In a bid to meet sustainability goals, temporary venues have featured highly in the London 2012 Olympic Games. Paul May, Head of Venue Development of the London Organising Committee for the Olympic and Paralympic Games and Steve Cardwell, lead project manager for London 2012 from Atkins, describe how both organisations have helped to transform some of London’s most prestigious locations into temporary sports venues.
In 2001, the London Development Agency (LDA) was asked by the then London Mayor, Ken Livingstone, to find a potential site for the Olympic Games in London, just one of several UK cities being considered for a 2012 Olympic bid. The LDA team settled on Stratford, in the Lower Lea Valley, a region ready for regeneration. Four years later, the International Olympic Committee (IOC) selected London as a potential host city for the Games.

In preparation for the final Olympic bid, the London bid team looked back to past Olympic hosts, and saw that some cities had retained an undesirable legacy: costly venues left unused. Sustainability had to be a priority for a London bid and so the final proposal included an unprecedented number of temporary facilities and venues. These could be swiftly erected and later removed, leaving no trace of the sporting events. The IOC, keen for the 2012 Games to be as ‘green’ as possible, chose London and the construction of both temporary and permanent venues is nearly complete.

**SETTING THE SCENE**

The London 2012 Olympic and Paralympic Games have 34 competition venues spread across London and the south east. Nine new permanent venues, including the Olympic Stadium and Aquatics Centre, have already been built, while 25 temporary sporting venues, at locations including Horse Guards Parade and the ExCel exhibition centre have been prepared. The Olympic Delivery Authority was tasked to deliver all permanent venues while the London Organising Committee for the Olympic and Paralympic Games (LOCOG) focused on the temporary infrastructure.

The balance between permanent and temporary venues was determined by considering potential future use. Competition venues with a clear legacy use, as indicated by post-games business plans, are permanent ones. For example, the Olympic Stadium will continue to be a venue for sport and athletics, as well as cultural and community events after the Games, while a new mountain bike course and road-cyle circuit will be added to the Olympic Velodrome and BMX track for local community sports clubs.

Sporting venues that did not meet these legacy criteria were allocated a temporary location, to be developed in one of two ways: either by erecting a stadium from scratch or by overlaying and adding to an existing venue. Eleven new temporary venues needed to be built, including structures at Horse Guards Parade and Greenwich Park, while 14 existing venues, such as Earls Court and Wembley arena, were adapted for a range of sports. To minimise waste, LOCOG reviewed a range of recommendations from their design and engineering partners and chose to rent existing components, such as seats and tents, from the temporary events industry, and return these to suppliers after the Games.

The work on temporary infrastructure doesn’t stop at the competition venues. A host of additional infrastructure is crucial...
to the functioning of the Games. Villages for the athletes, broadcast centre, logistics warehousing, press offices, training facilities, drugs testing and other requirements take the total number of temporary venues to 140. These venues will include nearly 200,000 temporary seats, 10,000 portable toilets, 230,000 m$^2$ of tents, 122 km of fencing and 230 km of crowd barriers. The logistical planning needed for this has been formidable.

**INTO ACTION**

LOCOG developed a brief in collaboration with the International Olympic Committee based on the original bid, which included details on venue capacities and facilities. The organisation also included a host of technical requirements from individual sports bodies, such as the International Association of Athletics Federations and International Federation for Equestrian Sports. Key requirements from Games participants, including broadcasters, press, spectators and of course athletes, were also incorporated.

LOCOG’s partners – design and overlay architect team Populous and engineering design consultancy Atkins took the reins and set the final brief for each venue, converting these into initial designs. This was then passed on to the chosen suppliers who developed detailed designs in line with their existing products.

In a bid to re-use as many materials as possible, LOCOG has rented, and owns very few of the venues. At least 95% of all venue facilities are hired and then will be returned after the Games.

And with many of the venues being erected on well-loved locations, designs have also been developed alongside environmental requirements. For example, archery is the first non-cricket event to ever take place at Lords Cricket Ground, and, therefore, a ‘light touch’ temporary engineering design was required to make the most of the historic site while protecting the hallowed pitch.

