

Case Analysis on Vehicle Parking and Departure Plans for the National Stadium

SHAO Chunfu^{1,*}, ZHAO Yi², YU Lei¹, XU Juan³

¹ School of Traffic and Transportation, Beijing Jiaotong University, Beijing 100044, China

² University of Nevada, Reno, NV 89557, USA

³ Beijing Transportation Research Center, Beijing 100055, China

Abstract: As the main venue of the 2008 Beijing Olympic Games, the National Stadium hosted the opening and closing ceremonies, field and track events, and final football games. This paper intends to study the problems associated with vehicle evacuation from the parking lot, and develop evacuation plans. First, the paper analyzes the particular conditions of the parking lot in the National Stadium, as well as its layout and vehicle evacuation. Then, it simulates and evaluates the evacuation plans with the suitably given parameters, based on the real blueprint of the National Stadium and scenarios. Finally, it conducts a comparative analysis on the accuracy and practicability of the vehicle evacuation plans based on the field data collected at the opening ceremony of the Olympic Games. The simulation result shows that the total vehicle evacuation time was 26 minutes and the real evacuation time was 27 minutes on the day of the opening ceremony, which verifies that the study is accurate and practical.

Key Words: Olympic Games; vehicle evacuation; microscopic traffic flow simulation; effect evaluation

1 Introduction

The 29th Olympic Games, which were held in Beijing from 8–24 August, were complimented as “truly exceptional” Games by the IOC president Jacques Rogge. Moreover, the successful transportation organization was one of the most important factors during this excellent game.

According to previous experience, large-scale parking facilities were seldom designed in the main Olympic stadiums, and VIPs, sponsors, and normal audience were required to choose public transportation to attend the opening ceremony. Therefore, large-scale parking facilities built in the National Stadium were the most significant difference compared to any other main Olympic stadiums. Accordingly, not only the complexity, but also difficulties of traffic organization and evacuation in both the National Stadium and Olympic Central Area had been increased greatly by those large-scale parking facilities. Under such circumstances, the questions of how to conduct a reasonable traffic organizing preplan to ensure the commitment to IOC, and maximize the efficiency in the evacuation were major problems to be solved.

There are significant differences between the characteristics

of vehicles evacuating from the Nation Stadium and general vehicles in the traffic flow. The reasons causing these diversities are: passengers' stratum, vehicle features, driving skills, highway network, organizing effort, and so on. These factors may lead to the different relationships of speed, density, and volume in the evacuation channels and exits. However, considering the particularity of the Olympic Games and parking facilities' structure, there was neither a precedent nor a theoretical model to follow.

As the most commonly used advanced technology to solve a complex system, computer simulation has been applied a lot more in system analysis, design, and evaluation^[1–4]. This study used microscopic traffic simulation techniques to simulate vehicle evacuation problem in the National Stadium. After choosing suitable parameters based on the real National Stadium blueprint, the traffic simulation software VISSIM was applied in several different scenarios, and the software outputs were analyzed in detail, thereby leading to the final evacuation plan. Finally, the final plan, as the authors have suggested, was compared to the actual evacuation field data, which has been obtained on August 8, 2008, to verify the accuracy of the plan.

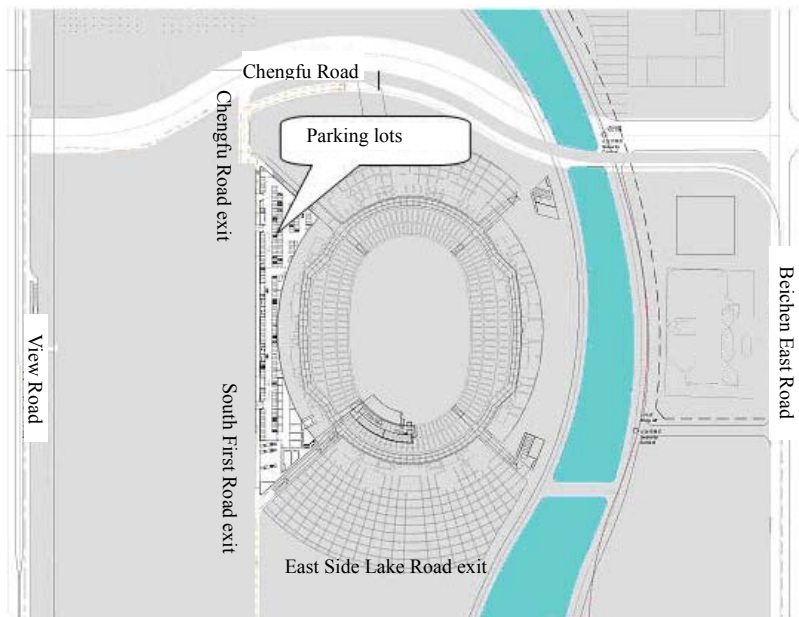


Fig. 1 Location of parking facilities in National Stadium

2 Methodology of evacuation and related parameters

2.1 Parameters

The construction of the National Stadium started in 2004, and according to the blueprints there were three-storey parking facilities for the VVIPs and Sponsors, to use, during the Olympic Games, on the west wing. At the same time, this study of vehicle evacuation in the parking lots started. Considering the layout of the parking facilities, the study focused on finding the most effective solutions to the quantity and location of evacuation exits, which should achieve the final effect of fast and efficient evacuation. The parking facilities in the National Stadium had three stories, which were B1st, B1st mezzanine, and 0th floor, as Fig. 1 illustrates^[5].

The parking facilities had a capacity for parking 1003 vehicles. The number of parking lots on each floor was 222 on the 0th storey, 230 on the west side of the B1st mezzanine, 287 on the south side of the B1st mezzanine, and 264 on the B1st floor.

Besides, there are three exits for the parking facilities, which are two laned on the South First Road exit on the south side of the stadium, two laned on the East Side Lake Road exit, at the east side of stadium, and with one lane on the Chengfu Road exit on the north side of stadium.

2.2 Microscopic traffic simulation

The evaluation of traffic organization based on microscopic traffic simulation is a brand new method, which takes into consideration not only the theoretic models such as car-following model, overtaking model, lane-changing model, but also of vehicle and road network parameters. When the

vehicles' routings are given, the microscopic simulation technique can be applied to reflect traffic flow movement in the entire evacuating period. The advantage of this method is: vehicle features and road network parameters are involved in the analyzing process, which can easily reflect the relationship between the transportation facilities and vehicles, as well as the relationship between different vehicles. Furthermore, microscopic traffic simulation can reflect a particular sub-area's traffic condition; compared to the traditional macroscopic traffic analysis; the simulations method is more specialized in uncovering problems between traffic facilities (supply) and vehicles (demand).

In this paper the VISSIM software package has been used to simulate different evacuation scenarios for the National Stadium's parking facilities, the simulation steps are as follows:

(1) Structure data entry. Input location of parking lots, lanes in evacuation passageway, lane width, length of longitudinal slope, longitudinal grade, location of exits, parking zone, and other structure data were entered to establish a three-dimensional parking facility physical model.

(2) Vehicle data entry. Input length, width, front overhang, wheelbase, acceleration, speed distribution, and other vehicle related parameters.

(3) Set the exits' traffic controlling mode and virtual detectors. Actually, uncontrolled exits are much easier to set up, which only need to set the speed limit and arrange the detector. However, the types of control should be defined if there are controlled exits.

(4) Flow data entry. Based on the structure and traffic organization plan, the relationships and travel routes between

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