

Green Olympics, Sustainable Buildings

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ABSTRACT

The Olympic Games of Beijing in 2008 will be the opportunity for China to take the reins as an international leader in sustainable development, aiming at realizing Green Olympics, enhancing sustainability of the city and ensuring to create sustainable and unique buildings for Beijing, China and also the Olympic movements. The main objective of this research is to investigate the impacts of 2008 Olympic Games in promoting sustainable buildings. Since 2001, 13 stadiums and gymnasiums have been built through three Green Olympic guidelines—Greenery, Culture and Sustainability. The concept of Green Olympic has led the overall sustainable development of Beijing, such as the sustainable transport, environment improvement, and public awareness of sustainable issues. It has accelerated the development of sustainable buildings in Beijing, not only in those huge scale athletic infrastructures, but also the sustainable utilization of current buildings. So that, how to make good use of those infrastructures in the long run and integrate them into people's daily activities, how to promote sustainable buildings by public sport and how to ensure huge scale of construction sustainable should also be taken into account.

KEYWORDS: Green Olympics, Beijing, sustainable buildings

1. Olympic and China

On June 20, 2000, Wang Wei, Secretary-General of the Beijing 2008 Olympic Bid Committee, formally turned in Beijing's bid questionnaire report to the International Olympic Committee (IOC) in Lausanne, Switzerland. This report answered the 22 questions raised by the IOC and stated plans for and ideas on Beijing's preparation for the 2008 Olympic Games, initiating “Green Olympics, Scientific Olympic and Humanity Olympics ” as three strategic concepts.

From the very beginning of China's application, it has fall to promoting every step of national affairs in the light of Olympic Games. Frankly to say, Olympic is changing all in China. For example, a little girl in Beijing said, she used to have a habit, which is to take two long-time showers every day. It was a big waste of water. One day, She saw a piece of news in Beijing Daily that about the lack of the Beijing water resource. Its said every year Beijing use up about 3.7 billions cubic meter of water. But Miyun reservoir only contains 0.77 billions cubic meter of water, and Guanting reservoir only contains 0.19 billion cubic meter of water. The Paper called for saving water for Olympic Games. After reading this news, she started to change her habit, and only take one quick shower each day. Further more, she have calculated that if everyone economizes one cubic meter of water during they are taking the shower in a month; the Beijing citizens will economize 14 million cubic meter of water in only one month.

So it is easy to see, Chinese people always appreciate the purposes and principles of Olympic ideal, support the efforts of Olympic Games to promote world development. The Chinese Government

and people are doing our the utmost to prepare for the 2008 Olympic Games in Beijing, and shooting at the pageant with advocating Olympic ideal, sparkplug world peace and enhancing the relationships among the world. Olympic spirit is going to spread again in orient cultural ancient China. In addition, the government and people of China have always admired the purposes and principles of the Olympic spirit and supported the efforts made by the Olympics in promoting world peace. The Chinese government and people are doing our utmost in preparation for the 2008 Olympics in Beijing. It is our hope to make it a grand gathering that will carry forward the Olympic spirit, promote world peace and enhance the friendship among people of the world, so that the Olympic spirit will flourish once again, this time in China, an oriental country with an ancient civilization.

2. WHY GREEN OLYMPIC ENHANCE CHINA'S SUSTAINABLE BUILDINGS

2.1 Green Olympic

“Green” was prioritized in Beijing Olympic concepts for two reasons. On the one hand, gets more concerns with the development of globalization. As a worldwide organization, International Olympic Committee (IOC) highlighted environmental protection in Olympic Games principles and put strict rules in selecting Olympic cities, which includes: obeying Environmental Law and international guidelines, handing in environmental impact assessment report, environmental improvement report, garbage disposal/ air quality/ noise pollution improvement plans, and transport improvement strategies, etc. According to Olympic Charter (2004), the mission of the IOC is to promote Olympism throughout the world and to lead the Olympic Movement. One of its roles is ‘to encourage and support a responsible concern for environmental issues, to promote sustainable development in sport and to require that the Olympic Games are held accordingly’ (Olympic Charter, 2004, pp12). Therefore, environmental protections are huge concerns among every city which have bided or are going to bid Olympic Games at the strategic level. On the other hand, modern China is in the transformation from its traditional centrally planned economy to a market-driven one. Profit and efficiency obtain more attentions rather than environmental issues, which leads to enormous damage of nature and natural resources. As the capital city of China, Beijing also hopes to comprehensively promote its environmental quality through preparing 2008 Olympic Games, which will make Beijing a real beautiful metropolitan.

