

Proceeding Paper

# Deconstruct, Don't Demolish: An Overview of Rio de Janeiro in 2016 and London in 2012 as Olympic Host Cities <sup>†</sup>

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**Abstract:** The buildings that house the events, which serve as icons of this most famous sporting event, must now be sustainable as well. Stadiums, arenas, gathering places, and athlete communities are all changing from expressions of architectural brilliance to instances of sustainable environments, built to last long after concluding the event and to aid in the redevelopment of the metropolitan areas that host them. The building business is one of the most environmentally destructive in the world since it directly affects how raw materials are used, and how they are determined to be used during their entire existence. This sector, however, is still in the early stages of transition from a linear to a circular economy. To minimize total resource use and landfill trash, business models must be updated to incorporate novel concepts and cutting-edge services. According to this approach, “deconstruction” plays a crucial role in the circularity of structures. It serves as a sustainable substitute for traditional demolition, which is generally an arbitrary and destructive process that, although being quicker and less expensive, typically produces a substantial amount of garbage. On this line, the goal of this research is to revisit the Olympic Games hosting cities, mainly London and Rio de Janeiro, and examine the possibility of the demolition of built infrastructure in the Olympics and to provide methods for minimizing its effects on the urban environment. The research paper aims to make it easier to implement circular economy strategies for buildings by outlining the key principles that must be followed throughout the design and planning process regardless of the kind of construction system or material employed and by recommending deconstruction as a sustainable alternative to demolition. By collaborating with the corporate, academic, and research sectors, we can further emphasize the sharing of information.

**Keywords:** sustainable environment; construction industry; circular economy; deconstruction



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## 1. Introduction

Since the first modern Games in Athens in 1896, the Olympic Games have left host towns with a terrible legacy, with few cities successfully repurposing the game infrastructure [1]. The Olympic towns in Rio de Janeiro and Athens are still abandoned, failing to deliver on the Games' promises of reviving metropolitan areas, while the Beijing National Stadium struggles to fill its 80,000 seats. Due to worries about how the Olympics will affect local companies, neighbourhoods, and public transportation, London experienced substantial anxiety before to the 2012 Summer Olympics. The post-Olympic efforts to reuse previous venues, such the Athlete's Village, fell short of expectations, and locals worried about more strain on already frail systems. Los Angeles is putting into action a 20-year urban plan to overhaul its transit system after winning the 2028 Olympic bid in 2018. A replacement for the current water infrastructure that is sustainable is also promised, along with increased communication and access. However, there are still worries that construction may put short-term demands for the Games ahead of long-term municipal needs, escalating tensions among residents.

In order to maintain a delicate balance, the Olympic host city must use a proactive strategy known as “anticipatory urban development,” a generative-design model that adapts when new variables and regional restrictions change. A more flexible metropolis is ensured by this flexibility, which removes the need to second-guess for unfavourable eventualities. Construction positions may be redesigned as design processes advance, such as a Dynamic Resourcing Supervisor overseeing projects in the Greater Los Angeles region. Robotics might increase production and predictability everywhere from the assembly line to the building site. Distribution of supplies, tools, and labour among several building sites may be made more efficient by automation in a Dynamic Resourcing Supervisor job [2]. Through the use of a centralised platform, the procedure may be expedited and made more effective, resulting in less waste and a symmetrical supply and demand pattern throughout the city. Additionally, this strategy can lower resource waste and increase the general effectiveness of building projects.

In order to educate about development and “decode data” for citizens, data advocates can close the gap between the public sector and private individuals by collaborating with the community, local government, and the International Olympic Committee (IOC) [3]. They may work together to specify resources and comprehend the effects of retrofits with professionals like Intelligent Retrofit Engineers. Managing public opinion requires this function to be vital. For the Olympic design and construction process, the IOC may encourage realistic financial planning, boost transparency, and promote sustainable investments. The results for host cities might drastically alter by redefining the Olympics as a chance for local authorities to achieve regional transit and infrastructure goals and by improving people’s access to data-driven insights. The IOC intends to encourage practical financial planning, openness, and sustainable investments in the design and construction of the Olympic Games, which could change the outcomes for the host city by assisting local authorities in achieving their goals for the region’s transit and infrastructure and enhancing data-driven insights. Planners may work with design and construction teams and manage complexity with the use of generative design technologies. The Olympics project is a chance for the master-builder team to put this method to the test. Using generative design, an adaptive reuse strategy may be created by fusing business metrics and resource restrictions.

