



Wrexham Association

Football Club

Kop Development

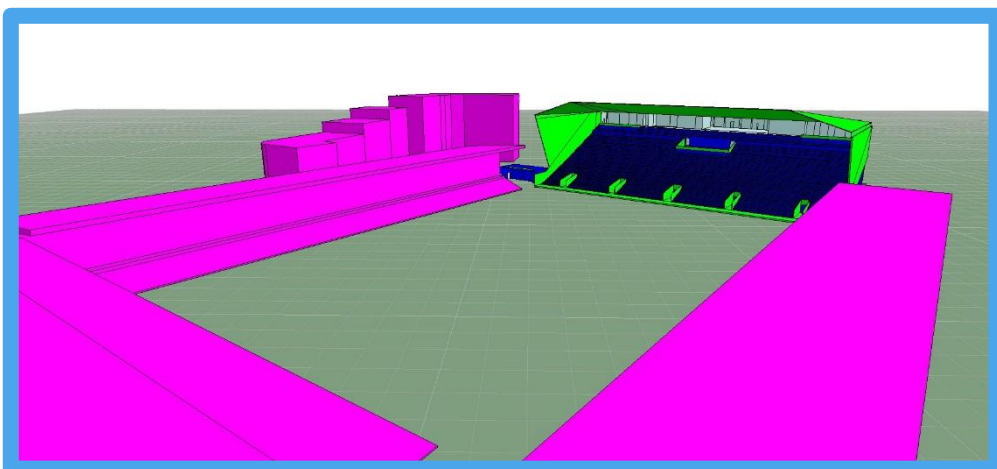
Energy Statement

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WREXHAM ASSOCIATION FOOTBALL CLUB KOP DEVELOPMENT ENERGY STATEMENT



KOP DEVELOPMENT

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1. EXECUTIVE SUMMARY

This Energy Statement has been prepared in support of the planning application for the proposed development of the new KOP Stand for Wrexham Association Football Club (WAFC) to demonstrate compliance with the planning policy requirements of Wrexham County Borough Council.

For the planning element of the application, comprising the replacement of the existing KOP Stand, the Energy Statement illustrates that energy efficiency and carbon reduction have been considered in accordance with the planning policy. The carbon dioxide (CO₂) emissions reduction over a Building Regulations compliant baseline delivered by the proposed carbon efficient energy strategy.

Energy – Part L2A 2014 Wales

- Fabric first approach with improved U-values and fabric specification, reducing energy demand for the new stand
- Mechanical ventilation with heat recovery (MVHR)
- Low energy LED lighting design and lighting controls
- Efficient heating, cooling and hot water systems to help further reduce energy demand

The results show that the proposed development meets the above planning and regulatory requirements through on-site measures. Where applicable, recommendations are made to mitigate against the long-term impacts of climate change on energy demand and occupant comfort and to allow further CO₂ emissions reductions to be realised in the future.

The adoption of the measures detailed above and within this report result in:

- A CO₂ emissions reduction over a Building Regulations compliant TER of 13.2% for the proposed new KOP stand
- The below table quantifies the total energy and CO₂ emissions for building regulated energy as per the Part L2A calculation.

Table 1 – Results Summary – KOP development

Description	TER (kgCO ₂ /m ² .yr)	BER (kgCO ₂ /m ² .yr)	Improvement over baseline (%)	TPEC (kWh/m ² .yr)	BPEC (kWh/m ² .yr)
KOP development	22.7	20.1	11.5	105.03	99.3

2. INTRODUCTION

This Energy Statement will be included as part of the planning application that addresses the environmental impact of the development. This report focuses on the energy strategy for the proposed new KOP stand development and how energy consumption and carbon emissions will be minimised and meet the targeted carbon emissions in accordance with the local planning policy.

