ACCELERATION/DECELERATION LANES

Description

Acceleration/deceleration lanes (also known as speed-change lanes or auxiliary lanes) provide drivers with an opportunity to speed up or slow down in a space not used by high-speed through traffic.

On freeways and some major streets, the speed change can be substantial and cause stop-and-go traffic and a higher number of collisions for the main vehicle flow. Incorporating speed change lanes into the roadway design can mitigate these issues.

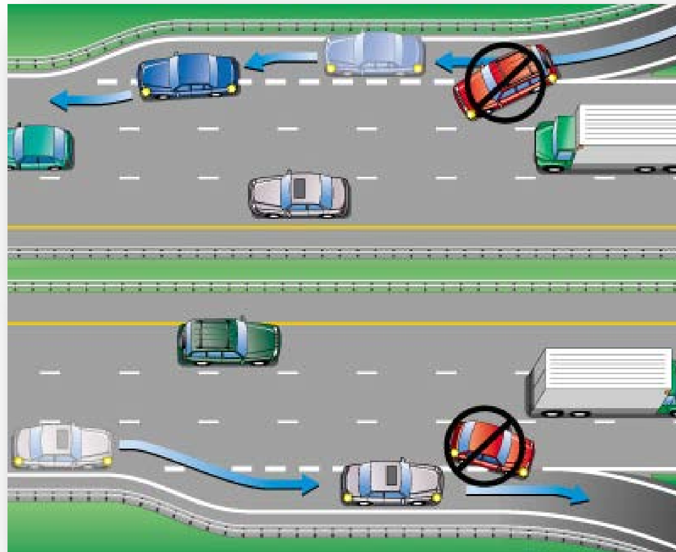
Deceleration lanes allow traffic exiting a major street to slow down to a safer speed to make a left or right turn at an intersection without affecting the main flow of traffic. Dedicated acceleration lanes allow cars that are joining the main road to speed up to match the flow of traffic.

Auxiliary lanes are another form of acceleration/deceleration lanes. These lanes continue a freeway entrance ramp into an additional freeway lane; this becomes an “exit only” lane at the next downstream exit. Using auxiliary lanes reduces the interference of exiting and entering traffic on the main lanes.

The proper use of acceleration/deceleration lanes increases the average speed on freeways and major streets, reduces the delays on ramps, and increases safety by reducing the number of conflicts between slow speed and higher speed vehicles.

Target Market

Freeway Interchange Ramps
Acceleration/deceleration lanes can reduce freeway congestion by creating designated areas for merging traffic to speed up and exiting traffic to slow down without being in the main lanes. These lanes allow cars to freely merge, reducing the stop-and-go effects and collisions caused by slower traffic on complex interchanges.



Ministry of Transportation, Canada

Cost:	●●●○○
Time:	**Moderate**
Impact:	**Spot**
Who:	**City/State**
Hurdles:	**Right-of-way, Institutional**

Areas between Freeway Entrance and Exit Ramps
Auxiliary lanes used between consecutive entrance and exit ramps allow traffic to speed up and slow down in designated lanes while reducing interference to the throughway. These lanes work best on entrance and exit ramps that are relatively short, requiring entering traffic to merge immediately and exiting traffic to slow before exiting the main traffic lane.

Major Streets with High Speeds and Turn Volumes
Major streets and frontage roads without acceleration/deceleration lanes or turning bays experience congestion from traffic slowing down to turn off of the main lanes or from traffic speeding up to the travel speed after turning onto the roadway. The differences in speed of through traffic and entering/exiting traffic can significantly slow traffic, cause stop-and-go traffic, and increase the number of collisions.

How Will This Help?

