

Investigation into Chinese Olympic Village Green Initiatives: A Look at the National Stadium and National Aquatics Center

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Abstract— Environmental sustainability often involves green building standards such as those detailed by a LEED certification. Previous research has determined a trend of “going green” to be an international phenomenon within new building and reconstruction projects. Countries such as the United States have gone so far as to integrate green initiatives into major building projects including sport venues. Green trends have also been forefront in many aspects of the Chinese governments building initiatives, yet no research specific to green initiatives as they pertain to sport and athletic facilities was discovered. As recent and future hosts of the Olympics, LEED offers an amazing platform for Chinese leadership to demonstrate their environmental initiatives. Therefore, a study to investigate the use of environmental initiatives (such as those found with the LEED guidelines) within sport venues in China was proposed.

Specifically, the purpose of this study was to examine sport venues in China to gain deeper insight in the integrated environmental sustainability initiatives. Methods included online site review and research, site visits to the major Olympic venues in Beijing, and interviews with Beijing Sport University faculty members. This research project explored the deliberate actions (or lack thereof) of Chinese sport stadium construction and management teams to integrate these green standards into their newly constructed facilities; specifically the National Stadium (Birds Nest) and National Aquatics Center (Cube) which are located at the 2008 Olympic Green in Beijing, China. This investigation highlighted the opportunities China has as they prepare to host another Olympic event in 2022.

Keywords— Chinese sport, Environmental sustainability, going-green, LEED certification, sport venues.

I. INTRODUCTION

Environmental sustainability often involves green building standards such as those detailed by a LEED certification. Previous research has determined a trend of “going green” to be an international phenomenon within new building and reconstruction projects. Countries such as the United States have gone so far as to integrate green initiatives into major building projects including sport venues.

As recent and future hosts of the Olympics, LEED offers an amazing platform for Chinese leadership to demonstrate their environmental initiatives. This research project will explore the decision of China to integrate these green standards into their newly constructed sport facilities; specifically the National Stadium (Birds Nest) and National Aquatics Center (Cube) which are located at the 2008 Olympic Green in Beijing.

II. LEED INFORMATION

In 2000, the United States Green Building Council launched the Leadership Energy and Environmental Design system, known as LEED. The LEED system consists of a certification rating system that examines facility design, construction, and operation by which a facility could qualify for one of four certification levels: Certified, Silver, Gold, or Platinum. The rating system was designed with the five credit categories of sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality; with bonus points offered for innovation and design. Since its inception, LEED has become an internationally recognized green building certification system providing third-party verification that a building integrates environmentally friendly strategies often utilized to increase resource development opportunities (Huberty, 2013).

A. Sport Facility LEED Trends in the United States

The increased commitment to sustainable facilities has also been seen in sport facilities in the United States. Over the last decade, sport facility managers have invested in environmentally friendly projects by building venues that meet LEED Certification guidelines. Firstenburg Community Center in Vancouver, Washington and Carbondale Recreation and Community Center in Colorado are examples of community sport and recreation facilities where leadership committed early in the design and build process to LEED guidelines.

Several collegiate athletics programs have also chosen to adhere to these green initiative as seen at the University of Minnesota, Duluth with AMSoil Arena and the LEED Gold Recreation Center expansion project at Colorado State University. Within professional sports, Major League Baseball (MLB) has integrated LEED standards into their major projects as well as several National Football League (NFL) franchises including the Minnesota Vikings US Bank Stadium in Minneapolis, Minnesota and the 49ers Levi Stadium in San Francisco, California.

B. Environmental Initiatives in China

In the mid-2000s the Chinese government developed and implemented an aggressive green building campaign (Zhou, 2015). “After a 2007 meeting with the US Environmental Protection Agency, the Chinese General Council launched the EPA-China Environmental Law Initiative to facilitate discussion on ways to foster environmental legislation and regulation” (Zhou, 2015, p. 335). By employing this government-centered approach, the country went on to experience a remarkable growth of green building projects. Research surrounding the employment of LEED standards in China uncovered illustrations where leadership encouraged environmental initiatives (Low, Liu, & Wu, 2009). Such projects have focused on office buildings, commercial buildings, and other general new construction and renovations projects. Overviews and results of two particular studies with sustainability foci are highlighted.

