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Traffic Engineering to Accommodate Bicycle Traffic: How to Accept Incompetent Operation and its Consequences

1 Political Requirements

Highway and traffic engineers are presented with tasks and purposes determined by the political powers in government. When the task refers to movement of motor vehicles, the standard designs enable the design of practical plans for reasonably safe and reasonably efficient movement, insofar as the task assigned can be accomplished within the usual technology and cost. Much the same can be done for pedestrian movement. However, when the task involves the movement of bicycle traffic, there is considerable controversy about the proper designs, and when, in addition, the task is increased to not only accommodate bicycle traffic but to persuade people to switch from motor transportation to bicycle transportation, the task has become very complicated indeed. This article is an attempt to sort out the complications.

2 Before Bikeways

Up until about 1940 or so the legal and societal expectation was that bicyclists would obey the rules of the road for drivers of vehicles. The highway and traffic engineer was not required to do anything special for them.

After about 1940 or so, this expectation faded. Bicyclists were expected to be children who were not capable of obeying the rules of the road for drivers of vehicles, but were to keep close to the edge of the roadway to be safe from traffic. Of course this did not work. Even if staying close to the edge of the roadway protected bicyclists

from same-direction motor traffic, not having the skill of obeying the rules of the road left bicyclists wide open to the situations posed by turning and crossing traffic, be it either motor traffic or the movements of the bicyclist himself.

Motoring society, being quite happy that bicycle traffic was “safely out of the way”, was unconcerned about the consequences of incompetent bicyclists on the road. Highway and traffic engineers were never asked to do anything to accommodate such incompetent users; what happened to them was their own fault. Furthermore, bicycling was seen as a dying activity; since adult cycling would disappear and child cycling would be playing on quiet residential streets, nothing much needed to be done.

However, the unpredicted resurgence of adult cycling in the 1960s led to demands for bikeways to control these incompetent cyclists. Following that, the environmental movement demanded that these incompetent cyclists not only be controlled but actively encouraged.

So highway and traffic engineers were faced, for the first time, with orders from above to install bikeways to increase the amount of incompetent bicycle traffic on the roadways.

3 Bikeways in Traffic Engineering

All bikeways have one functional characteristic: they are facilities designed to separate same-direction streams of bicycle and motor traffic. Motorists like the separation as getting bicycle traffic out of their way. Most bicyclists love (not an

inappropriate word) bikeways because they see the separation as protecting them from what they erroneously believe to be their greatest danger, same-direction motor traffic. The cause of these beliefs has become irrelevant to the traffic engineer; he has been instructed to obey them.

It is standard traffic-engineering knowledge that the great majority of car-bike collisions involve crossing or turning movements by either party, while straight-ahead, straight-ahead car-bike collisions are a very small minority. On city streets, a reasonable division would be 95% turning or crossing, 5% straight-ahead straight-ahead. It is also standard traffic-engineering knowledge that, for city streets, the great majority of collisions involve turning or crossing movements by either party, and that the great majority of traffic-engineering problems have to do with designing for turning and crossing movements. It should also be obvious that the introduction of a second, and separated, stream of traffic on roadways, or of a third stream of traffic on highways, presents considerable difficulties in designing and operating.

There are only two ways to provide actual separation of turning and crossing movements: grade separation and time separation. Grade separation of bikeways is politically impossible; the public would neither accept it nor pay for it. Time separation, through additional traffic signal phases and more traffic signals, has been forced on the Dutch and the Danes because their chosen sidepaths [cycle-tracks] would be horribly dangerous without it. The extent of time separation even in these nations is far from complete, a fact that goes to show that an extensive system of time separated sidepaths is practically impossible. But it has not been tried for bike-lane separation. It would involve installation costs and operational delays, and bicyclists are assumed to be able to operate without that assistance. Such an assumption, that bicyclists are assumed to be able to handle the problems of turning and crossing traffic, when it is also assumed that they are unable to ride straight with respect to same-direction motor traffic.

The traffic engineer has been assigned to deal with this list of politically inspired contradictions and he has no choice but to attempt to do the best he can.

4 Preferences of Bicyclists

There are three general sets of preferences for urban highway design among bicyclists using

highways. These general highway design preferences are with regard to the desired degree of separation from same-direction motor traffic. For those that desire separation, other considerations are viewed to be of such low importance that they are largely ignored. Each general preference is also associated with a view, or more nearly assumptions, about the appropriate bicycle operating method.

