Kansas Department of Transportation

TECHNICAL SUMMARY

Evaluation of Ramp Metering Effectiveness Along the I-35 Corridor in the Kansas City Metropolitan Area

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Introduction

Ramp metering, which has been used successfully since the late 1950s throughout the United States and internationally, can reduce traffic congestion, resulting in more efficient use of existing capacity. Ramp metering is commonly associated with increased throughput, higher speeds, decreased travel times, and reduced fuel consumption and vehicle emissions. In addition, results from field implementations in the United States have shown 9%–173% speed increases, smoother traffic flow entering the freeway, and improved driver safety due to reduced stop-and-go traffic, including a 15%–50% reduction in collision rate, especially rear-end and sideswipe collisions (Jacobson et al., 2006). Potential negative impacts of ramp metering include traffic diversions to alternative routes to avoid metered ramps and inequity since ramp metering typically favors motorists that make long trips versus short trips within the metered area.

Ramp metering was first implemented in the Kansas City metropolitan area in 2008 on seven interchanges along a 5-mile stretch of Interstate 435 (I-435) between Metcalf Avenue in Kansas and the 3-Trails Memorial Crossing Highway in Missouri. The Corridor Adaptive Ramp Metering Algorithm (CARMA), a system-wide traffic responsive, was implemented along this corridor. CARMA is an alteration of the System Wide Adaptive Ramp Metering (SWARM) algorithm currently utilized in California (Paesani et al., 1997). Results of metering evaluations 6 months and 12 months after the installation showed a 64% decrease in vehicle crashes during a.m. and p.m. peak periods, while travel times at most sections decreased or remained the same and demand increased by 20% (KC Scout, 2011).

Project Description

This research investigated the safety and operational benefits of ramp metering along the I-35 corridor in the Kansas City metropolitan area. A before-and-after study was conducted to compare selected performance measures, with a “before” period from August 2015 to December 2015 and an “after” period from October 2021 to February 2022. The research evaluation focused on six locations during morning and afternoon peak periods. Analysis of crash frequency revealed a significant crash reduction range of 54.8%–83.3%, except at the I-35 N @ 7th St. Trfy. location, where the number of crashes remained unchanged. Crash rates also decreased 13%–82.5% at most locations, except for the I-35 N @ 7th St. Trfy. location, where the crash rate increased by 5.8% due to reduced traffic volumes. In addition, most locations had increased speeds, and locations that previously experienced recurring congestion became uncongested during peak hours. Most notable average speed gains without

significant flow rate changes were observed at the I-35 S @ 7th St. location (20% during afternoon peak), the I-35 S @ Southwest Blvd. location (39.5% during morning peak and 72.8% during afternoon peak), and the I-35 N @ Johnson Dr. location (30.6% during morning peak). Because the results demonstrated their vast safety and operational benefits, this study recommends continued deployment of ramp meters along the I-35 corridor. However, the ramp meters at I-35 N @ 7th St. Trfy. should be further investigated since no safety or operational benefits were identified.

Project Results

This research project conducted a "before" and "after" evaluation of ramp metering along an I-35 corridor in the Kansas City area to consider safety and traffic impacts of ramp meters in specific locations. The "before" analysis period was August to December 2015, while the "after" analysis period was October 2021 to February 2022 to allow for final ramp meter location selection, construction, initial ramp meter implementation, and COVID-19-related delays. The analysis focused on six merge junctions with ramp meters: four along I-35 S and two along I-35 N. Crashes that occurred within a 1-mile radius from each merge during the analysis intervals (morning and afternoon peak periods) were further analyzed. Analysis results revealed significant safety benefits at all locations, with crash frequency decreasing 54.8%–83.3%, except for the I-35 N @ 7th St. Trfy. location, where the number of crashes did not change (0% reduction), which corresponded to only one crash event. The crash frequency was normalized for exposure, and the resulting crash rates decreased significantly (13%–82.5%, with an average of 56.4%) after the deployment of ramp metering at most locations. However, at the I-35 N @ 7th St. Trfy. location, the crash rate increased 5.8% due to reduced traffic.

Project Information

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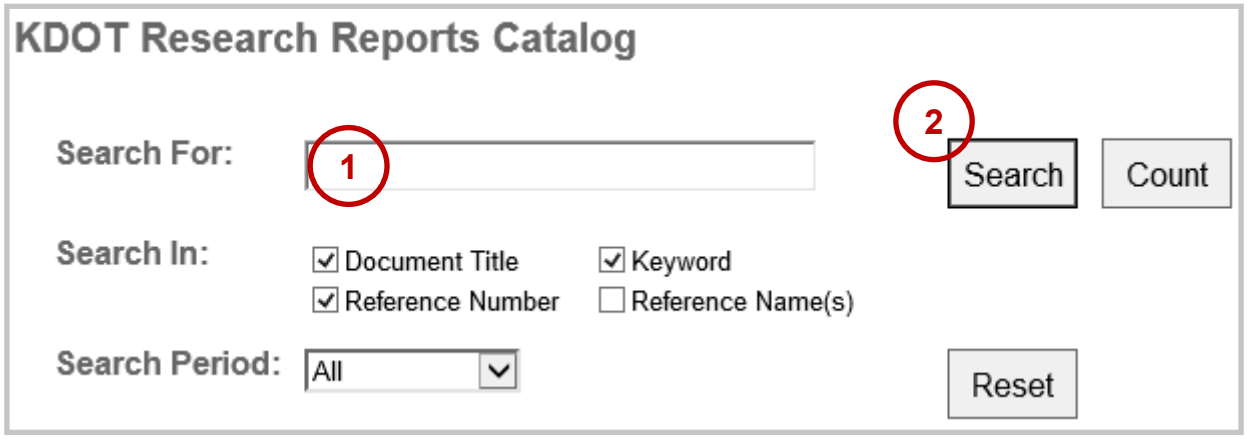

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