DDA
Building Services I Consultant Engineers

Castle Farm

Leisure Centre

Energy Report

Issue 0

AMENDMENT RECORD SHEET

Issue / Revision	Date	Prepared	Checked	Authorised	Remarks
Issue 0	July 2020	M Morgan	A Parry	P Guest	First Issue

EXECUTIVE SUMMARY

This report details the initial energy assessment for the proposed new combined leisure centre and scout hut at Castle Farm for Warwick District Council.

The report identifies sustainable and renewable technologies for consideration to be included in the project. These are designated with a 'traffic light' rating for recommended as good practise, recommended for further review, and not recommended.

The modelling undertaken has identified that the inclusion of air source heat pumps would serve as an efficient source of heating and cooling. This solution will also overcome the potential overheating issues to the activity and fitness spaces within the building.

The modelling has also identified that the inclusion of a photovoltaic array will further reduce the buildings carbon emissions.

The building design currently complies with building regulations Part L2A with the actual building emissions rate (BER) being 8% better than the target emissions rate (TER)

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	63.5
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	63.5
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	58.6
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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1. INTRODUCTION

The proposed new build leisure centre is to be located on the site of the existing recreation centre off Fishponds Road, Kenilworth.

The proposed building briefly comprises of 2 floors of dry sports facilities including large sports hall, fitness room, activity space, spin studio, changing rooms, toilets and entrance foyer/ café area. In addition to the sports facility a single storey scouts hut is provided to the side of the building comprising of 5No halls together with toilet accommodation, kitchen and staff rooms. The building is built over two storey's with the scout hut to the north of the development.

This report outlines the proposed energy strategy for the building to meet the requirements of the following:

a. Clients Brief
b. Building Regulations Part L Compliance
c. Planning Conditions
d. BREEAM

The report provides detailed analysis of potential energy systems including anticipated costs, energy projections and payback periods. From these the recommendations within the executive summary are derived.

1.1. CLIENT BRIEF

The clients brief for the project is to maximise their investment by determining the basic requirements for a Building Regulations compliant scheme while undertaking a review of supplementary renewable technologies that may be installed with additional investments to provide further operational cost reductions.

1.2. BULIDING REGULATIONS PART L COMPLIANCE

All new non-domestic buildings constructed in the UK must be compliant with Building Regulations, Part L2A, which sets the standards for building energy performance and refers to European legislation on energy use i.e. EPDB 'The Energy Performance Directive for Buildings'.

This legislation requires that the building energy usage is assessed using a national calculation method (NCM) and provides guidance on approved software systems that can be utilised to demonstrate compliance with the NCM such as SBEM.

Compliance is achieved if the Building Energy Rating (BER) is less than the Target Energy Rating (TER).

1.3. PLANNING CONDITIONS

There are currently no specific planning conditions with regards to energy performance from the new building. The Warwick District Council 'Local Plan' does not stipulate any minimum standard above building regulations compliance being required for non-residential projects.

Section 5, clause CC3 of the 'Local Plan' mentions the expectation for decentralised heat networks such as combined heat and power to be investigated for certain areas within the district. At present there is no plan to provide a district heating network close to the site which could be utilised in the future to provide the centres heating. As will be described later in this document, the leisure centre project is not suited to the incorporation of an on-site CHP system due to the operational hours of the building and low base heat load (particularly in summer).

In addition to the above Warwick District Council have made a pledge to be net zero carbon by 2025, which should be incorporated into future building design. Due to the leisure centre function and restrictions on the site it will not be possible to provide the range of measures required to achieve this target. Limitations on site restrict the availability of space for large PV arrays or other renewable technologies which would enable the site to generate its own heat and power.

1.4. BREEAM

The Warwick District Council 'Local Plan' requires all non-residential developments above 500m² to achieve a BREAAM rating of 'Very Good'. This requirement has been relaxed and there is currently no BREEAM target required for the development.

1.5. MODELLING SOFTWARE

The Part L energy modelling has been undertaken using the EDSL TAS Building Designer suite of software. The modelling has been completed using TAS calculation engine v9.5.0, and BRUKL compliance check v5.6.a.1.

The proposed building services design has been assessed against the NCM activity database associated with a **D2 General Assembly and Leisure, Night Clubs, and Theatres** building type.

1.6. BUILDING LOCATION

The simulations use the weather file for **Birmingham** in accordance with the SBEM weather locations lookup tool.

The proposed building is situated on the site of the existing recreation centre on Fishponds Road, Kenilworth, CV8 1EY.