4.1 No Separation; Integration into Traffic Flow

One group of bicyclists is content to be integrated into the normal traffic flow. The highway and traffic engineer can consider them as normal drivers of vehicles, with very few exceptions. These bicyclists should operate according to the rules of the road for drivers of vehicles, and to a large extent they do so. Furthermore, they tend to be proud of their skill, because they know that "Cyclists fare best when they act and are treated as drivers of vehicles."

This group is only a small part of the bicycling population.

4.2 Symbolic Separation; Bike-Lane Stripes

A second group of bicyclists is content with the symbolic separation provided by a bike-lane stripe. They feel that this stripe provides three services that they desire.

- 1: The stripe, by reserving an area for bicycle traffic, demonstrates bicyclists' right to use the roadway.
- 2: The stripe separates bicyclists from the greatest danger.
- 3: By separating bicyclists from the greatest danger, the stripe removes the need for traffic cycling skill.

This group is a large part of the bicycling population.

4.3 Physical Separation: Cycle Tracks

A third group of bicyclists feels that motor traffic is so unpleasant and dangerous that it should be separated from bicycle traffic by impenetrable physical barriers. This group of bicyclists feels that the physical barriers eliminate the need to operate with motor traffic.

This group of bicyclists is rather small at this time, because few existing conditions suit their

desire. However, this group is the subject of strenuous advocacy as being the most likely source of new bicyclists, people who have not been using bicycle transportation, with particular reference to women, children, and the elderly.

5 Consequences of Preferences

5.1 No Separation; Integration into Traffic Flow

Those who prefer integration into the traffic flow should be counted as part of the normal traffic flow, and the road built with appropriate width for the amount of traffic. If the traffic flow is such that overtaking of bicycle traffic will be significant to that flow, then the added width can be supplied either by another lane or by widening the outside through lane to permit overtaking bicycles within that lane.

The rest of the considerations are for conditions that should be present in any case: safe drainage grates, no slots or joints parallel to travel, bicycle responsive traffic signals, suitable signal phase durations.

If optional bike lanes exist on a street, integrated cyclists will sometimes be found using the bike lane, and sometimes not, because they ignore the bike-lane stripe when obeying the rules of the road for drivers of vehicles.

5.2 Symbolic Separation: Bike-Lane Stripes

Bike lanes are advocated for bicyclists who know that they do not possess the skill of obeying the rules of the road for drivers of vehicles. Probably nearly all those who prefer bike lanes are of this type, and this type must be considered to be the design bicyclist for bike lanes.

These bicyclists can be expected to stay in the normal bike lane and won't want to leave what they consider to be its safety. They will stop at stop signs and obey traffic signals.

However, they cannot be expected to operate with traffic sense. They will use the bike lane to overtake incautiously on the right-hand side of traffic that may turn right. For left turns they either use the pedestrian turn or they swerve incautiously across lanes. If a right-turn-only lane is added before an intersection, these bicyclists will either swerve to their left, which they consider dangerous, or, if a diagonal bike lane is designated, they will also swerve dangerously to the left, believing that the bike-lane stripe protects

them.

Considering that the politicians demand that bike lanes be provided to tempt these incompetent bicyclists, the traffic engineer has to just accept their presence. In fact, the more that is done to accommodate these incompetent cyclists, such as bike boxes and diagonal bike lanes, the more that these incompetent cyclists feel that they are being protected. This false confidence in protection that is absent then leads them to operate even more dangerously by following the lane stripes without exercising judgment.

If society demands that one class of driver be incompetent, there's very little that the traffic engineer can do to protect the incompetents.

5.3 Physical Separation: Cycle Tracks

Cycle tracks [side paths] are advocated for people who want to stay far away from same-direction motor traffic, particularly for women, children, and the elderly. It is accurate to describe these persons as having only pedestrian skills and refusing to learn any more. Such persons cannot be expected to exercise traffic skills at driveways, which may well cross their path, and at intersections, which will always cross their path, and they are often faced with difficult pedestrian traffic in the form of truckers transferring loads across the cycle-track, or bus passengers boarding and deboarding.

This makes design easy for the highway and traffic engineers. These cycle-track bicyclists have to operate like pedestrians, and the engineers know how to design for pedestrians. The problem, of course, is how to force the cycle-track bicyclists to act like pedestrians among pedestrians; if the bicyclists operate faster than pedestrians, both parties feel endangered, and are.

However, the politicians create another conundrum for traffic engineers by demanding cycle tracks that enable bicyclists to travel faster than pedestrians. That's not only a question of separate tracks for the two classes, but an entirely new question of traffic control for a new third category of traffic. Traffic control for every driveway, for every truck unloading position, for every bus stop, to say nothing of intersections? Any urban street that is not access-controlled will have either driveways or unloading trucks, the quantity determined by the local economy. And intersections are frequent.

