BREEAM ENE04 : PASSIVE DESIGN REPORT

AT

BIRDWORLD (PLAY BARN)
FARNHAM ROAD
HOLT POUND
GU10 4LD

FOR

BIRDWORLD LTD & HASKINS GARDEN CENTRES LTD

JANUARY 2024

DOCUMENT REVISION RECORD

Original Document

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1 EXECUTIVE SUMMARY

This analysis has been commissioned by the Client to verify the claim for points in compliance with the schedule of evidence required under the Energy Section (Credit Ene 04 Low Carbon Design: Passive Design) of BREEAM UK New Construction (2023).

Based on the modelling conducted, the results show that the proposed Birdworld Entrance Building meets the criteria with a 11% reduction in building CO_2 emission rate (BER) for the proposed building over the standard notional building. These results show that the passive design criteria as set out by BREEAM UK New Construction (2023) under the Energy Section (Credit Ene 04 Low Carbon Design: Passive Design) has been satisfied.

At the early design stage, the design team carried out a passive design analysis of the proposed building to identify opportunities for the implementation of passive design solutions that reduce demands for energy consuming building services. The passive design credit is achieved when the building uses passive design measures to reduce building energy consumption and associated carbon emissions and minimise reliance on active building services systems.

The proposed building passive design features include:

- The design team has targeted high standards of thermal insulation and fabric efficiency incorporating good air tightness and natural ventilation in the construction.
- Mechanical ventilation heat recovery (MVHR) system maximises efficiency and reduces heat loss.
- All lighting is of low energy design (LED) with most of the spaces having absence/presence detection systems to minimize use only when required.

This analysis has been performed using IES software which provides full dynamic thermal analysis and is a CIBSE certified Level 5 approved Dynamic Simulation Modelling Software. This analysis has been carried out in accordance with user instructions set out in IES manuals and CIBSE AM11 Building Energy and Environmental Modelling.

2 INTRODUCTION

2.1 REPORT PURPOSE

This analysis has been commissioned by the Client to verify the claim for points in compliance with the schedule of evidence required under the Energy Section (Credit Ene 04 Low Carbon Design: Passive Design) of BREEAM UK New Construction (2023).

At the early design stage, the design team carried out a passive design analysis of the proposed Birdworld Play Barn to identify opportunities for the implementation of passive design solutions that reduce demands for energy consuming building services. The passive design credit is achieved when the building uses passive design measures to reduce building energy consumption and associated carbon emissions and minimise reliance on active building services systems.

2.2 SITE ADDRESS

The proposed Birdworld Play Barn will be located at the following address:

Haskins Forest Lodge

Farnham Road

Holt Pound

Farnham GU10 4LD.

2.3 PASSIVE DESIGN

Passive design is an approach to building design and energy-efficient architecture that maximises the use of natural resources and environmental conditions to maintain a comfortable indoor climate without the need for mechanical systems. Passive design principles aim to harness the sun's energy, prevailing winds, and other natural elements to create a comfortable and energy-efficient living or working environment.

Passive design principles vary depending on the climate and local environmental conditions of a particular location. The goal is to create buildings that are comfortable, energy-efficient, and sustainable, reducing the reliance on mechanical heating and cooling systems and lowering energy costs while minimizing the environmental impact.

Daylighting incorporates natural light into the design of buildings, minimising the need for artificial lighting and thereby reducing energy consumption and promoting a healthier indoor environment. The benefits of daylighting are numerous, ranging from lower energy costs and reduced greenhouse gas emissions, to improved occupant comfort, health, and productivity.

Many of the health and wellbeing benefits associated with proper daylighting provision are highlighted within BS EN 17037:2018+A1:2021 and include:

- A regulated circadian system, which controls the body’s sleeping and waking cycles and core temperatures with the external day and night cycle.
- Reduced symptoms of seasonal affective disorder (SAD), which include depression, low energy, tiredness, increased appetite and weight gain.
- Maintenance of healthy levels of vitamin D, positively linked to healthy bones.
- Reduced amounts of bacteria and virus associated with respiratory infections common in winter.
- A positive impact on mood for those who spend a lot of time indoors.