Kenilwort
Mercia Ave
Brookside Ave
Castle Farm
Recreation Centre
Temporarily closed
Field House Day
Nursery & Pre-school
Fishponds Rd
Fishponds Rd
Willoughby Ave

2. MODELLING INPUT DATA

The following section outlines the input data used in the simulation to assess the performance of the proposed building services systems.

2.1. BUILDING GEOMETRY

The building geometry has been based on the architects revit model "*12944-DB3-B02-ZZ-M3-A-00001 Castle Farm Leisure Centre WIP Issue 8*"

2.2. FABRC DESIGN DATA

Following discussions with the project architect the following fabric design standards have been proposed for the building:

Construction U-Values	
Element	U-Value
Masonry Cavity Wall	0.18W/m²K
Cladding Cavity Wall	0.18W/m²K
Ground Floor	0.18W/m²K
Internal Walls	1.8W/m²K
Exposed Roof	0.15W/m²K
Glazing	1.6W/m²K G value = 0.4 LT value = 0.7
Roof lights	1.6W/m²K G value = 0.4 LT value = 0.7
Air Permeability	5m³/hr/m² @ 50Pa

2.3. BUILDING SERVICES SYSTEMS

The following data has been used to define the building services systems within the compliance software:

2.03.1 Heating Systems

Heating is generated via gas fired condensing boilers which feed LTHW to underfloor heating manifolds, air handling unit heating coils, radiant panels within the scout halls and also the indirect hot water cylinder.

The main entrance/ café area, staffrooms and activity spaces/ fitness studios are heated and cooled via a VRF system.

Heating System Data		
Element	Description	Efficiency
Main heating source	Gas fired boilers (95% efficient)	96%
Pumps	Variable speed with pressure sensors in the system	
Heat emitters	Underfloor heating to changing & toilets Gas fired radiant panels to sports hall VRF heating to staff rooms, café and fitness studios	91% SCOP = 4.5 SEER = 5.5

2.03.2 Domestic Hot Water System

Domestic hot water is generated by the gas fired condensing boilers. Circulation is via a 2 pipe secondary circulation system with associated circulation pump.

Domestic Hot Water System Data		
Element	Description	Efficiency
Hot Water Generator	Gas fired boilers	96%
Storage	3000L	
Storage losses	0.0361(kw/l/d)	
Circulation losses	6 (W/l)	
Pump power	0.05 (kW)	
DHW loop length	750 (m)	

2.03.3 Ventilation Systems

The main changing areas, entrance/ café and offices are provided with mechanical ventilation c/w heat recovery via a common air handling unit. A second air handling unit provides mechanical ventilation to the first floor fitness suite.

The outdoor changing area is mechanically ventilated by a heat recovery unit c/w plate heat exchanger heat recovery section.

The main sports hall is naturally ventilated via low level louvres and roof turrets taking advantage of the 'stack effect' from the high volume space.

The scout halls are mechanically ventilated by heat recovery units c/w plate heat exchanger heat recovery sections. Controls are arranged to provide demand based ventilation based on CO_2 levels.

Remote toilets and kitchens are provided with mechanical extract ventilation.

Ventilation System Data		
Element	Description	Efficiency
Air handling units	Thermal Wheel heat recovery Specific fan power	70% 1.9 (W/l/s)
Heat recovery units	Plate heat exchanger Specific fan power	70% 1 (W/l/s)
Local extract systems	Specific fan power	0.5 (W/l/s)
Ductwork	Class A assumed to be untested	

2.03.4 Management Features

The following management features are provided.

Management Features Data		
Element	Description	Efficiency
Power factor correction (PFC)	<0.9	
Metering	HVAC & Lighting	Yes
BMS	Out of range values	Yes

2.03.5 Lighting

Lighting throughout the project is LED provided with suitable controls to suit the occupancy and operation of each space.

Lighting System Data		
Room	Control	LLM/CW
Changing Areas	PIR presence on/off	100

Toilets	PIR presence on/off	100
Staff Rooms	PIR presence on/off	100
Entrance/ Café	Manual on/off Daylight dimming	100
Sports Hall	Manual on/off	100
Fitness Suites	Manual on/off	100
Scout Halls	Manual on/off	100
Kitchen	Manual on/off	100
Circulation	PIR presence on/off	100
Stores	Manual on/off	100

3. OPTIMISING ENERGY USAGE

The following section describes the energy features included to ensure the overall building design is efficient and low energy. The measures are described as either 'Passive' or 'Active'.

