inc VAT
Annual Maintenance Charge	£29,100
Annual Total Tenant Benefit	£262,330 (32.3% current costs)
Carbon Dioxide Emissions Annual Saving	1,840 tCO2
Payback	**7.4 years**
IRR	13.3%
NPV @3.50%	£701,000

4.5.5 Base Assumptions for CHP Calculations

The following assumptions have been made in the CHP calculations.

Parameter	Value
Gas	£25.00/MWh
Electricity Import	£115.50/MWh
Electricity Export	£34.70/MWh
CHP Plant Operating Hours	5,895 hrs pa
CHP Plant Power Output	1.4MWe
CHP Plant Heat Output	1.49MW
CHP Plant Fuel Input	3.70MW (GCV)
CO2 Emission / MWh Electricity Imported	0.537 tCO2/MWh
CO2 Emission / MWh Gas Imported	0.185 tCO2/MWh
District Heating Scheme Thermal Efficiency	65%
CHP Plant Availability	95% (17 hrs/day)

5 SITE DETAILS

The site comprises a number of blocks of varying types of dwellings as shown in the table below:

Blocks	Bedsit	1 bed	2 bed	3 bed	4 bed	5 bed	Total
1a-9b Ainsworth Way	0	4	9	4	0	0	**17**
10a-15b Ainsworth Way	1	3	6	0	1	1	**12**
16a-21b Ainsworth Way	7	0	4	1	0	0	**12**
Rowley way: 5-48 (a-b) except 5&48 and excl: the two rows below and flat 20	0	0	26	34	0	0	**60**
Rowley way: 4,7,11,14,18 (a-k)	0	29	7	14	0	0	**50**
Rowley way: 23,26,30,33,37,40,44,47(a-k)	0	49	16	15	0	0	**80**
Rowley way:50-76(a-b) except 50&76 and excl:51,54,58,61,65,68,72,75	0	0	0	36	0	0	**36**
Rowley way: 51,54,58,61,65,68,72,75(a-k)	0	49	13	18	0	0	**80**
Rowley way: 79,82,86,89,93,96,100,103 (a-k) not all letters listed	0	47	14	19	0	0	**80**
Rowley way: 78-104(a-b) except 78&104 and excl:79,82,86,89,93,96,100,103	0	19	7	10	0	0	**36**
Rowley way: 113-119 (c-k)	0	40	10	6	0	0	**56**
1-20 Ainsworth House	0	9	11	0	0	0	20
1-60 Besant House	19	0	22	19	0	0	60
1-36 Edgeworth House	0	0	36	0	0	0	36
1-10 Fielding House	0	10	0	0	0	0	10
1-24 Greenway House	0	0	24	0	0	0	24
1-10 Linnell House	0	0	0	0	10	0	10
1-20 Stevenson House	0	10	6	1	3	0	20

For the purposes of this report only Blocks A, B and C (shaded) are discussed. The remaining blocks are served by domestic boilers and are not discussed in this report.

5.1 Construction Details

The buildings are essentially in-situ cast reinforced, with block infill and plaster to inner walls. All buildings have single glazed timber windows and door sets.

The exact make-up of the structure is not known in terms of insulation properties, although approximately 3 years ago a roofing replacement exercise was undertaken which brought insulation values for the roof up to current standards.

6 REPAIRS HISTORY

6.1 General

Repairs history data provided by Camden's Planned Maintenance Group was analysed. The information was dated from 2 January 2003 (when Seaflame took over the scheme from Dalkia) to 7 January 2008.

The data give contains 2,574 items or incidents associated with the dwellings or block connected to the communal boiler plant, of which 2,209 are associated with the dwellings for this heating scheme (this equates to an average of just over 4 events per dwelling per year).

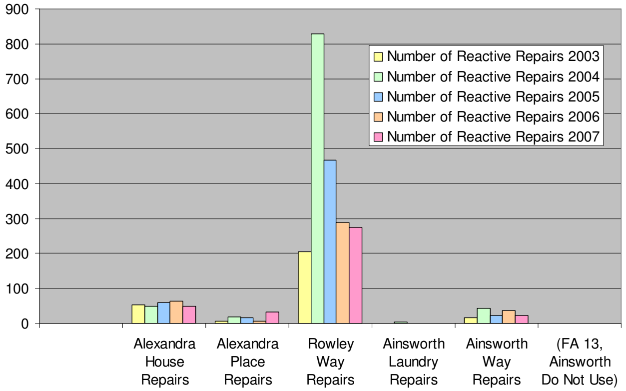
The data given as to the record of events varies considerably; for instance a defective hot water cylinder is recorded as burst boiler, leaking boiler, leaking cylinder, etc. In order to provide some consistency, each event has been reviewed and rationalised into a select number of categories as follows: -

DH - Defective heating
DHW - Defective hot water
DHHW - Defective heating and hot water
DR - Defective radiator
DCW - Defective cold water
L? - Leak somewhere
LHP - Leaking heating pipe
LHW - Leaking hot water
DT - Defective thermostat
PPM - Routine PPM
V - Replace valves
RC - Replace cylinder
U - Unknown

6.2 Summary of Reactive Repairs

Repair by Block	Reactive Repairs 2003	Reactive Repairs 2004	Reactive Repairs 2005	Reactive Repairs 2006	Reactive Repairs 2007	Total
Alexandra House	54	49	60	64	50	**277**
Alexandra Place	7	19	16	7	33	**82**
Rowley Way	205	829	467	290	275	**2066**
Ainsworth Laundry	0	4	1	0	1	**6**
Ainsworth Way	17	43	23	37	23	**143**
Total	**283**	**944**	**567**	**398**	**382**	**2574**

The chart below shows the number and type of repair since 2003.



From records viewed the current Maintenance Contract equates to £75,704 per Annum.

In addition to this works and repairs have been undertaken that fall outside the Maintenance Contract between 2003 and 2007 summarised as follows: -

Item	**Remedial Work Cost**
Ad-hoc Repairs	20,433
Replacement DHWS Cylinders	47,063
Replacement of Riser Block A	35,000
Distribution re-configuration Block A	292,400
Total	**394,896**

In simple terms the above costs indicate that almost £79,000 per annum has been spent on the system repairs over and above the Annual Maintenance costs over the last 5 years.

In summary the overall repair and maintenance cost over the last 5 years was £774,016 or £154,803 per annum or £298 per dwelling per annum and represents an ongoing burden to Camden.

6.3 Summary of Events by Block

The following summary of events just relates to those blocks associated with this scheme, these being Rowley Way and Ainsworth Way.

Item	**Description**	**Block A**	**Block B**	**Block C**	**Total**
DH	Defective heating	312	237	31	**580**
DHW	Defective hot water	901	267	77	**1245**
DHHW	Defective heating and hot water	88	43	14	**145**
DR	Defective radiator	17	2	4	**23**
DCW	Defective cold water	4	0	1	**5**
L?	Leak somewhere	11	3	1	**15**
LHP	Leaking heating pipe	75	19	8	**102**
LHW	Leaking hot water	0	1	2	**3**
DT	Defective thermostat	5	1	1	**7**
PPM	Routine PPM	9	2	2	**13**
V	Replace valves	6	3	2	**11**
RC	Replace cylinder	40	5	0	**45**
U	Unknown	8	0	0	**8**
Total		**1476**	**583**	**143**	**2202**

Of all the 2202 events listed since 2003, the largest numbers of repairs are associated with heating, hot water and leaking pipes (2072).

Given the number of defect events this suggests that reliability is becoming worse due to the age of the system and suggests a case for renewal.

Given the number of leak events, especially heating pipes, it suggests that the system infrastructure is becoming fragile due to the age of the system and suggests a case for renewal.

Given the number of combined defective heating and hot water events it suggests that such events occurred at the same time and it can therefore be assumed that this was attributed to main plant failure.

6.4 Summary of Events by Block Type

The following summary shows events on a block by block basis.

Item	Description	Block A1	Block A2	Block A3	Block A4	Block A5	Block B1	Block B2	Block B3	Block C1	Block C2	Block C3	Total
DH	Defective heating	54	54	68	66	70	97	52	87	18	8	3	**577**
DHW	Defective hot water	173	219	201	205	103	127	69	71	33	24	19	**1244**
DHHW	Defective heating/hot water	13	34	15	16	10	21	7	15	9	2	2	**144**
DR	Defective radiator	2	3	2	6	4	2	0	0	1	1	2	**23**
DCW	Defective cold water	0	2	0	1	1	0	0	0	1	0	1	**6**
L?	Leak somewhere	0	2	1	4	4	2	1	0	0	1	0	**15**
LHP	Leaking heating pipe	6	19	18	21	11	6	7	6	0	6	2	**102**
LHW	Leaking hot water	0	0	0	0	0	1	0	0	0	1	0	**2**
DT	Defective thermostat	0	1	1	2	1	0	0	1	1	0	0	**7**
PPM	Routine PPM	3	2	2	2	0	1	0	1	0	1	0	**12**
V	Replace valves	0	3	1	2	0	0	1	1	1	1	0	**10**
RC	Replace cylinder	34	3	1	1	1	2	1	2	0	0	0	**45**
U	Unknown	2	1	1	3	1	0	0	0	0	0	0	**8**
Total		**287**	**343**	**311**	**329**	**206**	**259**	**138**	**184**	**64**	**45**	**29**	**2195**
	Flats per block	50	80	80	80	56	60	36	36	18	12	11	**519**
	Average events per flat	**5.74**	**4.28**	**3.88**	**4.11**	**3.67**	**4.31**	**3.83**	**5.11**	**3.55**	**3.75**	**2.63**	**4.22**

The above table might suggest that block A1 has suffered the most disruption, and in fact it has, because 34 hot water cylinders have been replaced.

The number of events associated with defective hot water confirms the reason to undertake remedial work to the roof mains that serve the hot water cylinders.

Data such as the above can be analysed in various ways but without a suitable benchmark to compare these with it is not known whether the frequency of events is excessive or not. However, whatever is considered to be an acceptable benchmark, the number of events would reduce considerably with modern heating and water systems given that a digital control system for the boiler house would intercept faults and in some cases before the residents had registered that they had happened.

6.5 Grade II Listed Buildings

On this estate the following residential blocks are Grade 2* (star) listed: -

- Rowley Way - Block A - 346 Flats
- Rowley Way - Block B - 132 Flats
- Ainsworth Way - Block C - 42 Flats
- Langtry Walk - 2 Flats & 10 Workshops.

Langtry Walk does not form part of this report.

The remaining blocks are not listed: -

- Ainsworth Estate - 180 Dwellings approximately.
- Robert Morton House - 50 dwellings approximately
- Alexandra Place - 50 dwellings approximately
- Special School

All the above mentioned blocks are within a Conservation Area.

For any changes to the engineering systems that affect the visual appearance both internally and externally it will be necessary to obtain Listed Building Consent and Planning Consent.

6.6 Original Design Criteria

The following original design criteria were taken from the Operating and Maintenance Manuals kept on site:

- Heating operating pressure - 3 barg
- Primary hot water flow temperature - 115°C
- Primary hot water return temperature - 85°C
- Variable heating flow temperature - 82/60°C
- Variable heating return temperature - Variable.

The actual operating criteria taken from the various gauges on the primary hot water system were: -

- Flow temperature - 105°C
- Return temperature - 85°C

6.7 Existing Services within Boiler Room

6.7.1 Boilers

Three Allen Ygnis AY4208 dual fuel boilers (Natural gas and 35 second oil) each rated at 2345kW output although these have been running on natural gas for some years.

6.7.2 Flues

Three individual flue gas ducts run from the boiler room at high level, and then rise vertically into three steel clad chimneys.

The flues are original and would need to be replaced with the boiler room especially if condensing type boilers are installed (meaning that flues would need to be taller due to less buoyancy of flue gas).

6.7.3 Boiler Room Acoustics

The acoustics and noise emissions around the boiler room are not acceptable when compared to current Environmental standards. Also vibration is apparent in the Tenants Hall which appears to be regenerating as noise.

Part of the Planning Application is to produce an acoustic report of existing noise levels and advise the proposed design. The acoustic report will be submitted at the appropriate time.

6.7.4 Constant Temperature Pumps (Winter)

One Holden & Brooke Ltd belt driven pump providing 10.2 l/s; the pressure developed is 31 metres head.

One Lowara variable speed pump type FHE 50.200/110 providing between 10 l/s and 28 litres per second. The pressure developed is between 54 and 29 metres head.

