M&E Services & Consulting Engineers

# 72 Maresfield Gardens
# The Use of VRF Air Conditioning

Project: 72 Maresfield Gardens
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This report looks at the reasons air conditioning (AC) was installed, and the steps taken to mitigate the impact of its use on the local power grid. We have arranged the report into two sections: -

1. The use of a VRF system for secondary heating
2. The use of a VRF system for overheating

## Description

The existing MVHR (Mechanical Ventilation Heat Recovery) ventilation system comprises of a single Titon HRV1 heat recovery unit located in the basement plant room. It provides fresh air to the basement Gym and generally into the Hall on this level. Air is extracted from the toilet, utility room and storeroom.

A home battery storage unit was also installed comprising of a Tesla Powerwall, which provides up to 13.5kW of storage and 5kW of continuous power when the grid is at its “dirtiest”.

A design is in progress to extend the MVHR to the rest of the house and installation of photovoltaic (PV) panels. To manage the integration of the gas boiler and VRF plant, a new control system shall be introduced, which will ensure the most efficient system is used at any time. We shall also explore the use of window sensors to ensure that heating or cooling cannot run while windows are open.

A VRF air conditioning (AC) system was installed primarily to provide cooling for the 2nd floor home office. This room resides in the roof space of the building and despite being equipped with solar reflecting glazing and high performing fabric insulation, it is subject to significant solar gains. For these reasons, we feel AC cooling is justified.

## 1. The use of a VRF system for Secondary Heating

In line with the upcoming Building Regulations interim issue, London Plan, GLA guidance and 2025 Future Homes Standards, the need to alleviate combustible fuel sources is imperative to ensure sustainable and future proofed design. The carbon factor associated with the decarbonisation of the grid is now a driving force in sustainable specification and design. It is with this reason that a heat pump (VRF) system is adopted to the scheme. Where 1 unit of electricity is taken from the grid, the Coefficient of performance allows a 300-400% efficient heating and cooling system and will therefore reduce energy demand and do away with the mains gas as the only heating source.

It is the intent that the mains gas system is only used when the VRF system is unable to meet heating demands to an efficient standard (i.e., falling below a 1:1 COP). This strategy will provide an efficient transition from fossil fuel led building condition, to highly efficient, low carbon heating and cooling sources. When the gas system has fulfilled its lifecycle, the removal of the infrastructure would not cause detriment to the internal conditioning, as the VRF will already be supplying a large proportion of the heating and cooling load. The cooling will also allow any potential summer overheating issues to be reduced, if not alleviated in many of the zones.

## 2. The use of a VRF system for overheating

Using the ***Local Plan Policies CC1 Climate change mitigation***, and in particular ***Point a) promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy*** (see table 2.1 below).
***CC2 Adapting to climate change*** as a guide and the ***Mayor of London Policy 5.9 Overheating and cooling***, which states: -

1. minimise internal heat generation through energy efficient design
2. reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
3. manage the heat within the building through exposed internal thermal mass and high ceilings
4. passive ventilation
5. mechanical ventilation
6. active cooling systems (ensuring they are the lowest carbon options).

As our guides, we refer to the below report in Table 2.1.on the steps that have been implemented to comply with Policy 5.9. Overheating and cooling.

## Conclusion

As part of the upgrade works to the property, carried out in 2020, a large amount of remedials works vastly improved the building fabric and building services. This both reduced energy demand and provided a highly efficient means to service the house. The upgraded works include:

- Low-E, highly efficient glazing
- Excellent insulation to walls, floors, ceilings, and roof
- High performing insulation to all pipework and ductwork
- Mechanical ventilation with heat recovery
- Efficient heat pump system, to provide heating/cooling
- Low energy LED lighting throughout
- New, highly efficient gas boiler
- Home Battery Storage

The upgraded works exceed the standards set out in AD Part L1b with regards to fabric and services specification and there are plans to further enhance the building performance, which include: -

- Extend mechanical ventilation to the remainder of the house
- Install Photovoltaic solar panels to generate electricity

This work extended far beyond the regulations to satisfy Part L1b, and once the further interventions are installed, the dwelling will be a benchmark for other residential fitout schemes.

Table 2.1

## Limiting the Effect of Heat Gains in Summer Months

An assessment has been undertaken to determine the risk of summertime overheating and consider measures for the minimisation of cooling demand.