3.1. PASSIVE DESIGN FEATURES

Passive Design Features		
Design Feature	Description	Included
Orientation	The correct orientation of the building can contribute to reducing solar gains in summer, maximising solar gains in winter and maximising daylight	Glazing into main entrance orientated away from south to reduce peak solar gains while maximising daylight.
Daylight	Maximising daylight through the use of optimised window sizes, high floor to ceiling heights, shallow floor plates, roof lights and dual aspect spaces	Clearstory glazing into scout halls provide daylight while reducing solar gains.
Solar Gains	Optimised window sizes provide beneficial solar gains in winter. Solar gains in summer can be managed via the use of low g-value glazing.	Low g-value glazing used to control solar gains through entrance curtain walling and other glazing.
Insulation	High levels of insulation reduce heatloss and gains within a building, in conjunction with high levels of air tightness. High insulation levels of water pipework and storage vessels reduces distribution and standing losses.	Yes
Cold Bridging	Use of approved cold bridging details improves heat losses and eliminates the potential for cold spots which could lead to mould growth.	Yes
Thermal Mass	Using the exposed thermal mass of the building can help retain heat and also release heat to the cooler external environment at night to assist with night cooling.	No. Building is lightweight construction
Natural Ventilation	Use of natural ventilation can assist with natural cooling in summer and reduce energy consumption. Use of double façade or stack effect ventilation where pressure differentials drawn air through a building can help heat release	Included within the main sports hall

3.2. ACTIVE DESIGN FEATURES

Active Design Features		
Design Feature	Description	Included
Heating Efficiency	Use of high efficiency condensing boilers, reduced F&R temperatures, centralised heat networks, CHP etc	Condensing boilers proposed to run at return temp >55°C which encourages condensing.
Variable speed pumping	Use of variable speed pumps to match output of systems to demand from emitters.	2 port control strategy employed to make use of variable speed pumping.
Efficient cooling systems	Use of natural ventilation/ stack effect cooling strategies. Use of high efficiency active cooling systems such as chilled beams, evaporative cooling, VRF with heat recovery etc..	Natural ventilation included to sports hall. Chilled beams and evap cooling not suitable for this project. High efficiency VRF included to areas with high heat gains.
Efficient ventilation systems	Use of mechanical ventilation systems with heat recovery, high efficiency fans and low power consumption. Low pressure ductwork systems to reduce fan sizes.	Ventilation systems are low pressure to reduce specific fan powers, heat recovery included throughout.
Heat recovery	Use of heat recovery now commonplace due to increases to building air tightness to recover heat from ventilation exhaust systems for pre-heating incoming fresh air.	Thermal wheels included on air handling units. Plate heat exchangers included in heat recovery units.
Efficient lighting	Use of LED lighting systems in lieu of fluorescent, and occupancy/ daylight controls to reduce energy consumption	Lighting is LED throughout c/w either occupancy or daylight controls depending on area and activity.
Efficient controls	Use of weather compensation, zoning, metering etc to reduce energy consumption	Weather compensation not suitable due to constant temperature heating requirement. Building services are zoned and metered according to activity areas
Power Factor Correction	PFC uses banks of capacitors to correct the electrical waveform disruption caused by ‘reactive’ equipment such as motors., and reduce wasted energy.	Power factor correction included in scheme as a best practice solution for energy efficiency.

4. Renewable Energy Systems

The following section details an option appraisal of renewable energy systems that would improve the energy performance of the building and reduce its carbon generation.

The following table is a summary of systems identified for potential inclusion in the project. Each has been coded with a traffic light as follows:

Key	
System not included in design	System included in project design

System	Description	Impact on Building Design	Recommendation
1. Air Source Heat Pumps (ASHP) for heating and cooling.	Air source heat pumps used for heating and cooling will provide efficient sources of localised heating and cooling to areas of the building. The provision of mechanical cooling is required to resolve potential overheating issues to the large entrance/ café area due to the extent of glazed façade and also to fitness spaces due to high internal heatgains.	• Minimal – Internal units can be integrated into standard ceilings. External units have no impact on structural design	Recommended to provide heating and cooling to cafe/ entrance area due to high COP's and also due to potential overheating issues.
2. Air Source Heat Pumps (ASHP) for hot water generation.	An air source heat pump system used for the generation of hot water would require a substantial volume of stored hot water to serve the daily demand of the leisure centre. The large volume of water would be heated mainly through the night and topped up during the day. A backup source of hot water generation would be required to cope with unusual high demands such as a higher than normal influx of customers using the showers.	• The large volume of stored hot water would require additional plant space within the building and would require an uplift to the building structure to support the additional weight depending on location. • The condensers would require additional plant space and would require an uplift to the building structure to support the additional weight.	Not Recommended for implementation in the scheme due to the low grade heat generation required to ensure high COP's and the large amount of additional stored water volume required.