Effective daylighting can also reduce energy consumption as luminaires can be kept off for longer, helping to cut energy bills.

2.4 KEY METRICS

When assessing the effectiveness of passive design strategies for a building, several key metrics and performance indicators can be used to evaluate its energy efficiency, comfort, and sustainability. These metrics help architects, engineers, and building designers quantify the performance of passive design features and make informed decisions. Here are some key metrics for passive design:

- Heating and Cooling Demand: Tracking heating and cooling demand helps determine the extent to which passive design strategies reduce the need for heating or cooling.

- Thermal Comfort: Metrics like Predicted Mean Vote (PMV) and Predicted Percentage of Dissatisfied (PPD) are used to assess the thermal comfort of building occupants. Passive design should aim to maintain indoor conditions within recommended comfort ranges. See separate Thermal Comfort Report.
- Solar Heat Gain: Solar measures the amount of solar heat that enters through windows. Lower solar heat gain values indicate better control of solar heat gain and improved cooling efficiency.
- U-Value (Thermal Transmittance): U-value measures the rate of heat transfer through building elements like walls, roofs, and windows. Lower U-values indicate better insulation and reduced heat loss.
- Shading Effectiveness: Evaluate how well shading devices, such as overhangs or shading screens, reduce solar heat gain during the summer while allowing sunlight in during the winter. This can be quantified through shading coefficients, factors or reduced energy demand.
- Daylight Factor: Daylight factor measures the amount of natural light available in interior spaces. A higher daylight factor reduces the need for artificial lighting during the day. See separate Daylight Analysis report.
- Passive Solar Fraction: This metric calculates the percentage of a building's heating or cooling needs that are met through passive solar design strategies. A higher passive solar fraction signifies greater energy efficiency.
- Cooling Load Avoidance: Assess how effectively passive design reduces the need for mechanical cooling. This can be quantified by comparing the cooling loads of a passive building to a conventionally designed one.
- Total Energy Use: Track the overall energy consumption of the building, including heating, cooling, lighting, and other systems. Passive design should result in lower total energy use compared to conventional buildings.
- Carbon Emissions: Evaluate the building's carbon footprint, which is directly related to its energy use. Passive design should contribute to reduced carbon emissions.
- Overheating Risk: Analyse the potential for overheating in the building, especially during extreme weather conditions. Passive design should minimize the risk of indoor overheating. See separate Thermal Comfort Report.

These metrics can vary depending on the specific goals and objectives of a project, as well as the climate and local conditions. Using a combination of these metrics can provide a comprehensive assessment of how well passive design strategies perform in a particular building or design scenario.

2.5 PASSIVE DESIGN STRATEGY

The proposed buildings passive design features include:

- The design team has targeted high standards of thermal insulation and fabric efficiency incorporating good air tightness and natural ventilation in the construction.
- Mechanical ventilation heat recovery (MVHR) system maximises efficiency and reduces heat loss.
- All lighting is of low energy design (LED) with daylight dimming and absence/presence detection systems to minimize use only when required.

3 BREEAM ASSESSMENT

3.1 INTRODUCTION

BREEAM (BRE Environmental Assessment Method) is a certification system from the United Kingdom, developed and administrated by BRE (Building Research Establishment). It has been on the market in different versions since 1990 and is the most spread international environmental certification system in Europe.

Table 1 Project BREEAM Details

BREEAM Certification	New Construction UK V6.1
BREEAM Target	Excellent
BREEAM AP	RPS Group
BREEAM Pre-Assessment Ref:	15.09.23

3.2 PASSIVE DESIGN ASSESSMENT

Category: ENE (Energy)	→	Issue: ENE04 (Low Carbon Design)	→	Criteria: PASSIVE DESIGN	→	Target Credits: 1

Category: Energy

The BREEAM Environmental Category 'Energy' (ENE) encourages the specification and design of energy efficient building solutions, systems and equipment that support the sustainable use and management of energy during the building's operation.

