DALYMOUNT STADIUM REDEVELOPMENT

Dublin City Council

Sustainability Report

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Status:
S2A
Version:
01

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QUALITY INFORMATION

PROJECT INFORMATION

Project Title:	Dalymount Park Stadium Redevelopment
Client:	Dublin City Council
Location:	Dublin
Project Number:	102025

DOCUMENT INFORMATION

Document:	SUSTAINABILITY REPORT
Initiation Date:	06/09/2023
Final Date:	20/09/2023

DOCUMENT APPROVAL

Version History

Status/Rev	*Date*	*Description*

Document Approver:

Name:	*Role*	*Date*
Sergio Arús Gutiérrez	MEP Lead	20/09/2023

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DOCUMENT NUMBER

Project No.	*Originator Code*	*Document Type Code*	*Discipline Code*	*Sequential Number*	*Level Code*	*Zone Code*
102025	**IDO**	**RP**	**Y**	**0001**	**XX**	**XX**

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INTRODUCTION

Dalymount Park is a football stadium located in Phibsborough, Dublin, and aims to provide a new modern facility to be used for Irish league Football, as well as FAI & UEFA matches.

This development aims to cope with the climate action plan 2019-2024 by Dublin City Council. A design process has been planned for that purpose. Strategies (active and passive), which are consistent with the scope, are developed to achieve the greatest possible reduction in resource consumption. A well-insulated and air-tight building envelope, optimized window/wall ratio, heat recovery units or technologies that use renewables sources such as heat pumps, are some of the most relevant chosen measures.

Additional actions, such as an optimised drainage strategy or enough system capacity to respond to future higher summer temperatures have been implemented, to make the development a climate resilient asset.

Water utilisation has also been issued with the use of rainwater harvesting tanks for toilet flushing and pitch irrigation.

The use of PV panels has been dismissed so far due to the intermittent use of the stadium. Nevertheless, virtual batteries may be an option for this type of facility.

1.0 ENERGY AND COMFORT

1.1. ENERGY REGULATION AND DALYMOUNT ENERGY APPROACH

The Technical Guidance Document L outlined the minimum energy performance requirements for buildings and to achieve Nearly Zero Energy Buildings (NZEB), where primary non-renewable energy consumption and total energy consumption are limited. To achieve these consumption values and as well as ensure the indoor & visual comfort, the buildings have been designed by implementing a series of measures to reduce these consumptions, both passive and active, as well as the integration of renewable energy sources. Additionally, the minimum requirements and recommendations outlined in Part L of the building regulations were strictly adhered.

In addition to comply the requirements of the National Energy Performance (NEAP) standards, preliminary energy simulation) was conducted through the approved NEAP software, DesignBuilder and delved into the assessment of several vital aspects of the stadium's energy performance, including interior lighting, HVAC systems, and domestic hot water systems. It's important to note that certain aspects of the stadium's energy usage, such as floodlighting and facade lighting, were not within the scope of the NEAP requirements. Specifically, the simulation accounted for critical factors like U-Values & G-Value and system selections, ensuring that our designs met the requirement. This preliminary simulation provided us an insight of the energy performance of Dalymount and able to comply with the regulation with the proposed design intent, however it is necessary to appoint certified energy assessor to conduct an official energy simulation.

In the following section, the implementation of passive and active solutions will be explained in detail on how such measures are able to achieve NZEB.

1.2. PASSIVE SOLUTION

2.2.1 THERMAL ENVELOPE

Regarding the U-value of roof, floor and wall, the values are taken reference from the Technical Guidance Document L. Whereas, the U-value of window/glazing is designed as 1.2 W/m^{2}K in order to have better overall building performance. With optimising energy efficiency and occupant well-being, building fabric materials enhancing commendable thermal conductivity values were considered. The selected mineral wool and XPS insulation, with thermal conductivities of 0.038 W/mK and 0.034 W/mK, respectively, have been instrumental in achieving exemplary heat insulation. Moreover, by complying with the Technical Guidance Document L's baseline air tightness recommendation of 5 m^3/h.m^2 at 50 Pa. The development aims to achieve an air tightness level of 3 m^3/h.m^2 at 50 Pa in order to enhance the thermal performance.