With the fast economic development in Beijing, breakthroughs were also made in the prevention and control of environmental pollution, the improvement of environmental quality and the strengthening of eco-environmental conservation. During the Ninth Five-Year Plan period, about 34 billion RMB Yuan investment was made to protect the environment, accounting for 3.3% of the GDP of the period. From 1999 to 2001, the city’s annual environmental investment has exceeded 10 billion RMB Yuan. The programs for building urban green shelter, forestation in the remote area, development of ecological agriculture, soil erosion control and desert and barren land reclamation are all well under way. By 2001, urban and main towns’ green coverage rate increased to 38.8% and city-wide green coverage rate reached 47% (Table 1.1). Building of three green shelters in the mountainous, plain and urban areas has made great progress. The central government supported ecological restoration and conservation around Beijing-Tianjin and in the northern China as a whole is very well progressed.

With above progresses, a working mechanism led by the municipal government, supervised collectively by the environmental departments, managed by different departments and participated by the general public has been formed. The laws and regulations for the environmental protection and the management systems have been formulated and enforced. In August 2000, the Green Olympic Action Plan was signed jointly by Beijing Olympic Bidding Committee, the relevant municipal authorities and more than 20 environmental NGO’s. With the implementation of the plan, The concept of Green Olympics becomes more and more popular among the Beijing citizens.

The special effect of preparing and holding a Green Olympics in Beijing lies in: (a) to create a clean and beautiful environment for the 2008 Olympic Games and enhance the sustainability of the

city; (b) to avoid any possible negative impact on the environment by the Olympic activities, and make the Games play an exemplary role in environmental protection in Beijing and the whole country; (c) to highlighting the principle of achieving harmony between man and the nature so as to improve the environmental and ecological awareness of the public. Frankly, Achieving Green Olympics have

Table 1.1 Beijing 2006 Environmental Description (By District)

Areas	Area of Greenbelt	Rate for Increase of Greenbelt	Coverage Rate of Plants	Days of are quality above 2 degree	Partition of the days in a year
Dongcheng District	564.3*	2.52%	30.21%	240	65.8%
Xicheng District	784.08	6.37%	25.74%	239	65.6%
Chongwen District	355.44	1.06%	31.48%	238	65.4%
Xuanwu District	348.36	0.79%	21.5%	232	64.1%
Dongcheng District	564.3	2.52%	30.21%	240	65.8%
Xicheng District	784.08	6.37%	25.74%	239	65.6%
Chongwen District	355.44	1.06%	31.48%	238	65.4%
Shijingshan District	2387	18.7%	42.8%	242	66.7%

* Note) Unit=square meters

been taken as guiding principle of this plan, which is targeted at building a sound ecosystem for the city while fulfilling environmental commitments made in the bid. The plan gives full consideration to present status with first priority given to meeting the demands of the people. Phased measures are planned to realize an all-round improvement in Beijing's environmental quality and the sustainable development. In generally, the sub-plan aims to create a clean and beautiful environment for 2008 Olympic Games.

2.2 Green Olympic, sustainable construction industry

China's construction industry is now in a very important period, together with chances and challenge, from tradition to modernization. The most important, it faces on a very vital affaire—Olympics Games. After 1978, the beginning of China's reform and opening-up, its construction industry came into a fast development time, bringing along other industries' co-prosperity, making great contribution to China's GDP, exerting itself to mitigate employment or lay-off, promoting urbanization process and so on. Frankly, due to the closely association with other industries, it has been to a leading one in China nowadays, to guide the national economy more sustainable and stable. In fact, When Olympics came into China; its construction industry began a new growth.

Based on the statistic provided by the Group of Research on Olympic Economic, during the period that Beijing prepares for the Games, its rate of fixed assets investment increase is up to 9% annually. If we review the total amount in last 5 years, the number is 850 billion RMB. Among it, more than 29 billion is directly invested into the construction of Olympic Stadiums. In the light of this speed, till 2008 the investment relating to urban construction will reach to 240 billion, which is a huge promotion for real estate and other industries. Due to big-scale city rebuilding, the construction market will steps into a more prosperous time. Additionally, the Green concept could also enhance all kinds of new buildings of Beijing, including a lot of sustainable buildings. So China's construction industry especially Beijing's one will be the direct beneficiary of Olympic Games.

