Thorpe Astley Community Centre

Heat Loss Calculation

Location: Lakin Drive, Leicester LE3 3RU

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A	24/03/2022	L Bishop	First Issue

1 Executive Summary

A heat loss calculation has been carried out to ascertain the heat demand of Thorpe Astley Community Centre in Leicester. An air source heat pump is proposed for the site to replace the current gas fired boilers and hot water calorifier. The heat loss calculation can be used to select the heat pump for the building.

This report describes the process used to arrive at the peak and annual heat demand figures:

- The calculated peak demand for the community centre is 20.36kW
- The calculated annual space heating demand has been calculated as 43,606kWh.
- The estimated annual domestic hot water demand is 9,537kWh

Notes on U values, room dimensions, temperatures and ventilation rates been included within the report.

2 Introduction

Thorpe Astley Community Centre was built in 2009. The building comprises large reception area, hall and activity rooms for playgroup and private hire, 3 doctors' surgeries, changing rooms and WCs, office and storerooms. A building layout can be seen in Figure 1.

Figure 1 Building layout

2.1 Site Visit

Laura Bishop of Infinitas Design Ltd visited the community centre on 18th March 2022. She was accompanied by Lydia Assi, Resources & Facilities Manager for Braunstone Town Council. A member of the maintenance team was also in attendance.

2.2 References

No drawings for the building are available. Room dimensions were taken during the survey.

No U values or air change rates have been provided for the building.

U values meeting 2010 Part L building regulations have been assumed. See Section 4.1.

Air change rates (ACH) are taken from CIBSE Guide B Table 1.20. See Section 4.4.

Operating temperatures are based on CIBSE Domestic Heating Design Guide 2020-01 Table 3.7.

2.3 Report Purpose

This report has been created to summarise the heat loss calculations carried out on the building to ascertain the peak and annual demand at the community centre. Some notes from the survey are included for future reference.

3 Building and Plant Description

The community centre was built in 2009.

Space heating is delivered via underfloor heating throughout the building. A small air handler delivers tempered air to the changing rooms, WCs and doctors' surgery. Hot water demand extends to hand basins in the WCs, doctors' surgeries and kitchen sink. There are also 8 showers in the changing rooms and 1 shower in the disabled WC.

Figure 2 – Entrance to and side view of community centre

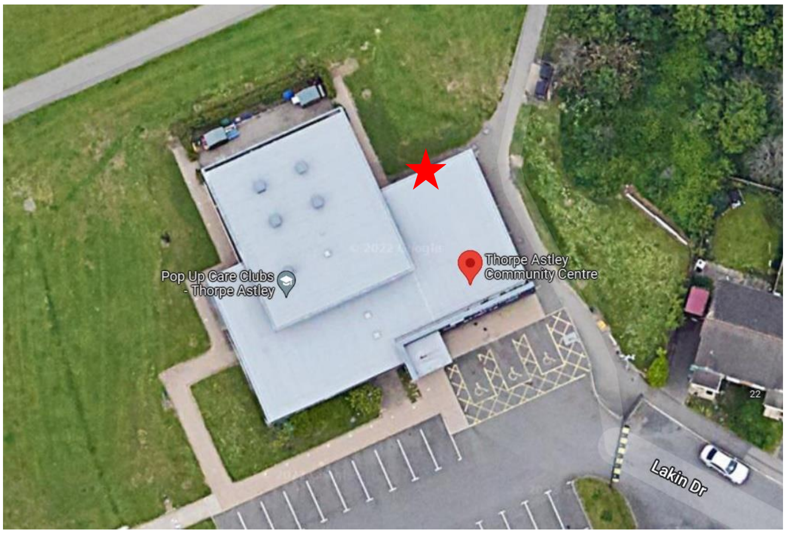

Figure 3 – Parklands satellite image provided by Pearce Property Partnership Ltd. Plant room starred.

The single plant room houses the following plant:

- 1no gas-fired Ethos 45 SD boiler, which provides heating to two circuits – underfloor heating circuit and the air handler. The boiler is rated at 41kW at 80/60°C flow/return.
- 1no gas-fired Ethos 54C boiler, which provides heat to the attached Mikrofill 300l hot water cylinder
- 1no direct hot water cylinder with immersion heater. Immersion capacity unknown. Cylinder is located on mezzanine floor above the boilers.