This development will replace the existing KOP Stand with a new state of the art stand at the Racecourse Ground, located in north-west Wrexham, Wales. The proposed new stand will provide seating for approx. 5000 fans on matchdays and consist of a large ground level concourse/exhibition area, along with hospitality facilities and office/retail spaces. This report is intended to demonstrate that energy savings and sustainable design has been considered in accordance with planning policy for this development. Sustainable design in the built environment is a three-stage hierarchical process and this report looks briefly at all three stages which must be continuously considered throughout the design process.

Table 2 – Three-stage hierarchical process

Passive Design (Be Lean)	Reduce Energy Demand – The team should first seek to design out excess energy requirements by optimising certain design elements of the building. These could include better fabric performance, reduced infiltration, solar shading, solar control devices to reduce cooling and where applicable the use of natural ventilation. This reduction in demand will result in a reduction of fuel use but may also mean smaller plant items required resulting in a greater cost saving.
Energy Efficiency (Be Clean)	Reduce Energy Consumption – The building services design should incorporate efficient heat and coolth generation systems, insulated distribution systems and adequately effective system controls; electrical lighting efficacy and control should also be designed for efficient usage. The remaining energy requirements will then be quantified to analyse the most appropriate renewable energy system for the project.
Low and Zero Carbon Technology (Be Green)	Provide Renewable Energy – The most suitable LZC technologies are selected and appraised for their likely contribution to the project. The aim is to maximise the amount of renewable energy utilisation for the project within a cost-effective manner. A summary will outline those that should be rejected and those that should be considered further during the more detailed stages of the design process.

2.1 Site Location

The site is in north-west Wrexham, Wales, which is a suburban location for this site. The stadium shares a boundary with the university campus to the north and general residential areas to the south and east. The site location is shown in figure 1.

For this non-domestic building, the TRY weather file is most appropriate for conducting energy studies and therefore the Cardiff TRY05.fwt weather file was used to carry out the energy compliance calculation, in accordance with Part L2 (2014 Wales) of the building regulations.

From the energy assessment for the development, an estimate for the predicted energy consumption and associated carbon emissions is documented.

3. PLANNING REQUIREMENTS

National and local planning policy guidance considered relevant to the principle of this development is set out in this section.

3.1 National Planning Policy

The Planning Policy Wales 11 (PPW 11) was designed to ensure that developments are designed and constructed with sustainability at the forefront. It aims to encourage sustainable developments through consideration of social, economic, environmental, and cultural wellbeing. The areas of PPW 11 that influence this report are:

Section 3.7 - Environmental Sustainability:

“Good design promotes environmental sustainability and contributes to the achievement of the well-being goals. Developments should seek to maximise energy efficiency and the efficient use of other resources (including land), maximise sustainable movement, minimise the use of non-renewable resources, encourage decarbonisation and prevent the generation of waste and pollution. An integrated and flexible approach to design, including early decisions regarding location, density, layout, built form, the choice of materials, the adaptability of buildings and site treatment will be an appropriate way of contributing to resilient development.”

Section 6 - Distinctive and Natural Places, Distinctive and Natural Placemaking and Well-being, Well-being of Future Generations Act, A Prosperous Wales, this section discusses the future proofing of Welsh economic assets in response to the challenges presented by climate change and providing clean air and water through the use of on-site measures.

3.2 Local Planning Policy

Wrexham County Borough Council have set out a Unitary Development Plan (1996 – 2011, Adopted Feb 2005) to adhere to for planning permission. It aims to outline the council's intention for development in the area and provide a framework for specific policies and proposals. The following excerpt should be considered during the design of the buildings: Policy GDP1 - Make the best use of design techniques, siting and orientation in order to conserve energy and water resources.

3.3 Building Regulations, Part L2A (2014 Wales)

Building Regulations Approved Document Part L2A sets out the energy efficiency standards, aimed at the conservation of fuel and power in non-domestic developments. It controls the minimum fabric specifications, the allowable area of windows, doors and other openings, air permeability of the structure, the efficiency and delivery strategy of all building services within the developments and controls for heating & cooling appliances, domestic hot water storage and lighting efficiency. The regulations further help determine the type/scale of low or zero carbon technologies (LZCGT) and the results of compliance simulations can contribute to this element of the design. Any new development must achieve compliance in accordance with the standards set out in the document.

