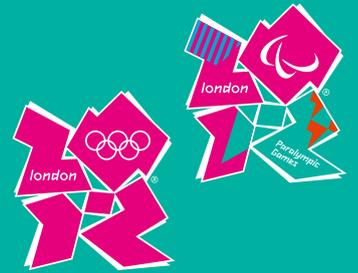


Learning legacy



Lessons learned from the London
2012 Games construction project

Development and use of BREEAM for Olympic Park venues

Abstract

When London won the right to host the London 2012 Olympic and Paralympic Games in 2005, the bid team pledged to treat sustainability as a major priority. The Olympic Delivery Authority (ODA) aimed to establish sustainability benchmarks for the design and construction of the sporting facilities and surrounding Olympic Park, which were above industry standard.

One tool trialled to support the achievement of these objectives was a new version of BREEAM (Building Research Establishment Environmental Assessment Methodology). BREEAM is a well established means of assessing the sustainability of a range of different types of new and

existing buildings; however, this was the first time assessments were created and used for major sports stadia. The intention was to develop a tailored version of BREEAM to drive reductions in environmental impacts and measure these robustly.

This research paper explains why BREEAM was selected and how a new, bespoke version was developed and applied. Particular reference is made to two venues: the Aquatics Centre and the Velodrome.

The experience has produced a number of useful lessons for industry about how to obtain the most benefit from an assessment, with specific learning for other major events.

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BREEAM criteria was applied to each of the venues as well as to the wider Park

Introduction

What is BREEAM?

BREEAM is used across the world and is a leading environmental assessment method for buildings, with over 200,000 buildings certified and more than one million registered.

Ten categories of environmental impact are assessed^a, each covering a number of clearly defined issues. These issues seek to mitigate the impact of a new or refurbished building on the environment by setting performance-based criteria and benchmarks and a given number of credits is available for addressing each one.

Where evidence is provided demonstrating that the criteria have been met, the appropriate number of credits can be awarded. A weighting is applied to account for the varying importance of the different categories and then the category totals are added together to produce a single overall score on a scale of Pass, Good, Very Good or Excellent. Since 2008, the standard schemes have included a top rating of Outstanding, though at the time of scheme development, Excellent was the highest rating available for the Games version.

All stakeholders play a role in achieving the target; from the client embedding the requirement in the brief, to the design team and contractor who deliver the project.

The operation of BREEAM is overseen by an independent Governing Board and a Standing Panel for Peer and Market Review. The Governing Board represents stakeholder interests to ensure, amongst other things, that BRE Global Limited and therefore BREEAM, are acting independently and impartially.

Why was BREEAM selected for the London 2012 Games?

The ODA selected BREEAM for several reasons:

- Using a tailored version provided the ODA with a method for benchmarking the sustainability impacts of the venues, accounting for, and consistent with, the objectives of its Sustainable Development Strategy.
- It is an independently managed tool and could be externally audited.
- Basing assessments on it provided reassurance for the ODA that the method would build upon a tried and tested approach.

It also provided a means for the planning authority to place a condition on development. This required the ODA to use reasonable endeavours to achieve a rating of Excellent on the permanent venues.

It should be noted that this was only one of many sustainability considerations for design teams and contractors to address. Complementary targets were set for key objectives including energy efficiency, water use, construction waste and materials.

The scope of the assessment framework

The bespoke BREEAM version for the Games venues was developed by BRE Global Limited to assess the environmental impacts of the following permanent buildings:

- Olympic Stadium
- Aquatics Centre
- Velodrome
- Multi-purpose sports facility (Handball Arena during Games time)
- Work and Business Centre (Media Press Centre (MPC) during Games time, though not the International Broadcast Centre (IBC) which is not a permanent structure)
- Eton Manor (Aquatics events training during Games time)

All stakeholders play a role in achieving the BREEAM target.

^a They are Management, Health and Wellbeing, Energy, Transport, Water, Materials, Waste, Land Use and Ecology, Pollution and Innovation.

The ODA set a target for all permanent Park venues to achieve BREEAM's Excellent rating in their long-term state after the Games.

Requirements for the Games are very energy intensive. For example, the lighting scheme for the Velodrome must deliver 2000 lux at track level to illuminate the racing for high definition television. The brief required a temperature of 28°C at track level for competition – warmer air is less dense and reduces wind resistance.

These demands are intense, but the majority of environmental impacts will be felt over the lifetime of the buildings rather than just the duration of the Games, so the ODA set a target for all permanent Park venues to achieve an Excellent rating in their long-term state after the Games.

