

Atlas Controls

North Street, Reading

Energy and sustainability

Report for

Miles Properties Reading Ltd

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2 Introduction

Atlas Controls has been appointed by Miles Properties Reading to identify options for the Mechanical & Electrical Services design for the development at 16 North Street, Reading.



Atlas Controls and sister company Atamate Ltd specialise in specification of building services and control systems to reduce energy consumption significantly below regulatory standards. Atlas Controls & Atamate partners with the following institutions to develop, extend and communicating these techniques:

- Innovate UK has awarded a 3 year Knowledge Transfer Partnership to work with Oxford University to develop machine learning techniques for low energy homes.
- Provide control and data logging for the BRE and Loughborough University for the low energy Dementia home in BRE innovation park.
- Jointly conducting a post occupancy evaluation with Oxford Brookes and Cardiff Universities into low energy student accommodation.
- Asked to join and present to the All Party Parliamentary Group for Energy Studies.

3 Policies and drivers

The development is influenced by both building and planning regulations. This section summarises the key local policies affecting the proposed development.

3.1 Building Regulations

3.1.1 Building regulations, part L

The energy efficiency standards required by Building Regulations are set out in Part L. It regulates both the building fabric and the building services.

Fabric includes the insulation values of building elements, the allowable area of windows, doors and other openings and air permeability of the structure.

The building services installed includes the heating system employed; the controls for heating appliances; ventilation system; hot water storage and lighting efficiency.

The energy efficiency along with the carbon emissions for the dwelling must be estimated via the Standard Assessment Procedure, or SAP, calculations.

3.2 Planning Regulations

Planning guidance is both national, regional and local. The key policies that affect the sustainability of the building are identified and the objectives that need to be achieved are identified.

3.2.1 National Planning Policy Framework (NPPF) 2012

The National Planning Policy Framework 2012 (NPPF) sets out the overarching planning policy vision on the delivery of sustainable development through the planning system. The key areas of the NPPF in relation to this development are:

1. Pursuing development in an integrated manner, promoting outcomes in which environmental, economic and social objective are achieved together over time; and adopting a holistic spatial planning approach (Paragraph 7).
2. Addressing the causes and potential impacts of climate change (Chapter 10).
3. Promoting high quality and inclusive design in the layout of new developments over the lifetime of the development; and including clear comprehensive and inclusive access policies that consider people's diverse needs and aims to break down unnecessary barriers and exclusions (Chapter 7).
4. That renewable energy should be considered in all new developments where it is appropriate. The NPPF identifies the following key principles in approaching renewable energy:

- a. Renewable energy developments should be capable of being accommodated in locations where the technology is viable.
- b. Developers should recognise the full range of renewable energy sources, their differing characteristics, location requirements and the potential for exploiting them.
- c. Development proposals should demonstrate any environmental, economic and social benefits as well as how any environmental and social impacts have been minimised.

3.3 Reading Borough local development framework

The Core Strategy was adopted with alterations on 27th January 2015

3.3.1 CS1 – Sustainable construction and design

Policy CS1 seeks to ensure that the design of buildings use energy, water, materials and other natural resources appropriately to meet these requirements developments should:

1. On larger developments of more than 10 dwellings or 1,000 m² of floor space, ensure that 50% of the provision meets the most up to date Eco-Homes and BREEAM Excellent standards;
2. All new developments maximise the use of energy efficiency and energy conservation measures in their design, layout and orientation to reduce overall energy demand;
3. All developments of more than 10 dwellings or 1000m² floor space incorporate onsite generation of energy from renewable sources and energy efficient design measures to off-set at least 20% of predicted carbon dioxide emissions from the estimated energy usage of the completed and occupied development;
4. All developments reduce mains water use and demonstrate that water conservation measures are incorporated so that predicted per capita consumption does not exceed the appropriate levels set out in the Code for Sustainable Homes or BREEAM Standards.

3.3.2 CS2 – Waste Minimisation

1. Minimising the generation of waste in the construction , use and life of the development including the reuse and recycling of construction waste

4 Design Philosophy

Underpinning all low energy building is excellent fabric design and construction. Buildings lose heat in 3 main ways; through the external envelope (walls, windows etc), through ventilation losses and through cold bridging. A good fabric design means addressing all these.

