

TECHNICAL ASSISTANCE REPORT
WHY BUILD LIMITED ACCESS HIGHWAYS?

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Virginia Transportation Research Council
(A Cooperative Organization Sponsored Jointly by the
Virginia Department of Transportation and
the University of Virginia)

In Cooperation with the U.S. Department of Transportation
Federal Highway Administration

Charlottesville, Virginia

January 1991
VTRC 91-TA2

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FOREWORD

This report was written by Eugene D. Arnold, Jr., Virginia Transportation Research Council, under the auspices of and with the assistance of the Task Group on Limited Access Highways. The group consisted of the following persons:

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WHY BUILD LIMITED ACCESS HIGHWAYS?

That is a good question! After all, limiting direct access to a highway can create the following problems:

- Motorists may have to go out of their way to get to the highway, and motorists on the highway may have to travel further distances to get to where they are going.
- Businesses may suffer because they do not have direct access for customers. There may be a loss of development at sites that have no direct access to an adjacent highway.
- And finally, limited access highways generally cost more than other types of highways because of right-of-way requirements and higher design standards.

So, why are limited access highways built? The many advantages of this type of highway far outweigh the disadvantages cited. This report describes the benefits and advantages of limited access highways. But first, let us define *limited access highway*.

What Is a Limited Access Highway?

Just as the name implies, a limited access highway is one in which the points of access (or the points at which motorists may enter or exit the highway) are limited. Officially, the regulated limitation of access is called *access control*, and it is achieved by regulating public access rights to and from properties next to the highway. These regulations are generally categorized as either “full control of access” or “partial control of access.”

- *Full control of access* means that preference is given to traffic going through the area. Access is regulated by providing interchanges with only selected public roads, by requiring roadway crossings to be grade-separated with bridges, and by prohibiting entrances for private driveways. Since no at-grade intersections are allowed, traffic can proceed nonstop. The most familiar example of highways with full control of access is the interstate system. Also, many bypasses in Virginia are limited access highways with full control of access.
- With *partial control of access*, preference is also given to through traffic, but to a lesser degree. Connections with selected public roads are allowed, but the design may be an at-grade crossing, that is, a crossing without a bridge. If the at-grade intersection is signalized, through traffic must often stop. Further, selected private driveway connections are allowed.

Although most of the benefits and advantages apply to some extent to both types of limited access highways, the greatest benefits apply to those with full control of access.

What Are the Benefits and Advantages?

As compared with highways with no control of access, limited access highways (especially those with full control) have:

- greater capacity
- improved safety
- reduced fuel consumption
- less pollution
- more positive impacts on motorists
- more positive impacts on neighborhoods.

Greater Capacity

Capacity is defined as the maximum number of vehicles a roadway can carry under ideal circumstances. It is usually expressed as the number of passenger cars per hour per lane. Highways with full control of access are usually built as multi-lane divided facilities, and each lane can carry 2,000 passenger cars per hour under ideal conditions. On the other hand, if a signal is installed at an intersection (under partial or no control of access), the capacity will be greatly reduced. The capacity can quickly be reduced to 1,000 passenger cars per hour for each lane because the right of way must be shared with the crossing traffic and travel time is lost due to starting and stopping at the signal.¹ It is clearly advantageous to carry twice the amount of traffic on the same "amount" of roadway. As a very simplified example, suppose that the traffic demand is 8,000 vehicles per hour. Which would be better—an 8-lane roadway with signalized intersections (1,000 vehicles/lane) or a 4-lane roadway with full control of access (2,000 vehicles/lane)? In most areas, the 4-lane facility would be better.

In addition, a highway with full control of access can more easily accommodate traffic growth. If there are partial or no controls on access, a highway will more quickly reach its capacity and motorists will begin to experience congestion. Capacity is reached more quickly not only because it is likely to be lower to begin with but also because traffic growth occurs more quickly as demands for access are made by rapid development along the highway. In other words, a controlled access highway typically starts with and maintains a high level of capacity, and access control prevents the rapid deterioration of traffic flow caused by entrances, strip development, and signals. Examples of this can be seen in many towns and cities

throughout Virginia. In these cases, a noncontrolled bypass that was initially a free-flowing highway developed into a second "Main Street," often to the detriment of the original downtown area.