Along with sport and culture, the International Olympic Committee has advised Tokyo to include sustainability in every facet of the Olympic Games. However, given Tokyo’s limited resources and probable cost overruns, incorporating sustainability programmes into the Olympics might be difficult and expensive. Increasing sustainability requires cost optimisation as well. Cost reductions may be delivered while concurrently achieving sustainability, and the two goals can work together to do so [4].

Low-energy, low-water, low-maintenance, and low-repair cost structures are more sustainable. Waste landfills are eliminated by well-designed recycling programmes, which also enable firms to reuse products for a fraction of the price of new ones. Long-term and short-term expenses are reduced by well-designed sustainability programmes, which help protect the environment’s resources and have a positive social impact. Strategies for the circular economy seek to maximise resource utilisation, value extraction, and material recovery in order to save costs over the long run and preserve the environment, while also encouraging material recovery and regeneration.

In a circular economy, resources are used for as long as possible, their greatest value is extracted while they are being used, and at the end of their useful life, they are recovered or recycled into new goods and materials [5]. According to BBC (2016), a mobile may be repaired using the original components after four years of usage for a price that can be as much as 50% cheaper than buying a new model built of the same components. By lowering enterprises’ bargaining strength and shielding them from fluctuating commodity prices, a circular economy enables development to be independent of resource limitations. Companies like Boeing, General Electric, Jaguar, Renault, and Phillips have successfully implemented circular economy strategies in the private sector, and there is a tonne of case studies that back up this claim. Due to the enormity of the Olympics, governments may

use Circular Economy ideas to projects, particularly big-scale events like the Olympics, which will result in considerable cost savings compared to conventional private sector approaches. Construction, design, transportation, lodging, food, energy, and waste management are some of the crucial areas where the Tokyo 2020 Olympics may benefit from circular economy ideas.

The essay covers the use of maintenance architecture, adaptive reuse, and cyclical heritage in architectural preservation [6]. In opposition to the tendency of professional football teams migrating to suburban areas, which disrupts the social and environmental elements of stadium renovation, Tynecastle Park is chosen as an illustration of socially sustainable alternatives. The inner-city location and continuing restoration work being conducted by a multidisciplinary team at Stadio Flaminio are the reasons it was chosen. A distinctive and pragmatic method, centred on historical values, architecture, social and sporting considerations, and circular economy concepts, goes into the restoration of a historic football stadium. After a decade of idleness, the renovation intends to reopen the stadium and highlight the value of sustainability. By encouraging reuse, repair, refurbishing, remanufacturing, and repurposing of existing things, circular heritage focuses on maximising value in economic, social, and cultural aspects for the longest period [7]. It promotes a long-term view of heritage by opposing the desire for new things and working to recycle and restore dilapidated structures [8].

### *1.1. 1900–1940: Rise of The Modern Stadium*

Stadium construction was a common practise in ancient Greece and the Roman empire. In the 1890s, Pierre de Coubertin tried to bring back the Olympic Games, but he could not find an open-air “athletic stadium” in Europe. At the start of the 20th century, the first wave of new stadium construction was spurred by the Olympic movement, the expansion of European soccer, and American baseball. Stadiums were originally just plain fields with wooden grandstands. The White City Stadium in London, which opened in 1908 and had a sports pitch and a visible steel structure, revolutionised stadium architecture. It was constructed in 10 months at a third of the price of stadiums made of stone or brick at the time. The stadium had a pool for diving and swimming. Early collegiate football stadiums in the US sought to imitate the Roman Colosseum, therefore White City’s steel frame design was not generally adopted. In the 1920s and 1930s, authoritarian, fascist, and communist administrations constructed huge stone stadiums to encourage large crowds and charismatic leaders [9].

### *1.2. 1940–1980: Multipurpose and Enclosed Stadiums*

Stadiums after World War II were generally surrounded by fans watching teams from their cities or regions play. In order to operate year-round in less hospitable conditions, multifunctional stadiums made of concrete were created. With stadiums built for convenient highway access and orderly spectator behaviour, function was valued over form. With its enclosed and roofed architecture, the Houston Astrodome, which first opened in 1965, signified a dramatic change in stadium design. It had a climate control system and a synthetic Astroturf playing surface. Often referred to as the “eighth wonder of the world,” it was one of a new breed of multi-use stadiums made to accommodate baseball, American football, concerts, and other events. It was one of the first stadiums to feature luxury suites and cushioned seating, with 42,217 seats and 30,000 parking spaces [8]. Air-inflated stadiums became more common in the 1970s, beginning with the Pontiac Silverdome in Michigan. These stadiums eventually had to be abandoned due to weather-related issues. The age of multifunctional stadiums was convenient, but spectators disliked it since the stadiums were removed from their local towns and the concrete bowl shape was monotonous for die-hard supporters. Around some teams, a “parking lot culture” developed [8].