Fabric Element	Recommended U-Value by Part L (W/m^{2}K)	Project U-Value (W/m^{2}K)	Insulation Material	Thickness Insulation (mm)
Roof	0.2	0.16	Mineral Wool	230
External Wall	0.21	0.2		170
Basement Wall	0.21	0.2		160
Basement Floor	0.21	0.2	XPS	150
Ground Floor	0.21	0.2	XPS	150
Glazing/ Window	1.6	1.2		

Table 1- Design Parameters of Building Fabric

2.2.2 NATURAL VENTILATION

In alignment with sustainable design principles, natural ventilation (NV) will be incorporated into the stadium, particularly in areas where mechanical ventilation is neither necessary nor advantageous. The integration of NV is guided by the stadium's layout constraints and orientation.

Throughout the stadium, openings, such as windows, louvers, and vents, will be utilised for natural ventilation. This strategic placement ensures the free flow of fresh air into designated areas, thereby promoting optimal indoor air quality and enhancing occupant comfort. By leveraging the stadium's design, our goal is to maximise the effectiveness of natural ventilation. This approach not only aligns with eco-friendly practices but also creating a sustainable and comfortable environment for all stadium users.

1.3. ACTIVE SOLUTION

2.3.1 MECHANICAL SYSTEM- VENTILATION

Heat Recovery Units (HRUs) will be utilised for mechanical ventilation, which are capable on providing both Variable Air Volume (VAV) and Constant Air Volume (CAV) control. This dynamic control capability allows the system to adapt to changing occupancy levels and varying air quality requirements. By adjusting the airflow rates based on real-time conditions, the HRUs can optimise energy consumption and maintain a consistent indoor air quality. Moreover, the HRUs contribute to overall energy efficiency by recovering and reusing the thermal energy from the exhaust airstream. The counter-flow heat exchangers with more than 80% efficiency within the HRUs transfer the heat from the outgoing air to the incoming fresh air, minimising the need for additional heating or cooling energy. This heat recovery process significantly reduces energy consumption and associated operational costs, making the ventilation system more environmentally friendly and economically sustainable. By incorporating these high-performance HRUs with their versatile control capabilities and energy recovery features, the building able to achieve optimal indoor air quality while prioritising energy efficiency and sustainability. The HRUs ensure a constant supply of fresh air, temperature control and humidity levels.

2.3.2 MECHANICAL SYSTEM- HEATING AND COOLING

According to the technical information of Dublin District Heating System (DDHS) by Dublin City Council, the district heating system will be provided to the North Lotts and Grand Canal Dock and Poolbeg Strategic Development Zone (SDZ), which the location of proposed development, Dalymount Park are not included in one of the three phases of DDHS project and SDZs area.

Figure 1- Location of Dublin District Heating System

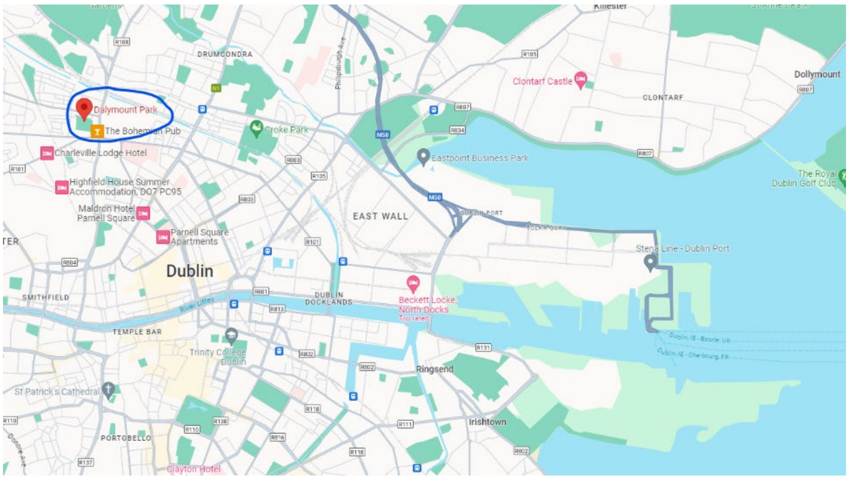

Figure 2- Location of Dalymount Park Stadium

The HVAC system incorporates energy-efficient strategies including Variable Refrigerant Flow (VRF) system with heat recovery for heating and cooling. By utilising VRF system within the Outdoor Units (ODUs) and Indoor Units (IDUs), the HVAC system capitalises on the abundant renewable energy available in the environment. Heat pumps extract heat from the outdoor air and transfer it indoors for heating purpose, or vice versa for cooling purposes. Besides, thermostat(s) will be installed in each heating/cooling areas in order to control the supply temperature and optimise the indoor thermal comfort. As a result, the overall energy consumption of the HVAC system is reduced, contributing to both energy savings and lowered carbon footprint.