- Acceleration/deceleration lanes encourage smooth increases in traffic flow, while also increasing speed and volume on freeways and major streets by allowing traffic to adjust to the proper speed in a designated area before merging into or out of the main traffic lanes. For example, exiting traffic will have a specified area to merge out of the main traffic to slow down for an upcoming maneuver.
- Incorporating acceleration/deceleration lanes for turning movements on major streets and at intersections increases intersection capacity and efficiency. These designated areas allow for turning traffic to move away from the main lanes or to join traffic without interrupting the flow or wasting signal time.
- Separating slower traffic improves the safety of the ramp area by allowing merging traffic to adjust to the proper speed before merging into traffic (or conversely for exiting vehicles). The reduced interference decreases the possibility of conflicts that may congest the freeway.

Implementation Examples

Minnesota DOT (MnDOT) implemented a bottleneck identification and implementation process in 2007. It was originally intended to explore low-cost congestion relief projects because of budgetary restrictions but soon realized that these projects could be implemented very quickly and, as a bonus, were highly visible and popular with the public. Through a series of screening and prioritization steps, 180 potential projects were reduced to 19 low-cost, high-return improvements that were selected for funding. Of these projects, 13 were categorized as low-cost capacity improvements that involved adding or extending auxiliary lanes. The summary report for the bottleneck implementation process highlights three auxiliary lane projects:

- I-394 at Louisiana Street (B/C ratio = 8:1) – MnDOT added an auxiliary lane one mile long at a cost of $2.6 million. Previously, queues could back up for six miles on this section; after completion, queues were reduced to zero for recurring conditions.
- I-94 in St. Paul (B/C ratio = 14:1) – A four-lane section of freeway connected to two six-lane sections (a lane-drop bottleneck). MnDOT increased the number of lanes to six throughout this extended segment at a cost of $10.5 million. Queues were reduced by 0.5 miles in the westbound direction and 2.0 miles in the eastbound direction.

Table 1. Cost and Travel Time Benefit of Completed Mn/DOT Congestion Management

	Project Cost (millions)	Reduction in Annual Hours of Delay	Estimated Annual Travel Time Benefit (millions)	Project Service Life (years)	Estimated Travel Time Benefit over Project Service Life (millions)	Estimated Travel Time Benefit to Cost Ratio
IH 394	$2.6	87,000	$1.1	20	$21.6	8
IH 94	$10.5	139,000	$1.7	20	$34.6	3
Trunk Road 100	$7.1	1,063,000	$13.2	7	$92.3	13
Total	**$20.2**	**1,289,000**	**$16.0**	**--**	**$148.5**	**--**

Source: Minnesota DOT (Mn/DOT) 2007 Bottleneck Reduction Process Summary Report. http://ops.fhwa.dot.gov/bn/resources/mndotprocess.pdf

Table 2. Summary of After Study Statistics for Austin Bottleneck Projects

Site	Freeway / Direction	Location / Type	Throughput Conditions (percent / year)	Speed Impacts (percent)	Significant Crash Reduction?
1	IH 35/NB	Parmer/Auxiliary lane extension	+6.2	+6.2	*
2	IH 35/SB	Wells Branch/Auxiliary lane	+24	+194	*
3	IH 35/NB	US 183/Auxiliary lane	-3.3	+107	Yes
4	IH 35/SB	Rundberg, US 183/Auxiliary lanes	None	+71	No
5	IH 35/SB	Riverside/Auxiliary lane	-1.7	+55	No
6	Loop 1/SB	Far West/Auxiliary lane	N/A	N/A	*
7	Loop 1/SB	Loop 360/Realignment	+1.6	+56	No

**After data not available*

Source; Venglar, S. and J. Wikander. TxDOT Austin Freeway Operations Improvements "After" Studies: Technical Memorandum. Texas Transportation Institute, San Antonio, TX. August 2001.

- TH 100 near St. Louis Park (B/C ratio = 13:1) – Similar lane configuration to I-94. Short sections of shoulder were used in some areas to create an additional through lane in each direction. A very nearby diamond interchange was redesigned and reconstructed, reducing access points from seven to four, all at a cost of $7.5 million. Northbound queues were reduced from 5.25 to 0.25 miles, and southbound queues were reduced from 6.0 miles to 0.25 miles.