The category comprises 8no Issues that BREEAM aims to address.

Issue: Low Carbon Design (ENE04)

This report specifically addresses the Low Carbon Design Issue which encourages the adoption of design measures which reduce building energy consumption and associated carbon emissions and minimise reliance on active building services system.

Assessment Criteria: Passive Design

This report specifically addresses the Passive Design Assessment Criteria which encourages project teams to proactively consider the ways in which the building could benefit from, and adopt, passive design measures.

Credits

1no BREEAM credits shall be awarded by completing the BREEAM Passive Design assessment.

The methodology for providing the necessary evidence for each assessment is described below:

Evidence Summary

- Use thermal modelling demonstrate that the building design delivers appropriate thermal comfort levels in occupied space.
- Analyse the proposed building design and development during Concept Design to identify opportunities for the implementation of passive design measures.
- Implement passive design measures to reduce the total heating, cooling, mechanical ventilation, lighting loads and energy consumption in line with the passive design analysis findings.
- Quantify the reduced total energy demand and carbon dioxide (CO_2-eq) emissions resulting from the passive design measures.

Evidence Targets

As a minimum, the passive design assessment should cover the following topics:

- Site location

- Site weather
- Microclimate
- Building layout
- Building orientation
- Building form
- Building fabric
- Thermal mass or other fabric thermal storage
- Building occupancy type
- Daylighting strategy
- Ventilation strategy
- Adaptation to climate change
- Passive design energy demand reduction

4 BUILDING SIMULATION

4.1 METHODOLOGY

The Passive Design analysis contained herein has been performed using IES software which provides full dynamic thermal analysis and is a CIBSE certified Level 5 approved Dynamic Simulation Modelling Software. This analysis has been carried out in accordance with user instructions set out in IES manuals and CIBSE AM11 Building Energy and Environmental Modelling. The CIBSE Test Reference Year (TRY) Weather File for London was chosen for the simulation.

Please note all modelling data and inputs used are as per Client's instructions and are the same for the proposed building and the standard notional building, except for the passive design measures.

All latest software patches have been applied, up to the date of simulation.

The weather file was selected due to proximity to the site thus allowing the simulation to accurately model the weather profiles.

Energy Demand Comparison for Passive Design Analysis

Any savings resulting from the incorporation of passive design measures should be demonstrated by comparing the energy demand and CO_2-eq emissions for the building with and without the proposed passive design measures adopted, as identified in the passive design analysis.

To enable a baseline for comparison to be established, a 'standard building' should be modelled with fabric performance equivalent to that of the local building regulations notional building (or for Scotland, an equivalent compliant building) and without the passive design measures (where feasible, i.e. building orientation is likely to be fixed). The glazing areas specified in the 'standard building' should be the same as those required by the Building Regulations Notional building.

This 'standard building' should be modelled as equivalent to the proposed building with the exception of any changes to account for passive design measures and fabric performance.

Any savings in energy demand or CO_2-eq emissions should then be calculated by comparing the respective Building Emission Rate (BER) outputs from two building models representing the 'proposed building' specification (fixed at a point as agreed by the project team and assessor), and the 'standard building' specification.

These calculations should be carried out by a building services engineer who is a member of the Chartered Institute of Building Services Engineers (CIBSE) or by an accredited energy assessor.