### 1.3. 1980–2020: New Urbanism, Environment, and Experience

Stadiums encountered difficulties in the early 1980s because of declining television commercial income, unsatisfied fans, and the need for smaller, better-equipped structures. Football experienced similar problems owing to stampedes and crowd panics, which resulted in fatalities and injuries, and concrete bowl stadiums went out of favour. Opening in 1992, Oriole Park at Camden Yards revolutionised American baseball stadiums by combining historical aspects, blending in with the surroundings, and aiding in the urban regeneration of Baltimore’s Inner Harbour neighbourhood. Fans frequently choose it because of the old warehouse and human-scale landscaping that were made possible by its placement below street level. In the three decades that followed, similar vintage stadiums were constructed all throughout the US. Environmental concerns drove stadium developments in the 2000s. In order to heat and cool Beijing National Stadium, also known as “the Birds Nest,” a geothermal system and a rainwater collection system were installed. With 8844 solar panels covering its roof, Kaohsiung Stadium in Taiwan, when inaugurated in 2009, was the first stadium to run entirely on solar energy [9].

In order to host the FIFA World Cup in 2022, Qatar is building seven new stadiums that incorporate community and environmental improvements. These stadiums include near-term plans for sport, retail, residential, and commercial sectors, and they are connected to existing communities or may be used after the event [10]. The Global Sustainability Assessment System (GSAS) and other environmental requirements are met by each stadium. A flawless 5-star rating was given to the newly finished Education City Stadium for its utilisation of energy, water, interior environment, site impact, recycled materials, urban connectedness, and community involvement. After the advent of new technology in the year 2000, stadiums have emerged as important hubs for the “experience economy,” with enhanced connection, digital interactives, and experiential elements. The 70,000 square foot “Oculus” display and different media-sharing capabilities for spectators will be available at SoFi Stadium in Los Angeles, which is a component of a \$5.1 billion sports and entertainment complex. These innovations seek to mellow and personalise the experience of large stadiums [11].

## 2. Potential Circular Economy Strategies for Overall Construction and Design

The expected cost of the Tokyo 2020 Olympics is \$18 billion, of which \$6 billion will go into building facilities and infrastructure. This budget is comparable to that of London 2012 and is four times that of Rio 2016’s final budget. Nevertheless, this substantial capital investment offers chances to use circular economy techniques to cut expenses over the long run and boost sustainability as shown in Table 1. The general layout and architecture of the athletic arenas, buildings, and structures for Tokyo 2020, as well as the surrounding infrastructure, might provide significant room for improvement [3].

**Table 1.** Overview of circular economy techniques in architecture and construction.

Where Can This Be Applied? Stadiums, Buildings, Facilities, Infrastructure	Apply Modular Design and Construction Methods	Apply Lean Design Principles	Promote Material Reuse	Build to Last
How can this strategy be applied?	To reduce post-Olympic trash, develop temporary venues and structures that can be dismantled and reused. To reduce onsite waste, employ offsite and modular construction as well as promote compact structure designs for improved energy and material efficiency.	The text makes recommendations for reducing waste through building design optimisation, using lightweight materials and structures for temporary venues, using virtualized process modelling to reduce logistical conflicts during construction, and working with creative companies to create unconventional designs in order to lower project costs.	Reuse resources from temporary Olympic constructions, construct structures out of recycled materials like crushed concrete, and make facades out of waste wood.	Older areas should be revitalised, and luxury condominiums should be constructed for displaced people, using the Olympics as a catalyst. Permanent structures should be LEED certified, have a post-Games usage strategy, and be constructed with that use in mind.

Table 1. Cont.