Within Texas, TxDOT and local agencies have been investigating ways to reduce bottlenecks on the state's freeways for quite some time. A comprehensive improvement project in Austin that concluded in 2001 examined the benefits of auxiliary lanes at seven interchanges in that metropolitan area. A review of the results of that project found that results were generally favorable for three measures of effectiveness: throughput, speed, and crashes.

Issues

Lane space and right-of-way are the primary design issues with adding acceleration/ deceleration lanes. Converting the current shoulders to useable lanes may require adding width and pavement structural strength. If the shoulder cannot be used, the road will need to be widened, possibly requiring acquisition of right-of-way and higher costs due to construction. Complex, dated, or elevated designs make it more difficult and costly to add these lanes. Right-of-way constraints at intersections may ultimately require a complete rebuild or alternative design.

The most significant implementation barrier is often the assignment of institutional responsibility. There are few DOTs with any staff assigned to look for locations where low-cost treatments can be installed. The contributions that acceleration/deceleration lanes might make are overlooked in favor of larger or more sophisticated programs.

Who Is Responsible?

The local TxDOT office and cities bear the primary responsibility of installing and maintaining acceleration/deceleration lanes. On state designated roads, the local office of the department of transportation may take responsibility. On city roads, however, the local government controls the construction and management of turn lanes and acceleration/ deceleration lanes. The improvements should be coordinated with local citizens and businesses in either case to ensure that the road serves the adjacent land.

Project Timeframe

The timeline for adding acceleration/ deceleration lanes will differ based upon which method is used, current road geometry, and the roadway class. A typical major street can be converted in a shorter timeframe (perhaps one to two months) than an elevated freeway section (as much as a year). Cost, complexity, design, and benefit should be considered when deciding to add speed change lanes to a desired roadway.

Cost

The cost of incorporating acceleration/ deceleration lanes is based on many factors. Costs can range from $50,000 to $100,000 for a simple shoulder conversion to over $1 million for more complex retrofits. The conversion of shoulders to speed change lanes reduces the cost when compared to widening the roadway, as that method may require increased right-of-way. Also, any construction method completed on an at-grade street is lower in comparison to an elevated freeway, due to the design, construction time, and material costs.

Data Needs

Useful data for adding acceleration/deceleration lanes include speed changes in the main traffic lanes caused by decelerating, exiting vehicles. Traffic counts on freeway exit and entrance ramps can be useful to determine where large entering and exiting volumes occur. Turn counts on major street intersections can be useful to determine the number of vehicles slowing down or speeding up. Measuring travel delays before and after the implementation of this technique is useful in evaluating the effectiveness of the method. Also, current lengths, widths, and presence of lanes, entrance, and off ramps will be needed for the congested roadway.

Acceleration/Deceleration Lane Best Practice

- Type of Location: Freeways.
- Agency Practices: Coordination between planning, design, safety, and operations.
- Frequency of Reanalysis: After substantial land use changes or development; as travel increases or trips change in the area; at time of roadway widening or reconstruction.
- Supporting Policies or Actions Needed: Capability to fund improvements, multi-agency agreements, and policies where roadways cross jurisdictional boundaries.
- Complementary Strategies: Managed lanes, variable speed limits, temporary shoulder use, queue warning.

For More Information

American Association of State Highway and Transportation Officials. *A Policy on the Geometric Design of Highways and Streets.* (The "*Green Book*"). AASHTO, Washington, DC, 2011.

Crawford, J.A., T.B. Carlson, W.L. Eisele, B.T. Kuhn. *A Michigan Toolbox for Mitigating Traffic Congestion*, Texas Transportation Institute, Texas A&M University, College Station, TX, September 2011.

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Venglar, S. and J. Wikander. TxDOT Austin District Freeway Operations Improvements "After" Studies: Technical Memorandum. Texas Transportation Institute, San Antonio, TX. August 2001.