System	Description	Impact on Building Design	Recommendation
3. Combined Heat and Power (CHP) for hot water and heat generation.	A CHP plant will generate electricity whilst using the 'waste' heat to generate a significant portion of the hot water demand. CHP systems are best utilised in buildings with large base heating loads and long operational hours to reduce system cycling.	• Minimal – consideration of location will negate weight impact on building structure. • Route for flues to be considered.	Base heating load and operational hours not suitable for chp to be financially viable.
4. Wind Turbine (vertical axis blades) for electricity generation.	A silently operating wind turbine would be a source of renewable energy for the centre whilst visibly demonstrating the Centre's 'green credentials' to visitors and residents.	• Visual impact of a 36m tall turbine would likely have planning issues • Requirement of a 5x5m area within the carpark for the turbine base and control cabin.	Not recommended due to potential planning issues.
5. Wind Turbine (horizontal axis blades) for electricity generation.	A horizontal axis wind turbine is not recommended due to the costs, area required for installation and operation along with reliance upon particular wind speed and direction which adversely affects the payback period for the investment.	• Visual impact of an extremely tall turbine will likely have planning implications • Significant loss of car parking.	Not Recommended due to cost and planning implications.

System	Description	Impact on Building Design	Recommendation
6. Photovoltaics (PV) for electricity generation.	A PV system would provide a source of renewable energy for the centre. The system would benefit the Operator with reduced energy costs which should be reflected in their business model. Alternatively the system could be connected separately to the grid allowing the Council to solely claim the revenue for the export of all generated electricity; the Operator would not see any benefits and their current proposal would remain.	• Minimal – consideration of location will negate weight impact on building structure. • Large area of pitched roof above main sports hall is potential ideal location for solar array.	Recommended for inclusion in the scheme to reduce energy demand and meet client aspirations.
7. Ground Source Heat Pumps for hot water generation.	Ground source heat pumps utilise deep bore holes to either take heat from the earth or transfer heat from the building into the earth. The heat is transferred through a piped water system which would require large volumes of stored hot/cold water to act as buffers for heat collection.	• Significant building works required to dig deep bore holes. • The large volume of stored hot water would require additional plant space within the building and would require an uplift to the building structure to support the additional weight.	Not Recommended for implementation in the scheme due to high cost, low grade heat generation required to ensure high COP efficiencies and the large area of site required for the bore holes or ground arrays.

System	Description	Impact on Building Design	Recommendation
8. Biomass Boiler for hot water and heat generation.	Biomass boilers burn fuels, typically wood pellets, which are dried to a specific moisture content to get the highest efficiency possible. Boilers generally have similar efficiencies to gas condensing boilers but have much lower carbon emissions factors.	• Requires additional plant area for the biomass boiler. • Requires additional plant area for the careful, humidity-controlled storage of the fuel. • Requires significantly high level of constant maintenance to ensure continued performance.	Not Recommended for implementation in the scheme due to the additional plant space required for pellet storage, and the minimal efficiency benefit over gas condensing boilers.
9. Solar Thermal for hot water generation.	Solar Thermal systems heat water passing through solar collectors, usually in the form of roof mounted panels (similar in appearance to PV arrays). The hot water is stored in tanks and takes a significant time to heat compared to conventional gas-fired boilers.	• The large volume of stored hot water would require additional plant space within the building and would require an uplift to the building structure to support the additional weight.	Not Recommended for implementation in the scheme.
10. Voltage Optimisation to reduce electricity consumption.	Voltage Optimisation equipment lowers the voltage of the electrical installation from the supply provided by the distributor. Most electrical equipment can operate at a range of supply voltages and at the lower end of the voltage range, savings can be made on the electrical consumption.	• Minimal, requires integration with the electrical supply. • Minimal, requires additional plant space near the electrical distribution equipment.	Recommended for inclusion in the project.

4.1. Air Source Heat Pump (heating & cooling)

Air source heat pumps extract heat from the outside air to provide heat or coolth via refrigerant to internal space conditioning units. The refrigerant used in the systems is either a hot gas or cool liquid depending on whether the system operates in heating or cooling mode. Systems can be equipped with control boxes to enable different spaces to operate in heating or cooling simultaneously.

Typically systems operate using COP's in the range 4 for heating and 6 for cooling. Meaning for every kW of electrical input energy provided 4kW of heating or 6kW of cooling can be delivered.