As a result of this, low energy buildings will behave differently to traditional buildings in 4 key ways:

1. Heating - they require significantly less heating. However more importantly, they require very responsive heating as they can easily overheat. A room may only need 300W of heat in mid winter, and as an average human gives out 100W and the sun shining through a window can give significantly more, it is easy to imagine a situation where heating requirements are met by internal gains alone. Consequently the heating system needs to respond to changes rapidly.
2. Ventilation - as the fabric is air tight, a ventilation system is needed to maintain the indoor air quality (IAQ) while minimising the heat losses from ventilation.
3. Domestic Hot Water - the biggest use of energy is likely to be for the hot water, so this should be the focus for energy reduction.
4. Cooling - they can be very prone to overheating in summer due to the focus on fabric performance i.e. increased insulation and air tightness. Design calculations will typically focus on winter temperatures, as this is when heat losses are most problematic because of the low outside temperatures. In summer, of course, the difference between outside and desired inside temperatures is very little so there is very little heat transfer through the building fabric. As a result, internal heat gains, such as occupants themselves, electrical appliances and the hot water system, plus the greater solar gains that summer could bring, can be enough to create very uncomfortable or even dangerous inside temperatures.

4.1 Building Fabric

A 'fabric first' approach will be adopted that minimises the amount of energy consumption from the outset. Buildings lose heat through the fabric (walls, roof, windows etc), ventilation losses (air movement through the building) and thermal bridges (where one material allows heat to easily transfer from the inside to the out). Ideally, the building would be of vapour open construction as this allows the building to 'breathe', this reduces the risk of condensation problems arising in the building.

The proposed building fabric will have the following performance:

Building elements	U-value
External Walls	0.16 W/m ² K
First floor (above unheated ground floor)	0.15 W/m ² K
Roof	0.15 W/m ² K
Glazing	0.8 to 1.2 W/m ² K

Building air tightness to be 2 - 4 m³/h/m² at 50Pa. Good detailing and design will prevent thermal bridges and the fabric will be vapour open with lime render externally and lime plaster internally to allow water vapour to naturally escape from the building.

4.2 Building Services

4.2.1 Flats

The specification of the services is critical to minimise emissions, cost and to ensure maximum comfort for the occupants.

Service	Issue	Proposed Solution
Heating	Rooms require a small amount of heat, which can be provided by internal gains, so can easily overheat. Need to have very responsive heating system with low thermal mass.	Infrared heating with control based on occupancy would be preferred choice.
Ventilation	Objective is to minimise heat losses to ventilation while maximising indoor air quality.	Mechanical extract ventilation (MEV) with controllable trickle vents measuring air quality (CO ₂ and humidity) to only ventilate the building when air quality poor.
Hot Water	Often the largest use of energy in a low energy building.	Using a micro heat pump to recover waste heat from ventilation stream.
Passive cooling	Low energy buildings are very susceptible to summer overheating as they are designed to capture heat in winter. Overheating can often be more of an issue than heating.	A number of strategies will be employed; controllable shutter to reduce sunlight into buildings, control of vents and motorised windows to provide cross-ventilation through the building, use of the cold air from micro heat pump to cool flats at no additional cost.

Lighting	Maximising daylighting and minimise heat energy from lighting	Large windows with low energy lighting. Light automatically controlled with occupancy to turn off when no one in room.
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4.2.1.1 Glazing

The exact glazing requirement will be determined with further modelling. There is a trade off; wanting the solar energy in winter, yet limiting the risk of overheating in other times of the year. In summer, shading will have to be provided by shutters during the day to prevent overheating, but again, this must be traded against not wanting to limit daylight and hence increase the need for electric lights.

4.2.1.2 Other Benefits

The proposed solution has other features with further benefits, detailed below:

1. There are no hot water circuits running round the building. This reduces the risk of legionella and the risk of overheating of communal areas from internal gains. This is often a problem for flats using communal water based heating.
2. There is no gas required in the building. This reduces fire risk and simplifies the operation and management of the building.

4.2.2 Offices

The offices will have a similar fabric design to the flats, but thermal behaviour will differ as they will have greater peak occupancy and hence, greater peak internal gains. As such, the key issue should be preventing overheating.

While there is no regulatory obligation to provide cooling in the workplace there is a requirement for workplaces to be reasonable and most employers will want to ensure the comfort of their employees.