4.2 BUILDING MODEL

Table 2. Building Simulation Model Parameters

Software	IES VE 2023
Weather File	CIBSE Weather File London (LON)
Location	SU 81044 43126
Architectural Drawing	Roberts Limbrick

Model Images

Figure 1: 3D Model (Plan View)

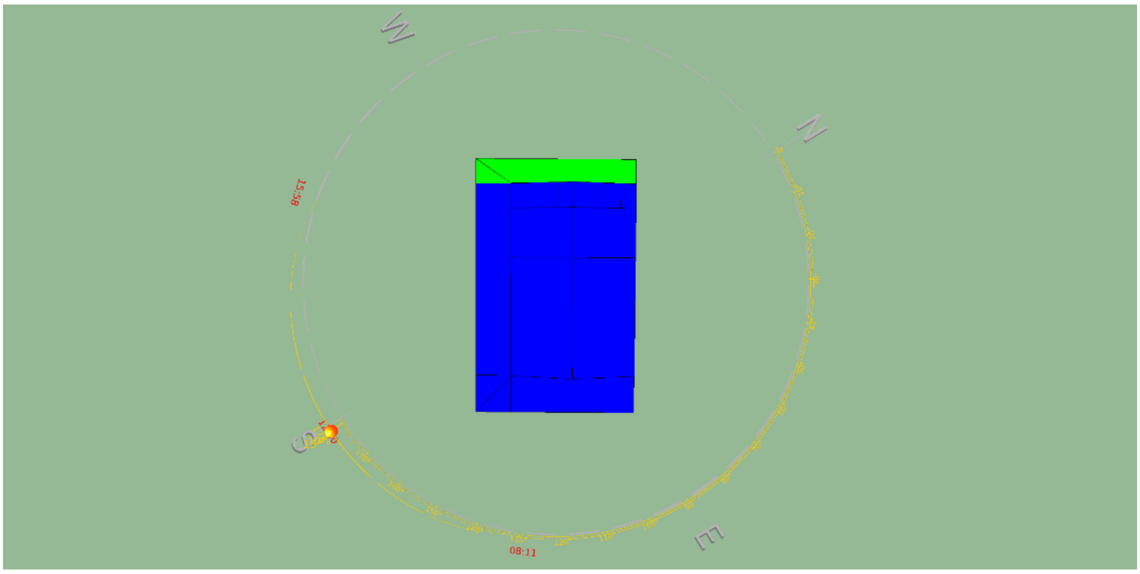


Figure 2: 3D Model (North West Facing)

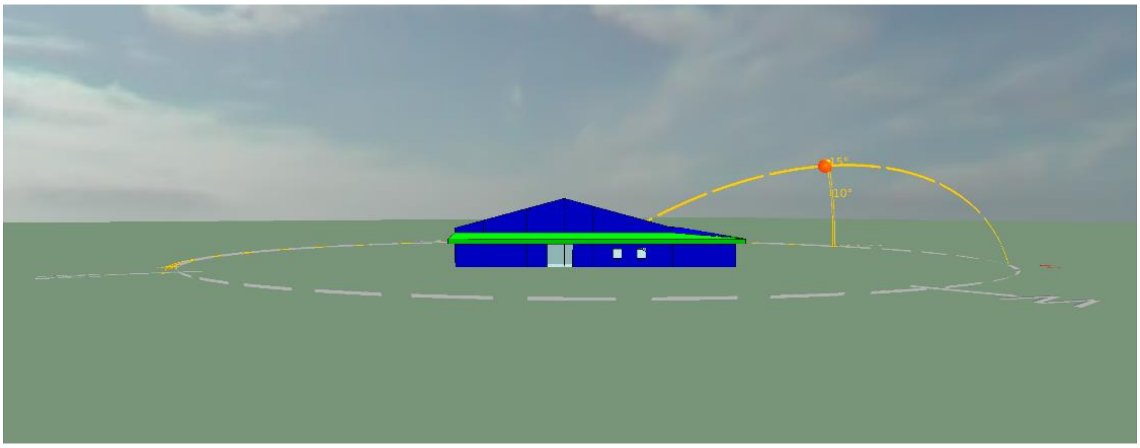


Figure 3: 3D Model (North East Facing)