Several buildings will undergo transformation after the Games. For example, the seating capacity of the Aquatics Centre will be reduced from 17,500 to 2,500 by removing two temporary wings. Such changes are intended to ensure that the facilities have a useful life in the long term. The scope of the bespoke assessment spans not only initial design, but also post-Games transformation design and construction.

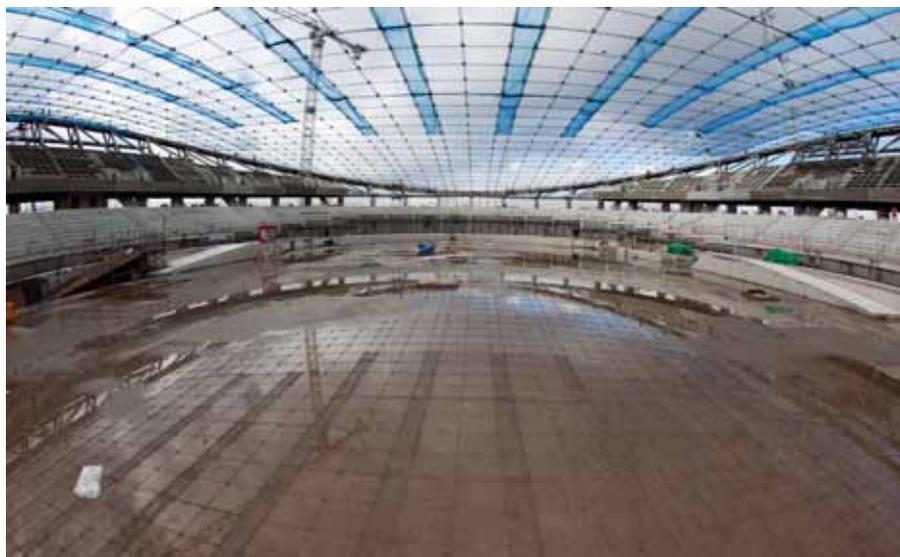
Tailoring performance criteria to suit the venues involved developing new criteria for issues not covered by the existing 'Standard' ones: examples included 'Inclusion' and 'Accessibility'.

Park and venue responsibilities

Contractual responsibilities for developing the vast Games site were very complex: there were important impacts within the control of the different venue design and construction teams, but also significant impacts, that emerged from the major infrastructure and landscape projects to manage.

A means of allocating responsibility for achieving BREEAM requirements was needed. Hence, BREEAM criteria were divided into specific 'venue' issues and then wider 'Park' issues. A third category of 'joint' issues was developed for matters requiring shared responsibility.

Several buildings will undergo transformation after the Games.



The interior of the Velodrome takes shape

Contractor, design team and client worked together to ensure Excellent was the expected outcome.

Case studies

Aquatics Centre project team

- Architect: Zaha Hadid Architects
- Specialist pool architect: S&P
- Structural and services engineer: Arup
- Contractor: Balfour Beatty

The Aquatics Centre is a significant engineering achievement. Some 2,400 concrete columns form the foundations for both the permanent and temporary structure. Concrete walls support the distinctive wave-like 160 metre-long steel roof at three points. The venue contains two 50m pools and a 25m diving pool, plus associated facilities.

The original design for the Aquatics Centre was the competition winning scheme submitted as part of the London 2012 bid. Once the bid was won, some aspects of the proposals needed to be reconsidered, including how to design flexibility into the seating capacity. Two temporary stands have been constructed for the Games. Additional credits are available in the assessment for the recycling of these elements.

The stands were designed to be constructed from bolted steelwork which allows them to be dismantled and means the steel can be reused. Rather than a traditional cladding system, the walls are finished in a fabric facade wrap. Once the projecting stands are removed, the openings into the Aquatics Centre will be closed with glazed curtain walling.

The programme was such that the design of the Aquatics Centre had to progress rapidly before the bespoke BREEAM assessment framework was in place. This was significant because the absence of the final credit list meant that an estimate of the score could not be made before the project was tendered. This in turn meant that the selected contractor, Balfour Beatty, could not be contracted to achieve Excellent and instead, their commitment was to achieve a minimum of Very Good.

Meanwhile, the design team had already signed up with the ODA to the target of Excellent. Novation of the design team to the contractor could have caused some conflict over this issue, however, contractor, design team and client worked successfully together to ensure Excellent is the expected outcome after the Games.



The completed Aquatics Centre

Rigorous value engineering was required to ensure the Velodrome design achieved a rating of Excellent within the budget.