6.7.5 Constant Temperature Pumps (Summer)

Two Holden & Brooke Ltd belt driven pumps providing 2.7 litres per second; the developed pressure is unknown although it is understood that these are not used.

6.7.6 Variable Temperature Pumps (Block A)

Two Holden & Brooke Ltd belt driven pumps providing 30.3 litres per second; the pressure developed is 55 metres head.

6.7.7 Variable Temperature Pumps (Block B)

Two Holden & Brooke Ltd belt driven pumps providing 16 litres per second; the pressure developed is 39 metres head.

6.7.8 Variable Temperature Pumps (Block C)

Two Holden & Brooke Ltd belt driven pumps providing 7.9 litres per second; the pressure developed is 30 metres head.

6.7.9 Other Equipment

There are three additional circuits serving a hot water cylinder primary coil, school heating circuit and a special school underfloor heating circuit.

6.7.10 Controls

The heating circuits serving blocks A, B and C are controlled via Satchwell 3-port motorised valves dictated by a Building Management System.

The boiler plant operates 24 hours per day, 7 days per week and 52 weeks per year.

The original boiler plant operating temperatures were 115°C flow and 85°C return. The temperatures have been reduced due to problems on the system.

6.8 Existing Heating and HWS Systems

6.8.1 Heating distribution

In Block 'A' VT heating and primary hot water services mains exit the boiler room and run on the underside of the pedestrian bridge towards the Estate Office. They enter the Estate Office at high level then run to the rear, rise up the existing lift shaft and onto the roof of block A. The pipes then run horizontally along the roof of block A as indicated below.

Block A - View looking West showing roof-top pipe work

From the horizontal pipe work, connections run laterally across the roof then drop down through flats in two locations with the heating to the rear and primary hot water to the centre via the rooftop cold water tank pods.

In other blocks (B and C) heating and HWS primary mains run at basement level through the garages with risers rising up through the building to serve pipe coils and hot water cylinders. Some pipes are buried underground.

6.8.2 Heating Services within Dwellings

The heating system was originally designed for providing heating to the standards the day.

Steel pipe coils are embedded within the concrete party walls which provide joint radiant heating to each flat either side of the party walls. It would appear that the radiant heating was designed to cater for the fabric proportion of the heat loss.

A concealed fan coil/warm air unit provides heat for "topping up purposes" to bring the ambient air temperature up to around 21°C i.e. to provide heat to cover the ventilation loss. Fresh outside air is brought into the fan coil unit where a damper is fitted such that it can divert fresh air in summer for nominal cooling or via the heating coil to provide heating.

6.8.3 Hot Water Services within Dwellings

Difficulties have been experienced with the hot water services system in that the extremes of the system, particularly Block A1 had become so poor that remedial works to install immersion heaters to cylinders and some re-piping work has been undertaken. In addition further remedial work was undertaken during 2007 to reinstate the hot water service primary connections by installing new roof top pipe work to Block A together with new circulating pumps within the boiler room. This exercise was successful and seems to have stemmed the flow of complaints regarding hot water.

HWS cylinders are controlled by Drayton Cyltrol hot water thermostatically operated valves. The hot water services primary flow temperature has been reduced to 95°C because the original Cyltrol thermostatic control valves were failing and passing hot water. The fail-safe high limit valves on the cylinders are set at 97°C which discharge when the water temperature to the cylinders reach 115°C.

Spirax Sarco fusible link operated fail-safe valves are situated after the Drayton valves and operate as the high limit protection for the cylinders but these are also failing and spare parts are no longer available. This is why the primary temperature as reduced so as to prevent boiling of the cylinders.

All HWS cylinders have ⅜" or 10mm primary connections.

The cylinders are served by cold water via roof top water tanks. The roof top tanks are in good condition having been replaced approximately 3 years ago.

7 DISCUSSION ON HEATING AND WATER SERVICES

7.1 General

The fact that the majority of the systems are in excess of 30 years old means that they have exceeded the life expectancy indicated by Trade Associations.

7.2 Boilers

The existing boilers have reached the end of their lifetime and need to be replaced. Condensing type boilers would be required to comply with current Building Regulations requirements and to benefit from greatly improved energy efficiencies.

7.2.1 Heating Pipe work

The existing heating system to flats is via heating coils embedded in walls within flats. Heating water from the communal boilers is circulated within these coils to provide background heating to a limited number of rooms within each dwelling.

As a result when external air temperatures are low, some residents complain of lack of heating; but when external air temperatures are high, tenants complain of high room temperatures which lead to opening windows to dissipate heat and thus wasting energy.

With conventional radiator systems such complaints are virtually eliminated due to rapid response times. Each radiator is controlled individually, giving flexibility for different temperatures in different rooms. The combination of both radiant and some convective heat provides for better comfort.

The existing heating system distribution pipe work is corroding from the outside in and also from the inside out.

7.2.2 Primary Hot water services

As per the heating system; distribution pipe work is corroding from the outside in and it is understood that pipe work is also corroding from the inside out.

It is known that there is a considerable amount of sludge/sediment throughout the system and that this sludge is causing blockage in the ⅜" primary pipe work causing circulation problems, in particular to the cylinders in Block 'A' at the lower two levels.

7.3 Information from Maintenance Contractor

Camden's Term Maintenance Contractor Seaflame verbally indicated that: -

a) The distribution pipe work is in very poor condition throughout. The pipe work is corroding from the outside in. Due to the sludge in the system the pipe work is also corroding from the inside out. A considerable amount of this pipe work is buried inside concrete walls, which over the life of the system so far, is partly responsible for the corrosion problem on the outside of the pipes.

b) It is not known how much ⅜" pipe there is buried in the walls. There are no flushing valves on the risers, although Seaflame have now started putting them in.

c) Seaflame have also started putting in new cylinders with immersion heaters in worst areas where there is little or no primary heating water circulation.

d) When running the system at original design temperature of 115°C but due to control valve failure it has been reported that secondary hot water has on occasion boiled. In order to reduce the obvious health and safety problems with this system Seaflame now operate the system at 95 to 105°C.

e) A new constant temperature pump was added in order to improve circulation but this did not help enough to make any significant improvement.

f) Where the existing Drayton Cyltrol cylinder control valves are failing, Seaflame are replacing them with new Drayton Tapstat valves.

It is understood that Seaflame continue to undertake works on the HWS systems where a number of cylinders have been replaced. Also Seaflame have installed a number of heating systems with radiator systems with independent domestic boilers.

These replacements have been installed due to failures of the existing heating system.

7.4 Heat Metering

Heat metering has been discussed by Camden many times and considerable benefits can be achieved.

The advantage of heat metering means that residents would pay for what they use. A disadvantage is that the meters have to be read manually, by hard wiring, digital signal or radio signals, and then the bill has to be produced and managed. The raising of bills and collection of payment can be labour intensive.

As an alternative to this prepayment heat meters are available whereby a smart card is credited and the resident simply inserts it into the meter. Such an option may be suitable for most but vulnerable residents may be at risk during cold periods if for instance the card "ran out" of funds, as such special arrangements would need to be made for the vulnerable.

7.5 General Note

For a full Options Appraisal/Feasibility Report it is traditional to include options to completely replace heating systems on a like for like basis such that all options can be fairly compared and on a level "playing field".

However, a number of items/issues are placing a burden on timescales such as Planning Permission for boiler flues and confirmation from the gas provider as to whether the gas pipes are adequate or require replacing.

From NIFES experience the performance of the gas provider has been poor and if the "Domestic Option" is implemented there can be no guarantees to meet the delivery of a programme.

8 OPTIONS AND SCOPE OF WORKS

The following options that have been considered for whole life cycle costs analysis in line with Camden's Policy. An additional three options are included at the request of the Heating Working Group.

The scope of work required for each option is discussed below.

Due to the natural progress, programming and sequence of retro-fitting heating systems, together with the timeous parameters of installing a replacement heating and hot water system, it was considered that to maintain heating services it was necessary to run new services while keeping the old running.

In joint consultation with English Heritage, Camden Planners, Camden's Capital Investment Group and Levitt Bernstein it has been tentatively agreed that new services tubes be run to the rear of Block A to house forthcoming services and also allow space for future services such as gas, water, electricity, TV and other services. As such this services tube is common to all options discussed below.

The services to Blocks B and C would need to be run in similar positions laterally and internally.

Option 1A: Complete Replacement With Heat Meters

Complete removal and replacement of communal 2-pipe heating system and hot water system (with hydraulic boards and heat meters in dwellings) with new external service tubes to block A.

Option 1B: Complete Replacement <u>Without</u> Heat Meters

Complete removal and replacement of communal 2-pipe heating system and hot water system (with hydraulic boards but without heat meters) with new external service tubes to block A.

Option 1C: Complete Replacement With Heat Meters

Complete removal and replacement of communal 3-pipe heating system and hot water system (with hydraulic boards and heat meters in dwellings) with new external service tubes to block A.

Option 1D: Complete Replacement <u>Without</u> Heat Meters

Complete removal and replacement of communal 3-pipe heating system and hot water system (with hydraulic boards but without heat meters) with new external service tubes to block A.

Option 2: Domestic Condensing Boilers

Complete removal of communal heating and hot water system and replacement with domestic condensing boilers (with new external service tubes to block A).

Option 3: Domestic Combination Boilers

Complete removal of communal heating and hot water system and replacement with domestic condensing combination boilers (with new external service tubes to block A).

Option 4: All Electric Heating

Complete removal of communal heating and hot water system and replacement with all electric heating and hot water (with new external service tubes to block A).

Option 5: Retain and Repair Existing Radiant Heating System

Retain and repair existing embedded radiant and warm air system and replacement hot water system, but retaining the communal boiler plant until replacement is due (with new external service tubes to block A). Assumed major replacement within 5 years.

Option 6: Replace Radiant Heating System

Complete removal and replacement of communal radiant heating (wall or ceiling panels) and hot water systems (with new external service tubes to block A).

Option 7: Underfloor Communal Heating

Complete removal of communal heating and hot water system and replacement with underfloor heating and hot water cylinders (with new external service tubes to block A.).

Option 8: Underfloor Electric Heating

Complete removal of communal heating and hot water system and replacement with all electric underfloor heating with hot water system (with new external service tubes to block A).

8.1 Option 1A: Complete Replacement With Heat Meters

This option would consist of complete replacement of boiler house, 2-pipe heating mains, decorative radiators and domestic hot water systems within dwellings. Hydraulic boards would be installed to each dwelling and heat meters would be installed.

8.1.1 Boilers and Associated Equipment

The existing boilers and associated equipment would be replaced which modern and efficient condensing type boilers.

A review would be undertaken at installation stage as to whether the existing heating circulation pumps would meet the duty of the new system.

However the cost for replacement pumps is included in the appraisal.

8.1.2 Flue System

The existing chimney stack would need to be replaced.

8.1.3 Boiler Room Acoustics

Part of the Planning Application is to produce an acoustic report of existing and advise the proposed design. The acoustic report will be submitted at the appropriate time.

Nevertheless a sum is included for application of acoustic and anti-vibration measures.

8.1.4 Domestic Hot Water Cylinders

The existing DHW cylinders would be replaced and connected to existing cold water down services via the new roof top water tanks.

8.1.5 Natural Gas Services

No work is required to the gas supply for dwellings as the gas infrastructure belongs to National Grid, although space would be made available in the new external service tubes so as to avoid unsightly surface fixed services.

8.1.6 Boiler Control System and Wiring

A control system exists at present but this is outdated. A new system would be installed, compatible with Camden's extensive controls network.

8.1.7 Internal Heating Distribution Pipe Work

New decorative radiators would be sized and installed to replace the heating coils existing within dwellings walls. A new dwelling control board (hydraulic board) would be installed to interconnect and control the new radiator and hot water system. An option exists to install a trench type heater in the boxed section below the lounge window in block A.

New copper pipe work would be installed to interconnect radiators with hydraulic board and new isolation and commissioning valves installed to control the flow of water to each dwelling.

8.1.8 Heating, Hot and Cold Water Services in Dwellings

In the case of Block A mild steel heating connections in the external services tube new copper pipe work would run within the existing cupboard. In the case of Block B and C heating pipe work would be installed in the same location as the existing.

Dwellings would be provided with individual heating and hot water controls. These would be mounted on a "hydraulic board" located in each warm air unit cupboard.

The hydraulic board would contain all controls and valves necessary for the user operation, maintenance of the system and emergency shut down.

From the hydraulic board connections would be made to the new hot water cylinder.