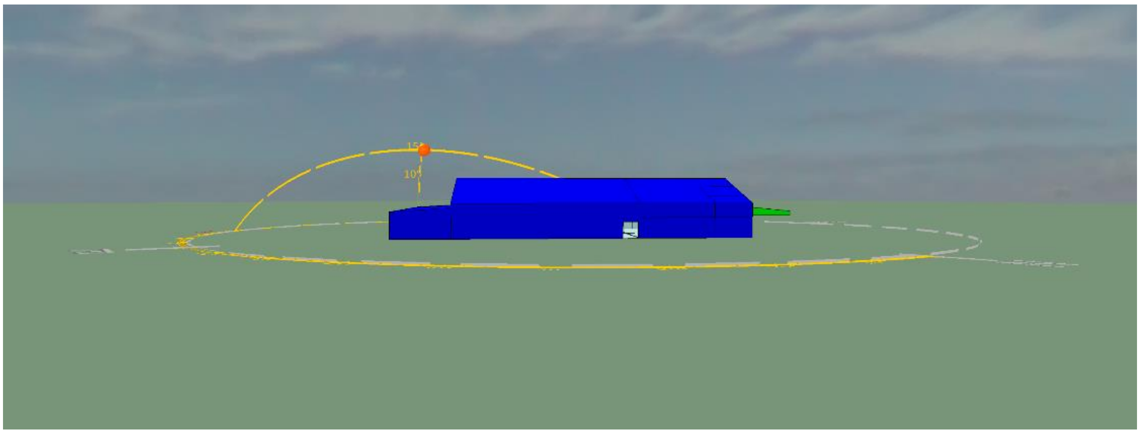


Figure 4: 3D Model (South East Facing)

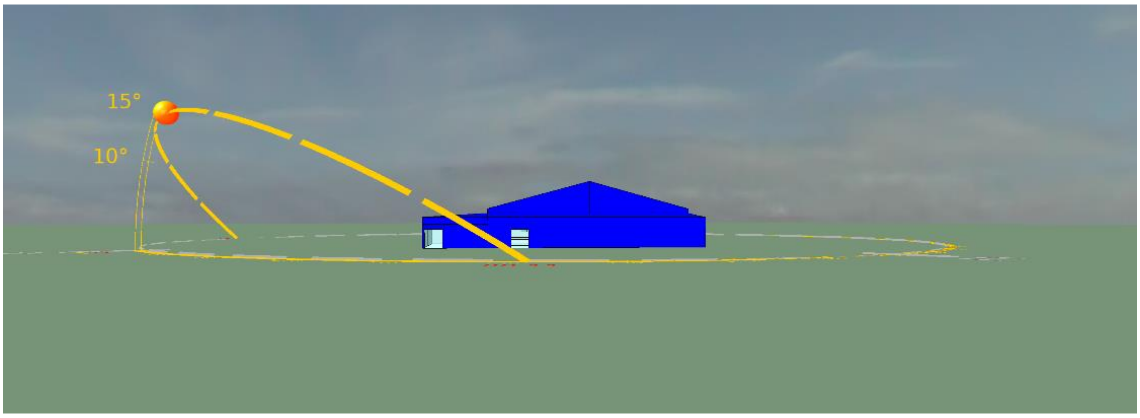
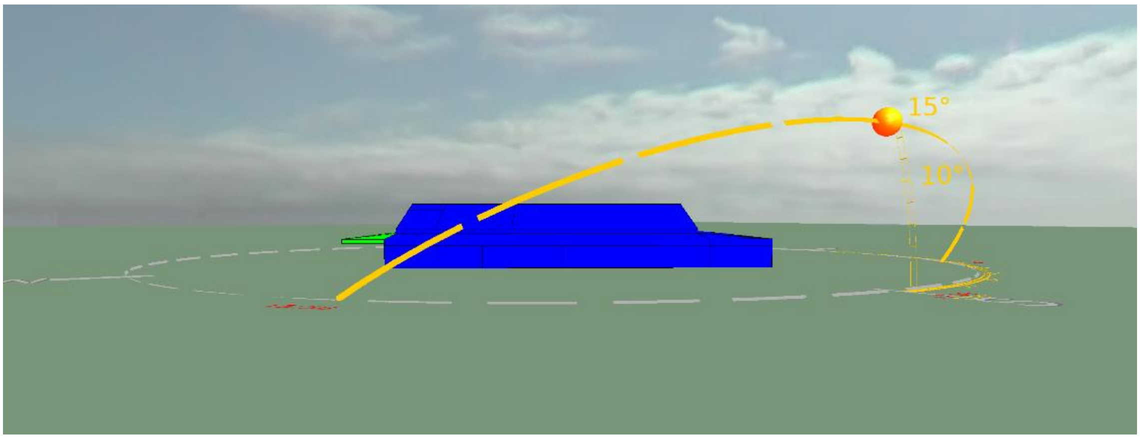