Bidding for the Olympics also brings benefits to cities because it attracts public investment for infrastructure for the games from higher levels of government (Law 1994). The IOC Manual for Candidate Cities (2000) stresses the importance of offering high-quality sporting facilities and general infrastructure to becoming elected as a host city. Much of this investment takes place already before it is decided which city gets to host the games. Candidate cities must start the building of infrastructure during the bid period because the IOC stresses the importance of maintaining 'coherence and harmony

between the projects described in the Candidature File and those developed in the promotion campaign' (IOC 2000). In addition to providing the financial resources for urban renewal, projects connected with Olympic bids are often given exemption from normal planning processes, and developments can therefore be undertaken faster and with less public interference (Hall 1992).

Since Beijing won the Olympic Bid in 2001, China's construction industry has changed a lot, especially in its GDP contribution. As the table 1.1, with the fast national economy increase and the advance of investment rate of fixed assets, China's added value of construction industry raised annually, from 6.63 in 1998 to 7.28 in 2006 (Table 1.2). Further more, the development of construction industry promotes other industries' innovation. For example, the property is one of the direct beneficiaries in the last 10 years. Due to its fast development, China's urbanization, especially the growth of large- and medium-sized cities is a great concern about it. In addition, its effect in employment should also be taken into account. In 1998, there were in all 33.27 million practitioners in this industry, compared with 26.41 million in 2006. In fact, the most important is that its total production value is up to 1869.6 billion RMB. Relating to that the revenue from construction industry increased rapidly. Starting from 1992, its speed of going up is 30% per year. In conclusion, the construction industry plays a very significant effect in China's Olympic preparation.

Table 1.2 China's situation of construction industry from 1981—2005

Year	Rate of fixed assets investment (%)	Proportion of added value of construction Industry in GDP (%)	Amount of practitioners in construction industry (10, 000)	<u>Practitioners in construction</u> All practitioners (%)
1998	35.78	6.63	3327	4.76
1999	24.58	6.67	3412	4.78
2000	37.59	6.58	3552	4.93
2001	39.82	6.55	3669	5.02
2002	40.61	6.68	3893	5.28
2003	48.33	6.62	3542	4.79
2004	52.24	6.73	3253	4.33
2005	54.94	6.9	3450	4.98
2006	58.32	7.28	3641	5.13

It has been six years since Beijing won the Olympic Bid in 2001. During this period, how many improvements have been taken place under Beijing Green Olympic Guidelines? Until the end of 2006, twelve new stadiums and five relative facilities have finished their main construction projects. In addition, constructions on temporary stadiums and refurbishments on the current urban sports infrastructure are under going. Fengtai Baseball Court has been successfully testified and nearly one third of roads, freeways, and bridges have been renovated around stadiums. In a word, there have been significant improvements on urban infrastructure constructions, ranging from power system to transport, to ensure all these procedures are gone through a healthy and sustainable way.

2.3 Beijing Olympic Games shows sustainable buildings

Hosting the Olympic Games has a multitude of consequences, and the promotion of Beijing's Olympic candidature must be understood with reference to a wide set of goals. In most cities, the main rationale presented for bidding for the Olympic Games is their presumed contribution to economic growth (Hiller 1998). But some other aims should also taken into account, just like enhancing sustainability of the city, Reinforcing construction of rural infrastructural facilities and improving on the environment. In Beijing's Olympic, there is another affect, to lead to a sustainable building concept is the priority of it.

In modern construction of stadiums, sustainable concept should be the guidelines of all buildings. Especially in Olympic Games, there is a significant time to show all kinds of new thoughts about

buildings, new thoughts about life. The vital problem are how to make good use of those infrastructures in the long run and integrate them into people's daily activities, how to promote sustainable buildings by public sport and how to ensure huge scale of construction sustainable.

Due to they are huge and big-scale, so how to make the Olympic stadiums sustainable may be the vital problem which need to be concerned. Beijing builds the National Olympic Centre and International Exhibition together, to use the 5 exhibitions as the Table Tennis, Fence-play, Gunnery, Rattle and Badminton, gymnasiums. For the Ball Park and Softball Park in WUKESONG Sport Centre, it is defined temporary stadiums, which should be pulled down after the Games. And for some big stadiums, Beijing makes them to be the main sport stadiums in the long time. The Beijing ways give us a advisable suggestions for the big stadiums. To make them multiple, together with a lot of non-sport functions, for example, exhibition, entertainment, shopping mall, may be the all-pervading approaches in all nations.