Improved Safety

When access is controlled, intersections with and entrances to the highway are minimized. Further, they are located at points best suited for traffic and land-use needs and are designed to allow vehicles to enter and exit as safely as possible. Thus, regardless of the type or intensity of roadside development, a high quality of service is maintained and accident potential is reduced. In fact, it has been stated that the most significant design factor contributing to safety is full control of access.²

The reduction in accident potential is reflected in accident rates. An accident rate is the number of accidents, persons injured, or persons killed for every 100 million vehicle miles traveled (VMT) (1 VMT = 1 vehicle traveling 1 mile). The following are the 1988 accident rates for Virginia³:

Highway Type	Accidents	Persons Injured	Persons Killed
Interstate	76	41	1.0
Primary (full access control)	89	54	0.9
Primary (partial access control)	205	138	2.1
Primary (no access control)	184	113	2.8

Similar accident rates were reported for interstate and primary highways with full control of access. On the other hand, primary highways with partial or no control of access had significantly higher accident rates. In every category, the rate more than doubled!

Further accident analysis of specific highway sections in the Richmond area yielded the following accident rates for 1987-1989:

Highway	Accidents	Persons Injured
Rte. 250 from Short Pump to Glenside Dr. (no access control)	435	241
I-64 from Short Pump to Glenside Dr. (full access control)	60	29
Rte. 60 from Richmond City Limits to Huguenot Rd. (no access control)	432	226
Rte. 150 from Jeff. Davis Hwy. to Powhite Pkwy. (full access control)	107	57

In the first set of statistics, accident rates for a section of Route 250, which has no access control, and a similar section of the parallel I-64 were compared. The accident rate for Route 250 was more than 7 times the rate for I-64. Similarly, the injury rate was more than 8 times the rate for I-64. During the 3-year period, I-64 carried almost 19 million more vehicles than Route 250. In the second set of statistics, accident rates for Route 60 and Route 150 in southside Richmond were compared.

Both roads are major primary routes and serve both commuters and shoppers. The accident rate for Route 60 (no access control) was slightly more than 4 times the rate for Route 150 (full access control), and the injury rate was slightly less than 4 times the rate for Route 150.

Reduced Fuel Consumption

Vehicles traveling at a steady speed are more fuel-efficient than vehicles traveling in stop-and-go traffic. Based on a formula developed by the Federal Highway Administration (FHWA),⁴ for speeds up to about 55 mph, it can be shown that the miles per gallon (mpg) increase as speed increases. (At higher speeds, air resistance or wind drag causes decreased fuel efficiency.) Considered another way, fuel consumption, in gallons per mile (gpm), decreases as speed increases (up to 55 mph). Thus, highways on which vehicles travel at steady speeds and higher speeds are associated with less fuel consumption—thus fuel is saved. It is clearly the case that highways with full control of access are typically associated with a higher average speed than highways with partial control or no control of access. Obviously, when at-grade signalized intersections and frequent driveways and entrances are located along a highway, neither steady nor high speeds can be maintained.

Although statewide average highway speeds are unavailable, a hypothetical example can demonstrate the potential fuel savings on limited access highways. Let us compare fuel consumption on a limited access highway with a speed limit of 55 mph with that on an uncontrolled highway with a speed limit of 35 mph. Assuming that the average speed is close to the speed limit, and using the FHWA formula, the following statistics can be derived:

Type of Highway	Average Speed (mph)	Fuel Efficiency (mpg)	Fuel Consumption (gpm)
Limited access	55	22.55	0.044
Uncontrolled access	35	17.55	0.057

Let us further consider a 10-mile section of each type of highway, each with a daily traffic volume of 15,000 vehicles. In this situation, 6,600 gallons of fuel are consumed on the limited access highway and 8,550 gallons are consumed on the uncontrolled highway. The 1,950 gallons saved daily on the limited access highway amounts to almost 712,000 gallons in a year's time!

Less Pollution

The major pollutant emitted by motor vehicles is carbon monoxide (CO). Vehicles operate more efficiently when traveling at high, steady speeds than at slow, varying speeds, with the result that smaller amounts of CO are emitted. The FHWA developed tables that relate grams of CO per vehicle-mile and average highway speed.⁴ As speed increases, CO emissions decrease. Thus, highways with full control of access (higher average speed) are associated with less pollution.

Again, a hypothetical example can demonstrate the potential reduction in CO pollution. By using the speeds given previously, and the FHWA tables, the following statistics can be derived:

Type of Highway	Average Speed (mph)	CO/Mile (grams)
Limited access	55	14
Uncontrolled access	35	38

Again, let us consider a 10-mile section of each type of highway, each carrying 15,000 vehicles per day. On a daily basis, 2,100 kilograms (kg) of CO are emitted by vehicles on the limited access highway and 5,700 kg are emitted on the uncontrolled highway. Thus, 3,600 fewer kilograms of CO are emitted per day on the limited access highway. This amounts to more than 1.3 million kg per year, which is equivalent to almost 1,450 tons!