Figure 5: 3D Model (South West Facing)



5 PASSIVE DESIGN EVIDENCE

5.1 ASSESSMENT STRATEGY

Evidence of compliance is provided in accordance with BREEAM ENE04 – Passive Design, as defined in Section 3 of this report and using the modelling software and methodology as defined within Section 4 of this report.

Each evidence topic is addressed below:

5.2 SITE LOCATION

Haskins Garden Centres have purchased a site southwest of Farnham at the following address:

Haskins Forest Lodge, Farnham Road, Holt Pound, Farnham, GU10 4LD.

5.3 SITE WEATHER AND MICROCLIMATE

The CIBSE (Test Reference Year) weather file for London was used for the simulations. This approved weather data is the closest available for the site geographical location. The IESVE Compliance software uses orientation, weather and location data to accurately model the solar gain to the building.

5.4 BUILDING LAYOUT, ORIENTATION AND FORM

The building is an existing building which will be redeveloped and has been designed specifically to meet the particular needs of the end Client.

5.5 BUILDING FABRIC

The building fabric has been enhanced above the requirements outlined in Part L2A of the Building Regulations. This reduces the heating and cooling load for the building. A maximum air permeability of $5m^3/h/m^2$@50pa will be targeted in the building design.

Table 3. Building Fabric Data

Building Element	U-Value	G-Value
Roof	$0.12W/m^2k$	-
Wall	$0.15W/m^2k$	-
Floor	$0.12W/m^2k$	-
Glazing	$1.20W/m^2k$	0.69
Personnel Door	$1.30W/m^2k$	-
Vehicle Door	$1.30W/m^2k$	-
Air Permeability	$5m^3/h/m^2$@50pa	-

5.6 THERMAL MASS OR OTHER FABRIC THERMAL STORAGE

The design team has incorporated thermal mass where possible into the proposed building fabric, with reinforced concrete sub-floors. The building will be a portal steel frame with external walls constructed of masonry and overclad.

5.7 DAYLIGHTING STRATEGY

Due to the function of the building, fenestration within the occupied spaces is limited. All lighting is of Low Energy Design (LED) and where possible, presence detection systems minimize use only when required.

5.8 VENTILATION STRATEGY

All of the occupied spaces within the proposed Birdworld Entrance Building will utilise a high efficiency mechanical heat recovery ventilation system which will provide fresh air to the occupants whilst recovering as much energy as possible.

5.9 ADAPTATION TO CLIMATE CHANGE

The project team have maximized the use of passive design features, where possible. These passive design measures (detailed above) will help the building and its users adapt to future climate change.

5.10 PASSIVE DESIGN ENERGY DEMAND REDUCTION

The passive design demand reduction is demonstrated by comparing the respective energy demand and CO_2-eq emission rate (BER (Kg/m^2 CO_2.annum)) for the building with and without the proposed passive design measures adopted, as identified in the passive design analysis.