## Basis of the Study

The London Plan Policy 5.9 (Overheating and Cooling) requests that Development's should reduce potential overheating risk and reliance on air conditioning systems. A 'cooling hierarchy' is provided and the Development has sought to follow this hierarchy

## Cooling Hierarchy

The following cooling hierarchy has been followed to limit the effects of heat gains in summer:

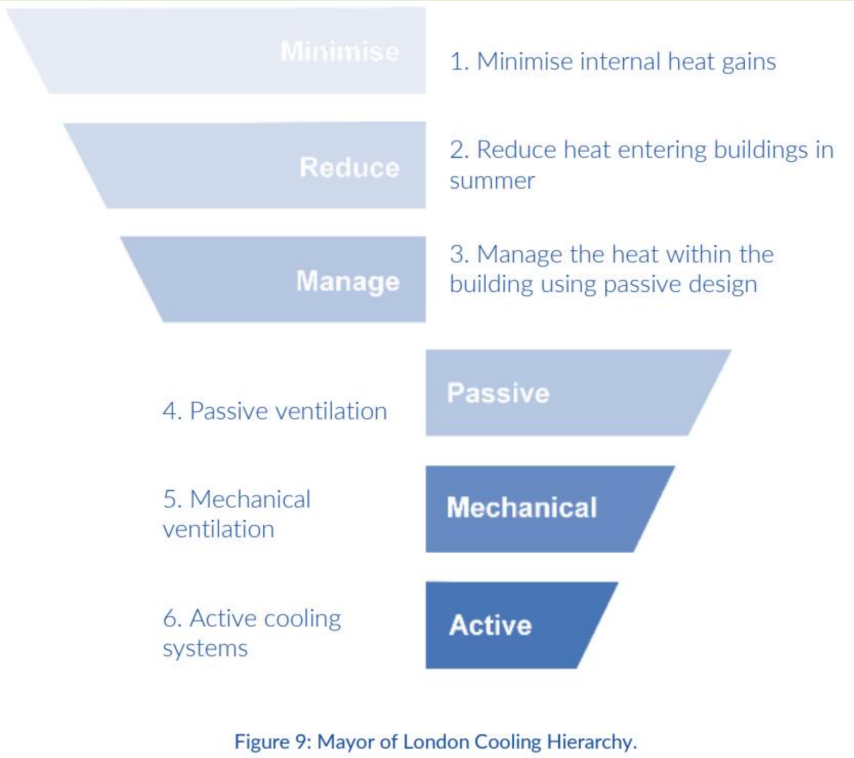


Figure 9: Mayor of London Cooling Hierarchy.

## Measures of Mitigation Measures – Internal Gains

The following mitigation methods were implemented at the Development to minimise internal heat gains.

## Energy Efficient Lighting and Equipment

Energy efficient lighting was used in most areas with low heat output, such as LED lamps. Equipment was selected in accordance with the Energy Rating as per the EU product Energy Labelling scheme. Where possible, preference was given to 'A' rated goods and above.

## Pipework Insulation

All necessary space heating and hot water pipework was insulated in accordance with the requirements of the Building Regulations. This was carried out to minimise heat gains and losses to / from distribution pipework and assist in maximising system efficiency. Careful attention was paid to insulating joints and knuckles to minimise standing heat losses. Ductwork was also insulated to minimise heat gains and losses and will be of suitable construction to minimise air leakage.

## Measures of Mitigation Measures – External Gains

The following mitigation methods were implemented at the Development to minimise external heat gains.

## Glazing Ratio, G-value and Light Transmittance

The glazing ratio was considered to manage limiting summertime solar gains to reduce space cooling demands and ensure good levels of natural daylight. The window dimensions proposed strike a good balance between beneficial winter solar gain, daylight levels and unnecessary solar gain. The total glazed proportion of the Development is approximately 36%.
Additional solar gains received by each space has been controlled through an appropriate g-value (currently expected g=0.40), whilst having regard for adequate daylight transmittance.

## Insulation and Fabric Air Permeability

High levels of insulation and low fabric air permeability were targeted, demonstrating significant improvements over the Building Regulations Part L limiting values and the notional building.

## Ventilation

The building makes use of highly efficient mechanical ventilation heat recovery (MVHR) to some areas with a design underway to provide MVHR ventilation to the remainder of the property.

## Summary of Calculation Results

Dynamic modelling for Part L compliance has been carried out for the Development. The analysis includes a Criterion 3 compliance check. The cooling demand is shown to be less than the notional building, according to the Part L methodology.