4. NON-DOMESTIC ENERGY ASSESSMENT

Energy and carbon savings for the proposed development follow the hierarchical approach below. The proposed new stand development has an approximate treated floor area of 5511 m².

- Lean: Maximise passive design to minimise energy usage, greatest return on investment
- Clean: Ensure any technologies added into the building are efficient, well designed and efficient
- Green: Once building is made passively efficient, less renewables are required to achieve the required energy benchmark. Which reduces capital cost as renewable are the most costly

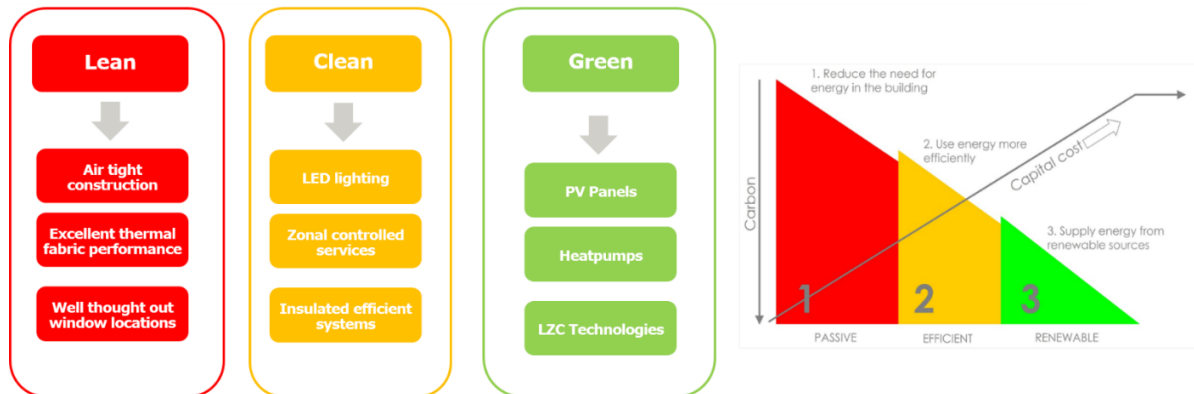


Figure 2 – Hierarchical approach

The thermal modelling work has been carried out using the Virtual Environment (VE) dynamic simulation modelling (DSM) tool developed by Integrated Environmental Solutions Ltd (IES Ltd) in accordance with CIBSE AM11 “Building Energy and Environment Modelling”.

