

Role of Differential Equation Models in Highway Congestion Management

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Abstract: *Traffic congestion is one of the major challenges in modern transportation systems. Mathematical modeling plays a crucial role in understanding and managing highway traffic flow. Differential equation models are widely used to represent the dynamic behavior of traffic density, speed, and flow over space and time. This paper discusses the role of differential equation models in highway congestion management. Key traffic flow models such as the Lighthill–Whitham–Richards (LWR) model and Greenshields fundamental relationship are explained. A numerical example is also provided to illustrate how differential equations help analyze congestion conditions. The results demonstrate that these models help traffic engineers predict congestion formation and implement control strategies such as speed regulation and traffic flow management.*

Keywords: Traffic flow modeling, differential equations, highway congestion, LWR model, traffic density