Air to air heat pump provide heating in winter and cooling in summer. This will be controlled on a zone basis so only occupied zones are heated or cooled at any time. Window switches prevent the heating or cooling being in operation when the windows are open. External units will be in unheated space on ground floor of building not on boundary, this will help provide air flow through the bin stores.

Ventilation, hot water and lighting for the offices will use the same control technology as the flats.

4.3 Energy generation

The final part of the strategy is to generate energy from low or zero carbon technologies. Due to the location and size of the site, solar photovoltaic (PV) panels are the only technology considered.

The price of PV installation has dropped by around 70% in the last 5 years and government feed in tariff has been correspondingly reduced and is likely to be phased out in 2019. As time of use metering is not an option of a development of this scale, the best option both environmentally and financially is to use locally generated power on site.

The challenge with most low or zero energy sources is effectively employing the energy generated, as the power is often generated when it is not required. Solar panels produce eight times more power in the summer than winter and on a daily basis, domestic demand normally peaks in early evening. Storage of energy is difficult as batteries are expensive. Currently, the only viable option to store energy is in hot water tanks. As batteries reduce in price, they may be a future option.

The proposal would use photovoltaic electricity generation on the building roof and south wall. The roof would be at the optimum angle of 30 degrees.

As a mixed use development, the power generated can be effectively used throughout the year. There will be a background requirement for hot water heating and lighting throughout the year.

An additional energy efficiency feature is available via the hot water system. While heating hot water the waste product from the micro heat pumps is 6C cold air that can be used for cooling in summer.

This energy management strategy is predicated on good control of the building to enable the most efficient use of the energy at all times. It is anticipated that all power generated will be used on site.

The total area of solar panel is 245m², which will provide a 35kW peak array which will generate approximately 28MWh per year. (Estimate via correspondence with Chris Jardine, Joju Solar <https://www.jojuSolar.co.uk/>).

5 Estimated energy demand

Energy modelling of the dwellings has been undertaken to establish the likely energy use and carbon emissions of the buildings. These results also indicate the required amount of renewable technology needed to comply with CS1 criteria of reducing carbon emissions by 20% through renewable technology.

The models are based on real data collected by the controls company, Atamate Ltd, from buildings built with the with same fabric and building service provision as proposed here. Results obtained from Atamate suggest that buildings built to this design can reduce overall energy use by an average of 30%, and up to 45%, when compared to their SAP estimates. It has been found that the SAP approach cannot represent dynamic occupancy and therefore cannot accurately estimate the heating and ventilation profiles generated by the Atamate control system. Hence it was felt that this approach was necessary to calculate the the likely energy use and carbon emissions as accurately as possible.

The table below provides the average energy use figure per unit floor area that was calculated from the Atamate data. This figure is then scaled to generate the other estimates. All of the energy use accounted for here is electricity, and hence the SAP recommended carbon emission factor of 0.519 kgCO₂/kWh is used to estimate the carbon emissions. (see 'The Government's Standard Assessment Procedure for Energy Rating of Dwellings', Table 12). A full SAP calculation has not yet been carried out, but a likely estimate has been generated using the data provided by Atamate and this is included in the table to illustrate the additional energy and carbon efficiencies made available by the building design alone

	Per unit floor area	Likely SAP Estimate (/m ²)	Whole building	Likely Sap Estimate
Annual Energy Demand	32.5 (kWh/yr/m ²)	45.8 (kWh/yr/m ²)	38 (MWh/yr)	53 (MWh/yr)
Annual Carbon Emissions: based on Energy Demand	16.9 (kgCO ₂ /yr/m ²)	23.7 (kgCO ₂ /yr/m ²)	20 (tCO ₂ /yr)	28 (tCO ₂ /yr)

As explained, the efficiencies made available by the building services control system are already estimated to lead to a 30% reduction in energy use and carbon emissions on SAP estimates.

In terms of specific renewable energy technologies, it can be seen that around 26% of the energy demand could potentially be met by the solar PV array described in Section [4.3 Energy generation](#), leading to a corresponding, on-site, carbon emission reduction. Therefore the proposal is compliant with the CS1 criteria of the local development framework.

6 Conclusion

We recommend a combination of high quality building fabric, solar photovoltaic (PV), mechanical extract ventilation (MEV) with heat recovery and a cutting edge building services control system. This design will exceed local planning and building regulation sustainability requirements.

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