Velodrome project team

- Architect: Hopkins Architects
- Structural engineer: Expedition Engineering
- Services engineer: BDSP
- Contractor: ISG

The venue is built on the challenging ground of a former landfill site, and its foundations have 900 piles up to 26m deep. The concrete lower bowl of the venue has 3,500 seats. Two upper tiers of seating are suspended within the two curves of the cable-net roof to give a total 6,000 seating capacity. The roof structure is covered in prefabricated timber cassettes, with birch-faced plywood on the underside and oriented strand board (OSB), a waterproof membrane, insulation and a standing seam system on top.

The design team's approach started with the budget, the team recognising that part of reducing cost would be ensuring materials were used efficiently. This was married with the architect's philosophy that the structure itself should be used as an important part of the architecture. The team took a cautious approach to estimating a BREEAM score in case cost constraints meant it was not possible to deliver all that was planned.

Feasibility studies were carried out at Royal Institute of British Architects (RIBA) Stage B and lengthy discussion took place on options for achieving Excellent measured against cost. Several rigorous value engineering

stages were required to ensure the design sat within budget. Different options for the roof were explored: The architects and engineers favoured the cable net solution, but the quantity surveyors found it difficult to put a price on such an innovative approach.

The confidentiality surrounding the London 2012 Construction Programme meant that the designers could not have the usual informal discussions with contractors and other specialists about the realities of assembling such a structure. It was only when ISG were contracted that the benefit of their experience became available and it could be proved that a cable net solution would be quicker and require less temporary structure (and therefore, be more cost effective overall) than a more traditional roof.

In July 2009 with the predicted score at 68.75 (70 is required for Excellent), an application for additional funding was made to the ODA's Sustainability Board to cover further initiatives including a water leak detection system, a compactor/baler for managing operational waste and chilled drinking-water dispensers throughout the building. As the scheme progressed it became clear that the cautious approach the team had taken to awarding credits meant the building would be on course to achieve an Excellent rating without the need to draw on all the additional funding.



The Velodrome during construction, showing its distinctive roof form

Bringing main contractors in at an early stage can help improve buildability and cost.

Getting the best out of BREEAM – lessons for industry

Prepare thoroughly

For huge projects such as these, ensure that management systems are in place prior to the appointment of design teams and contractors. The ODA and its project managers incorporated BREEAM requirements into the Sustainability Strategy and contract documents. The ODA required the Excellent rating to be achieved as part of the design briefs and ensured that where possible, specific credit requirements were built into the project management system.

Appoint an experienced BREEAM assessor at the beginning of the project, before fundamental design decisions have been taken

An assessor who understands the way bespoke assessments are developed is best placed to explain what is required of the design team, and provide feedback to BRE Global Limited where any refinements to the methodology may be appropriate.

Consider whether the target rating is achievable and at what cost

Once design teams are appointed, use the BREEAM Pre-Assessment Estimator tool to establish a consensus on the achievable rating. The assessor can generate alternative scenarios in regular reports to aid decision-making, showing when additional funds may be required and which credits offer best value for money.

Appoint contractors early and foster collaborative relationships

Bringing main contractors in at an early stage can help improve buildability and reduce cost, though contractors may be wary of committing to a given BREEAM rating. The main contractor for the Aquatics Centre was appointed at an early stage of the design when it was not possible to be confident that the Excellent rating was achievable; designs were not fully developed and only a percentage of the credits were within their direct control, with the rest coming from other site-related issues. Good communication and collaborative working between teams were required to ensure an Excellent rating was attainable.

Contractors that have systems already in place have an advantage

A number of BREEAM requirements are more easily achieved if the contractor is well prepared and has effective systems in place for managing an assessment. Many contractors have already developed internal processes for managing the construction site and dealing with waste that satisfy requirements and can identify preferred suppliers of products and materials in advance to help secure credits.

Use the flexibility in BREEAM to promote innovation

BREEAM sets standards for sustainability but is generally not prescriptive about how these are met. Designers and contractors can be encouraged to use this flexibility to develop innovative design solutions that address the particular challenges of unusual building types. In addition, it includes 'Innovation credits' to give recognition for features that achieve levels of sustainable performance, above and beyond the level currently recognised and rewarded. The Velodrome and Aquatics Centre teams sought Innovation credits relating to innovative structural design and use of a sustainable concrete mix respectively.

Identify key responsible personnel within organisations who have the power to make quick decisions

Decide who is responsible for what and set targets that reflect responsibilities. BRE Global Limited has produced guidance on integrating BREEAM with the design process¹.

Issues that are time-critical must be factored into the design process

For example, issues may require feasibility work to be carried out at RIBA Stage C (Concept Design). If the project proceeds past Stage C without a feasibility study, the opportunity to win the credit is lost.

BREEAM is designed to measure 'outcome' rather than 'effort'.