To provide a comprehensive overview of our HVAC system's performance, a summary of the Seasonal Energy Efficiency Ratio (SEER) and Season Coefficient of Performance (SCOP) values for cooling and heating across different ODUs were illustrated in the Table 2.

Equipment	Model	SEER	SCOP
ODU 1 &2	REYA8A + REYA12A	7.27	4.38
ODU 3	REYA16A	7.1	4.26
ODU 4	REYA8A	7.35	4.11
ODU 5	REMA5A	7.62	
ODU 6			
ODU 7			

Table 2- Summary of SEER and SCOP of Different ODUs

2.3.4 MECHANICAL SYSTEM- DOMESTIC HOT WATER

In accordance with the energy performance and renewable energy guidelines set forth in the Irish Energy Guide, the integration of air-to-water heat pumps for hot water supply in this design report is a strategic choice. Air-to-water heat pumps offer an eco-conscious solution by efficiently extracting latent heat from the surrounding air and utilising it to heat water. By adopting this technology, significant benefits can be realised, including reduced energy consumption and lower carbon emissions when compared to conventional heating systems. The utilisation of air-to-water heat pumps in this design not only aligns with Ireland's commitment to sustainable development but also contributes to the promotion of renewable energy sources. This design approach exemplifies a proactive stance towards achieving energy efficiency objectives and embracing environmental sustainability, as outlined in the Irish Energy Guide. The hot water supply to the kitchenette in the club office on the first floor will be provided from the instant water heater. Avoiding hot water draws off to achieve a desired temperature means that water consumption will be reduced when compared to centralised systems. The SCOP and details of the air source heat pump for domestic hot water production is as follows:

Equipment	Specification	SCOP
2 Nos. of DHW air source heat pump in west stand	14kW R32 1Ph Mono ASHP Outdoor Unit	4.33

1 No of DHW air source heat pump in east stand	14kW R32 1Ph Mono ASHP Outdoor Unit	4.33

Table 3- DHW Heat pump Details and SCOP

2.3.5 LED LIGHTING

Regarding to the energy performance of all lighting system in the building, LED lighting fixtures would be installed as LED bulbs are highly energy-efficient and have a longer lifespan and they consume significantly less electricity and produce less heat, making them an excellent choice for lighting homes, offices and public spaces. Along with using energy-efficient bulbs, consider installing lighting fixtures specifically designed to maximise energy savings. Fixtures with built-in reflectors and diffusers would be used to optimise light distribution while minimising energy waste. Motion sensors and timers would be incorporated in areas with low occupancy or where lights are frequently left on unintentionally. These devices automatically turn lights on and off, reducing energy consumption and costs. Natural light would be captured by maximising window openings and using light-coloured paints or reflective surfaces to enhance natural light distribution within buildings. Lighting control such as dimmers and sensors would be used to reduce the energy usage.

2.0 DAYLIGHT UTILISATION

Daylight simulation is used to optimize the use of natural daylight in the architectural building design. By simulation, the openings and spaces that are well-lift and energy efficient are designed. Low U-value glazing will be adopted in order to minimise energy consumption and optimal G-Value had been considered to avoid overheating. For the layout design, it had been designed to enhance daylight in occupant areas. A solar energy analysis has been performed in order to optimise both glazing and solar shading elements. Design Builder software has been used for it. This program considers the hourly climate data from Dublin Airport. The main project components and the surrounding relevant buildings have been included in the model.