Air source heat pumps provide an efficient method for delivering heating and cooling to the building. They are proposed to be used in the entrance and café area which has an extensive glazed façade which will contribute heatgains to the space and require cooling. The fitness and activity spaces are also proposed to be served by the VRF system as these will also require cooling due to high internal heatgains. The air source heat pump can also provide heating and cooling to various areas not suited to the proposed underfloor heating system for the building.

For this reason an air source heat pump is recommended for use on the project due to the cooling requirement and its ability to provide energy efficient heating.

4.2. Photovoltaic Panels

Photovoltaic panels generate electricity from the suns rays. The panels are roof mounted, either mounted on or integrated into the building structure.

Photovoltaics are most efficient when facing south-east and angled at 10° to achieve maximum perpendicular collection of the solar rays, and maximise efficiency. In addition, installing the panels at an angle helps avoid rainwater and dirt collection on the panels which reduces their efficiency.

The large areas of pitched roof above the main sports hall is an ideal location for a photovoltaic array. It is recommended for inclusion in the scheme to provide additional carbon savings.

A photovoltaic array with the following characteristics has been modelled:

Photovoltaic Array	
Element	Description
Array Size	150m²
Array pitch	30°
Orientation	135°

Photovoltaic Array	
Element	Description
Panel Efficiency	18%
Estimated Output	26.9MW/annum 32.8kWp

4.3. Voltage Optimisation

A Voltage optimiser reduces the voltage of the electrical distribution system within a building which in turn reduces the energy consumed.

Although the UK network distribution voltages are harmonised with the rest of Europe, the typical supply to a building is higher. Most equipment has an operating voltage range that is significantly lower than the supply voltages measured at the incoming meter point.

As an example, a basic lamp operating at 230V and not the typical 240V supplied, would reduce its energy consumption by 9% and extend its life by up to 45%.

The system is selected and designed to reduce the voltage from the incoming supply to ensure the voltage at the farthest end of a circuit is as low as possible to reduce energy consumption.

A voltage optimisation unit is recommended for this development.

5. Part L Certificate (BRUKL Report)

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Castle Farm recreational Centre

As designed

Date: Fri Jul 17 15:15:28 2020

Administrative information

Building Details

Address: Castle Farm, Recreational Centre, Warwick,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.0

BRUKL compliance check version: v5.6.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Andrew Parry

Telephone number: 01924 265757

Address: RCM Business Centres, Dewsbury Road, Ossett, Wakefield, WF5 9ND

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	63.5
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	63.5
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	58.6
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.18	0.18	External Wall
Floor	0.25	0.18	0.18	Ground Floor
Roof	0.25	0.15	0.15	Roof
Windows***, roof windows, and rooflights	2.2	1.59	1.7	Over Main Entrance Door - Glazing
Personnel doors	2.2	2.18	2.18	Solid Door - Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	1.62	1.63	Glazed Door - Door

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- VRF with Mech. vent (8 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.5	5.5	-	1.9	0.7
Standard value	2.5*	2.6	N/A	N/A	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

2- Mechanical Ventilation (23 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	0.95	0.7
Standard value	N/A	N/A	N/A	N/A	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

3- VRF with Nat. Vent (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.5	5.5	-	-	-
Standard value	2.5*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

4- Natural ventilation

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

5- Gas Heaters & Nat. Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.91	-	-	-	-
Standard value	0.86	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

6- LTHW with Mech. Vent. (9 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	-	1.9	0.7
Standard value	0.91*	N/A	N/A	N/A	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

7- LTHW with Mech. Vent. (8 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.96	-	-	0.95	0.7
Standard value	0.91*	N/A	N/A	N/A	0.65
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

8- VRF with Mech. Vent - Scouts (5 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.5	5.5	-	1.9	0.75
Standard value	2.5*	2.6	N/A	N/A	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