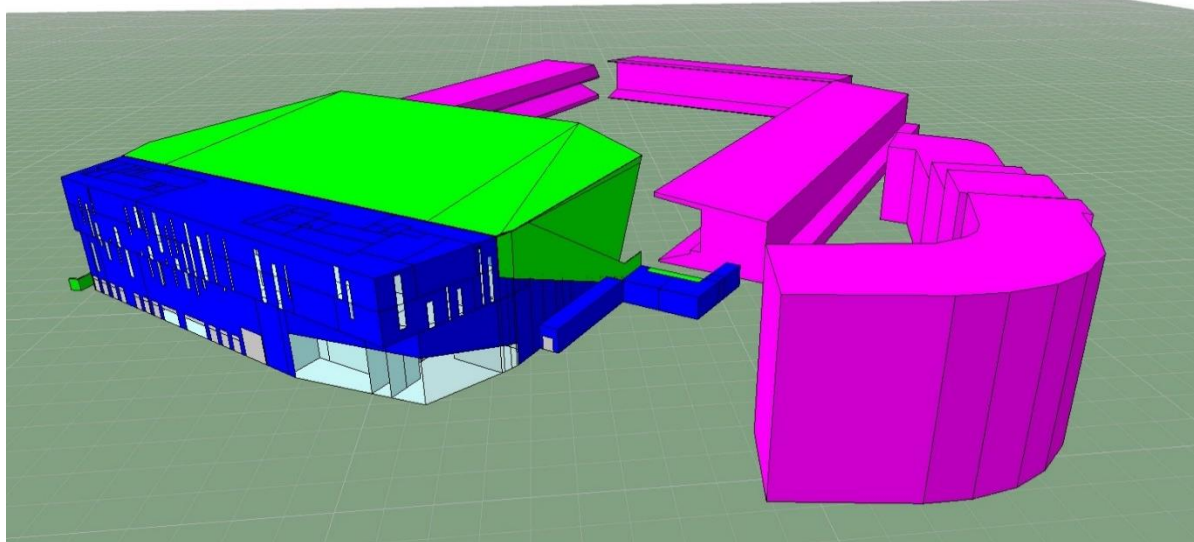


Figure 3 – KOP Stand development thermal model

The calculations have been carried out by a thermal modelling engineer who is a member of the Chartered Institute of Building Services Engineers (CIBSE) and an accredited Low Carbon Energy Assessor (LCEA). The author has substantial previous experience in undertaking assessments of LZC technologies within the non-domestic buildings sector.

The tool has been used to calculate compliance with Part L2A (2014 Wales) and to demonstrate energy and carbon emissions reduction achievable through designing a low carbon services strategy.

4.1 Fabric Performance and Air Tightness

As part of the energy hierarchy, the first stage is to introduce demand reduction measures. Reducing energy demand determines a more cost-effective means of achieving carbon savings and have greater longevity. Passive design measures should be applied to the proposed development to minimise energy demand and therefore improve energy performance of the development. Careful consideration of the building fabric insulation levels and air infiltration rates could help to further reduce the requirement for space heating.

The proposed U-values (refer to section 5.1) are generally in line with the current notional building specification outlined in the Welsh building regulations and therefore an opportunity to further improve, in consultation with the architect. The air permeability for this project has been targeted at **10m³/m².h@50Pa**, this is the minimum allowable air infiltration for a new building.

4.2 Clean Energy Efficient Measures

The proposed development incorporates clean and energy efficiency measures to achieve compliance with the Part L2A requirement. Further design enhancements (other than described above) have been applied:

- Mechanical Ventilation with Heat Recovery (MVHR)
- Low energy LED lighting design and lighting controls
- Efficient heating, cooling and hot water systems to help further reduce energy demand

MVHR complements the fabric first approach as heat that would normally be lost through the opening of windows is recovered through the ventilation system and therefore the reclaim of heat leads to improved energy performance. MVHR systems provide controlled ventilation with slow but constant air movements in contrast to natural ventilation (i.e. trickle vents). Besides the energy savings, MVHR systems have other benefits and reasons for its implementation:

- MVHR systems promote excellent indoor air quality with continuous fresh air intake.
- Filtered air: pollen filters are a great advantage for people with allergies
- Reduced outside noise pollution

The heating and cooling infrastructure for the proposed development has been considered in accordance with the planning policy. It is proposed that the development would incorporate a high efficiency Variable Refrigerant Flow (VRF) system for the heating and cooling demand. The system will distribute heating and cooling to the occupied rooms with minimal distribution losses. The hot water is proposed to be provided through a carbon efficient air source heat pump (ASHP) system through low temperature hot water (LTHW) distribution.

The M&E consultant for the development may investigate further to design in connections to a proposed future network. A site-wide heat network has not been considered at this stage.

