Project: South Southwark Athletics Centre
Title: Route to Net Zero Carbon Building
Date: 21st February 2020
Rev.: 0

1.0 Introduction

South Southwark Athletics Centre will see the demolition of an existing sports pavilion, with the construction of a new, energy efficient sports pavilion providing sports studios / training rooms and changing facilities.

Southwark Council require the design team to carry out a study to ascertain the feasibility of achieving a net zero carbon building. The UK Green Building Council define a net zero carbon building as follows:

"When the amount of carbon emissions associated with the building's operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset." (UK Green Building Council; Net Zero Carbon Buildings: A Framework Definition – Section 1. Establish Net Zero Carbon Scope; 1.2 Net Zero Carbon – Operational Energy is Defined As:)

They go on to detail the steps to achieving a net zero carbon building:

1. **Reduce Operational Energy Use**
    a. Reductions in energy demand and consumption should be prioritised over all other measures.
    b. In-use energy consumption should be calculated and publicly disclosed on an annual basis.
2. **Increase Renewable Energy Supply**
    a. On-site renewable energy sources should be prioritised.
    b. Off-site renewables should be demonstrated additionally.
3. **Offset Any Remaining Carbon**
    a. Any remaining carbon should be offset using a recognised offsetting framework.
    b. The amount of offsets used should be publicly disclosed.

2.0 Calculating a Buildings Carbon Emissions

Current legislation requires us to assess a buildings energy consumption and associated carbon emissions against Part L2A Conservation of Fuel & Power, utilising a National Calculation Methodology (NCM) SBEM tool. This will produce a BRUKL report which details compliance with Building Regulations, and an Energy Performance Certificate (EPC), which details the energy efficiency standard of the building on a scaled chart from A+ - G. In order to demonstrate net zero carbon performance, we must ensure the building achieves an A+ on the EPC, with ≤0 $kgCO_2/m^2$ emissions on the corresponding BRUKL output report.

3.0 Current Building Services Strategy and Performance

A Part L2A calculation has been carried out on the building using the approved NCM SBEM tool, TAS V9.4.4. The calculation has been based on the architectural drawings provided by HCD Architects to ascertain the geometry, with the building services strategy being put forward by Dave Dickinson & Associates.

The fabric and building services specification currently proposed is as follows:

3.1 Thermal Performance (Fabric Specification U-values):

External Walls – 0.25W/m²K
Ground Floor – 0.25W/m²K
Roof – 0.18W/m²K
Glazing – 2.0W/m²K (G-value 0.40)
Personal Doors – 2.2W/m²K
High Usage Entrance Doors – 2.0W/m²K (G-value 0.40)
Air Permeability – 5.0m³/m²Hr @ 50Pa

3.2 Lighting & Controls

LED lights to be installed throughout with a Lumens per Circuit Watt rating of 90L/CW. PIR occupancy controls to be provided to all changing rooms, WC, circulation spaces and store rooms. Canteen, training / studio rooms and reception through the BMS system.

3.3 Ventilation

Where mechanical supply and extract is required to the changing facilities and studio / training rooms, a Mechanical Ventilation & Heat Recovery (MVHR) unit will be installed. This ensures any fresh air entering the space is pre-treated by extracted air bringing it closer to the internal design temperature, thus reducing associated heating / cooling loads. Energy efficient EC fans will be specified and the fans within the studio area will be occupancy controlled to reduce auxiliary loads.

3.3.1 Low Energy Fans

Low energy fans will be used with specific fan powers as good as or better than the limiting efficiencies detailed in the Non-Domestic Building Services Compliance Guide (2013).

3.3.2 Variable Speed Drives

Variable speed drives will be used to ensure fans and pumps operate no faster than required, thereby reducing energy consumption.

3.4 Space Heating & Cooling

Air Source Heat Pumps – These will provide both heating and cooling to the training / studio rooms. The heat pumps will have seasonal efficiencies of ≥4.0 SCOP for winter heating, and ≥6.50 SEER for summer cooling.

LTHW Under Floor Heating – This will provide heating only to the reception / circulation space and will be supplied by a high efficient gas fired boiler.

Electric Heater Batteries – These will provide space heating only to the changing facilities through air distribution. Electric heater batteries to be installed on the supply runs serving the changing facilities.

3.5 Domestic Hot Water

Domestic hot water will be supplied by a high efficiency gas fired calorifier.