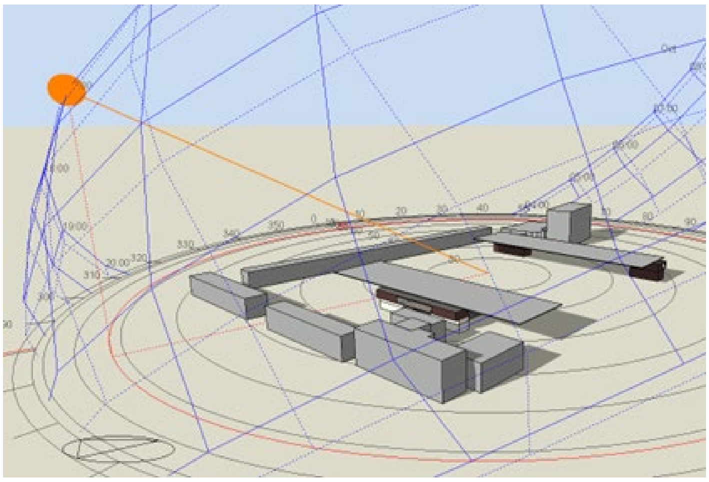

Figure 3- Solar path analysis. 21st June at 5 pm (solar time)

The main rooms that have been analysed are the following:

1. Stadium bar (West stand, firs floor)

2. Gym (East stand, ground floor)
3. Multipurpose room (East stand, first floor)
4. Merchandising room (East stand, ground floor)
5. Office room (East stand, first floor)

Initial glazing properties are the following:

- Light Transmittance = 65%
- G value= 0,3
- U-value = 1.2 W/m^2K

The stadium bar has a large proportion of glazing on both east and west facades.

- East facade is quite well protected with the west stand roof.
- The west façade of this room is highly exposed to solar radiation even though some buildings in the west are diminishing this radiation.

A simulation below shows the effect of installing vertical louvres @ 90 and 45 degrees on the west facade of this room, decreasing the peak solar radiation to 55 W/m^2 to 40 W/m^2 respectively.

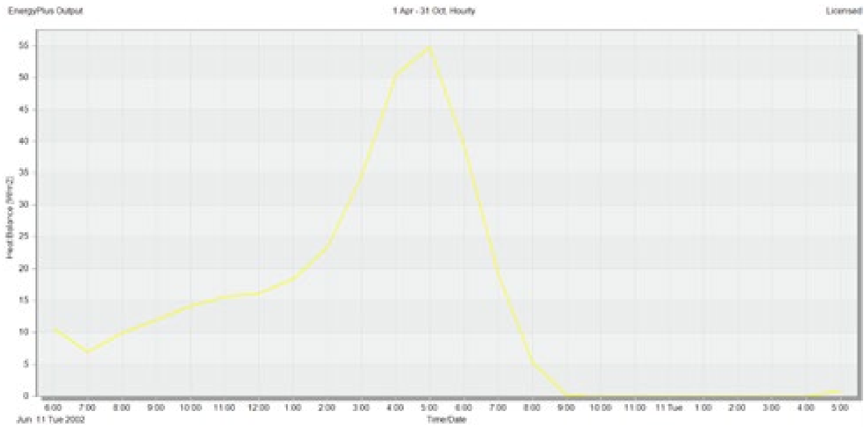

Figure 4- Results at 5 pm solar time (6 pm Irish time) with too high solar radiation (55 W/m2) with vertical louvers @90º

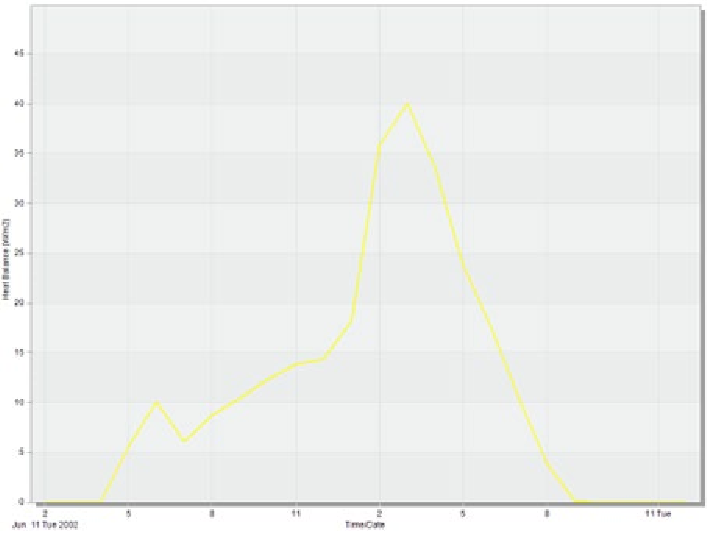

Figure 5- Results at 3 pm solar time (4 pm Irish time) with admissible high solar radiation (40W/m2) with louvers @45º