4.3 Low or Zero Carbon Generating Technologies (LZCGT)

The proposed development has considered a number of renewable energy technologies for this development. A feasibility study has been undertaken to determine the most appropriate renewable energy technologies for the development and is summarised in the table below:

Table 3 – LZC Feasibility

Technology	Appropriate	Comments
Biomass heating, cooling and electricity	NO	The site lies within a suburban area with little opportunity to build appropriate fuel storage and also there is a lack of local fuel source
Renewable energy from waste	NO	No capability to generate on-site electricity from waste and may present potential local air quality issues.
Solar Photovoltaics	YES	There is suitable roof space and no obvious shading from nearby buildings however will require to be further investigated as the design progresses.
Wind	NO	Building-integrated wind turbines perform poorly due to unfavourable wind microclimate and present a structural issue for the building.
CHP	NO	CHP are suited for buildings with a significant base load of heat and electricity. CHP are most efficient when running in continuous operation and therefore not ideal for this type of development.
Heat Pumps	YES	Suitable for this type of development and being applied, however requires further investigation and cost analysis
District Heating	NO	Whilst the Future Wales plan identifies Wrexham as an area suitable for town/city District Heat Network. Should there be development of a DHN in the locality of the stadium, connection could be assessed. However, we are not currently aware of any plans to implement a DHN infrastructure near to the site.

Further information on the suitable LZC technologies is provided below.

4.3.1 Photovoltaic Cells

PV panels can be utilised to offer a practical solution to offsetting any energy used by the development to achieve “Low or Zero Carbon” status.

Photovoltaic (PV) cells convert the sun’s light energy into electricity. Silicon-based cells are electrically joined together to form modules, which are constructed by laminating the cells to protect the surfaces.

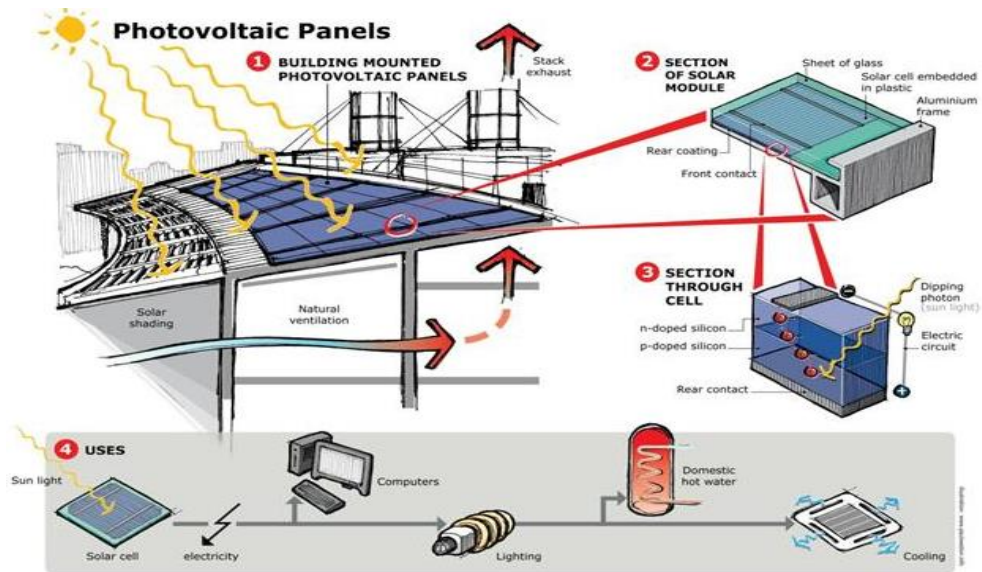


Figure 4: PV Panel diagram

Cables connect PV modules with an inverter (which converts direct current electricity into alternating current – as is used by normal appliances). PV modules are rated by the power they generate – kilowatt hour peak (kWp). Types of PV fall into categories which include: mono-crystalline, polycrystalline, amorphous and hybrid. The differences between each type relate to the construction and energy efficiencies, with Hybrid PVs tending to be the most energy efficient.

The various types of PV systems can be configured to provide electrical power which can be used on site. PV systems generally come in modules with each module providing a peak electrical output, multiple modules can be mounted to form a complete system with the desired output requirement. A PV system connected to the grid requires protection equipment to disconnect the system in the case of grid voltage frequency fluctuations or in the case of loss of mains grid supply.

