MnPASS Express Lanes: Open or Closed Access?

What Was the Need?
High occupancy toll lanes are a relatively new method for improving mobility on freeways. As implemented in Minnesota, HOT lanes are freeway lanes separated by either physical barriers or painted buffers, and limited to buses, carpools and solo motorists with a transponder who pay a fee to use the lane during rush hours. HOT lanes improve mobility by providing free-flow conditions on otherwise congested freeways.

MnDOT currently has two HOT lanes, branded as MnPASS Express Lanes, that take different approaches to providing access. On Interstate 394 (I-394) between I-494 and downtown Minneapolis, the lane is mostly closed access, with only a few sections where vehicles may legally enter or exit the HOT lane. The HOT lane on I-35W between Burnsville Parkway and downtown Minneapolis has mostly open access, so drivers may change between the HOT and general purpose lanes almost anywhere.

Because HOT lanes are so new, there is little research available about whether open or closed access is more effective at improving traffic capacity safely. MnDOT plans to build new HOT lanes—the state transportation policy plan specifies the use of MnPASS as the first choice for capacity expansion—so research was needed to compare these access design strategies.

What Was Our Goal?
This project sought to determine which access strategy is better for HOT lanes by evaluating the existing facilities, and to create design tools for future facilities.

What Did We Do?
Researchers first used video to evaluate current conditions on both of MnDOT’s HOT lanes and their impact on safety and mobility. They examined video for “shockwaves” caused when vehicles had to brake for slower traffic ahead. These shockwaves indicate reduced mobility because they reduce travel speeds. They also pose safety concerns because they create opportunities for collisions if distracted drivers fail to brake as they encounter slowing traffic.

Using data such as vehicle spacing, traffic density and traffic speed, the research team developed two HOT lane design tools. The first tool calculates the Optimal Lane Changing Region location and length for a closed-access lane. The OLCR includes the distance needed for a vehicle entering the expressway to change lanes and merge into the HOT lane as well as the size of the allowed access section.

The second tool is for open-access HOT lanes. It identifies locations where shockwaves caused by vehicles merging into and out of the HOT lane are severe, impairing mobility and safety. Those sites are places to consider restricting HOT lane access.
What Did We Learn?

Researchers found that both access strategies are effective in some situations. Closed access works well for I-394 because most of the vehicles using the HOT lane come from three specific interchanges. Open access works well for I-35W because interchanges are more frequent, and demand for entry into the lane is spread out among more sites.

At current HOT lane utilization levels, shockwaves are not severe enough to have major impacts on safety or mobility. Researchers did identify several areas of concern on I-35W that would likely be the first to experience safety or mobility impacts if HOT lane use were to increase (for example, if the prices were decreased). Restricting access to the HOT lane at these sites would be the likely mitigation for these issues.

What's Next?

MnDOT and other states will use the results of this project to design new HOT lanes. The research suggests that for most roads, an effective approach is to start with open access but periodically evaluate and limit access in specific areas as appropriate based on traffic density in the HOT lane and the speed differential between HOT and general traffic lanes.

The MATLAB design tools that were developed in this project are still considered experimental and will require further validation on additional MnPASS lane designs before being incorporated into MnDOT’s formal HOT lane design processes. However, this project has provided MnDOT much greater understanding about how to move travelers safely through this lane-changing environment.

Another MnDOT project concluding soon will examine how pricing affects driver decisions of whether to use HOT lanes. Incorporating that information into the design tools would improve their simulations.

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