Take Beijing National Stadium for example, which also shows sustainable design. On the roof, the cushions will be mounted on the outside of the structure to make the roof completely weatherproof. Whilst the rain is collected for rainwater recuperation the sunlight filters through the translucent roof providing the lawn with essential UV-Radiation. On the facade, the inflated cushions will be mounted on the inside of the structure where necessary, e.g. to provide wind protection. Since all of the facilities – restaurants, suites, shops and restrooms – are all self-contained units, it is possible to do largely without a solid, enclosed facade. This allows natural ventilation of the stadium, which is the most important aspect of the stadium sustainable design.

Frankly, compared with the daily use, the Olympic stadiums are big enough to suit for 80-100 thousands people. How to coordinate the site use and daily use is another question for the operation. In common, there are two ways to solve this problem. To build temporary simple stand could save a lot cost and also usable for controlling flexible audience. Another way is to design a multifunctional stadium to try its best to content more programs of Olympic Games. This condition in China is multifunctional owing to its large population. We could forecast, because of more participants, Beijing Olympic Games will be the biggest one in its history. So that is necessary for it to choose more flexible design for the feast.

In order to improve the environmental quality, it is not only needed to conduct pollution control around the city urban itself, but also needed to strengthen the ecological conservation and construction at city-wide and regional level. In it, green construction is a important measure for Beijing Olympic Games preparation. That allows all the construction activities must conform to the site selection, clean energy, clean transportation, resources conservation, wastes management, forestation, green product, clean technology, clean construction, environmental education and public participation. All measures should be taken to control noise, dust and arrange transportation so as to minimize impact on the environment and people's daily life. And for it Beijing could insist a permanent improvement of the urban environment, which needs a healthy regional ecological system. Therefore, the green construction in Beijing also includes ecological conservation and construction in the suburban plain and mountainous area and the vicinity of the Capital, as well as the prevention and treatment of the urban pollution.

The recycle of Olympic temporary buildings allows high technique, better quality, and more convenient. Its construction should be content to the need of simple installation, disassembly, division and rebuilding. At the same time, the material of the buildings should be sustainable firstly, with reproducible resource, safer and cleaner. Based on the plan of Beijing Olympic Games, the temporary buildings are separated into 12 kinds, including one-off stadiums, stopping place, washroom, green spaces and so on. After games, some of them could come into people's daily life. The others could be taken down to assemble additional facilities.

3. SAMPLE INTRUCUTION OF SUSAINABLE BUILDINGS IN BEIJING

Beijing has both excellent and classical architecture, but few distinguished modern buildings. Now Olympic give Beijing a opportunity to create its own style and fashion. For it, a lot of world famous

architects come to Beijing to display their skills here. With the speeding up of China's urbanization and the challenging concept of the 2008 Olympic Games, almost all famous design consortiums from around the world have found that China is one of the few countries which provides not only imaginary space but also abundant funds for modern architecture today.

3.1 National Stadium

The Beijing National Stadium, also known as the bird's nest is the main track and field stadium for the 2008 Summer Olympics and also is host to the Opening and Closing ceremonies. The stadium will seat as many as 100,000 spectators during the Olympics, but this will be reduced to 80,000 after the games. It has replaced the original intended venue of the Guangdong Olympic Stadium. The stadium is 330 meters long by 220 meters wide, and is 69.2 meters tall. The 250,000 square meter (gross floor area) stadium is to be built with 36 km of unwrapped steel, with a combined weight of 45,000 tones.

The stadium will cost up to 3.5 billion RMB (422,873,850 USD/ 325,395,593 EUR).

In the new design, the roof of the stadium had been omitted from the design. Experts say that this will make the stadium safer, whilst reducing construction costs. The construction of the Olympic buildings will continue once again in the beginning of 2005. The stadium's appearance is one of synergy, with no distinction made between the facade and the superstructure. The structural elements mutually support each other and converge into a grid-like formation - almost like a bird's nest with its interwoven twigs. The spatial effect of the stadium is novel and radical, yet simple and of an almost archaic immediacy, thus creating a unique historical landmark for the Olympics of 2008. The stadium was conceived as a large collective vessel, which makes a distinctive and unmistakable impression both from a distance and when seen from up close. It meets all the functional and technical requirements of an Olympic National Stadium, but without communicating the insistent sameness of technocratic architecture dominated by large spans and digital screens.