PV modules can be fixed to a sub framework mounted above the roof covering. Equally, this system is easily retrofitted to existing roofs and incorporated above new roofs. The advantage of this type of system is that the equipment minimises the visual impact and acts as additional weather and UV radiation protection to the roof covering (which will reduce the required mechanical cooling loads as the solar energy is turned to electricity, rather than heat energy which then transfers to internal spaces).

The development is applying an electrically fuelled services strategy and therefore a solar PV solution would complement this approach. At this stage of design, a solar PV system has not been selected as it is not required to achieve compliance with the local building regulations, however, can be implemented at a later stage by the design team.

4.3.2 Air Source Heat Pump

Air Source Heat Pumps are a technology that transports low-grade energy and converts it into useful heating energy. The image below illustrates an air to refrigerant heat pump system, linking an outdoor 'heat pump' inverter unit and indoor fan coil units.

The Air Source Heat Pump is a common solution to provide heating and cooling.



Figure 5: Typical ASHP Arrangement

The heat pump system consists of an external condenser/invertor unit, internal fan coil units and adjoining refrigerant pipework. There will be auxiliary controls with these items as well as condensate drainage pipework and pumps. The main plant items are shown in the image above.

The noise from air source heat pumps is significant but can be attenuated by acoustic screens. This is common practice and deals with any residual noise complaints effectively. The external units are normally contained in locations which are not sensitive to noise, such as the roof.

In this development the proposal is to use a ASHP system to provide the domestic hot water for the building. The system will generate hot water up to 90 degrees without the use of an electric immersion heater. The coefficient of performance (COP) for this system can be advantageous and supports the carbon reduction strategy for the development. This is an ideal solution for a commercial development such as this.

4.3.3 LZCT Summary

In summary, for this development, further use of LZCT is not required to achieve compliance with the planning requirements. The use of an improved fabric specification and carbon efficient heating, cooling and hot water system is sufficient to achieve compliance with the Part L2A requirements. The above suitable technologies can be considered at a later design stage to further improve the carbon credentials of the development.

5. PART L2 ANALYSIS

5.1 Fabric Assumptions

The U-values

Category	U-Value (W/m ² K)	G-Value
Roof	0.18	N/A
Ground Floor	0.22	N/A
External Wall	0.26	N/A
External Window (H only)	1.60	0.40
External Window (H&C)	1.80	0.40
Door	2.20	N/A
High Usage Entrance Door	3.50	N/A

5.2 Mechanical Services

Usage	Ventilation Strategy	Heating/Cooling Strategy
Offices/Meeting Rooms/Hospitality	Mechanical Ventilation with heat recovery	VRF
Concourse	Natural ventilation	Minimal background heating
Kitchen	Mechanical Ventilation with heat recovery	VRF
WC's (Office and Hospitality)	Mechanical Ventilation with heat recovery	VRF
WC's (Concourse)	Mechanical Ventilation (extract only)	Minimal background heating
Club Shop	Mechanical Ventilation with heat recovery	VRF

The efficiencies of the main energy using plant are as follows:

Ventilation Type	SFP (W/l/s)
Mechanical Ventilation with heat recovery (Offices/Meeting Rooms/Hospitality)	1.0
Mechanical Ventilation with heat recovery (Kitchen)	1.0
Mechanical Ventilation with heat recovery (WCs for Offices/Hospitality)	1.2
Mechanical Ventilation with heat recovery (Club Shop)	1.2
Mechanical Extract Ventilation (WCs for Concourse/Exhibition area)	0.5

5.3 Electrical Service

The provisional electrical design was developed promoting the use of energy efficient building services equipment. Energy efficient lighting has been specified for all areas of the building (at a standard better than the notional targets).