Copper heating pipe work would run at high and low level and connect to pre-finished, powder coated, steel radiators at positions agreed with English Heritage.

The heating pipe work would be boxed in.

A new hot water cylinder with double insulated foam would be provided. The local pipe work within the airing cupboard would be renewed. The cylinders would incorporate an electric immersion heater for emergencies during maintenance or summer use.

The heating control valve mounted on the hydraulic board would be wired to a domestic programmer to enable on and off times to be set by the resident (the style of control would be exactly the same as a domestic boiler control system). Such a system would complement the thermostatic radiator valves fitted to each radiator to enable temperatures to be set by the resident.

The individual domestic hot water services cylinders would incorporate a control valve and sensor so that each resident would have a choice of water temperature, but recommended water temperatures will be advised.

The controls would enable residents to control the following: -

- The times of day that dwelling is heated.
- The times of day hot water service is heated.
- The temperature to which dwellings are heated via thermostatic radiator valves.
- Adjustable sensors for residents to control hot water cylinder temperature.
- An internal sensor would enable frost protection when residents are away.

It is proposed that the hot and cold water services pipe work be replaced as far as is practicable without disturbing connected appliances.

8.1.9 Heat Meters

Following approval at Camden's District Management Team (DMT) it was agreed that a Pilot Heat Metering Scheme be implemented to enable residents to pay for what they use.

It is a possibility that heat meter installations will be undertaken to other communal systems in Camden. The gathering of heat data can be made in various ways via hard wiring, radio signal, and labour intensive means via visiting each dwelling or by pre-payment card. Details of capital, maintenance and calibration costs of heat meters and also different methods of reading and billing costs will be discussed later in this report.

For the purpose of this report a sum of £770 per dwelling is included.

8.1.10 Builders' Work and General Items

Builders' work would be required as a result of installing new pipe work within dwellings. Builders' work within the boiler room would be required to accommodate the new modern condensing boilers and associated equipment.

In addition, a provisional sum for decorations is allowed. Also, despite accurate records, a provisional sum is included for asbestos removal.

8.2 Option 1B: Communal Replacement Without Heat Meters

This option is the same as Option 1A but <u>without</u> heat meters to each dwelling.

8.3 Option 1C: Communal Replacement With Heat Meters

This option is the same as Option 1A but <u>without</u> heat meters to each dwelling but with a replacement 3-pipe heating system similar to that at present. However the pipework configuration with and extra flow pipe serving the primary hot water would mean that an addition heat meter is required.

8.4 Option 1D: Communal Replacement Without Heat Meters

This option is the same as Option 1A but <u>without</u> heat meters to each dwelling but with a replacement 3-pipe heating system similar to that at present.

8.5 Option 2 – Domestic Condensing Boilers

Option 2 would consist of complete replacement of boiler house, heating mains, decorative radiators and domestic hot water systems within dwellings. Hydraulic boards would be installed to each dwelling but without heat meters.

All existing boiler plant and heating mains would be removed and structures made good.

New gas fired condensing wall mounted domestic boilers would be installed to each dwelling with flues positioned across the underside of the walkway balconies to comply with boiler manufacturer's and gas safety standards.

Due to the impact of flue penetrations a planning application or Listed Building Consent has not been progressed.

A domestic heating controls package would provide individual time and temperature control for each dwelling as described in Option 1A.

The whole site has underground ductile iron and cast iron gas mains and is owned and operated by National Grid. National Grid has undertaken some replacements with polyethylene gas mains which are owned and managed by Transco. Only National Grid can work on these mains so any work/upgrade will be expensive and impose an unsuitable delay in delivering a new or reinforced gas supply.

Enquiries have not been made with the Gas Provider so as to confirm whether or not the existing site gas services are capable of supplying the gas required to serve both cooking and the new gas boilers. However, the gas pipe work serving Blocks A, B and C is sized for cookers only. A considerable replacement programme would therefore be required to cater for domestic boilers and cookers.

For the purposes of this report costs have been included to reinforce the underground mains and above ground lateral mains. Similarly whole life cycle costs have been undertaken to indicate the results if the gas supply was adequate and the results are that the communal options 1A and 1B would still be the recommended choice.

The addition of domestic boilers would impose an additional burden to the Council due to the need to undertake gas safety checks on an annual basis.

8.6 Option 3 – Domestic Condensing Combination Boilers

Option 3 would be the same as Option 2 except that hot water would be generated via combination boilers.

All gas pipe work would need to be removed and replaced to comply with current regulations and would be larger than those for the domestic condensing boilers described above due to the provision of domestic hot water directly from the boiler (increased boiler rating).

All existing boiler plant and heating mains would be removed and structures made good.

The gas provider scenarios also apply to this option although the gas supply would need to be larger due to the greater consumption of combination boilers. For the purposes of this report costs have been included to replace the underground mains and above ground lateral mains.

Due to the water requirements of the condensing combination boilers the water pipe work would need to be reviewed and additional water boosters installed to convey adequate flow and pressure.

The addition of a domestic condensing combination boiler would impose an additional burden as described above in terms of annual gas safety tests.

8.7 Option 4 – All Electric Heating

The heating would be provided by electric storage heaters. The storage heaters would "charge-up" overnight on off-peak electricity then discharge or dissipate throughout the day.

The controllability of storage heaters is such that once the heat has been dissipated the resident would then have to wait until the next morning for additional heat. Modern storage heaters have an option for a supplementary heater to cover events described above but this would mean running on peak tariff electricity.

Due to increased electrical demand the whole electrical infrastructure would need to be reviewed.

Electric heating has an advantage in that the installation and maintenance costs are low, but given that electricity is approximately 2 to 3 time more expensive than gas which Camden purchase then the 30 year life cycle costs are not viable.

8.7.1 Option 5 – Retain and Repair Existing Radiant System

This option would basically retain radiant heating existing services but with enhancement in terms of dwelling control boards for hot water service control and future heating control.

As the existing embedded radiant pipe coils share heat between each dwelling it is not possible for individual residents to control the radiant heating in their dwelling.

The communal boiler plant would be retained initially but for appraisal purposes would be replaced at year 5.

The heating distribution pipe work would be replaced and terminate at a dwelling control board and from this the pipe work would connect to existing. No heat meters are included in this option until year 5.

The hot water cylinders would be replaced.

The existing heating system within dwellings would continue to be maintained and repaired although the frequency and failures mare likely to become more frequent over time and may mean a further review of priorities.

A failure of one communal heating coil affects two dwellings; failure of an existing heating or hot water riser affects 10 dwellings. The effect of compensation due to loss of service cannot be quantified by NIFES Consulting Group.

The amount of Camden Officer time to deal with such complaints also cannot be quantified by NIFES Consulting Group.

8.7.2 Option 6 – Replace Radiant Heating System

This option would include complete replacement of the existing communal radiant heating by means of recessed wall or ceiling panels.

The heating distribution pipe work would be replaced and terminate at a dwelling control board and from this the pipe work would connect to existing.

The hot water cylinders would be replaced.

All heating distribution pipe work and boiler plant would be replaced.

This option will be particularly disruptive to residents and they may require decanting due to extensive concrete cutting to embed the panels. Decanting costs are not quantified or included in the report.

8.7.3 Option 7 – Underfloor Communal Heating

This option is essentially the same as Option 6 but with underfloor heating served from the communal boiler plant.

The existing floor finished would have to be removed, screed floors would need to be broken up, electrical services reviewed and expansion joints on sub-concrete floors inspected and repaired.

After applying insulation the underfloor heating would be installed and screed replaced.

All heating distribution pipe work and boiler plant would be replaced.

This option would also be particularly disruptive to residents would require decanting especially as new screed would require a curing and drying time. Such decanting costs are excluded.

Also any existing floor finishes would probably be destroyed and then have to be replaced.

This option will be particularly disruptive to residents and they may require decanting due to extensive concrete cutting to embed the panels. Decanting costs are not quantified or included in the report.

8.7.4 Option 8 – Underfloor Electric Heating

This option is essentially the same as Option 7 but with underfloor electric heating pads.

For this option the existing floor coverings would need to be removed although the floor screed would not need to be broken.

A system is available where electric heater pads are stuck down onto the floor, 6mm of insulation applied and then the floor covering replaced.

Consideration would need to be given to door clearances between the door and the floor finish.

The controllability of the heating is more responsive that electric storage heaters but it would mean running on peak tariff electricity (expensive to run)

Due to increased electrical demand for peak use the whole electrical infrastructure would need to be reviewed.

Electric heating has an advantage in that the installation and maintenance costs are low, but given that electricity is approximately 2 to 3 time more expensive than gas which Camden purchase then the 30 year life cycle costs are not viable.

9 ESTIMATED CAPITAL COSTS

The estimated capital costs for each option are summarised below. Detailed costs are indicated in the appendices. The costs below represent those that would apply to a capital scheme.

9.1 Option 1A: Complete Replacement with Heat Meters

ITEM	DESCRIPTION	COST £
1	Preliminaries	400,000
2	General Items	262,850
3	Boiler house	1,078,575
4	Block A	2,186,699
5	Block B	956,566
6	Block C	319,661
7	Heat Meters	458,250
8	**Sub-Total**	**5,662,601**
9	Contingency sum @ 10% of sub-total	566,260
10	**Sub-Total**	**6,228,861**
11	Provisional sums	191,650
12	**GRAND TOTAL**	**6,420,511**

9.2 Option 1B: Complete Replacement without Heat Meters

ITEM	DESCRIPTION	COST £
1	Preliminaries	400,000
2	General Items	262,850
3	Boiler house	1,078,575
4	Block A	2,186,699
5	Block B	956,566
6	Block C	319,661
7	Heat Meters	0
8	**Sub-Total**	**5,204,351**
9	Contingency sum @ 10% of sub-total	520,435
10	**Sub-Total**	**5,724,786**
11	Provisional sums	191,650
12	**GRAND TOTAL**	**5,916,436**

9.3 Option 1C: Complete Replacement with Heat Meters

ITEM	DESCRIPTION	COST £
1	Preliminaries	400,000
2	General Items	262,850
3	Boiler house	1,105,938
4	Block A	2,377,474
5	Block B	1,095,144
6	Block C	524,331
7	Heat Meters	665,850
8	**Sub-Total**	**6,431,587**
9	Contingency sum @ 10% of sub-total	643,159
10	**Sub-Total**	**7,074,745**
11	Provisional sums	191,650
12	**GRAND TOTAL**	**7,266,395**

9.4 Option 1D: Complete Replacement without Heat Meters

ITEM	DESCRIPTION	COST £
1	Preliminaries	400,000
2	General Items	262,850
3	Boiler house	1,105,938
4	Block A	2,377,474
5	Block B	1,095,144
6	Block C	524,331
7	Heat Meters	0
8	**Sub-Total**	**5,765,737**
9	Contingency sum @ 10% of sub-total	576,574
10	**Sub-Total**	**6,342,310**
11	Provisional sums	191,650
12	**GRAND TOTAL**	**6,533,960**

9.5 Option 2 – Domestic Condensing Boilers

ITEM	DESCRIPTION	COST £
1	Preliminaries	400,000
2	Boiler house	100,100
3	Distribution pipe work	2,911,060
4	Dwellings	2,751,513
5	General items	245,850
6	**Sub-Total**	**6,408,523**
7	Contingency sum @ 10% of sub-total	640,852
8	**Sub-Total**	**7,049,375**
9	Provisional sums	191,650
10	**GRAND TOTAL**	**7,241,025**

9.6 Option 3 – Domestic Condensing Combination Boilers

ITEM	DESCRIPTION	COST £
1	Preliminaries	400,000
2	Boiler house	100,100
3	Distribution pipe work	3,710,320
4	Dwellings	2,745,628
5	General items	244,850
6	**Sub-Total**	**7,200,898**
7	Contingency sum @ 10% of sub-total	720,090
8	**Sub-Total**	**7,920,987**
9	Provisional sums	191,650
10	**GRAND TOTAL**	**8,112,637**

9.7 Option 4 – All Electric Heating and Hot Water

ITEM	DESCRIPTION	COST £
1	Preliminaries	400,000
2	Boiler house	100,100
3	Distribution pipe work	2,508,875
4	Dwellings	1,825,926
5	General items	8,000
6	**Sub-Total**	**4,842,901**
7	Contingency sum @ 10% of sub-total	484,290
8	**Sub-Total**	**5,327,191**
9	Provisional sums	331,650
10	**GRAND TOTAL**	**5,658,841**