Positive Impacts on Motorists

The benefits of limited access highways have direct, positive impacts on motorists. Motorists are in a safer and much more comfortable driving environment. There are minimal conflicts, little stop-and-go travel, less congestion, and steady driving conditions.

In addition to these comforts, there are direct out-of-pocket savings to motorists. Based on accident records in Virginia,³ the average cost of property damage per accident on highways with full control of access in 1988 was \$3,970, and on highways with partial or no control was \$3,340. This did not include the distress and costs associated with injuries and deaths. There is less than one-half the number of accidents on highways with full control of access than on other highways. Thus, for every 100 million VMT on highways with full control of access, the cost of property damage caused by accidents in 1988 was about \$310,000. The comparable amount for highways with partial or no control of access was \$618,000. Thus, \$308,000 in out-of-pocket costs were saved by motorists per 100 million VMT. Since travel on these two categories of highways was approximately the same in 1988 (16 billion VMT), it can be said that motorists saved about \$49 million in the costs of property damage in 1988 by traveling on highways with full control of access.

Fuel savings also translate into direct out-of-pocket savings. If the calculations from the previous hypothetical example are used, a motorist traveling 10 miles on a limited access highway uses about 0.13 gallons of fuel less than a motorist traveling 10 miles on an uncontrolled highway. If it is assumed that the trip is made daily, the motorist saves more than 47 gallons per year. At a cost of \$1.25/gallon, the motorist saves about \$59 per year. Considered another way, the 15,000 daily travelers on the 10-mile section of limited access highway save, over a year's time, about 712,000 gallons—worth about \$890,000!

The final cost incurred by motorists is the cost of lost time, or delay. Because of the steady and higher speeds on limited access highways, there is less delay than

on other roads. The reduction in delay can be estimated by comparing average speeds on different types of highways. For any given trip, the higher the speed, the less the delay. At the speeds given earlier, it takes 1.09 minutes to travel 1 mile on a limited access highway and 1.71 minutes on an uncontrolled highway. The difference in time represents the savings attributable to control of access. Thus, a motorist making a daily 10-mile trip saves more than 6 minutes, which amounts to more than 37 hours a year. Based on a cost of time at \$6.50/hour, the motorist on the limited access highway saves about \$245 per year. If these savings are applied to the 15,000 vehicles a day, almost 566,000 hours are saved per year. Assuming an average occupancy of 1.5 persons per vehicle, this amounts to more than \$5.5 million in cost savings!

Positive Impacts on Neighborhoods

Nobody wants a highway in his or her backyard! However, if one must be there, a limited access highway is preferable to a highway with no control of access. To begin with, a limited access highway is typically much more attractive—extensive landscaping with trees and shrubbery is usually incorporated in its design. The neighborhood has a healthier environment because there are fewer harmful emissions. Fencing affords protection to both children and pets. Neighborhood streets are safer because fewer commuters try to avoid congested, stop-and-go traffic by cutting through parallel neighborhood streets. Land usage is stable in the corridor. The neighborhood remains a pleasant place to live, even with a highway as a neighbor.

SO — WHY BUILD LIMITED ACCESS HIGHWAYS?

The answer to the question is now known! Despite the disadvantages of limiting access to a highway, the benefits and advantages clearly justify such a highway. Limited access highways, especially those with full control of access, are associated with the following benefits:

- They can carry much more traffic per lane (typically, 2,000 vs. 1,000 vehicles).
- They are *significantly* safer (accident rates are less than half those for other roads).
- They conserve fuel (47 gallons per vehicle per year for a daily 10-mile trip).
- They reduce pollution (88 kg, or 194 lb, of CO per vehicle per year for a daily 10-mile trip).
- They provide positive impacts on motorists:

- more comfortable driving
- savings in accident costs (\$630 in property damage per accident)
- savings in fuel costs (\$59 per vehicle per year for a daily 10-mile trip)
- savings in delay costs (\$368 per vehicle per year for a daily 10-mile trip).
- They provide positive impacts on neighborhoods:
 - more attractive
 - healthier environment
 - safer for children and pets
 - no detrimental changes.

SO . . . continue to support and build limited access highways!

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