The supplied design information is as follows:

- Electric Power Factor Correction is proposed for the building: YES >0.95
- Lighting System: LED fittings

- Lighting Luminaire efficacy: minimum of 90-110lm/cW
- Lighting system has provision for metering: NO
- Lighting system warns out of range values: NO
- Lighting Controls:
 - Presence Detection (PIR sensors): Offices, WCs and Circulation Areas
 - Absence detection with manual switch: Meeting Rooms and Stores
 - Manual controls: In all other areas

Assumed Lighting Power densities and Controls are shown in the table below:

Room Type	Lighting Efficacy (lm/cW)
Plant Rooms, Stores	90
Offices, Meeting Rooms, Hospitality Lounge, Club Shop, Concourse/Exhibition area, Kitchen, Circulation areas	100
WCs, Changing areas	110

5.4 Results

The energy demand and associated CO₂ emissions have been estimated from the initial building layout and through an initial Part L2A compliance calculation. The Part L2A calculation is based upon the initial development design and is used as a guideline to assess the percentage of the building's total CO₂ emissions that can be potentially reduced or offset by applying different passive design solutions and the proposed services strategy. The energy demand figures should be continually reviewed as the design progresses.

The below table quantifies the total energy and CO₂ emissions for building regulated energy as per the Part L2A calculation.

Table 4 – Baseline Results Summary – KOP development

Description	TER (kgCO ₂ /m ² .yr)	BER (kgCO ₂ /m ² .yr)	Improvement over baseline (%)	TPEC (kWhr/m ² .yr)	BPEC (kWhr/m ² .yr)
KOP development	22.7	20.1	11.5	105.03	99.3

Technical Data Sheet (Actual vs. Notional Building)					
Building Global Parameters			Building Use		
	Actual	Notional	% Area	Building Type	
Area [m ²]	5526.8	5526.8		A1/A2 Retail/Financial and Professional services	
External area [m ²]	11943.4	11943.4		A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways	
Weather	CAR	CAR	2	B1 Offices and Workshop businesses	
Infiltration [m ³ /hm ² @ 50Pa]	10	4		B2 to B7 General Industrial and Special Industrial Groups	
Average conductance [W/K]	3843.07	4081.74		B8 Storage or Distribution	
Average U-value [W/m ² K]	0.32	0.34		C1 Hotels	
Alpha value* [%]	10.46	10		C2 Residential Institutions: Hospitals and Care Homes	
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging				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	
			98	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	6.42	7.85
Cooling	1.68	3.15
Auxiliary	6.11	5.14
Lighting	20.94	27.11
Hot water	4.32	7.12
Equipment*	35.28	35.28
TOTAL**	39.47	50.37
* 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	0	6.36
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]	81.87	80.47
Primary energy* [kWh/m ²]	99.3	105.03
Total emissions [kg/m ²]	20.1	22.7
* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.		

Figure 6 – BRUKL Energy Summary

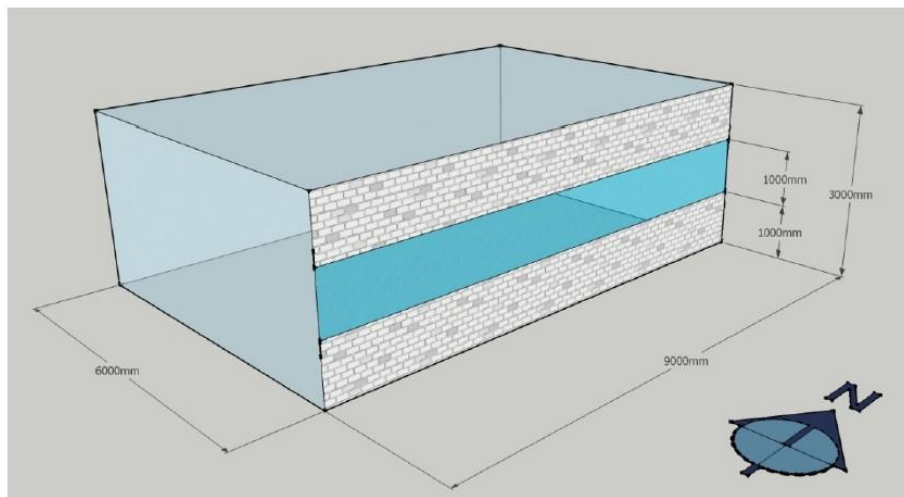
Reasonable provision should be made to limit overheating in this building from solar and other heat gains during the summer months, to comply with the Building Regulations. Criterion 3 is a section within the BRUKL report that applies to all buildings, irrespective of whether they are air conditioned or not. The solar gains to spaces should not exceed the reference glazing systems outlined within the Welsh building regulations.