Lo, Hui, and Zhang (2014) detailed the benefits derived from sustainable buildings in China. The focus of this green feature inventory was office buildings touting energy efficiency. The survey found most building tenants to be “concerned with sustainable operations, practices, and policies” (Lo, Hui, & Zhang, 2014, pg. 337). These tenants were from 12 of the 40 green buildings in the City of Shenzhen, PRC; four of these 12 are LEED certified. Common benefits identified included higher occupancy rate and rent and higher rental rates as compared to conventional office buildings, along with an enhanced public image of the tenant companies. Also, lower utility expenses means energy savings and lower monthly expenses. Fifty-seven percent of those surveyed noted a higher level of employee productivity since moving into the green office space, as well as a fewer sick leaves (Lo, Hui, & Zhang, 2014).

Diamond, Ye, Feng, Yan, Mao, Li, Guo, and Wang (2013) examined green initiatives within commercial buildings throughout China.

These investigators noted commercial building growth in China to be “...two billion square meters per year, with considerable interest and activity in green design and construction” (pg. 639). These buildings remarkably incorporated the Shenzhen Institute of Building Research (IRB) designs of over 40 sustainable technologies and strategies. These actions were said to be part of the China 2007 program entitled “100 demonstration projects of green buildings and 100 demonstration projects of low-energy consumption buildings” (pg. 640). At that time, China charged that more than 80 percent of new public development involving government monies needed to be green (Diamond, et al., 2013). This commitment demonstrated the Chinese governments’ commitment to addressing environmental issues. Since 2007, noteworthy efforts have been made involving HVAC systems and zoning, natural ventilation, hot water systems, and lighting. Ultimately, these strategies hope to lead to both energy savings and emission reduction.

These studies highlighted examples where the Chinese officials have successfully implemented environmental initiatives to address their recent rapid economic expansion (Dooley, 2008). This evidence supports how the 2007 EPA-China Environmental Law Initiative, launched by the Chinese General Council, has been successful in facilitating discussions surrounding environmental legislation and regulation. The trends resulting from these discussions has been a step forward in the promotion of green initiatives within this country.

III. METHODS

Previous studies pertaining to environmental initiatives in China highlighted examples where the Chinese officials have successfully implemented environmental initiatives to address their recent rapid economic expansion (Dooley, 2008). While these green trends have been forefront in many aspects of the Chinese governments building initiatives, no research specific to green initiatives as they pertain to sport and athletic facilities was discovered. Therefore, a study to investigate the use of environmental initiatives (such as those found with the LEED guidelines) within sport venues in China was proposed. The purpose of this study was to examine sport venues in China to gain deeper insight in the integrated environmental sustainability initiatives.

Due to the vast geographic size of China, the City of Beijing was the focus of this study; specifically the two most famous venues of the total thirty-one 2008 Olympic venues: The National Stadium and the National Aquatics Center.

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As the previous host of the 2008 Olympics and future host of the 2022 Winter Olympics and Paralympics, Beijing offered relevant insight into previous green initiative commitments by the country's leadership. This investigation included document review, site visits, and personal communication with Beijing Sport University Professor, Dr. Liu. The aim of these methods was to capture information on the environmental initiatives employed within these two sport venues.

V. FINDINGS

The National Stadium, also known as the Bird's Nest, was the 2008 Summer Olympic Games' most striking structure (Arup, 2015, para. 1). "The circular shape of the stadium represents heaven, while the adjacent square form of the National Aquatics Center (Water Cube) is a reflection of the Chinese symbol for Earth" (Arup, 2015, para. 2). Additionally, the National Stadium and National Aquatics Center will be central to the 2022 Winter Olympics and Paralympics which will be held in Beijing. These two arenas were the focus of this investigation.

The National Stadium: The National Stadium is better known as the Birds Nest due to its unique design. The Birds Nest cost \$423 million and took five years to construct. According to the Travel China Guide website (www.travelchinaguide.com/attraction/beijing/national-stadium) the Olympic events of track and field, football, gave lock, weight throw, and discus were held within the National Stadium. Included in this massive building project were several environmentally sustainable initiatives ("A green Bird's Nest", 2008). Such features included a 24 hour-per-day rainwater collector that moves the water through a purifier and back into use within the stadium, geothermal heating and cooling systems with pipes running under the playing surface, and eco-friendly ventilation systems (Birds Nest, 2008).