9- Extract Only (8 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	0.5	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.96	0
Standard value	0.8	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
00 Outdoor Change 1 - Changing 1	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Outdoor Cange 2 - Changing 2	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Outdoor Change 3 - Changing 3	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Outdoor chnage 4 - Changing 4	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Outdoor Chnage WC 1 - Toilet 1	-	-	-	1	-	-	-	-	-	-	N/A
00 Outdoor Change WC 2 - Toilet 2	-	-	-	1	-	-	-	-	-	-	N/A
00 Outdoor Change WC 3 - Toilet 3	-	-	-	1	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
00 Outdoor Change WC 4 - Toilet 4	-	-	-	1	-	-	-	-	-	-	N/A
00 Outdoor Store - Store 1	-	-	-	1	-	-	-	-	-	-	N/A
00 Acc WC 1 - Toilet 5	-	-	-	1	-	-	-	-	-	-	N/A
00 Acc WC 2 - Toilet 6	-	-	-	1	-	-	-	-	-	-	N/A
00 Acc WC 3 - Toilet 7	-	-	-	1	-	-	-	-	-	-	N/A
00 Cafe / Viewing - EatDrink 1	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Servery Store - Store 2	-	-	-	1	-	-	-	-	-	-	N/A
00 Store 1 - Store 3	-	-	-	1	-	-	-	-	-	-	N/A
00 Reception - Reception 1	-	-	-	1	-	-	-	-	-	-	N/A
00 Main Office - Office 1	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Store 2 - Store 5	-	-	-	1	-	-	-	-	-	-	N/A
00 Male Change - Changing 5	-	-	-	1	-	-	-	-	-	-	N/A
00 Female Change - Changing 6	-	-	-	1	-	-	-	-	-	-	N/A
00 Acc Change - Changing 7	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Male Change WC - Toilet 8	-	-	-	1	-	-	-	-	-	-	N/A
00 Female Change WC - Toilet 9	-	-	-	1	-	-	-	-	-	-	N/A
00 Acc WC 4 - Toilet 10	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Spin Studio - FitStud 1	-	-	-	1.9	-	-	-	-	-	-	N/A
01 Fitness Suite - FitGym 1	-	-	-	1.9	-	-	-	-	-	-	N/A
01 Meeting - Office 2	-	-	-	1.9	-	-	-	-	-	-	N/A
01 Male Change - Changing 8	-	-	-	1	-	-	-	-	-	-	N/A
01 Female Change - Changing 9	-	-	-	1	-	-	-	-	-	-	N/A
01 Acc Change - D2_Changing 10	-	-	-	1.9	-	-	-	-	-	-	N/A
01 Male Change WC - Toilet 11	-	-	-	1	-	-	-	-	-	-	N/A
01 Female Change WC - Toilet 12	-	-	-	1	-	-	-	-	-	-	N/A
01 Acc WC - Toilet 13	-	-	-	1.9	-	-	-	-	-	-	N/A
01 Staff Room - EatDrink 2	-	-	-	1.9	-	-	-	-	-	-	N/A
01 Managers - Office 3	-	-	-	1.9	-	-	-	-	-	-	N/A
01 Studio Store - Store 8	-	-	-	1	-	-	-	-	-	-	N/A
01 Multi Use Studio - FitStud 2	-	-	-	1.9	-	-	-	-	-	-	N/A
00 Activity Space - FitStud 3	-	-	-	1.9	-	-	-	-	-	-	N/A
Scout Hall 1 - FitStud 4	-	-	-	1.9	-	-	-	-	-	-	N/A
Scout Hall 2 - FitStud 5	-	-	-	1.9	-	-	-	-	-	-	N/A
Scout Hall 3 - FitStud 6	-	-	-	1.9	-	-	-	-	-	-	N/A
Scout Hall 4 - FitStud 7	-	-	-	1.9	-	-	-	-	-	-	N/A
Scout Hall 5 - FitStud 8	-	-	-	1.9	-	-	-	-	-	-	N/A
Scout WC 1 - Toilet 14	-	-	-	1	-	-	-	-	-	-	N/A
Scout WC 2 - Toilet 15	-	-	-	1	-	-	-	-	-	-	N/A
Scout WC 3 - Toilet 16	-	-	-	1	-	-	-	-	-	-	N/A
Scout WC 4 - Toilet 17	-	-	-	1	-	-	-	-	-	-	N/A
Scout WC 5 - Toilet 18	-	-	-	1	-	-	-	-	-	-	N/A
Scout WC 6 - Toilet 19	-	-	-	1	-	-	-	-	-	-	N/A
Scout WC 7 - Toilet 20	-	-	-	1	-	-	-	-	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Scout DDA Shower - Toilet 21	-	-	-	1	-	-	-	-	-	-	N/A
Scout Office - Office 4	-	-	-	1	-	-	-	-	-	-	N/A
Scout Meeting - Office 5	-	-	-	1	-	-	-	-	-	-	N/A
Scout Kitchen 1 - FoodPrep 2	-	-	0.5	-	-	-	-	-	-	-	N/A
Scout kitchen 2 - FoodPrep 3	-	-	0.5	-	-	-	-	-	-	-	N/A
Scout Store 1 - Store 9	-	-	0.5	-	-	-	-	-	-	-	N/A
Scout Store 2 - Store 10	-	-	0.5	-	-	-	-	-	-	-	N/A
Scout Store 3 - Store 11	-	-	0.5	-	-	-	-	-	-	-	N/A
Scout Store 4 - Store 12	-	-	0.5	-	-	-	-	-	-	-	N/A
Scout Store 5 - Store 13	-	-	0.5	-	-	-	-	-	-	-	N/A
Scout Cleaners - Store 15	-	-	0.5	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
00 Outdoor Change 1 - Changing 1	-	100	-	41
00 Outdoor Cange 2 - Changing 2	-	100	-	41
00 Outdoor Change 3 - Changing 3	-	100	-	41
00 Outdoor chnage 4 - Changing 4	-	100	-	40
00 Outdoor Chnage WC 1 - Toilet 1	-	100	-	17
00 Outdoor Change WC 2 - Toilet 2	-	100	-	18
00 Outdoor Change WC 3 - Toilet 3	-	100	-	18
00 Outdoor Change WC 4 - Toilet 4	-	100	-	18
00 Outdoor Change Corridor - Circulation 1	-	100	-	122
00 Outdoor Store - Store 1	100	-	-	5
00 Acc WC 1 - Toilet 5	-	100	-	23
00 Acc WC 2 - Toilet 6	-	100	-	23
00 Acc WC 3 - Toilet 7	-	100	-	22
00 Cafe / Viewing - EatDrink 1	-	100	-	388
00 Servery - FoodPrep 1	-	100	-	64
00 Servery Store - Store 2	100	-	-	8
00 Store 1 - Store 3	100	-	-	10
Escape Stair 1 - Circulation 2	-	100	-	80
00 Entrance Lobby - Circulation 3	-	100	-	42
00 Foyer - Circulation 4	-	100	-	205
00 Changing Corridor - Circulation 5	-	100	-	81
00 Reception - Reception 1	-	100	100	48
00 Main Office - Office 1	100	-	-	168
00 Store 2 - Store 5	100	-	-	6
00 Male Change - Changing 5	-	100	-	35
00 Female Change - Changing 6	-	100	-	34
00 Acc Change - Changing 7	-	100	-	26
00 Male Change WC - Toilet 8	-	100	-	53