After the Games, LOCOG, supported by its technical partners, will be responsible for dismantling the venues and reinstating each site to its original condition. Design collaboration and advance planning means the entire process will take weeks, rather than months.

**GREENWICH PARK**

Greenwich Park, home to the 2012 equestrian events, is perhaps the most spectacular, and indeed, the second largest venue after the Olympic Park. The venue will seat 23,000 spectators eager to watch Olympic and Paralympic dressage and show jumping events on three sides of the 80 m by 100 m field of play; on the cross country day this rises to an estimated 75,000 people. The riding and run-shoot sections of the modern pentathlon will also take place here.

When developing the venue, engineering design consultants Atkins had to consider several key features. Greenwich Park is a world heritage site and the team had to prepare over 200 drawings to deliver the environmental impact assessment to demonstrate to the authorities that the venue had been planned to minimise the impacts. The venue also had to be designed in line with strict International Equestrian Federation (FEI) regulations. They dictate that dressage and jumping events have to take place on a flat surface and that the
longitudinal fall on the field of play must be less than 1%. In addition, the surface must be firm; horses are very sensitive to vibrations and any ground movement could hamper their performance.

Atkins initially proposed three ideas. First, an earthworks solution involved levelling the park ground with soil; a second solution filled the gaps between the field of play and the sloping park ground with expanded polystyrene blocks; and a third option consisted of a scaffold and decking system, already widely used in supermarket warehouses. The system is designed to support heavy loads such as heavily laden forklifts or shelves, so why not horses and riders?

From a sustainability point of view, the team felt this third option made sense and became the preferred alternative; the volume occupied by a scaffold is a lot less than a solid deck, reducing the number of vehicle movements. Indeed, calculations indicated the embodied carbon of this solution, that is the carbon released over its lifecycle, was around half that of any other option.

**BAD VIBRATIONS**

But what about vibrations? Clearly a scaffold would not perform in the same way as a solid earthworks or polystyrene structure, but could this option be made to feel as if the riders and horses were jumping on solid ground? At this point, Atkins brought in engineers from its structural dynamics team, with experience in the structural movement of floors.

Working alongside the specialist platform designers, the team experimented with different scaffold layouts beneath the decking, altering the spacing between scaffold legs. A range of decking materials was also tried out. At each design variation, vibrations were measured using a series of accelerometers placed under the deck to measure movement. Vibrations were produced by either dropping weights or actually having horses jump onto the decking, with riders being consulted at each design iteration.

Following extensive testing, the refined design was produced. The span between the steel-aluminium scaffold legs was set at 1.5 m while steel base-plates on the ground were replaced with larger versions to spread the weight of the deck and reduce the impact on the underlying historic site.

Testing also showed that when the horses started to jump over a fence, the deck vibrated, but by the time they had landed on the other side, vibrations had stopped thanks to the damping of the structure. Indeed, vibrations during the events were low and on a par with those specified for the floor of a hospital operating theatre. Following successful field trials with horses and riders during the summer of 2010, the FEI signed off the design.

**DECKING TESTS**

Following successful field tests, the engineers’ attention turned to the structure’s surface or footings. In the test version, a 300 mm specialist equestrian surface – a composite sand, wax and recycled rubber
surface – had been laid on top of the wooden decking, providing the necessary damping effect for the structure. However, this layer did not retain enough moisture, leaving the surface so dry such that riders said the ground felt “dead”.

To counter this, the Atkins and TSG team developed a further test deck comprising 150 mm of compacted gravel beneath a 150 mm layer of the composite surface. This reduced water drainage and the riders felt that this was a much more ‘natural’ surface to ride on.

The final system can be jacked up and down to ensure an even height. And importantly, it can be rented, rapidly bolted together, and then dismantled and returned to the supplier after the Games, fulfilling legacy requirements.

Close collaboration with an advisory group comprising The Royal Parks, English Heritage, Natural England and Sport England also took place, to monitor plans and potential impacts on the park’s trees. The horses’ cross-country course has been designed and developed alongside an agricultural consultant and is regularly irrigated to maintain root systems. And portable obstacles will be used as part of the cross-country course, secured to the ground by 500 mm anchors instead of posts, to minimise ground damage.