The reason for the two types of hot water generator is that there were a lot of problems obtaining parts for the boiler. A back up electric cylinder was put in to ensure there was always hot water, especially in the doctors' surgeries.

The heating circulaiton pumps in the plant room are Grundfos UPSD pumps with no variable speed drives. It is recommended that these are reviewed and possibly replaced with high efficiency VSDs when the heat pump is installed.

There is no zoning on the heating side in the plant room so it is assumed that a standard (unknown) temperature is delivered into each circuit. There is a mixing valve at each underfloor heating manifold to allow temperatures to be adjusted locally. Only two manifolds were seen during the visit.

4 Heat Loss Calculation

4.1 U Values

The following U values have been used in the heat loss calculations.

Table 1 U values used in the heat loss calculations based on Part L 2010 limiting fabric U values

	U, $W/m^2.K$
External wall	0.3
Ceiling	0.2
Window/Door	2.0
Internal Wall	0.2
Floor	P/A formula used

Ground floor U values are complex to calculate and cannot be achieved in the same way for other U values. Thermal transmission varies according to the shape of the room and the exposed edge proportion. The following formula has been used for each room to calculate the individual heat loss in the room.

$$U = 0.05 + [1.65*(P/A))] – [0.6*(P/A)^2]$$

Where U is the uninsulated irregular floor U value in W/m2.K

P = length of exposed perimeter in m

A is the area of the floor in m2

In the calculations, the entire perimeter of each floor has been assumed as exposed.

4.2 Temperatures

The following ambient and internal temperatures have been used.

External temperature for t_{eo} Lat 52-54°N = -3°C

Internal desired temperature upper & lower floor = 20°C

Ground reference temperature for t_{eo} Lat 52-54°N = 6.5°C

Note that it has been assumed that the entire building is kept at the same temperature so there is no heat loss/gain between individual rooms.

4.3 Area and Volume

Each room was measured during the site survey. Windows and doors were also measured, and these measurements were used directly in the room-by-room heat loss calculation.

4.4 Air Change Rate

Ventilation heat loss is directly related to air change rate, volume and internal/external dT. The air change rate has not been provided but the figures in CIBSE Guide B Table 1.20 have been used as follows:

Table 2 Air change rates used

	Air change rate ACH
Offices, private	1
Sports pavillion changing rooms	1
Schools studios	1
Gymnasia	0.75
Canteens and dining rooms	1
WC	1.5*

*Table 3.8 CIBSE Domestic Heating Design Guide used

5 Heat Loss Results

The calculation used for each element of heat loss is:

- Heat loss Q_F = U.A.dT kW

The calculation used for ventilation heat loss is:

- Heat loss Q_V = 0.33.ACH.V.dT kW

Total heat loss Q = Q_F + Q_V, kW

The peak heat loss for the community centre at design conditions set out above is **20.36kW**.

5.1 Impact of Increased Internal Temperature

If there is a requirement to operate the internals at 21°C instead of 20°C, the peak demand increases to 21.41kW.

6 Annual Heat Demand

Heating degree days (HDD) for East Midlands airport have been used to estimate the annual heat demand in the building. Over 20 years, the average HDD was 2,142. Multiplying the peak heat demand by the average HDD provides an annual estimated heat demand of **43,606kWh.**

The current gas bills are estimated at the community centre. This should be rectified to actual bills as soon as possible. It is not possible to check the calculations against actual gas consumption.

6.1 Annual DHW Demand

The community centre has the following hot water outlets:

Table 3 DHW outlets

	Qty	Estimated flow rate l/s
Kitchen sink	1	0.2
Hand basin	12	0.08
Shower	9	0.08
Cleaners sink	1	0.2

Rules of thumb have been used to arrive at an estimated annual DHW demand, which should be added to the heating demand as follows:

- Annual DHW demand = 9,537kWh
- Total heat & hot water demand = **53,143kWh**

Rules of thumb used were:

- Start temperature 10°C
- End temperature 50°C
- 5 minutes per day per sink/hand basin/shower
- 10 minutes per day for the cleaners sink
- Flow rates as per Table 3 from Table 14 Plumbing Engineering Services Design Guide

7 Conclusion

An air source heat pump with capacity ~25kW at correct design conditions should be selected for the community centre.

The annual heating and hot water demand is estimated at 53,143kWh.

Further design work is required to specify plant room fitout and equipment selection including hot water generation.