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
00 Female Change WC - Toilet 9	-	100	-	54
00 Acc WC 4 - Toilet 10	-	100	-	27
00 Spin Studio - FitStud 1	-	100	-	354
00 Plant Room - Plant 1	100	-	-	483
00 Sports Hall Store 1 - Store 6	100	-	-	133
Sports Hall - DrySptHall 1	-	100	-	4403
Escape Stair 2 - Circulation 6	-	100	-	156
01 Fitness Suite - FitGym 1	-	100	-	936
01 Meeting - Office 2	100	-	-	146
IT Hub - 24HrMisc	100	-	-	13
01 Male Change - Changing 8	-	100	-	34
01 Female Change - Changing 9	-	100	-	34
01 Acc Change - D2_Changing 10	-	100	-	20
01 Male Change WC - Toilet 11	-	100	-	53
01 Female Change WC - Toilet 12	-	100	-	53
01 Acc WC - Toilet 13	-	100	-	27
01 Staff Room - EatDrink 2	-	100	-	37
01 Managers - Office 3	100	-	-	119
01 Studio Store - Store 8	100	-	-	23
01 Balcony - Circulation 7	-	100	-	143
01 Multi Use Studio - FitStud 2	-	100	-	478
00 Activity Space - FitStud 3	-	100	-	307
Scout Hall 1 - FitStud 4	-	100	-	207
Scout Hall 2 - FitStud 5	-	100	-	207
Scout Hall 3 - FitStud 6	-	100	-	209
Scout Hall 4 - FitStud 7	-	100	-	276
Scout Hall 5 - FitStud 8	-	100	-	252
Main Scout - Corridor - Circulation 8	-	100	-	233
Scout WC Corridor - Circulation 9	-	100	-	38
Roof Deck Access - Circulation 10	-	100	-	84
Scout WC 1 - Toilet 14	-	100	-	22
Scout WC 2 - Toilet 15	-	100	-	19
Scout WC 3 - Toilet 16	-	100	-	19
Scout WC 4 - Toilet 17	-	100	-	19
Scout WC 5 - Toilet 18	-	100	-	19
Scout WC 6 - Toilet 19	-	100	-	19
Scout WC 7 - Toilet 20	-	100	-	22
Scout DDA Shower - Toilet 21	-	100	-	26
Scout WC WHB's - Circulation 11	-	100	-	24
Scout Office - Office 4	100	-	-	72
Scout Meeting - Office 5	100	-	-	189
Scout Kitchen 1 - FoodPrep 2	-	100	-	179
Scout kitchen 2 - FoodPrep 3	-	100	-	167