A daylight simulation has been performed for the same room with high daylight values as can be seen below:

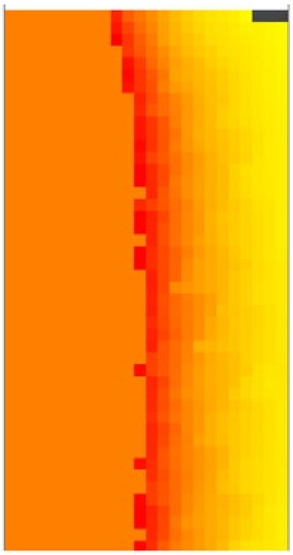

Figure 6- Approx. 50 % above daylight values of 500 lux in orange in overcast sky (standard indoor values for occupied areas), overcast sky with louvres @45°. Lower glazing area.

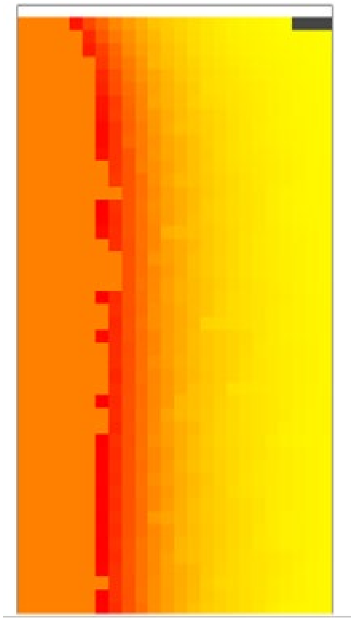

Figure 7- 25 % of room above 1000 lux, overcast sky with louvres @45°. Lower glazing area.

Gym, multipurpose and office rooms do not need external glazing with the current design. Internal blinds may be used against glare. Club Merchandise room has a bit too high solar radiation, a further analysis needs to be done.

3.0 MATERIALS

In our dedication to reducing carbon consumption during implementation and construction, sourcing materials locally whenever feasible will be prioritised. This approach significantly reduces the carbon footprint associated with transportation. Additionally, liaised with manufacturer, Kenoteg, regarding high performance brick in order to enhance the thermal performance, as such the feasibility will be on utilising high thermal performance bricks for the building in the next phase.

4.0 WATER

4.1. SUDS

Due to the nature of the new redevelopment, a stadium with long-span lightweight roofs, and the constrained dimensions of the site, the opportunities to incorporate SUDS are limited. However, these have been incorporated wherever possible.

Green Roofs- The total of 270m^2 green roofs are located on the small building of the Northwest corner and on the community facility centre at the Northeast Side. Meanwhile, the green roof and various green areas at the building could facilitate the building to reduce air pollution and net gain of biodiversity.

Permeable Paving – The total of 4042 m^2 Type B (partial infiltration) Permeable Paving is considered for the access areas. The storm water from the access areas and roofs are stored on the sub-base layer of permeable paving of 50cm.

Attenuation tanks - Both the surface water of the pitch and its perimeter area (i.e., the area between the pitch and the stands), are collected and stored in two attenuation tanks to control the discharge flow rate limitation. A total volume of two attenuation tanks is 391m3 (2 times 200 m^3).

4.2. RAINWATER HARVESTING

The rainwater collected from the west stand roof and the north terrace roof is collected through the common collector and is discharged to the 52m^3 underground rainwater harvesting tank located at the north-west corner. The rainwater collected from the east stand roof and the south terrace roof is collected through the common collector and is discharged to the 52m^3 underground rainwater harvesting tank located at the south-east corner.

The overflow water from the harvesting tanks is distributed on the gravels of permeable paving. Regarding the implementation of rainwater harvesting, it could facilitate the water stress, by collecting rainwater from all roof areas will be harvested and recovered to utilise the pitch irrigation, toilets and urinals flushing.

