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RESEARCH ON THE AVERAGE MINIMUM HEADWAY OF NON-OVERTAKING SECTIONS IN HIGH-SPEED RAILWAYS

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With the rapid development of high-speed railways in China, the backbone network of high-speed railways has been basically formed, and the sharp increase in passenger traffic has led to the capacity of some sections of busy high-speed railways approaching saturation [1].

Due to the differences in transport objects, the capacity of passenger and freight mixed railway lines is maximized by fully utilizing existing facilities. However, the capacity of high-speed railways is influenced not only by facilities but also closely tied to passenger flow. For passenger and freight mixed railway lines, freight trains can be flexibly scheduled for stops and overtaking, resulting in a relatively flat timetable. In contrast, high-speed railways, which serve passengers, have certain requirements for transport service quality, and their capacity has the following characteristics:

1 The passenger flow section is the unit for calculating the capacity of high-speed railways. Due to the inability to flexibly arrange stops and overtaking, which is constrained by passenger demand, the capacity of high-speed railways should be described using the passenger flow section as the unit.

2 The capacity of high-speed railways has a strong time-of-day characteristic. Given the clear peak and off-peak periods in passenger flow, it is highly practical to calculate the capacity of high-speed railways for specific time periods.

3 The effectiveness of the capacity of high-speed railways. The capacity of high-speed railways must be combined with passenger demand; only the capacity that meets passenger demand is considered effective. Otherwise, it is deemed ineffective capacity.

Currently, three methods are commonly used to calculate railway capacity both domestically and internationally: computer simulation, deduction coefficient method, and average minimum headway method [2]. While computer simulation has the function of graphical analysis and calculation, the large number of feasible solutions generated by computer layout makes it difficult to compare and optimize [3]. The deduction coefficient method is widely used in China for railway capacity calculation. This method is based on the capacity of parallel running diagrams and calculates the capacity of non-parallel running diagrams by computing the deduction coefficients for different types of trains [4]. However, the deduction coefficient method calculates the full capacity of a tightly packed diagram, which is rigid and does not accurately reflect the actual utilization of high-speed railway capacity. The average minimum headway method, commonly used in Germany and Western European countries, emphasizes the quality of train operations. It is a flexible capacity calculation method that considers a certain buffer time based on the structural relationship between train operation lines. In principle, this method can accurately calculate the capacity utilization of China's high-speed railways and effectively improve operational service quality [5]. Given that the foreign approach of using sections as capacity calculation units does not suit the passenger characteristics of China's high-speed railway sections, it is urgent to study the minimum headway of high-speed railway sections using the principles of this method, making it applicable to the calculation of average minimum headway capacity for China's high-speed railways.

Zhao Dong and Hu Sij [6] developed a new method for calculating the capacity of high-speed railways based on the principle of calculating the average minimum headway between trains. However, the minimum headway is still calculated on a section-by-section basis, failing to reflect the characteristics of high-speed railway passenger flow sections. Wu Xu, Cui Yanping, et al. [7] analyzed the average minimum headway for sections of high-speed railways without overtaking, but their analysis was limited to some stopping patterns of operating train sets, failing to derive the average minimum headway for any stopping pattern. Chen Weidong [8] compared the applicability of the average minimum headway method for passenger and freight mixed lines and high-speed railways, but the calculation of the minimum headway still relies on sections. In summary, the current analysis of the average minimum headway method is mainly based on the average minimum headway between sections, which cannot adapt to the characteristics of high-speed railway passenger flow sections, leading to poor practicality of the method. The calculation of the average minimum headway for sections is influenced by various factors such as train stopping patterns, train types, and the number of intermediate stations, and has been primarily qualitative in the past, lacking quantitative mathematical description. This paper starts with sections of high-speed railways without overtaking, analyzes the stopping patterns of operating train sets, and derives a method for calculating the average minimum headway for high-speed railway sections, significantly improving the applicability of the average minimum headway method in the capacity calculation of high-speed railways, which is of great significance for the market-oriented development of China's high-speed railways.

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ОСОБЕННОСТИ ПЕРЕВОЗОК ПАССАЖИРОВ НА БЕЛОРУССКОЙ ЖЕЛЕЗНОЙ ДОРОГЕ

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Существующая транспортная маршрутная сеть Белорусской железной дороги обеспечивает перевозки пассажиров в международном, межрегиональном, региональном и городском видах сообщений.

Актуальное расписание движения поездов в международном сообщении предусматривает направление пассажирского сообщения с городами, расположенными в России. При выполнении перевозок в международном сообщении используются поезда экономкласса и бизнес-класса. Это позволяет расширить доступ к транспортным услугам в международном сообщении гражданам Беларуси и России с различным достатком. На международных маршрутах применяются поезда с ло-