9.8 Option 5 – Retain and Repair Existing Radiant System

ITEM	DESCRIPTION	COST £
1	Preliminaries	400,000
2	General Items	215,850
3	Boiler House	1,105,938
4	Block A	1,879,317
5	Block B	454,784
6	Block C	131,368
7	**Sub-Total**	**4,187,256**
8	Contingency Sum @ 10% of Sub-Total	418,726
9	**Sub-Total**	**4,605,982**
10	Provisional Sums	191,650
11	**GRAND TOTAL**	**4,797,632**

9.9 Option 6 – Replace Radiant Heating System

ITEM	DESCRIPTION	COST £
1	Preliminaries	400,000
2	General Items	215,850
3	Boiler House	1,078,575
4	Block A	2,964,454
5	Block B	979,693
6	Block C	276,045
7	**Sub-Total**	**5,914,617**
8	Contingency Sum @ 10% of Sub-Total	591,462
9	**Sub-Total**	**6,506,079**
10	Provisional Sums	191,650
11	**GRAND TOTAL**	**6,697,729**

9.10 Option 7 – Underfloor Communal Heating

ITEM	DESCRIPTION	COST £
1	Preliminaries	400,000
2	General Items	215,850
3	Boiler House	1,078,575
4	Block A	4,351,279
5	Block B	1,865,369
6	Block C	498,630
7	**Sub-Total**	**8,409,703**
8	Contingency Sum @ 10% of Sub-Total	840,970
9	**Sub-Total**	**9,250,673**
10	Provisional Sums	191,650
11	**GRAND TOTAL**	**9,442,323**

9.11 Option 8 – Underfloor Electric Heating

ITEM	DESCRIPTION	COST £
1	Preliminaries	400,000
2	Boiler house	100,100
3	Electrical risers	2,508,875
4	Dwellings	1,991,920
5	General items	8,000
6	**Sub-Total**	**5,008,894**
7	Contingency sum @ 10% of sub-total	500,889
8	**Sub-Total**	**5,509,784**
9	Provisional sums	331,650
10	**GRAND TOTAL**	**5,841,434**

9.12 Summary of Capital Scheme Costs

OPTION	DESCRIPTION	COST £
1A	Communal 2-Pipe Heating with Heat Meters	6,374,686
1B	Communal 2-Pipe Heating without Heat Meters	5,916,436
1C	Communal 3-Pipe Heating with Heat Meters	6,689,660
1D	Communal 3-Pipe Heating without Heat Meters	6,533,960
2	Domestic Condensing Boilers	7,241,025
3	Domestic Combi Boilers	8,112,637
4	Electric Heating	5,658,841
5	Retain and Repair Communal Heating	4,797,632
6	Replacement Radiant Heating	6,697,729
7	Communal Underfloor Heating	9,442,323
8	Electric Underfloor Heating	5,841,434

10 APPRAISAL OF WHOLE LIFE CYCLE COSTING

10.1 General

The cost appraisal takes the form of estimated capital costs, running costs and life cycle costs.

The estimated capital costs include for supply and installation of all equipment, associated electrical and builders' works and contractors costs.

The data used for the appraisal is contained in Section 3 of this report.

10.2 Whole Life Cycle Costs NPV Appraisal

The full appraisal details are contained in the appendices but are summarised below.

10.2.1 Option 1A – Communal Heating and Hot Water with Heat Meters

The communal boilers and 2-pipe heating distribution pipe work would require replacing at year 25, i.e. once within the 30-year period assessed in this report.

10.2.2 Option 1B – Communal Heating and Hot Water without Heat Meters

The communal boilers and 2-pipe heating distribution pipe work would require replacing at year 25, i.e. once within the 30-year period assessed in this report.

10.2.3 Option 1C – Communal Heating and Hot Water with Heat Meters

The communal boilers and 3-pipe heating distribution pipe work would require replacing at year 25, i.e. once within the 30-year period assessed in this report.

10.2.4 Option 1D – Communal Heating and Hot Water without Heat Meters

The communal boilers and 3-pipe heating distribution pipe work would require replacing at year 25, i.e. once within the 30-year period assessed in this report.

10.2.5 Option 2 – Domestic Condensing Boilers

The individual gas fired condensing boilers and radiators would require replacing two times within the 30-year period assessed in this report, at years 13 and 25.

10.2.6 Option 3 – Domestic Combination Boilers

The individual gas fired combination boilers and radiators would require replacing two times within the 30-year period assessed in this report, at years 13 and 25.

10.2.7 Option 4 – All Electric Heating and Hot Water

The storage heaters would require replacing twice within the 30-year period assessed in this report, at years 13 and 25.

10.2.8 Option 5 – Retain and Repair Existing Radiant System

Retain and repair existing embedded radiant and warm air system and replacement hot water system but retaining the communal boiler plant until replacement is due.

It has been assumed that the communal heating distribution pipe work requires replacement together with hot water cylinders at year 1. It has also been assumed that the communal boilers and radiant embedded pipes would be retained initially, but replacement is indicated at year 5. The resulting increase in energy efficiency due to the replacement boiler plant is factored in from year 5.

10.2.9 Option 6 – Replace Radiant Heating System

Replacement of communal radiant heating (wall or ceiling panels) and hot water system.

It has been assumed that all systems would be replaced now with the communal boilers only indicated for replacement at year 25.

10.2.10 Option 7 – Underfloor Communal Heating

Replacement of communal heating and hot water system with underfloor heating.

It has been assumed that all systems would be replaced now with the communal boilers only indicated for replacement at year 25.

10.2.11 Option 8 – Underfloor Electric Heating

Replacement of communal heating and hot water system with underfloor electric heating.

10.3 Summary

The net present value of whole life cycle costs for combined capital, maintenance, and fuel costs for all options is indicated in the table below: -

Option	COSTS TO LEASEHOLDERS AND CAMDEN			NPV WHOLE LIFE CYCLE COSTINGS						
	Capital Cost if Capital Scheme	Leasehold Charge	Net Cost to Camden	Capital Cost applied to NPV	Replace Costs	Fuel Cost	Meter Reading	Maintenance Cost	Residual Value of Plant	Total Life Cycle Cost
	£	£	£	£	£	£	£	£	£	£
1A	6,420,511	1,323,071	5,097,440	5,662,601	1,152,075	5,317,672	572,728	1,336,366	179,175	13,862,266
1B	5,916,436	1,219,196	4,697,239	5,204,351	1,152,075	5,414,857		1,336,366	179,175	12,928,474
1C	7,266,395	1,497,381	5,769,014	6,431,587	1,320,191	5,781,353	859,092	1,384,093	256,046	15,520,270
1D	6,533,960	1,346,449	5,187,511	5,765,737	1,320,191	5,889,646	0	1,384,093	256,046	14,103,621
2	7,241,025	1,492,153	5,748,871	6,408,523	1,178,688	8,136,784	0	1,431,821	164,675	16,991,141
3	8,112,637	1,671,766	6,440,871	7,200,898	1,344,127	7,715,298	0	1,527,275	187,788	17,599,810
4	5,658,841	1,166,114	4,492,727	4,842,901	1,030,887	9,660,274	0	477,274	144,026	15,867,310
5	4,797,632	988,645	3,808,987	2,521,928	4,532,877	6,473,059	0	1,384,093	-173,329	15,085,286
6	6,697,729	1,380,197	5,317,532	5,914,617	2,354,057	5,945,629	0	1,384,093	435,015	15,163,380
7	9,442,323	1,945,774	7,496,550	8,409,703	538,682	5,414,857	0	477,274	69,367	15,677,968
8	5,841,434	1,203,740	4,637,693	5,008,894	103,089	15,148,447	0	471,845	14,403	20,723,301

Based on the above total NPV for capital cost, maintenance and fuel the best option would be **Option 1B** for Complete Replacement of Communal Heating/Hot Water System without Heat Meters due to the lowest capital investment, maintenance and fuel cost.

Leasehold charge assumes 93 Leasehold dwellings.

11 ENVIRONMENTAL ITEMS

11.1 General

Environmental issues are discussed below in terms of estimated energy usage due to natural gas. As a general observation it is often noticed that windows are opened to regulate heat when dwellings are too hot during periods of mild weather. Therefore energy is being wasted due to a lack of control.♣

The major benefit achieved from the works described will be consistent and reliable heating to all rooms. Also, each dwelling whether communal or domestic will have its own individual time control and each room will have temperature control.

11.2 Heating

As the existing heating system was designed to meet the heating/temperature standards of the day (18ºC) against an outside temperature of 0ºC, the new heating requirements will be higher due to higher room temperatures required at 21ºC internal against -3ºC external.

The energy consumption is difficult to calculate due to a number of variables relating to residents' usage.

11.3 Hot Water

There are two options for supply of hot water: -

- Run boiler plant for 52 weeks of the year for domestic hot water via the boiler plant.
- Run boiler plant for 35 weeks a year (normal heating season) and use electricity for hot water throughout the remaining period as at present.

Running the boiler plant 52 weeks of the year to supply hot water via the boiler plant might be considered un-economical due to reduced transfer efficiency from boilers to cylinders and the static heat losses from boilers and length of runs of heating pipe work, etc. However, it should be noted that the domestic electricity tariff is at least twice the cost of gas and even by taking into account the reduced thermal efficiency it would be more economical to use natural gas for hot water.

The decision to run the plant continuously for 52 weeks of the year should be the subject of residents' choice and also Home Ownership Services will need to review the heating/lease arrangements before the chosen option is implemented.

♣ An overall 1ºC increase in room temperature results in an 8 to 10% increases in energy consumption.

As a compromise the boiler plant could be allowed to run for the same period as present and continue to use electricity to generate hot water during the heating off periods. Each immersion heater would be fitted with a new controller to enable timed control. During the heating on periods the residents would have the benefit of cheaper hot water via the heating system when compared with electricity.

If heat meters are installed the choice to heat water via electric or via the main boilers remains with residents.

11.4 Energy Consumption

Due to the diverse usage of hot water the energy consumption for hot water is taken as the same with the exception of Option 3 for combination boiler where this would consume approximately 10% less than the other options as it would be heated as and when required.

The estimated annual energy consumptions are tabled below. Due to the various options/types of heating discussed each option would attract different annual energy consumption. For the purposes of the energy calculations it is considered that communal heating boilers would be more efficient than domestic boilers, as communal boilers have reduced cycling. However, communal systems do have additional pipe heat losses due to the length of pipe work to get to each dwelling.

Nevertheless taking into account an allowance for behaviour patterns with residents on flat rate week heating costs the communal energy costs are considered higher than domestic boilers.

The existing energy consumption is 12,302,376kwh per annum.

Option	Heating, kWh	HWS, kWh	Total kWh	% Saving
1A	8,107,391	1,036,588	9,143,979	26%
1B	8,624,884	1,151,765	9,776,649	21%
1C	8,713,761	1,227,539	9,941,300	19%
1D	9,269,959	1,363,932	10,633,891	14%
2	6,886,614	1,515,480	7,872,161	32%
3	6,508,229	1,363,932	7,872,161	36%
4	6,057,090	1,515,480	7,572,570	38%
5	10,087,584	1,599,673	11,687,257	5%
6	9,583,205	1,151,765	10,734,969	13%
7	8,624,884	1,151,765	9,776,649	21%
8	7,106,986	1,515,480	8,622,466	30%

This data is based on theoretical calculations and the energy data listed may increase or decrease as the occupancy patterns and residents' particular comfort levels are so varied. Nevertheless if the occupancy patterns are different to that indicated the fuel consumption for each option would follow a similar trend.

11.5 Environmental Benefits

Option	kg CO_2 emissions	% Savings	CO_2 Saving kg per Annum
1A	1,776,675	26%	613,676
1B	1,899,603	21%	490,749
1C	1,931,595	19%	458,757
1D	2,066,165	14%	324,187
2	1,632,527	32%	757,825
3	1,529,561	36%	860,791
4	3,256,205	-36%	(865,853)
5	2,270,834	5%	119,518
6	2,085,805	13%	304,547
7	1,899,603	21%	490,749
8	3,707,660	-55%	(1,317,309)

Option 8 would increase carbon dioxide emissions by 55% because electricity is the most polluting fuel due to poor operational efficiencies, typically 40%.

Retention of communal heating will enable future installation of, or connection to, combined heat and power which is the most energy efficient solution for Camden to delivering carbon reduction.