Horse Guards Parade

During the Games, the beach volleyball competition will take place at Horse Guards Parade, off Whitehall. Sand will be brought in, creating London’s very own beach encircled by a temporary 15,000 outdoor seating bowl with views of historic sites and the London skyline.

In the recent August 2011 test event, 2,274 tonnes of sand, donated by a Surrey quarry, was delivered by 120 trucks over the course of a single day. This filled the competition court, two warm-up courts and two training courts. The test event was a success and for the 2012 Games, 3,000 tonnes of sand will deposited over the same courts.

Horse Guards Parade itself dates from 1745 and is an essential component of London’s ceremonial life, hosting the Trooping the Colour which takes place on the Queen’s official birthday every year. This year will see the Queen’s Diamond Jubilee celebrations taking place at the site, leaving LOCOG and their technical partners 36 days to set up the temporary venue and support buildings while ensuring that this busy part of London keeps moving. As a result, the team felt that the best approach was to contract a single design-and-build supplier that could respond quickly to requirements.

The venue comprises a lower bowl, providing what architects Populous describe as a ‘high energy’ atmosphere, close to the sports. Meanwhile a three-sided upper bowl opens out over central London, providing spectacular views.

The temporary structure is a similar in size to Wimbledon’s Centre Court and will be constructed in a modular fashion to make construction as straightforward and fast as possible. Standard components are being rented from the temporary events industry, which will later be returned for later use in other locations.

Seating stands have been routinely erected on Horse Guards Parade for years, so while minimal impact is crucial, the site is less sensitive to these structures. However, other environmental aspects have been considered.

The events continue into the night, so a high powered lighting system – providing light levels of around 1,500 lux and consistent with the requirements for high-definition television broadcasting – is a must. Outdoor noise can be expected; Atkins has developed plans to manage noise and mitigate unwanted lighting wherever possible.

Wind monitoring is also crucial at this site as well as at the other temporary venues. For example, as with most structures, the scaffold-type seating stands are vulnerable to wind, and, in addition, many of these as well as other components – from broadcast towers to pedestrian bridges – are wrapped in Olympic logo fabric, increasing the wind loading on these structures. And so, anemometers, equipped with wireless transmitters, will be placed in venues with more susceptible structures. These will send information back to a central communications core via the local mobile network.

After the Games

Post-games, the temporary structures will be dismantled leaving no indication that tens of thousands of people gathered to watch an Olympic sport.
Olympic Games could help to close the gap and develop best practice to the benefit of both. Past temporary events have not needed the rigorous planning, building and environmental regulations that permanent structures must meet; this one, however, must. From noise control at Horse Guards Parade to tree protection at Greenwich Park, the Olympic Games now provides a framework for achieving permissions that the temporary events industry can use in the future. Temporary structures can last from a few weeks to a few years; if this is recognised, unnecessary and unsustainable permanent builds could become a legacy of the past.

**BIOGRAPHY**

Paul May is the Head of Venue Development at LOCOG. His team is responsible for ensuring the successful delivery of all competition and non-competition venues for the London 2012 Olympic and Paralympic Games. This has included working in partnership with the ODA across their programme of works on the permanent venues as well as delivering the multitude of temporary venues and all event ‘overlay’ required for the successful operation of the Games. Paul May is a Chartered Surveyor with a background in construction and property development. Prior to joining LOCOG he held the position of Estates Director for ExCeL, the major events venue in London Docklands.

Steve Cardwell, lead project manager for London 2012 for Atkins, has worked in the construction industry for over 30 years working for contractors, local authorities and for the last 20 years with Atkins. He started work on the Olympics prior to the Host City announcement in 2005 when Atkins was bidding for the Olympic Park infrastructure design contract and worked on the project through to Games time.

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*Players take part in the VISA FIVB Beach Volleyball International and Test Event for the London 2012 Olympic Games and part of the London Prepares series, August 2011 © LOCOG.*