Issues that cannot be influenced by the design team can be taken off the critical path

For example, the provision of cycle racks fell outside the remit of the Velodrome project team. The location of these has yet to be fixed. However, the knock-on effect is that credits for changing facilities and showers which are the responsibility of the project team and depend on the provision of cycle racks, cannot be awarded until details are confirmed.

Consider the environmental weighting per credit to help identify the most valuable credits

In the bespoke assessment for the games, the Pollution category is not the largest in terms of the number of credits available. However, the individual credits are worth more than the credits in the Energy category, which has the greatest number of credits available.

Collect evidence rigorously and use standard templates for collecting information for issues such as travel plans

Credits are awarded on the basis of documentary evidence provided. If testing or consultancy has been commissioned, it is critical that records are properly noted in accordance with the evidential requirements.

Do not let a focus on the big construction decisions detract from the overall score

BREEAM covers the full range of sustainability issues, including softer Health and Wellbeing issues. These can be easy to overlook when value engineering focuses attention on the major construction decisions, but are important when aiming for a high score.

Balance design effort against outcome

BREEAM is designed to measure 'outcome' rather than 'effort'. Efforts will only be fully rewarded by the assessment if they can be shown to directly contribute to improved performance or give other environmental benefits. Only a single credit was available for the major effort by the Aquatics team to make the extension wings of the building demountable/recyclable.

Information management

During the project, the assessor trialled new management methods for dealing with the volume of information generated by multiple projects and has since adopted new ways of working. For example, all assessment work is now made available online rather than circulated by email or as a hard copy. Clients are able to upload evidence and other information, and download reports produced.



Only one credit was awarded for the major effort by the Aquatics team to make the extension wings of the building demountable/recyclable

Future uses of BREEAM for major events

Benchmarking the performance of buildings

The design of the Park and its infrastructure contribute significantly to the overall sustainability of the venues. Credits from the venues and the Park are combined to give the overall venue rating. In practice, this means that less than half of the overall score is contributed directly by the buildings.

The Park-wide energy strategy and Park-level coordination of Transport and Land Use and Ecology credits are good examples of areas where all venues benefited in equal measure, regardless of their own environmental performance. Separating out the performance of venues and setting targets would highlight the environmental strengths of buildings and incentivise project teams.

Park credits have taken longer than venue credits to sign off.

Lessons for other major events

The division of responsibility for Park and venue issues created some challenges

Park credits have taken longer than the venue credits to sign-off, holding up the evaluation of the final score. Initially, this led to uncertainty about the likely overall BREEAM rating and whether additional investment in measures for the venues was required.

Planning for legacy

BREEAM certification for the venues will be based on the buildings once they have been transformed for long-term use after the Games. In the period after the Games before transformation is complete, changes on or around the site may affect scoring, for example, carbon emissions may be different due to changes in energy generation methods or fuel type. These changes will have to be carefully monitored to ensure the Excellent rating remains possible.

With this in mind, it is best if the ultimate owners of the buildings after the Games can be identified early, so they can commit to undertaking any additional steps to ensure the Excellent rating is achieved.



The Velodrome with landscaped parkland in the foreground

Assessing the environmental impact of venues during the Games phase
The state of the permanent buildings after the Games has been the focus of the assessments since the majority of environmental impacts will be felt over the lifetime of the buildings. An assessment of the performance of the buildings during the Games phase would be a useful addition. The operational environmental impacts of buildings are higher at this time and are influenced by a range of unusual factors, which change or disappear once the Games are over.

Further development
BREEAM's holistic approach to the assessment of environmental issues was a strength highlighted by design teams. Feedback suggests that some additional metrics could be employed to help assess the special characteristics of these unusual types

of building. Structural and materials efficiency along with embodied impacts were two areas identified.

Future versions of BREEAM will align more closely with emerging international standards, including the new European standard: CEN/TC 350 – Sustainability of construction works. This will place a greater focus on quantifiable whole-life impacts of projects, and therefore provide clearer tracking of issues such as embodied carbon.

BREEAM will seek to combine this with the existing sustainable management and procurement aspects of the methodology and maintain the score card of best practice, which is important in highlighting tangible and measurable ways in which the sustainability of a building can be improved.

The design of the Park and its infrastructure contribute significantly to the overall sustainability of the venues.



The design of the Park was integral to the ratings of the venues

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- 1 Cinquemani, V. and Prior, J. (2010). Integrating BREEAM throughout the design process: A guide to achieving higher BREEAM and Code for Sustainable Homes ratings through incorporation with the RIBA Outline Plan of Work and other procurement routes. Bracknell, IHS BRE Press

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Related research

This research paper is a summary of a longer paper produced by the authors. Refer to the BRE website (www.bre.co.uk) for further details.



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