11.6 Social Cost and Benefits

11.6.1 General

Each radiator is controlled individually, giving flexibility for different temperatures in different rooms. The combination of radiant and some convective heat provides for better comfort.

In terms of basic weekly running costs the following table indicates the estimated weekly fuel costs for each type of dwelling.

11.6.2 Weekly Running Costs

Option	Bed-sit	1-Bed	2-Bed	3-Bed	4-Bed	5-Bed
2007/2008 (H/HW) Charges	7.03	9.30	14.10	15.89	17.58	20.15
1A	5.73	4.47	9.63	9.98	13.76	13.76
1B	4.55	4.55	9.81	10.16	14.01	14.01
1C	4.86	4.86	10.47	10.85	14.96	14.96
1D	4.95	4.95	10.67	11.05	15.24	15.24
2	6.84	6.84	14.74	15.26	21.05	21.05
3	6.49	6.49	13.97	14.47	19.96	19.96
4	8.12	8.12	17.50	18.12	25.00	25.00
5	5.44	5.44	11.72	12.14	16.75	16.75
6	5.00	5.00	10.77	11.15	15.38	15.38
7	4.55	4.55	9.81	10.16	14.01	14.01
8	12.74	12.74	27.44	28.42	39.20	39.20

The first row reflects actual Camden heating and hot water charges for the year 2007/2008.

Option 1A and 1B reflects the predicted fuel cost that Camden may pay based on calculation methodology on fuel demand for the new system.

Option 1C and 1D reflects the predicted fuel cost that Camden may pay based on calculation methodology on fuel demand for the new system.

Option 2 and 3 costs for individual boilers represent the cost to the residents via their own gas meter and supply agreement.

For option 4 the resident would pay via their own electric meter and provider.

Options 5, 6 and 7 reflect the predicted fuel cost that Camden may pay based on calculation methodology on fuel demand for the new system.

For option 8 the resident would pay via their own electric meter and provider.

11.7 Evaluation Matrix

It is a requirement of Camden’s Option Appraisal Methodology that and evaluation matrix be undertaken for Economic, Social and Environmental items.

Such a matrix is undertaken when the preferred option and nearest preferred option results for NPV cost, maintenance and fuel, are within 5% of each other.

In this case the two lowest are separated by around 13% and as such the matrix calculations are excluded.

12 PROGRAMMING CONSIDERATIONS

12.1 Risk

Where new heating distribution pipe work replaces old distribution pipe work a conflict of services can often result if for instance: -

- The existing heating needs to remain in operation during installation.
- There is no convenient location to run the new services.

It is expected that the new system will be installed during 2010/11.

In order to minimise disruption to the heating and hot water services it is proposed to run new heating mains along the roof of Block A and down new service tubes during the heating season, say January 2010 and the services tested for integrity. This means that new core services can be installed in readiness for the Summer 2010 Shutdown, where services within dwellings can be installed. This would reduce the disruption to residents to an absolute minimum during the change-over periods for the respective heating risers. However, this is weather dependant and the further the programme extends into the closed heating season the more strain it will put on a prospective Contractor.

It is possible to run new lateral heating mains in the garages to Blocks B and C via newly formed holes in the concrete walls and with careful planning undertake the same scenario as above.

For Option 2 and 3 for domestic boilers a risk in terms of scheme delivery in a timely manner is dependent upon National Grid replacing gas mains in a timely manner. If the gas supply for this site accrues such a delay it would have a severe effect on the Contract Programme and potentially impose a disproportion burden on the Project Team. Subject to the gas provider scenarios the domestic boiler option does not really impact on the contract programme as the communal system would be isolated and removed as each domestic system was installed.

For Option 5 the existing service will remain as is until such a time a major failure occurs.

For Option 6 the new services can be installed in a similar manner to Option 1A, B, C and D. The new recessed radiant panels means that the existing radiant embedded tubes may be compromised resulting in possible disruption.

For Option 7 and this represents the largest disruption to residents due to the possible decanting and the destruction of wood/laminate flooring.

For Option 8 and this represents a disruption to residents due to the possible destruction of wood/laminate flooring and also removing and relaying carpets.

12.2 Planning

Planning of the scheme is considered in two parts: -

- Planning permission for statutory purposes.
- Planning of the scheme before and during site works.

12.2.1 Planning Permission

A Planning Approval has been granted for the proposed external service tubes to the rear of Block A. Permission is being sought for internal services at Block B and C.

12.2.2 Planning at Site Level

Careful planning and phasing between retaining existing while the “new” is being installed is required to enable disruption to be kept to a minimum.

The ideal time for commissioning is during the winter. However, this would cause some disruption in the heating service and affect residents. The careful issue of portable electric heaters (with due regard to electrical demand) would however compensate for any heating disruption.

12.3 Access

The key to the success of any scheme involving residents in occupation is the ability of the contractor to gain access to each dwelling. Access is of particular importance during the re-commissioning exercise. Access to dwellings with residents in occupation can be a frustrating exercise and therefore any implementation contract should include a procedure for the contractor to gain access via a number of letter drops, cards, door knocking, telephone calls and if necessary Special Delivery letters. A "Resident Liaison Officer" would be provided.

However, it is a general fact that access is greatly improved with careful and structured consultation at scheme inception.

12.4 Contract period

The contract period for implementing the proposed scope of work could be relatively short, provided good access is afforded.

In reality 'residents in occupation' contracts can be difficult due to access and therefore the contract period should be selected to give a balance between giving the contractor a reasonable time whilst keeping the contract preliminary costs to a minimum, resulting in value for money.

For discussion the contract period might be as follows: -

- Option 1A/B/C/D - 80 weeks.
- Option 2, 3 and 4 - 100 weeks.
- Option 5 - Open ended programme due to retain and repair.
- Option 6, 7 and 8 - 120 weeks.

Appendix C - Notes from site inspection 1

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EXTERNAL –ALEXANDRA AND AINSWORTH ESTATE,

SITE INSPECTION NOTES – 1 FINAL

MF site inspection with Camden and GEM to provide evidence of the state of the embedded coil space heating system including tail connections and pipe risers. BYA and LB to be in attendance.

Project	Alexandra and Ainsworth Estate, Camden		
Job Reference	J6690		
Time	Tuesday 17th September 2019, 10:00 until 14:00		
Location	Alexandra and Ainsworth Estate		
Notes prepared by	David Lindsey		
Attendees			
	Richard Michael	LB Camden – Contracts Manager	RM
	Rob Stiles	GEM	RS
	David Manuell	Butler and Young Associates (BYA)	DM
	Andy Jobling	Levitt Bernstein	AJ
	David	Butler & Young	INITIALS
	David Lindsey	Max Fordham	DL
Distribution	Attendees plus:		
	Primesh Kalia	LB Camden – Team Leader (Planned Works)	PK
	Clare Murray	Levitt Bernstein	CM

Item		Action
1.1	**Introduction** 1.1.1 The site visit was arranged by Camden to allow Max Fordham to: • understand at first hand the operational issues the Estate has been experiencing with the Heating and Hot Water systems and how this was effecting the quality of service to residents, • understand the condition of the heating pipework supplying dwellings, • understand the installed arrangement and current condition of embedded pipe heating coils in the party walls supplying space heating to dwelling pairs. In particular the pipework coil tails, connections and the building riser pipework, 1.1.2 Rob Stiles (GEM – Camden Term Maintenance Contractor) has worked at the Alexandra and Ainsworth Estate and has knowledge of the heating and pipework system over many years. He has had day to day site experience of operation and the maintenance and replacement activities that have been necessary to sustain the system. 1.1.3 The condition of the distribution pipework and the maintenance activities are relevant to the new heating design and installation. The design aims to reduce the maintenance burden and improve the quality of service to residents including the availability of the heat supply. 1.1.4 It is not easy to inspect the pipe coils themselves as they are embedded in the concrete walls. Inspection of the connecting riser pipework will inform their likely condition. 1.15 Reusing the embedded pipe coils effectively is reliant on the condition of the connecting coil pipe tails and the arrangement of pipework connections.	

1.2	**Inspection of pipework removed from the heating distribution installation** 1.2.1 Samples of above ground steel heating pipework removed from the heating system over recent months were viewed at the boiler room. Lengths of pipework showed excessive corrosion of the steel from the outside, "delamination" of the oxidised material, thinning of the structural steel pipe wall and holes where the heating water had broken through the pipe wall as a leak. Around holes the pipe wall was thin and had lost much of its structural strength.   MF asked for sections of pipework to be cut in half so the inside of the pipe could be inspected for corrosion from inside. **1.2.2** MF commentary on maintenance and replacement activities based on input from GEM and Camden FM team: Pipework at roof level, in building risers, buried in floor screed has all been subject to periodic failure. Inspecting pipework is constrained where concealed in non accessible ducts, boxing or where run within the building fabric such as within screed depths. Small leaks at pipe joints, valve glands and the like over time has led to extensive pipe wall corrosion and subsequent external rusting. Additionally flood water from kitchen and bathrooms is problematic as it travels down through the building. Steel pipes in common ducts (with plumbing and water services) have suffered most as there are many sources of water and connect spatially to kitchens and bathroom floors. Vertical pipework has been at greatest risk as water travels downwards along the pipe. Buried pipework in floors has also suffered badly particularly in proximity to kitchens and bathrooms. Lots of examples of removed pipe with reduced wall thickness and hole failures. Failures are unpredictable, difficult to find (routes run through dwellings and are concealed), difficult to isolate (valves often to not close shut) and take time to remove from the system. Heating can often only be reinstated to dwellings not directly affected by the failure following work to find a leak and isolate it. A small hole leak on a heating riser can drain the whole heating system causing disruption to all residents. 1.2.3 Post Meeting Note DL inspected the cut open pipework on site on the 1st October. Internal corrosion of the 2 sections of pipework cut open did not appear extensive. The inside of the pipe was covered with iron oxide as a thin crust of powder. The pipe wall thinning was	**MR**

however significant presumably from external corrosion.

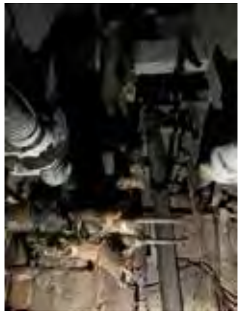
1.3 Inspection of riser pipework and embedded coil tails in an under stair service void supplying dwelling space heating and hot water cylinders Block B

1.3.1
The distribution pipework ran in the garages below?
Pipework and pipe fittings were generally badly corroded where visible and beneath pipe insulation.
The embedded coil tails to the adjacent dwellings could be inspected as they came out of the end of the concrete wall. There is a welded socket on the end of the steel tail into with the connection pipework end is screwed.
The ones we inspected had not suffered significant external corrosion possibly because they were hot in winter, not insulated and horizontal as opposed to vertical with pipework above.

1.3.2
MF commentary on maintenance and replacement activities based on input from GEM and Camden FM team:

Access was reasonable but required working at height within the duct to maintain the upper floor coils.

The risers set over at high level within the upper dwelling above the kitchen cupboards to then rise in the higher dwellings within ducts adjacent to the entrance doors. Access is difficult.



1.4 Inspection of distribution pipework on the roof of Block A

1.4.1
The main distribution pipework runs across the roof of Block A. It appeared the pipework has already been replaced at least once.
The pipework is prefabricated with a thin wall steel water carrier, foam insulation and spiral wound galvanised steel protective cover. The pipework is hung from roof supported hoop brackets will rollers and offsets to accommodate expansion.

There were sections of pipe on the roof that has been removed from the system and which had failed. These pipes have failed from corrosion thinning the pipe wall, holing or structural collapse.

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Where pipes dropped through the roof there was evidence of external corrosion and risk from pipe failure.

Strainers had been added to collect pipe corrosion deposits before they entered the riser pipework to reduce “sludge” blockages. They were cleared periodically. When a main pipe leaked or collapsed and was replaced there was often a spike of debris collected.

1.5 Inspection of riser pipework and embedded coil tails in a garage supplying dwelling space heating and hot water cylinders Block C

1.5.1
The distribution pipework ran through the garages.
Pipework and pipe fittings were generally badly corroded where visible and beneath pipe insulation.
The embedded coil tails could be inspected as they came out of the end of the wall. There is a welded socket on the end of the tail into with the pipework end is screwed.
The ones we inspected had not suffered significant external corrosion possibly because they were hot in winter, not insulated and horizontal as opposed to vertical with pipework above.

1.5.2
MF commentary on maintenance and replacement activities based on input from GEM and Camden FM team:

Access was reasonable.