4.0 Current Carbon Emissions

With the above fabric and services strategy input into the NCM SBEM tool, the building will achieve an 8.35% carbon reduction, and an EPC score of 28, which equates to a B rating. As can be seen, the current strategy does not achieve net zero carbon performance, therefore, the following proposals based on the UK Green Building Councils guidance for achieving net zero carbon can be considered by the client and assessed under the NCM software tools:

5.0 Enhanced Specification

To reduce operational energy use further, the following enhancements can be considered:

- Introduce Power Factor Correct to ensure the electrical consumption unity factor is >0.95. This ensures the electrical energy input into the building is used as efficiently as possible.
- Lighting efficacy is increased to achieve no less than 105Lumens per Circuit Watt.
- Photo electric lighting control and dimming with back space sensors and time clocks are incorporated into the reception / circulation area and training / studios spaces.
- The fabric thermal performance is enhanced to achieve the following U-values:
    - External Walls – 0.22W/m²K
    - Roof – 0.15W/m²K
    - Ground Floor – 0.20W/m²K
    - Glazing – 1.4W/m²K (G-value 0.40)
    - High Usage Glazed Doors – 1.4W/m²K (G-value 0.40)
    - Air Permeability – 4m³/m²Hr @ 50Pa

  A series of calculations have been carried out to ascertain the optimum thermal performance properties for this development, with the above deemed to be the most suited. Over insulating and creating a building which is too airtight, the energy demand can increase. This is due to the increased cooling load associated with the building as the high insulative values prevent natural heat loss during summer periods, thus increasing the cooling loads. The cooling loads will increase at a disproportionate rate to the heating load reduction, therefore causing an uplift in energy demand and carbon emissions. We have proposed a fabric specification which works well for both heat demand reduction and heat gain management.

To increase the renewable energy supply, the following enhancements can be considered:

- The gas fired LTHW boiler to be removed and the under floor heated spaces (reception / circulation, offices etc.) to be heated / cooled via air source heat pumps.
- Gas fired water heater removed and replaced with a heat pump system – This will need to be carefully sized to ensure there is sufficient hot water during peak periods as they require high storage space and have a relatively long re-heat time.
- Photovoltaic panels to be installed on the roof – approximate P.V. array of 403m², providing 75kWp to be installed (subject to the review of roof space, orientation and over shadowing by trees).

5.1 Enhanced Specification Results

With the above enhancements incorporated, the building will achieve a **54.20%** carbon reduction and an EPC score of **11** which results in an **A** rating.

This is a significant improvement over the proposed strategy, however, is still a significant shortfall from being zero carbon. There are alternative technologies capable of supplying both on and off-site energy generation, however not deemed suited for this development:

District Heating - There is a planned network very close to the site, proposed South East London (SEL) CHP network. The heating network is currently in operation, and Southwark council have recently entered into a contract with VEOLIA to provide heat and hot water from the SEL CHP district heating network to residential homes in Lewisham and Southwark, with extensions being proposed to serve areas within close proximity to the sports pavilion. Unfortunately, the aim of the extension is to

provide heating and hot water to residential properties, and as such, the pavilion will be unlikely to qualify as a suitable development.

Solar Thermal Panels – Solar thermal panels could be well suited to a development of this kind due to the relatively high hot water demand. However, the high storage requirements associated with the system, along with the increased roof structure requirements to accommodate a heavy solar thermal array render the system un-economical.

Additionally, there is limited roof space to accommodate both photovoltaic panels and a solar thermal array. P.V. has been deemed to be a more compatible technology for the entire building services strategy. The generated electricity from P.V. panels will be capable of providing a vast majority of the electrical demand for space heating and cooling, hot water generation, ventilation and auxiliary equipment etc. and are considered a more economical use of roof space capable of offering higher benefits than solar thermal.

6.0 Offsetting Remaining Carbon

It has been confirmed that there is insufficient scope at the Southwark Sports Pavilion to make it net zero carbo solely through on-site measures. It is therefore necessary to look at offsetting the remaining carbon emissions through the purchase of green energy. A commitment can be made to ensure all grid supplied electricity is provided by a green energy provider with 100% of the electricity being renewably sourced and generated.

7.0 Conclusion

The Southwark Athletics Centre has the potential to reduce its Carbon emissions by **54.20%** and achieve an EPC score of **11**, equating to an **A** rating. This does not represent a Net Zero Carbon building, however, does represent one with very high sustainable credentials with a significant betterment over current building regulation standards.

There is an opportunity to ensure the remaining electrical requirements are obtained from a green energy supplier where 100% of the electrical energy is generated through renewable technologies. This can then offset the remaining 45.80% carbon emissions, thus achieving the equivalent of an A+, Net Zero Carbon building.