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Scout Store 1 - Store 9	100	-	-	21
Scout Store 2 - Store 10	100	-	-	18
Scout Store 3 - Store 11	100	-	-	18
Scout Store 4 - Store 12	100	-	-	18
Scout Store 5 - Store 13	100	-	-	18
Scout Cleaners - Store 15	100	-	-	8
Sportshall Escape Corridor - Circulation 12	-	100	-	30

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
00 Cafe / Viewing - EatDrink 1	NO (-62%)	NO
00 Foyer - Circulation 4	YES (+222%)	NO
00 Reception - Reception 1	YES (+33%)	NO
00 Main Office - Office 1	N/A	N/A
00 Spin Studio - FitStud 1	NO (-78%)	NO
Sports Hall - DrySptHall 1	N/A	N/A
01 Fitness Suite - FitGym 1	YES (+1%)	NO
01 Meeting - Office 2	N/A	N/A
IT Hub - 24HrMisc	N/A	N/A
01 Staff Room - EatDrink 2	N/A	N/A
01 Managers - Office 3	N/A	N/A
01 Balcony - Circulation 7	NO (-46%)	NO
01 Multi Use Studio - FitStud 2	NO (-9%)	NO
00 Activity Space - FitStud 3	NO (-53%)	NO
Scout Hall 1 - FitStud 4	NO (-66%)	NO
Scout Hall 2 - FitStud 5	NO (-66%)	NO
Scout Hall 3 - FitStud 6	NO (-85%)	NO
Scout Hall 4 - FitStud 7	NO (-33%)	NO
Scout Hall 5 - FitStud 8	NO (-36%)	NO
Scout Office - Office 4	N/A	N/A
Scout Meeting - Office 5	N/A	N/A

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	3976	3976
External area [m^2]	8953	8953
Weather	BIR	BIR
Infiltration [m^3/hm^2@ 50Pa]	5	4
Average conductance [W/K]	2466	2903
Average U-value [W/m^2K]	0.28	0.32
Alpha value* [%]	5.55	5.55

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
100	**D2 General Assembly and Leisure, Night Clubs, and Theatres**
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	11.39	14.01
Cooling	1.46	2.33
Auxiliary	15.51	9.21
Lighting	11.82	14
Hot water	197.77	215.12
Equipment*	37.24	37.24
TOTAL**	**237.96**	**254.67**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	6.77	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	85.18	85.25
Primary energy* [kWh/m^2]	355.91	357.88
Total emissions [kg/m^2]	58.6	63.5

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance										
System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	14.9	40	0.9	2	40.2	4.5	5.5	4.5	5.5
	Notional	7.9	57.9	0.9	4.5	19.7	2.43	3.6	----	----
[ST] No Heating or Cooling										
	Actual	50.7	0	14.3	0	6.2	0.98	0	0.99	0
	Notional	34.5	0	11.7	0	9.8	0.82	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	16.7	291.7	1	14.7	0	4.5	5.5	4.5	5.5
	Notional	0	243.4	0	18.8	0	0	3.6	----	----
[ST] No Heating or Cooling										
	Actual	186.2	0	51.7	0	0	1	0	1	0
	Notional	143.4	0	48.7	0	0	0.82	0	----	----
[ST] Other local room heater - unfanned, [HS] Radiant heater, [HFT] Natural Gas, [CFT] Electricity										
	Actual	58.4	0	17.8	0	0	0.91	0	0.91	0
	Notional	84.8	0	27.4	0	0	0.86	0	----	----
[ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	27	0	8	0	13	0.94	0	0.96	0
	Notional	8.4	0	2.9	0	13.4	0.82	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	17.7	27.8	1.1	1.4	25.4	4.5	5.5	4.5	5.5
	Notional	12.9	16.1	1.5	1.2	18.9	2.43	3.6	----	----
[ST] No Heating or Cooling										
	Actual	271.3	0	75.4	0	25.5	1	0	1	0
	Notional	281	0	95.3	0	20.4	0.82	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.18	External Wall
Floor	0.2	0.18	Ground Floor
Roof	0.15	0.15	Roof
Windows, roof windows, and rooflights	1.5	1.57	Front Scout Glazing - Glazing
Personnel doors	1.5	2.18	Solid Door - Door
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	1.61	Main Entrance Door - Door

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	5