The BRUKL report indicates that three spaces at the main entrance (club shop, hospitality entrance and tickets office), where there is a large amount of feature glazing, fail to meet Criterion 3.

With this in mind, we would like to note that the building is being compared against a solar gain limit equivalent to glazing just 1m in height, as shown below:

Figure 7 – Extract from NCM Modelling Guide

Figure 1 Isometric view of standard test-space for benchmark glazing type 1



While the development could propose this limited amount of glazing to allow it to meet Criterion 3 in these spaces, it would stray significantly from the architectural vision for the development, and the overall impact to fan's experience.

In order to maintain the architectural merits, while ensuring energy consumption and occupant wellbeing are preserved, the following passive design measures have been implemented:

- The spaces above the entrance form an overhang which will function as a shade for the rooms in question, blocking detrimental energy from the high angle sun, lowering cooling energy consumption and overheating risk.
- The proposed glazing specification has a g-value of 0.4. This low g-value will further minimise the effect solar gains will have on the spaces in question.

It is also considered that the hospitality entrance is a transient space where people move freely through and will not be situated for long periods, therefore the effects of potential higher temperatures in this space will be of low impact to occupants.

To ensure occupant comfort to the club shop and tickets office, where there will be higher occupancy periods, they will be provided with mechanical cooling via a VRF system, to combat the increased solar gains.

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?
L00: Acc WC	N/A	N/A
L00: Acc WC	N/A	N/A
L00: Acc WC	N/A	N/A
L00: Beer Wall	N/A	N/A
L00: Club Shop	YES (+52.4%)	NO
L00: Community Classroom	NO (-36.8%)	NO
L00: Concourse/Exhibition	NO (-36.6%)	NO
L00: Female WC	N/A	N/A
L00: Hospitality Entrance	YES (+181.9%)	NO
L00: Kiosk	NO (-83.2%)	NO
L00: Kiosk	N/A	N/A
L00: Kiosk	N/A	N/A
L00: Kiosk	N/A	N/A
L00: Kiosk	N/A	N/A
L00: Male WC	N/A	N/A
L00: Male WC	N/A	N/A
L00: Office	N/A	N/A
L00: Tickets	YES (+54.6%)	NO
L00: WC	N/A	N/A
L01: Community Use	NO (-76.5%)	NO
L01: D WC	N/A	N/A
L01: D WC	N/A	N/A
L01: Female WC	N/A	N/A
L01: Male WC	N/A	N/A
L01: Meeting Room 2	N/A	N/A
L01: Meeting Room 2	N/A	N/A
L01: Office	N/A	N/A
L01: Office	N/A	N/A
L01: Office	N/A	N/A
L01: Office	NO (-53.4%)	NO
L01: Office Entrance	N/A	N/A
L01: Offices	NO (-54.1%)	NO
L01: Reception	N/A	N/A
L01: Tea Room	N/A	N/A
L02: Bar	NO (-99.9%)	NO
L02: D WC	N/A	N/A
L02: D WC	N/A	N/A
L02: Female WC	N/A	N/A
L02: Hospitality Lounge	NO (-57.4%)	NO
L02: Kitchen	NO (-81.1%)	NO
L02: Male WC	N/A	N/A

Figure 8 – BRUKL Criterion 3

6. CONCLUSION

The assessments completed for this proposed KOP stand development confirm compliance with the below:

- Part L2A (2014 Wales) requirements of the building regulations

The proposed development meets the planning requirements by implementing a well performing fabric specification and carbon efficient services solution as outlined in this report. It is anticipated that further detailed energy assessments will be produced at building warrant stage and will further inform the energy credentials for the building.