Polyurethane foam insulation using Honeywell's Enovate blowing agent is helping to insulate China's National Olympic Stadium, and the blowing agent supplier says this is "the first such use for a major public building in the region" (BIRD'S NEST STADIUM USES PU MATERIALS, 2008, p. 1). According to Honeywell, the insulation technology will "help meet strict energy efficiency and environmental guidelines required by government construction authorities, as well as international Olympic construction guidelines regarding environmental protection."

The energy-efficient insulation is used on walls for seating areas for the more than 90,000 spectators within the stadium. "Closed-cell spray foam insulation using Enovate is rapidly being adopted globally," said Ken Gayer, global business director for Honeywell's foam insulation blowing agents, in a company statement. "Honeywell is honoured that our technology will be a part of such a high-profile event like the upcoming Beijing Olympics" (BIRD'S NEST STADIUM USES PU MATERIALS, 2008, p. 2).

The National Aquatics Center: The National Aquatics Center was the official 2008 Olympics swimming facility. This sport venue took five years to construct at a cost of \$100 million (Moolman, 2007). And featured pools for the Olympic swimming and diving competitions, along with seating for 17,000 spectators (Moolman, 2007). The architects on this project received special awards and recognition for the stunning design which featured ethyl tetra fluoro ethylene (ETFE). ETFE is a recyclable material predicted to maintain its durability for over 20 years. This material offers the benefit of filtering in more light than glass, and maintains its shine with each rainfall. Furthermore, Moolman (2007) mentioned ETFE's unique ability to insulate the facility, allowing it to operate more efficiently throughout the extreme climate changes of Beijing. Moolman (2007, p. 24), Coonan (2008, p. 1), and Zou et al. (2008, p. 176) termed to the Water Cube as a "Giant Greenhouse" offering a 30% reduction in energy consumption and up to 55% savings on lighting energy. Other environmentally sustainable initiatives included solar energy utilized to heat the interior spaces and the pool water, variation shading, and recycled rainwater and pool water filtration systems. After undergoing facility renovations, current functional zones within the National Aquatics Center include a themed indoor water park, spa, restaurants and bars, and several souvenir gift shops.

Both of these Olympic sport facilities were built with creative designs and environmentally friendly features in mind. However, when it comes to green initiatives, Dr. Liu, a renowned Sports Professor at Beijing Sport University, predicted that the 2022 Olympics will offer China an even better platform in which to showcase their green efforts. Dr. Liu described the environmental sustainability initiatives within the National Stadium and National Aquatics Center as "not a conscious effort by the Chinese Olympic Committee" (personal communication, May 23, 2016).

Although the literature review reported green efforts, the site visits to each of these venues uncovered no obvious evidence of these environmental sustainability with the exception of recycling containers through the sites.

VI. DISCUSSION AND CONCLUSION

This study began with a definition of the popular LEED certification process often used across the world for new building developments to promote environmental sustainability. Evidence detailed how the United States has chosen to include such green standards in several sport venue projects. Green trends have also been forefront in many aspects of the Chinese governments building initiatives, yet no research specific to green initiatives as they pertain to sport and athletic facilities was discovered. Beijing, China is the only country ever to be chosen to host the summer and winter Olympic Games. Therefore, a study to investigate the use of environmental initiatives (such as those found with the LEED guidelines) within sport venues in China was proposed. Specifically, the purpose of this study was to examine sport venues in China to gain deeper insight in the integrated environmental sustainability initiatives.

After researching the two Olympic sport facilities in China, the Birds Nest and the Cube, is evident that Chinese leadership did make environmental friendly efforts within these venues. Although, some put environmental initiatives have been implemented, BSU faculty stated this was not a top priority for the 2008 Olympic Games. Based on feedback from Dr. Liu, the 2022 Olympic Games facility construction projects will be different (personal communication, May 23, 2016). The Chinese government has already committed to focus both on economic and environmental sustainability. Recent feedback by Xuefei, R. (2008) revealed underlying support for global architecture among political elites in China which directly influenced local cultural discourses and politics. This research supports further integration of environmentally friendly amenities into sport stadiums such as those being constructed in China.

Recommendations for future studies include a post 2022 Olympics investigation to record the environmental initiatives incorporated into the new venues. A comparison of what the 2008 and 2022 Olympic venues offered could then be conducted to identify progress made in this area for the Chinese government. Furthermore, previous Olympic host sites around the world could be evaluated for green trends.

Although the LEED certification offer a standard set of guidelines by which to do these evaluations, other standards could be considered.

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