Figure 1. the construction of National Stadium

Visitors walk through this formation and enter the spacious ambulatory that runs full circle around the stands. From there, one can survey the circulation of the entire area including the stairs that access the three tiers of the stands. Functioning like an arcade or a concourse, the lobby is a covered urban space with restaurants and stores that invite visitors to stroll around. Just as birds stuff the spaces between the woven twigs of their nests with a soft filler, the spaces in the structure of the stadium will be filled with inflated ETFE cushions. Originally, on the roof, the cushions were to be mounted on the outside of the structure to make the roof completely weatherproof, but the roof has been omitted from the design in 2004. While the rain was to be collected for rainwater recuperation, the sunlight was to filter through the translucent roof, providing the lawn with essential ultraviolet radiation. On the facade, the inflated cushions will be mounted on the inside of the structure where necessary, e.g. to provide wind protection. Since all of the facilities -- restaurants, suites, shops and restrooms -- are all self-contained units, it is possible to do largely without a solid, enclosed facade. This allows for natural ventilation of the stadium, which is the most important aspect of the stadium's sustainable design.

3.2 National Swimming Center

The National Swimming Center, known as “The Water Cube”, will be one of the most dramatic and exciting venues to feature sporting events for the Beijing Olympics in 2008. The Water Cube will set to be ready in October 2007. Both the concrete and the steel structure have been completed, and 500 m² of prototype cladding was installed in April, 2006. The next phase is to install all of the cladding and then follow on with de-propping the internal structure and completing the interior.

The building's structural design is based on the natural formation of soap bubbles. To arrive at the building's structural design, which is based on the natural formation of soap bubbles to give a random, organic appearance, we used research undertaken by Wearier and Phelan (professors of physics) into how soap bubbles might be arranged in an infinite array. To bring the design to life, the individual bubbles are incorporated into a plastic film and tailored like a sewing pattern. An entire section is pieced together and then put into place within the structure. There are interior and exterior films, and the film is then inflated once it is in-situ. It will be continuously pumped thereafter.

The actual pumping has been sub-contracted, and once the installation is complete the operator will be responsible for both the operation and maintenance of the facade for ten years. This was a key component of the brief and in the choice of contractor. The project is an opportunity for us to offer our expertise in sustainable services. The building will use solar energy to heat the pools and the interior area, and all backwash water is to be filtered and returned to the swimming pools.

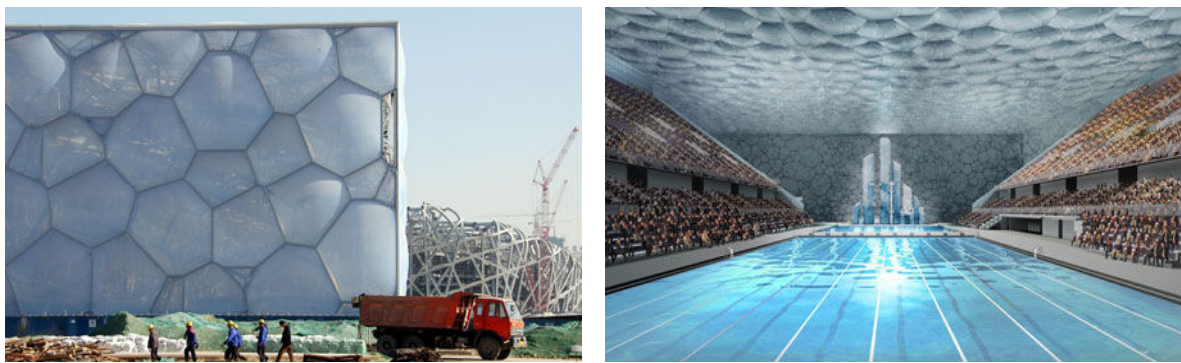


Figure 2. the construction of National Swimming Centre

The scheme and design for the project was developed in Australia. The project has now been handed over to a team in Beijing who are taking care of the construction. In the current fully coupled analysis, an advance rate of 1 m per day was assumed based on the typical tunnelling practice for cases similar to that considered in this study (Shin et al. 2002a). The tunnelling process was simulated by excavating a 2 m span of soil over two days after which a 2 m long shotcrete lining is installed over the excavation boundary of a previous span, thus leaving the current excavation surface unlined. This process is repeated until the desired excavation length of 40 m is achieved.

4. CONCLUSIONS

This paper examined the main objective of Beijing Olympic Games to investigate the impacts of 2008 Olympic Games in promoting sustainable buildings. Due to the facts and samples, it is obvious that public sport could promote sustainable buildings in regions, especially the big games just like Olympic, has a huge enhance to the sustainable concept and construction. At the same time, it is also important to ensure the good use of those infrastructures in the long run and integrate them into people's daily activities. To realize multiple and flexible is a good way for them to come into people's life. For huge scale of construction, sustainable concept is the vital approach to achieve environment and green GDP goals.

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