Where Can This Be Applied? Stadiums, Buildings, Facilities, Infrastructure	Apply Modular Design and Construction Methods	Apply Lean Design Principles	Promote Material Reuse	Build to Last
<b>Financial, social, environmental benefits</b>	The initiative decreases overall expenses, buys time, and lowers carbon emissions.	Virtual modelling was used at London 2012 to reduce logistical problems and make it easier to dig holes for stadium building. Only 10% of the steel used in Beijing 2008's main stadium was used in London 2012's light, steel framework. The Dutch headquarters of Liander worked with a business that makes roller coasters to develop a "hollow" steel roof that is structurally sound and reduces the use of steel by 30%.	By generating as much construction waste from building and waste processing as possible, the carbon footprint is meant to be reduced.	The suggested remedy enhances public confidence, lowers long-term building and maintenance costs, and leaves a less carbon imprint.
<b>Successful examples</b>	The Rio Committee Head Office for Rio 2016 was constructed in under six months, using pre-molded steel constructions, and will be dismantled after the event with 80% of its components going into new installations. To reduce construction waste, offsite, modular building was used in <b>London in 2012</b> .	<b>In Athens in 2004</b> , the choice of fixed venues rather than foldable ones resulted in real costs exceeding the budgeted budget.	<b>In London 2012</b> , 104,000 tonnes of recovered crushed concrete were utilised again, saving £1 million and averting the need to import new materials by lowering the number of truck trips by almost 20,000. Only 10% of the steel used in Beijing 2008's major stadium was utilised in <b>London 2012's</b> light steel framework. 50% of the internal facade of the <b>Liander main office</b> in the <b>Netherlands</b> was lined with improved scrapwood.	In order to improve <b>infrastructure, Rio 2016</b> built new water, sewage, energy, and telecommunications networks as well as walkways, street lighting, and landscaping in key districts. All new, permanent structures that are now <b>LEED-certified</b> were built for <b>Rio 2016</b> . Families impacted by construction were transferred to upscale condos like Parque Carioca in <b>Rio 2016</b> , minimising unhappiness and offering a viable alternative for long-term rehabilitation.

### 2.1. Apply Modular Design and Construction Methods

By enabling temporary structures to be dismantled and used after the Olympics, modular design and construction methods may greatly decrease construction waste and post-Olympic ruins. This improves the efficiency of the whole construction process. Along with temporary constructions intended for deconstruction and reuse after the Olympics, modular design emphasises the value of planning and constructing buildings/structures by their constituent components.

### 2.2. Apply Lean Design Principles

In order to save material costs, lean design concepts place an emphasis on hollow, light-weight structural design for buildings. Buildings' structural designs should be thin and hollow, minimising the usage of big, solid chunks of weighty materials.

### 2.3. Promote Material Reuse

By not throwing away recyclable resources, the reuse of materials in new construction lowers costs and waste. Because it reduces the amount of recyclable materials that need to be disposed of, using recycled materials in new construction is essential for cost savings and waste reduction. Reuse after the Olympics modular design emphasises the value of planning and constructing buildings by their constituent of different component.

### 2.4. Build to Last

Considering future usage and minimal maintenance costs while selecting buildings and structures for long-term use. By ensuring that all permanent structures are LEED-certified, the most widely recognised accreditation for sustainable buildings, this offers a chance to revitalise older urban neighbourhoods. In order to rejuvenate older districts, pick

permanent structures with minimal maintenance requirements and frequent future usage. Aim for 100% LEED certification.

### 3. Conclusions

According to the report, worldwide societal change has led to more environmentally friendly sports venues, which is important for environmental activists. Architects contend that their impact is constrained because politicians are subject to social pressure from their supporters, activists, and constituents. The use of a team's environmental commitment might promote the use of sustainable design in athletics. The most efficient ways to make this link are not yet understood, though. Examining successful implementations, the research looks at how sustainable stadium designs are being adopted by facilities. Future studies should look at the reasons taken into account when rejecting sustainable measures while building new stadiums that do not adhere to environmental regulations. It is essential to comprehend how societal change affects green construction. The study also looks into the factors that influence decision-making when it comes to adopting sustainable design, such as cost analysis, owner willingness to accept cost surcharges, and main sources of support and resistance. Interviews with decision-makers and team members may provide further light on environmentally friendly programmes. This study investigates the relationship between the environmental movement and environmentally friendly sporting facilities. According to those who participated in the interviews, growing public awareness in environmental stewardship had an impact on early adopters of sustainable stadium designs. Additionally, they think that praise for the first environmentally friendly sports facilities will inspire fans and athletes to transform society. The project seeks to add to the body of knowledge already available on sport, social change, and the environment. According to evidence from architects, facility owners choose ecologically sustainable technology for a variety of reasons. Advocates must be flexible and thorough, illustrating societal change as a driver and result of sustainable design, depending on the perspectives of different decision-makers, to boost the adoption of eco-friendly facilities in sports.

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