1.6 Inspection of riser pipework and embedded coil tails in a void dwelling Block A

1.6.1
Space heating pipework runs either side of the heated party wall dropping floor to floor. Flow on one side, return on the other. Boxing is breeze block with access to isolation valve sets.
As the building steps over floor to floor pipework offsets within the depth of the screeded floor.

The coil connections and tails can be inspected through the access panels. For the void dwelling we inspected 2 coil flow connections were visible with isolation valves and tails. The pipework, valves and other pipe fittings showed signs of external corrosion. The pipe tails less so.

Branch hot water cylinder primary heating branches ran from the riser behind the bathroom to the cylinder position. As the dwelling was being refurbished it was possible to inspect the risers passing floor to floor and the branches running to the cylinder. The pipe work was is very poor conditions with substantial external corrosion.

1.6.2
MF commentary on maintenance and replacement activities based on input from GEM and Camden FM team:

Access to the space heating risers is difficult. From any dwelling pair only the flow connection/valve could be accessed from one of the dwelling (the wall heating both dwellings of the pair). The return was in a dwelling on the other side of the party wall one floor above. Access is reasonable for regulation but repair and replacement more often requires the enclosing breeze block to be broken out. It was not possible to see how the return connections leave the wall/coil before connecting to the return isolation valve in the dwelling above.

	MF asked for the top of the riser to be broken out in the void dwelling to allow inspection of the coil return arrangement and condition. Post Meeting Note BYA have located from the digital archive MF design drawing (65)D403. It shows the proposed arrangement of the coil connections for Block A with the return connections leaving the wall at high level on the "return or paired" side of the wall before rising to above and crossing in the screed to the valve position offset by the building section.	RM
153.8	**AOB (Any Other Business)**	
	Testing of the coils was discussed. Testing of this type had been carried out a few years back. 8 dwellings in Block B were chosen as access and isolation for the test were less intrusive to residents. Ideally 8 void dwellings could be identified across the estate. Access would need agreed with residents to prepare a detailed method statement for each case covering the preparation/duration and remedial work required to carry out the test. It was pointed out that live coils were all currently under pressure and that leaks would be visible as a damp patch on the face of the wall.	
153.9	**Date of next meeting**	
	None	

Appendix D - Observations and opinions following site inspection 1

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MAX FORDHAM OBSERVATIONS AND OPINIONS – 1 FOLLOWING SITE VISIT DATED 17TH SEPTEMBER 2019

Final v3

1. Discussion of the likely condition of embedded space heating coils and the risks/opportunity for reuse.

It is not possible to be certain as to the condition of the embedded pipe coils.

The existing heating install is now approximately 45 years old. CIBSE provide industry guidance as to the "indicative life" as 25 years. This is intended "primarily for life cycle costing and are likely to provide a conservative forecast" (CIBSE Guide M 13.2 and Appendix 13.A1).

The pipes have been embedded in reinforced concrete which will have protected them from sustained **external corrosion**. The wall is heated and so will have dried out quickly once heat was applied following construction.

The heating system has leaked continuously over a number of years introducing fresh water and there have been frequent drain downs and refills following catastrophic failure due to major leaks and for repairs. Such leaks are not unexpected in large systems of this age. The extent of water treatment and the water quality within the heating system over the pipework's life is not known. Fresh oxygen rich water and poor water quality control can allow rapid internal corrosion of the pipework.

The pipework sections removed from the heating risers as a result of failure and cut in half to allow inspection of the inside of the pipe do not indicate high rates of internal pipe wall corrosion. There is the normal thin crust of particles of oxidised steel. The pipework sampled has lost much of its thickness from external corrosion rather than internal corrosion.

GEM report that leaks to pipework in the depth of the heated wall has occurred leading to abandonment of the coils and the installation of radiators for heating in some dwellings. When this happens damp is visible at the wall surface. There are no available records of where and how often this has happened but it appears to MF based on discussion that the occurrence is low. Any pipe failure within the wall coil is likely to be manageable rather than catastrophic (as does occur with riser and connection pipework failure) as the pipe wall is bound by the concrete. This gives warning of the issue and time for it to be dealt with in a controlled way.

It is proposed to test the integrity of a sample of pipe coils. See proposed test methodology and report of testing to date.

2. Discussion of the condition of embedded space heating coil tails, installation constraints and the risks/opportunity for reuse and reconfiguration.

The coil pipe tails we inspected during our visits where on the whole in a reasonable condition externally. Possibly this is because they were short horizontal lengths and continuous pipe without mechanical joints. The tail was ended with a welded socket.

There was one exception within Block B where the connecting pipe tail had corroded and the welded socket had failed mechanically during repair.

Based on the design drawings the coil connections are accessible for reconnection through local removal of the enclosing building fabric.

Access to the coil tails within the completed building is much more limited than during the original installation condition. Enclosing breeze block risers would need to be removed in dwellings in order to provide access for pipework alterations to be carried out.

For A Block this is additionally complicated by the way the flow and return connections are on opposite sides of the shared heated party wall and with the return riser isolation valve and connection in the dwelling on the floor above.

3. Discussion of the condition of riser pipework, installation constraints and the risks/opportunity for reuse, replacement and reconfiguration.

The riser pipework and coil connections including isolation valves and fittings are in poor condition having suffered extensive external corrosion and need to be replaced as soon as is possible.

Isolation valves need to be replaced to provide robust isolation for maintenance activities.

Existing riser pipework common to groups of dwellings pass through a number of dwellings. In the event of a heating system leak or other maintenance activity access is required to dwellings to identify the location and source of the leak. This makes access for inspection and maintenance difficult and time consuming. It reduces the quality of heating service Camden are able to provide to residents.

The heating replacement scheme should aim to relocate common pipework to locations outside dwellings so that it is more readily accessible - this will help reduce future disruption to residents.

Existing riser pipework is also concealed by breeze block ducts/boxing/floor screed and the like with limited access. This makes access for inspection and maintenance difficult and time consuming.

The replacement scheme should aim to provide fully accessible distribution routes with as much common pipework and fittings readily accessible for inspection, repair or replacement.

Rerouting the heating distribution outside the dwellings is the design approach taken by BYA. The use of HIUs with heating exchanger plates provides additionally water separation between the common heating water distribution system and that within each dwelling. This means a leak on a heating system within a dwelling does not impact on the supply of heat to all other dwellings.

The current wall heating coil risers cannot in our view simply be replaced within their current locations. Reuse would require the wall heating coil connections to be reconfigured so that they can be supplied by an HIU, with the HIU located in one of the two dwellings heated by the coil.

Work to achieve this will require significant intervention within the dwellings to allow access for testing and to accommodate the new pipework and coil reconfiguration. Enclosing breeze block risers, window and door boxing and the associated finishes would need to be removed in dwellings in order to provide access for pipework alterations to be carried out. This will be disruptive to residents in terms of the nature of work (noise, rubble and dust) and the time needed to complete the work.

The requirement for access, coil testing and a typical coil reconfiguration for a dwelling pair within Block A and B is shown on the attached diagrams. Each dwelling pair type will need to be investigated in a similar way. The intervention needs to be shown to be practical, the cost needs to be reasonable and the work acceptable to residents.

Each stack of paired dwellings within a block will need the concurrent interruption of the existing space heating supply and access.

Once each embedded coil has been inspected and tested to confirm it is suitable for re-use the coil connections can then be reconfigured. If not suitable an alternative heating solution will be required for the dwelling pair.

4. Discussion of the minimum system technical requirements for reuse of the embedded heating coils to provide more effective and reliable space heating for residents, the constraints and how it might be achieved.

If the embedded heating coil heat emitters were to be reused they would need to be reconfigured to connect to individual dwelling pair HIUs for the reasons described above. New connecting heat pipework is required within the dwelling between the HIU and the coils.

HIUs provide modern accurate, dynamic and robust heat supply balancing between all of the dwellings connected.

HIUs allow external temperature compensation of the coil heat output to be reinstated and enhanced. The heating water temperature circulating in each coil can be varied individually and adjusted according to the actual need for heat within each flat pair through room reset temperature control. However, this cannot provide fully independent individual time and temperature control within each dwelling or room (as a radiator heating system with TRVs and timeclock within each dwelling would) as the heat output from the wall is the same for both dwellings. A control hierarchy between the dwellings of the pair would determine when and how strongly the wall was heated.

This type of arrangement and modern control will provide a faster heating response time to weather, sunshine and heat gain changes on an individual flat pair basis. Although the concrete wall is massive its heating characteristics are not dissimilar to that of screed embedded floor heating more often found in housing schemes. Changes in the room demand for heat are moderated by the other concrete walls in the dwelling which are exposed to the spaces and capable of buffering the changes effectively. It is an enhancement of the original temperature control provision (centralised compensation) and will provide a higher quality of heating control than residents currently experience.

Metering of space heating would happen at each HIU and so is only possible per dwelling pair - metering of heat to each individual dwelling is not possible with this arrangement.

Metering of hot water heating for each dwelling is possible with separate, hot-water only HIUs (with one per dwelling)

In the event of a leak to the embedded coil access to both dwellings is still required to inspect the walls. Repair of the embedded coil is unlikely to be practical as it would require intrusion into the structural wall to the pipe. Each dwelling would then need a conventional replacement heating system to be installed at this point in time to take the place of the embedded coil. It would be sensible to plan for this eventuality in advance with agreed radiator positions, specifications and pipe routes.

5. Broader Quality of Service and Cost considerations of reusing the embedded coils.

The embedded coils will need replacement at some time. There is a risk that the rate of failure will increase substantially over the next 20 year operational period.

Camden may wish to deal with this risk now and at a lower cost as it will form part of the estate wide planned replacement works.

The rate of coil failure can be monitored going forward. High rates of annual failure would indicate that it would be preferable to replace the embedded coils within all dwellings at that time to avoid an ongoing piecemeal, more costly and disruptive resolution of issues. The HIU once installed provides the required dwelling infra structure to do this within the associated dwellings pair basis.

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Residents may feel that they require fully independently controlled heating systems whereby they can vary the time and temperature of space heating in their dwelling. The embedded coils cannot provide this as the heat output is to both flats of the dwelling pair.

Better dwelling temperature control than exists and a high performance heat distribution system will reduce the use of heat and the heating cost. There is an inherent inefficiency associated with the wall coil heating in that the heated party walls extend across the thermal insulation line of the building. The magnitude of this could be assessed. In the context of the Climate Emergency and the need for much lower use of heat an alternative heating solution may offer advantages.

Appendix E - Pressure test report and associated methodologies

MAX FORDHAM

Alexandra and Ainsworth Estate, Camden

Embedded Coil Pressure Test Report

Following site visit on

21st October 2019

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ISSUE HISTORY

Issue	Date	Description
1	22/10/19	For team comment

MAX FORDHAM LLP TEAM CONTRIBUTORS

Engineer (Initials)	Role
David Lindsey	Senior Partner

J:\J6690\Reports\20191022 Embedded Coil Pressure Test Report.docx

CONTENTS

1.0 INTRODUCTION

The aim of the work was to explore the integrity of representative embedded coils and the way in which the coils might be inspected, tested and reconfigured where they to be considered for reuse for space heating in the future.

The test was carried out for Camden by GEM (Rob Staines) on the 21st October 2019.

Parts of the test where observed by Max Fordham (David Lindsey).

A void dwelling in Block B was chosen as access to the coil connections was good and to minimise the disruption to residents.

Three embedded coils where individually pressure tested. All tests were satisfactory.

The coil connections were inspected and their condition was satisfactory.

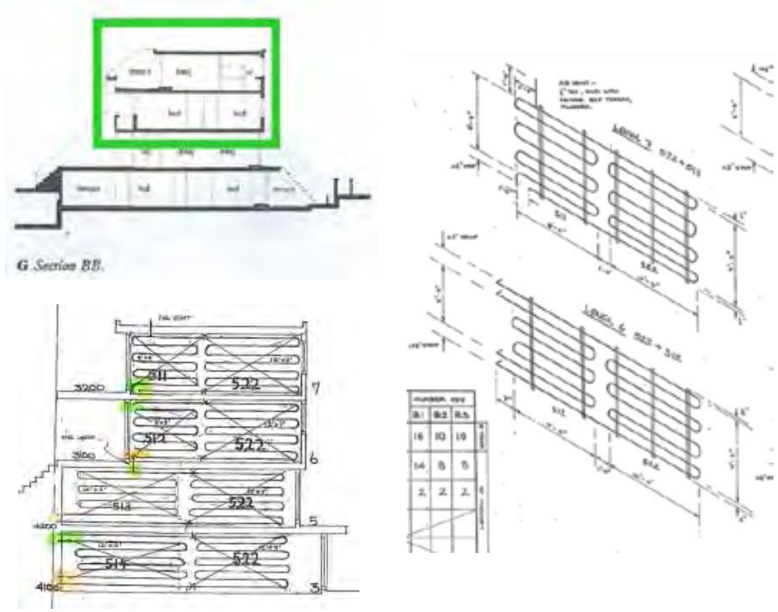
Heating water taken from coil 1 was black. The suspended solids separated from the clear water over time in a sealed bottle.

