# 10.9 ATMOSPHERIC ENVIRONMENT ANALYSIS OF DIFFERENT DESIGNS FOR BEIJING OLYMPIC STADIUM

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## 1. INTRODUCTION

Many experimental studies and numerical simulations have indicated that the building layout directly impacts upon and determines the local atmospheric environment. In Beijing, through the growth of the city and the increase in the number of vehicles, the atmospheric environment is worse than ever. Many approaches and techniques have been investigated and applied, but the environmental betterment is limited and the cost is huge. So we focus on urban planning. What is the relationship between urban planning and the atmospheric environment? Can we improve the atmospheric environment through rational and scientific planning?

In this paper, in order to satisfy Green Olympics and High-Tech Olympics of Beijing 2008, and meet the demand of planning office to compare and evaluate the layouts of Olympic stadium facilities, based on an urban sub-domain scale meteorology and pollutant diffusion model, an index system and evaluation method is set up especially for the impact on meteorology and atmospheric environment effected by Olympic stadium facilities. As an example, two layouts of Wukesong Culture & Sport Center in Beijing are assessed.

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## 2. METHODS

The index system is established using an analytical hierarchy process (AHP) (Saaty, 1980), which is made up of six indices (I1: The comfort level of body, I2: The comfort level of pedestrian, I3: Pollutant concentration on the ground, I4: Pollutant concentration below the highest building, I5: Pollutant concentration on the surface of buildings, I6: Diffusion capability).

Based on much expert advice, the weighting factors of six indices are fixed, so the impact assessment integration index I can be written as (Research group, 2004),

$$I = 0.2I_1 + 0.1I_2 + 0.1I_3 + 0.1I_4 + 0.1I_5 + 0.4I_6$$

## 3. EXAMPLE AND RESULTS

As an example, the impact on atmospheric environment by two layouts of Wukesong Culture & Sport Center is assessed.

Figure 1 show two layouts of Wukesong Culture & Sport Center.

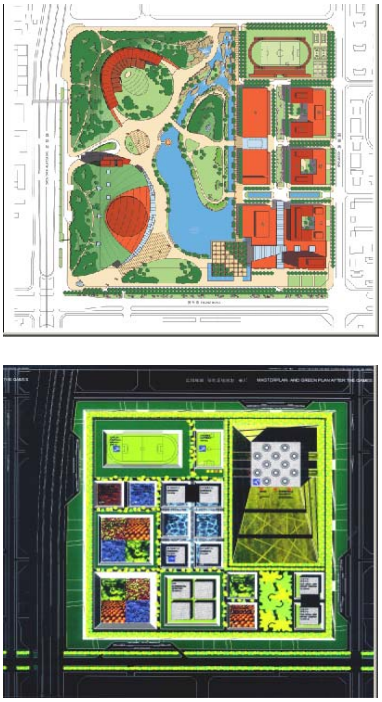
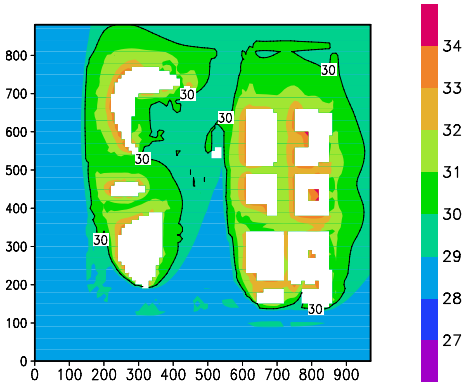


**Figure 1:** Two layouts of Wukesong Culture & Sport Center: (a) Plan A; (b) Plan B

Four numerical simulations in January and July of two layouts are run.



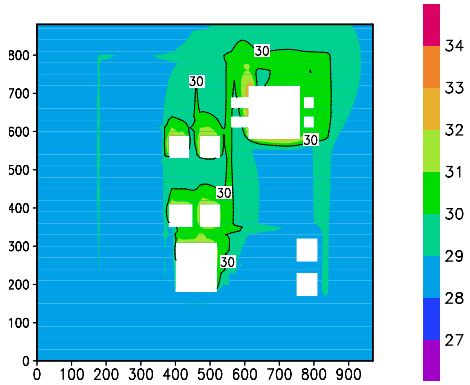




**Figure 2:** The distribution of air temperature near ground: (a) Plan A; (b) Plan B

Figure 2 indicate that the area percentage, where the air temperature near ground is higher than 30 centigrade, of Plan A (40%) is almost thrice that of Plan B (14%). And the area percentage, where the wind speed near ground is less that 1 m/s, of Plan A (31%) is larger than that of Plan B (14%) (The figures are omitted). The area percentage, where the concentration of pollutant from traffic source is higher than level II of ambient air quality standard of China, of Plan A is larger than that of Plan B. And the diffusion capability (diffusion time of an instantaneous pollutant source, e.g. traffic source) of Plan A is longer than that of Plan B.

**Table 1:** The assessment result of two layouts

| Index | Plan A | | Plan B | |
|---|---|---|---|---|
| | January | July | January | July |
| $I_1$ | 5 | 1 | 5 | 2 |
| $I_2$ | 2 | 2 | 1 | 1 |
| $I_3$ | 4 | 4 | 4 | 4 |
| $I_4$ | 4 | 5 | 4 | 4 |
| $I_5$ | 5 | 5 | 5 | 5 |
| $I_6$ | 3 | 5 | 5 | 5 |
| Integration $I$ | 3.7 | 3.8 | 4.4 | 3.8 |
| Final $I$ | 3.75 | | 4.1 | |

Table 1 summarizes the assessment result.

It shows that due to their difference of green and building planning, temperature, wind, pollutant concentration fields and the indices of Plan B is better than that of Plan A. So based on urban sub-domain scale numerical model, it is practical to simulate and assess the impact on atmospheric environment by Olympic stadium facilities.

## 4. DISCUSSION

The impact assessment system of urban meteorology and the atmospheric environment, which includes the urban sub-domain scale numerical model, index system and evaluation method, provides an effective approach to improve the atmospheric environment through rational and scientific planning.

## 5. ACKNOWLEDGEMENT

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