Please see Table 4 for comparison of results for energy demand and CO_2-eq emission rate (BER) between the proposed building with the passive design measures and a standard notional building without any passive design measures.

Table 4. Comparison of simulated building energy demand and CO_2-eq emission rate (BER (Kg/m^2 CO_2.annum)) between the proposed Birdworld Play Barn with the passive design measures and a standard notional building without any passive design measures.

BER (Kg/m^2 CO_2.annum)		% Reduction	Meets BREEAM Requirements?
Proposed Building After Passive Design Enhancements	Notional Building		
5.10	5.70	11%	Yes

Section 7 includes the respective building emission rate (BER (Kg/m^2 CO_2.annum)) outputs from the two building models representing the 'proposed building' specification and the 'standard notional building' specification.

5.11 CONCLUSIONS

From Table 5, the results show that the proposed Birdworld Entrance Building will achieve an 11% reduction in carbon emissions through the specification of passive design measures.

Please see Section 7 for the respective building CO_2 emission rate (BER) outputs from the two building models representing the 'proposed building' specification and the 'standard notional building' specification.

6 SUMMARY

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At the early design stage, the design team carried out a passive design analysis of the proposed Birdworld Play Barn to identify opportunities for the implementation of passive design solutions that reduce demands for energy consuming building services. The passive design credit is achieved when the building uses passive design measures to reduce building energy consumption and associated carbon emissions and minimise reliance on active building services systems.

Based on the modelling conducted, the results show that the proposed Birdworld Play Barn meets the criteria with an 11% reduction in building CO_2 emission rate (BER) for the proposed building over the standard notional building. These results show that the passive design criteria as set out by BREEAM UK New Construction (2023) under the Energy Section (Credit Ene 04 Low Carbon Design: Passive Design) has been satisfied.

7 PASSIVE DESIGN: BUILDING EMISSION RATE OUTPUT

Building CO_2 emission rate (BER (Kg/m2 CO2.annum)) outputs for the 'standard notional building' specification for the Birdworld Play Barn.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Birdworld Play Barn (without passive design features)

As designed

Date: Fri Dec 15 12:26:20 2023

Administrative information

Building Details

Address: Birdworld Play Barn, Farnham, GU10 4LD

Certifier details

Name: Neil Bajaj

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.23

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.23

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 1782.12

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	6.93	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	5.7	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	74.54	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	57.81	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.21	0.26	2_000017:Surf[3]
Floors	0.18	0.19	0.22	2_000017:Surf[0]
Pitched roofs	0.16	0.17	0.18	2_000017:Surf[6]
Flat roofs	0.18	0.14	0.18	2_000017:Surf[1]
Windows** and roof windows	1.6	1.39	1.4	2_000017:Surf[2]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]
* 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.
*** Values for rooflights refer to the horizontal position.
^ For fire doors, limiting U-value is 1.8 W/m²K
NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	5

Building CO_2 emission rate (BER (Kg/m2 CO2.annum)) outputs for the 'proposed building' specification for the Birdworld Play Barn.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Birdworld Play Barn

As designed

Date: Fri Dec 15 12:09:50 2023

Administrative information

Building Details

Address: Birdworld Play Barn, Farnham, GU10 4LD

Certifier details

Name: Neil Bajaj

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.23

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.23

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 1782.12

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	7.02	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	5.1	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	75.42	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	51.73	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

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

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.15	0.15	2_000019:Surf[0]
Floors	0.18	0.12	0.12	2_000017:Surf[0]
Pitched roofs	0.16	0.12	0.12	2_000017:Surf[6]
Flat roofs	0.18	0.12	0.12	2_000019:Surf[2]
Windows** and roof windows	1.6	1.2	1.2	2_000017:Surf[2]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* 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. *** Values for rooflights refer to the horizontal position.
^ For fire doors, limiting U-value is 1.8 W/m²K

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

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	5