5.0 MOBILITY

5.1. EV CHARGING

The world's transition to sustainable transportation is a vital answer to the problems that the traditional combustion engine vehicles face in terms of the environment, the economy and society. Providing the EV charger is a significant step toward promoting sustainable energy and supporting the adoption of electrical vehicles. In this project, there are total 12 Nos of car parking spaces located at the north-west corner accessed from the St Peter's Road existing gate as shown in figure 8.

Besides, 6 numbers of 22kW fully functional EV charging points are included, which are 50% of all 12 numbers of parking spaces. The remaining spaces are planned to support the necessary ducting infrastructure for future EV charging. The charging stations are accessible to a diverse range of users including the stadium employees, football club teams, spectators and media, etc.

5.2. BICYCLE BAYS

With the view to encourage individuals to opt for cycling as a mode of transportation which is eco-friendly and reduces the carbon footprint, total of 10 bicycle bays are included in this project. The bike stands are made sure to be able to access from everyone, which can be accessed from the existing gate at the St Peter's Road. The location of the bike stands is shown in the figure 8.

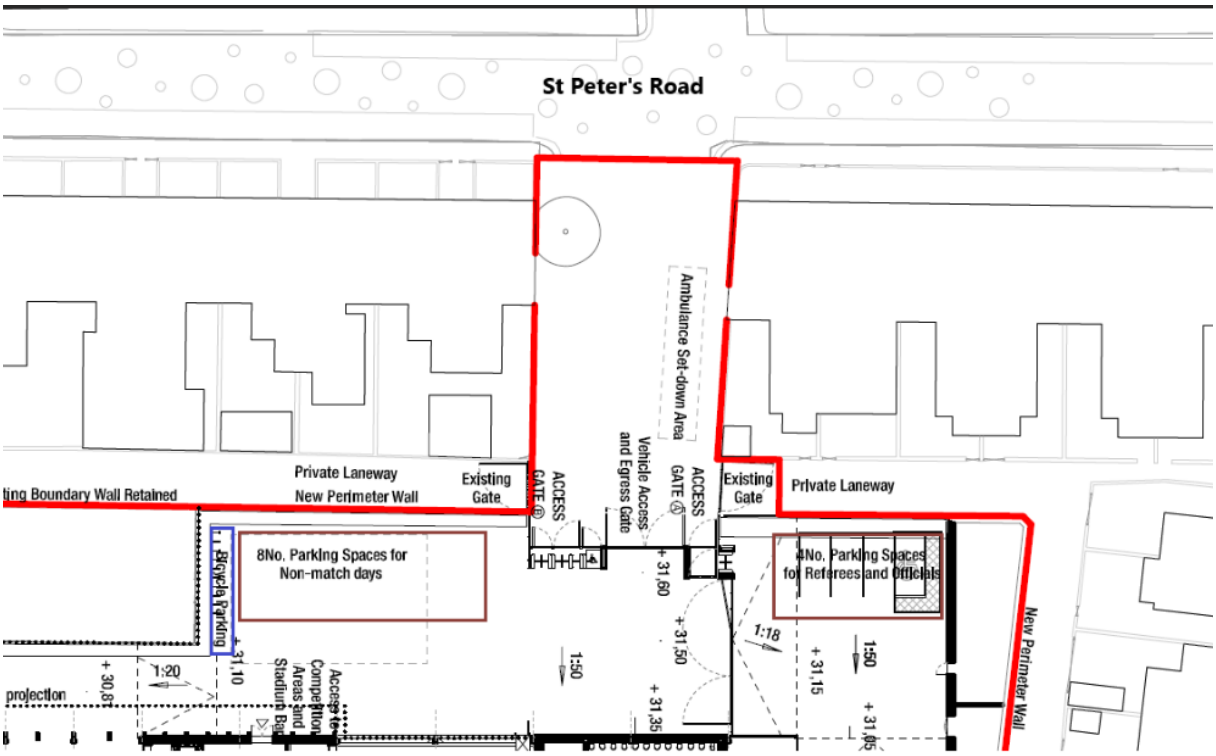

Figure 8- EV Charger and Bicycle Parking Bays Areas