The fabric enclosing the riser constrained the work to disassemble the pipework fully. If the coils were to be permanently reconfigured there would have been the need for some removal and reinstatement of the building fabric and finishes within the dwelling.

Testing in Block A and C will be more disruptive. In Block A it is not possible to test in void dwellings as concurrent access is required to 3 adjacent dwellings.

2.0 PRECIS OF ACTUAL TEST METHODOLOGY

Three embedded wall coils were separately tested in Block B Dwelling 78 (end block and current void)



The associated riser pipework from the heating distribution mains was isolated and drained down. Heating to dwelling 80 was interrupted for testing as a result.

The pipework coil connections were disassembled as far as was possible in order to test the coils and coil tails only without the riser pipework and isolation valves. Coil ends were plugged for testing where possible. In this way the test was for the coil and not the coil and coil pipe connections/riser.

Heating water was taken from coil 1 for inspection.

Coils were pressure tested for 1 hour at 6barg.

The change in pressure over this period recorded.

Coil 1 was reassembled and put back into use.

Coils 2 & 3 coil connection to risers where plugged to allow the riser to be refilled and heating to Dwelling 80 reinstated. Pipes to be reassembled the next day and the coils put back into use.

3.0 COIL TEST RESULTS, CONSTRAINTS AND OBSERVATIONS

Coil	*Location*	*Change in pressure*	*Notes*
1	Upper floor living	Dropped 0.2 bar	Not possible to remove air from the test.
2	Lower floor hall	Dropped 0.25 bar	Not possible to remove the return valve from the test. Air vented for test.
3	Lower floor bedroom	Dropped 0.1 bar	Not possible to disconnect return riser connection for the test. The front door frame prevented this. Return isolation relied on the closed isolation gate valve. Not possible to verify directly if there was any leakage across the valve. Not possible to remove air for the test.

3.1 Coil 2 & 3 Test Disassembled Connections

3.2 Coil 3 Test Gauge Readings

Coil 3: 16:36

Coil 3: 17:18

4.0 MAX FORDHAM COMMENTARY

4.1 Test Limitations

It was not possible to remove all of the coil connection pipework and fittings in all cases. The connected valves in particular are a likely source of leakage and this may have affected the final pressure readings.

It was not possible to remove air from all coils for the test. This will have affected the final pressure readings.

The walls were warm. Cold water was introduced and will have heated up over the test period affecting the final pressure readings.

4.2 Test Observations

The standard pressure test for heating pipework installations is described in BESA publication TR6:

5.16 The test procedure shall be as follows:

- 5.16.1 When the system is full of water, raise the pressure to the test pressure and seal the system.
- 5.16.2 A hold period of 15 minutes should be observed to allow for pressure stabilisation. If the test medium temperature is below the ambient temperature then ensure the system pressure does not exceed the test pressure as the test medium temperature approaches ambient.
- 5.16.3 Monitor the pressure. If the pressure falls, walk around the system to check for leaks or valves letting by.
- 5.16.4 If the test pressure holds steady for one hour, the system is deemed to be satisfactory.

All 3 coils held the test pressure over the 1 hour period and there were no identified water tightness leaks. It is unlikely the coil pipework had corroded to the extent that the pipework had lost its water tightness integrity.

Any leaks were small and likely to be from valve glands or connection pipe joints and the like.

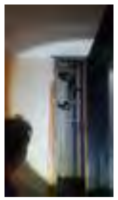
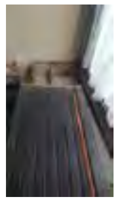
Disassembling the coil connection pipework had some risk in that it put strain on the coil tails which could have failed. Access to the pipework in Block B was generally good but the disassembly process was constrained by the building fabric (e.g. for the coils 2 & 3 the duct construction and adjacent front door frame) and the time available.

For Block A testing will be more disruptive to the dwelling finishes and fabric and will need more to organise and implement. Remedial works to finishes and fabric will be required after the test. Residents will need to engage with the process for this to be carried out.

Block C has not yet been investigated.

Alexandra and Ainsworth Estate,

MAX FORDHAM EMBEDDED COIL TESTING METHODOLOGY – REV2

Item	Intent	Proposed Action	
Identify 8 dwellings to test	RM: Dave Wadsworth has confirmed that works have not yet been carried out in the six radiant heating trial properties and so we can use those for investigation/coil test purposes. This will allow us to attempt one of each type of property.	In order to manage disruption to residents an initial test will be undertaken within Block B Dwelling 78 (3 individual coils). This is currently a void and end wall dwelling without a common heated wall/paired dwelling.  On the day of the test the heating to Dwelling 78 and the dwelling below will be isolated for the duration of the test. No access will be required to the dwelling below.	
Prepare individual dwelling methodology to test viably of the test	For each dwelling inspect the coil connection pipework and define the work required to carry out the test Identify requirements for access to enable the work to be carried out For Block A identify the riser isolation valve positions at roof level For Block A identify the dwelling pair for which access is	A methodology for the test has been agreed with GEM and documented.  	

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	required for isolation of the return.	MF and GEM believe the test is viable with limited risks to the supply of heating to residents.	
IR camera scan of heated wall	Record image of the heated walls within each dwelling and examine for any indication of leaks.	Dwellings Black A 117H & 118G (a dwelling pair with a common heated wall) have been imaged by MF. MF will issue a report enclosing the images and observations.	
Hydraulic Pressure Test parameters	GEM have confirmed the LTHW space heating static pressure as 2 barg at the boiler room. GEM have confirmed the LTHW Block space heating pump speeds are varied according to the weather. They are not run above 2.5bar pump pressure in deep winter. The normal working pressure at the coils is therefore currently between 5barg and 3barg. We propose coils are tested at test pressure of 6barg. Test as BESA TR6/3rd Edition.	MF and GEM have agreed coils will be tested to 6barg.	
Flow test parameters	The coils to be flushed from the heating system to a 500 litre container to demonstrate that they are free flowing. Throttle the flow of 0.1kg/s and measure the pressure loss across the coil. Collect any sediment from the coil.	MF and GEM will trial this on Block B Dwelling 78.	

Template Methodology for Block A Arrangement

Planned Activity	Description	Identified Risks	
Survey	Carry out detail survey to confirm the test is viable and the pre planning required.		
A**: Isolation of the dwelling coils from the live system**	Relies on the existing gate valves Record open position of the valves for resetting following the test. It is likely the valves will operate but let by. In order to carry out the pressure test the pipe will need to be broken and the isolation valve/pipe end plugged/capped May be better to cut return pipe high level in the void dwelling. Identify access requirements in the 2 dwellings Take down duct breeze block wall. Requires asbestos check. Detail test pipe lengths to be fabricated.	Pipe integrity is such that the pipe cannot be plugged/capped and further pipe replacement is required Mitigation: examine the condition of the pipe externally	
TP: Add test connections	Remove lengths of existing pipe to adjacent fittings. Add pre made pipe sections to provide test points, air vent, drain cock and connection of the test equipment	Pipe integrity is such that the pipe cannot be plugged/capped and further pipe replacement is required Mitigation: examine the condition of the pipe externally	
Carry out test	AS BESA TR6/3rd Edition		
Remake the return connection	Fit and test for leakage Close coil flow valves Open coil return valve Refill coil from return		
Flush pipework	Flush pipework to container and measure dP at design flow. Examine any sediment.		

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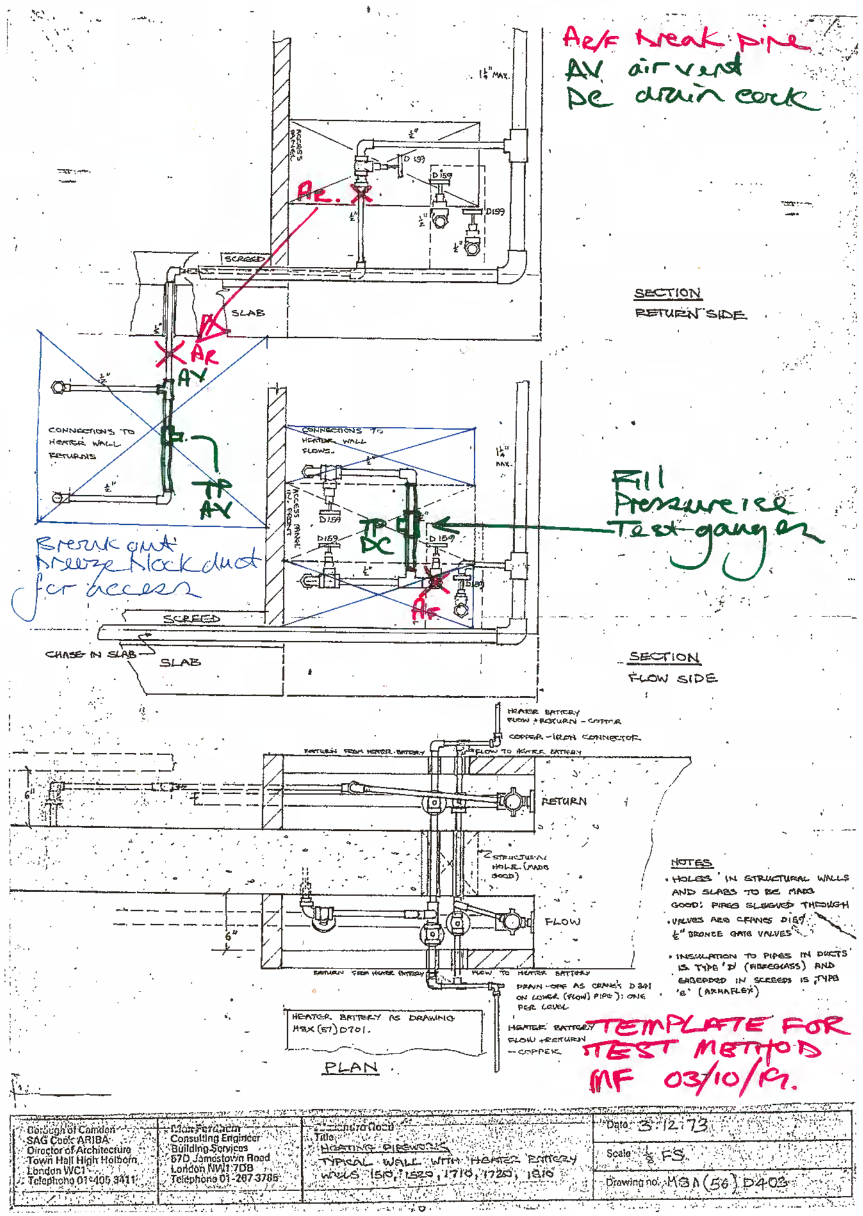
Remake the flow connection	Fit and test for leakage Return coil to operation. Reset flow and return valves.		
Reinstate duct enclosures and finishes	BWIC	Ensure fire separation between dwellings is maintained	



AR/F break pipe
AV air vent
DC drain cock
SECTION
RETURN SIDE
SCREED
SLAB
CONNECTIONS TO HEATER WALL RETURNS
Break out breeze block duct for access
CONNECTIONS TO HEATER WALL FLOWS
Fill Pressurise Test gauges
SECTION
FLOW SIDE
CHASE IN SLAB
RETURN
FLOW
NOTES
PLAN
TEMPLATE FOR TEST METHOD
MF 03/10/19.
Borough of Camden
SAG Cook ARIBA
Director of Architecture
Town Hall High Holborn
London WC1
Telephone 01-405 3411
Consulting Engineer
Building Services
London NW1 7DB
Date 3.12.73
Scale FS
HEATING PIPEWORK
TYPICAL WALL WITH HEATER BATTERY

Test Methodology for Block B Dwelling 78

Planned Activity	**Description**	**Identified Risks**	
Survey	Carry out detail survey to confirm the test is viable and the pre planning required. Void dwelling End wall dwelling so no heated pair from common wall. Good wall panel and plinth access. Pipework appears in good condition to withstand manipulation. Unions available for disassembly for and reassembly following the test. Drainage available from lower level service duct.		
A: **Isolation of the dwelling coils from the live system**	Relies on the existing gate valves Record open position of the valves for resetting following the test. It is likely the valves will operate but let by. In order to carry out the pressure test the riser will need to be isolated and drained down. Pipe will need to be disassembled and the isolation valve/pipe end plugged/capped. May be better to cut return pipe high level in the void dwelling. ~~Detail test pipe lengths to be fabricated.~~	Pipe integrity is such that the pipe cannot be plugged/capped and further pipe replacement is required Mitigation: examine the condition of the pipe externally. Risk is low In the event of difficult only the void dwelling heating will be affected. Impact is low.	
TP: Add test connections	Remove lengths of existing pipe to adjacent fittings. Add pre made pipe sections to provide test points, air vent, drain cock and connection of the test equipment	Pipe integrity is such that the pipe cannot be plugged/capped and further pipe replacement is required Mitigation: examine the condition of the pipe externally Risk is low In the event of difficult only the void dwelling heating will be affected. Impact is low.	

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Carry out test	AS BESA TR6/3rd Edition		
Remake the return connection	Fit and test for leakage Close coil flow valves Open coil return valve Refill coil from return		
Flush pipework	Flush pipework to container and measure dP at design flow. Examine any sediment.		
Remake the flow connection	Fit and test for leakage Return coil to operation. Reset flow and return valves.		
Reinstate duct enclosures and finishes	BWIC	Ensure fire separation between dwellings is maintained	

Appendix F - Max Fordham thermal imaging of heating coils

Alexandra and Ainsworth Estate,

MAX FORDHAM OBSERVATIONS
FOLLOWING SITE VISIT DATED 8TH OCTOBER 2019
REV B

Void flats were visited in Block A and Block B. The wall coils were operational in each, with the flats heated to high temperatures.

The walls facing living rooms generally have a higher density of coil than those facing bedrooms. The warmest parts of the walls within bedrooms are generally where the flow/return pipes to the living room coils are routed.

The surface temperature of the heated walls varies between 30-40°C.

The external parts of the heated walls typically have a surface temperature ~2-3°C higher than the unheated walls

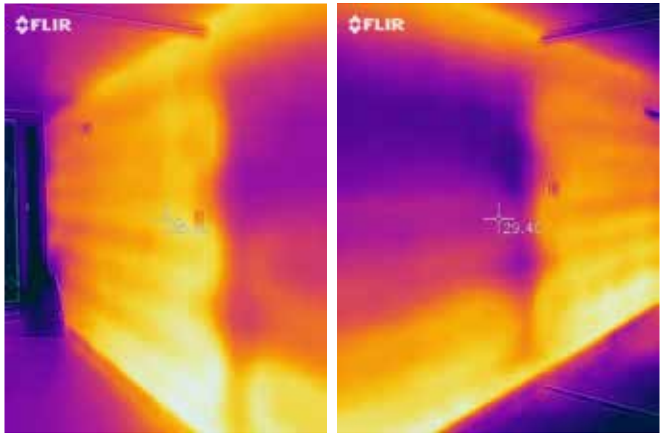

Figure 1: Heated wall in BLock-A flat showing difference in coil density and surface temperature for living room and bedroom

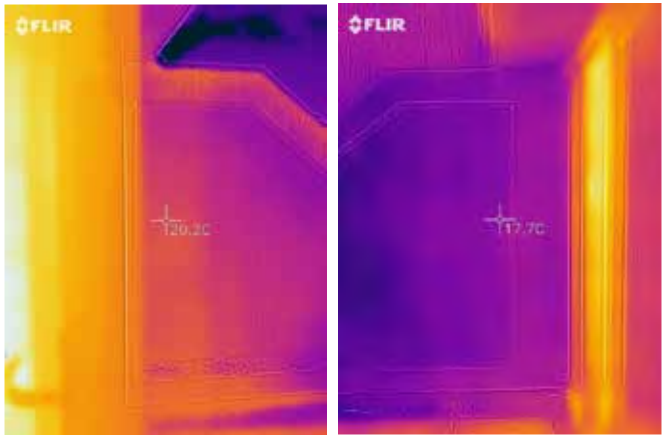

Figure 2: IR photo of external part of heated wall and external part of unheated wall

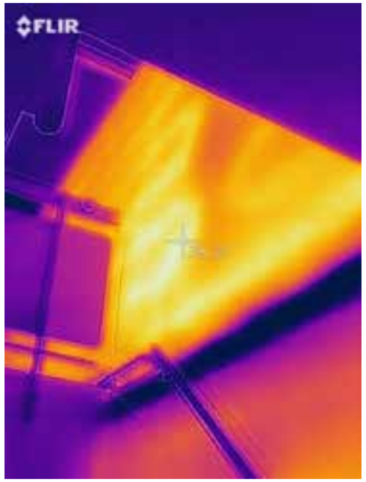

Figure 3: IR photo of Block B flat

Appendix G - Levitt Bernstein preliminary thermal analysis

Alexandra Road

Thermal Imaging | October 2019

Site Notes

This report contains Levitt Bernstein's observations during site visits on 16th October 2019 at 8pm and 17th October 2019 between 10am and 1pm.

The external air temperature at the time of visit on 17th October was approximately 10-12°C in the shade. It was cold with a clear sky and sunny. Areas of the building in the sun had been viewed at night the previous day (16th October) to prevent the sun warming the concrete and providing a skewed result.

Void flats were visited in block A. The wall coils were operational during the visit with the surface temperature of the walls around 30-40°C at the time.

This is a supplementary report to that provided by Max Fordham on 8th October 2019.

Levitt Bernstein People.Design

External Thermal Imaging

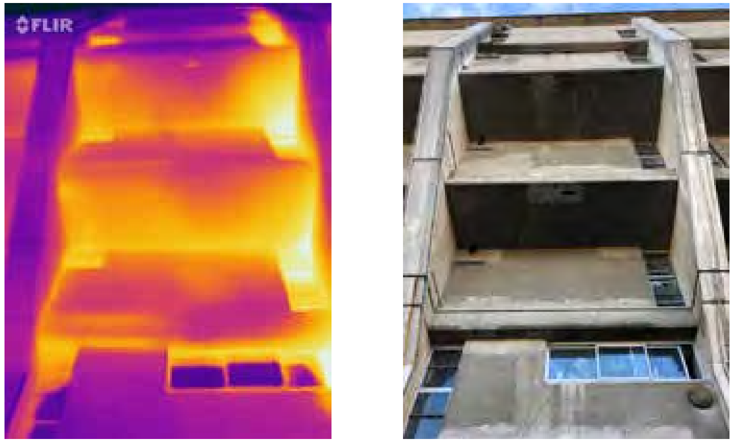

Figure 1 : Rear of block A showing the heated party wall from the coils (right) and the unheated wall (left).

Figure 2 : Rear of block A showing the heated party wall (right) and an unheated wall (left). The temperature readings from the image show that there are significant thermal bridges from the party walls. The unheated wall has a 3°C difference between the external wall (14°C) and the edge of the spine (11°C). The heated party wall (20°C) is 6oC warmer than the unheated wall (14°C).

Figure 3: The base of the spine wall between the parking spaces at the ground floor of block A was measured at 9°C. This shows that the thermal bridge from the flats extends to the edge of the spines with a 2°C difference between the lower (9°C) areas and upper floors (11°C).

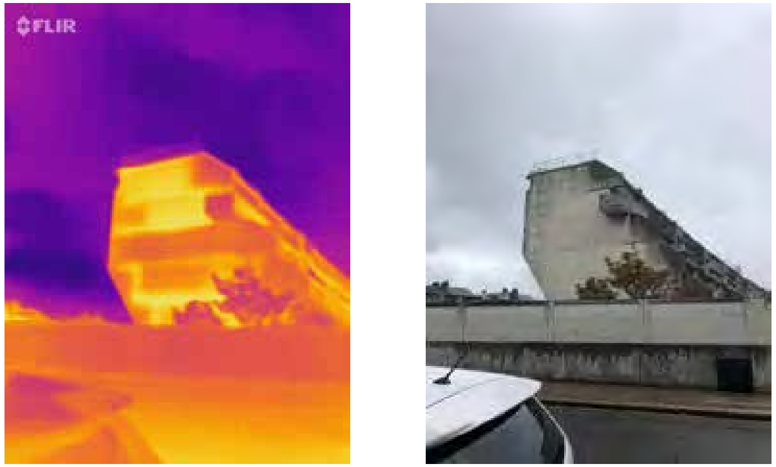

Figure 4: The western end wall of block A illustrating heat loss from the flats and significant thermal bridges at the floor and wall junctions.

External Thermal Imaging

Figure 5 : Eastern end wall of block A illustrating heat loss from the flats. The thermal image was taken at 8pm to prevent the heat from the sun affecting the image. The photograph was taken the following day.

Figure 6 : Underside of block A at the eastern end showing the heat loss and thermal bridges though the exposed floors of the flats.

Figure 7 : Front of block A illustrating heat loss and the thermal bridge from the heated party wall. Temperature where the concrete fin meets the window wall shows 15°C. The thermal image was taken at 8pm to prevent the heat from the sun affecting the image. The photograph was taken the following day.

Figure 8 : Front of block A illustrating heat loss and the thermal bridge from the unheated party wall. This image shows that it was 3°C cooler on the unheated side (12°C) than the heated wall (15°C, figure 7) The thermal image was taken at 8pm to prevent the heat from the sun affecting the image. The photograph was taken the following day.

Internal Thermal Imaging

Figure 9: Internal image of a void A1 unit, showing the coil heated party wall - facing towards Rowley Way.

Figure 10: Internal image of the same A1 unit showing the unheated party wall and the effect of the thermal mass of the concrete with solar gains. It is assumed that the solar gains contributes approximately 9°C warming when compared to flat type A3 which received no solar gains on its unheated wall.

Figure 11 : Internal image of the same void A1 unit, showing the coil heated party wall - facing towards the railway line. It is possible to see the route of the tail pipes at the top and bottom of the wall from the heated coil.

Figure 12 : Similar image as figure 11 above. Assumed the heated coil tail pipe runs in the wall behind the skirting board, due to warm patch shown along base of skirting board.

Internal Thermal Imaging

Figure 13: Internal image of a void A3 unit (Mulalley's site office), showing the coil heated party wall in the double height space.

Figure 14: Image of the kitchen area in same A3 void unit at mezzanine level showing the location of heating coil tails.

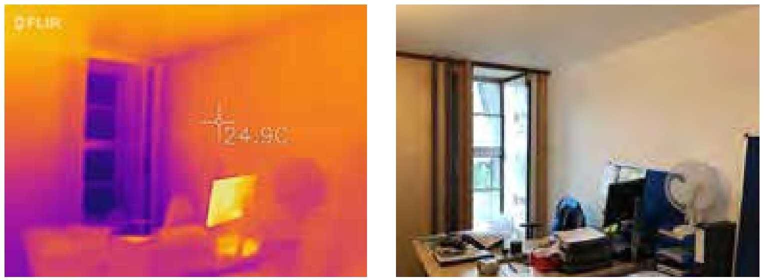

Figure 15: Image of the bedroom in same A3 void unit at mezzanine level showing the unheated wall 14°C cooler than the heated coil wall in figure 13.

Figure 16: Image of the bathroom wall in same A3 void unit on the lower floor showing the heating coils and likely zone for the tails.

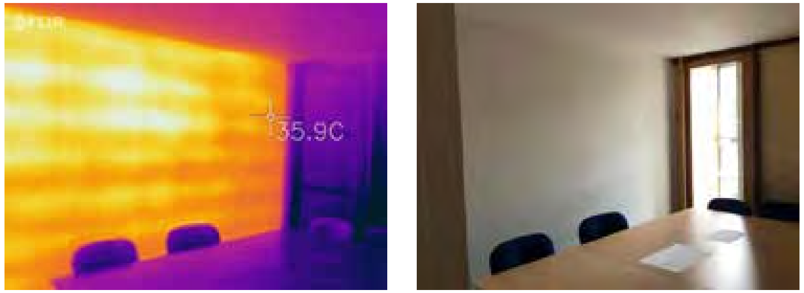

Figure 17: Image of the bedroom in same A3 void on the lower floor unit showing the location of heating coil.

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