The typical solution, where cycle-tracks are deployed, is to do so on streets with few drive-

ways, to ignore the unloading trucks and cars, and to install a new set of signal phases to time-separate the conflicting movements of the three types of traffic. The more signal phases, the less green time that any type of traffic receives. This slows everybody down, which may or may not be an acceptable solution.

6 Operating Methods; Laws

6.1 Plain Roadways

One might think that each system has its own operating system with appropriate laws, but that is not so. There are only two sets of operating systems with laws, one for drivers on roadways and one for pedestrians on sidewalks. While the operating system may require books for its complete description, its laws set out the limits of operation and specify the operating system for most engineering purposes. As the driver system and the pedestrian system are well understood by traffic engineers, they need no further discussion. The fact that there are laws for bicyclists on the roadway, for bicyclists on bike laned streets, and for bicyclists near side paths, does not change the preceding statement.

Until about 1940, American bicyclists were expected to obey the rules of the road for drivers of vehicles. After about that time bicyclists were expected to be children incapable of obeying the rules of the road for drivers, and were made subject to a new law. However, that law did not specify a new operating system. All that it did was to remove some rights that previously existed under the rules of the road. The law required that bicyclists stay as far right as practicable, thus removing the right to operate at any other part of the roadway. Of course, this was impractical, so certain exceptions were specified, such as the right to overtake slower traffic, or, even, to prepare for a left turn.

Whatever may be the motivation for this far to right law (FTR), it was justified by the argument that since bicyclists are unable to obey the rules of the road, it was necessary to keep them safe. But if bicyclists were not expected to be capable of obeying the rules of the road, what rules were they expected to obey? Some rules still applied at the edge of the road: stay right, stop at stop signs and signal for turns; these were emphasized in instruction.

Such a system constitutes incompetent operation. Because of its self-serving belief that stay-

ing out of the way of motorists kept bicyclists safe, American society accepted incompetent operation by bicyclists as the proper method. But even though this incompetent operation was the socially accepted standard, American society did not ask traffic engineers to accommodate it. Indeed, if American society had asked for designs to accommodate incompetent operation on the roadway, there would have been no designs for traffic engineers to offer. No known designs would accommodate an additional new method of operation on the same roadway, particularly one based on incompetent operation. So traffic engineers had to accept that some portion, hopefully becoming smaller, of roadway users would operate incompetently, and there was nothing that traffic engineers could do about it.

6.2 Bike Lanes

In the 1960s there was a resurgence of bicycling among American young adults who had been raised according to the system of incompetent operation. Among other things, this exposed the weakness of this system and annoyed motorists. Therefore, American society compelled traffic engineers to install bike-lane stripes as a means of physically enforcing the standard incompetent operation on all cyclists. Therefore, the standard FTR law was rewritten to require staying to the right of the bike-lane stripe. No other change.

But requiring that bicyclists stay to the right of the bike-lane stripe doesn't produce any better operating system than does requiring bicyclists to stay to the right edge of the roadway. Therefore, besides the additional traffic complications of the bike-lane stripe, traffic engineers are still faced with knowledge that a considerable part, and this time a part intended to largely increase, of the roadway users will operate in the incompetent manner. And there is nothing that the traffic engineer has to offer to fix the problem of politically desired increasingly incompetent operation of roadway traffic.

6.3 Side Paths

Requiring bicyclists to use sidepaths does not eliminate the problem of incompetent operation; it merely puts the incompetent operators into roadways at intersections in a manner that makes more intense the problems they create. It is assumed that such operators have the ability to obey the rules for pedestrian operation. As long as they obey those rules, the situation is manage-

able. But, all too frequently, bicyclists on sidepaths refuse to obey those rules and choose to operate as incompetent pedestrians. Again, there's nothing that the traffic engineer has to offer to fix the problem of politically desired increasing incompetent operation of traffic on normal sidepaths.

The provision of additional signal phases at traffic signals offers a partial solution. These signal phases provide time separated operation of motor, bicycle, and pedestrian traffic. But in doing so, they reduce the proportion of time in which each type of traffic can move, thus reducing mobility for all users. And they do nothing for the intersections and driveways that don't have signals; provision of more signals would delay all users even more. And such signals do nothing about the traffic that crosses the sidepath at any location, being pedestrian traffic from parked vehicles, including truckers with handtrucks of goods. Therefore, incompetent operation on sidepaths creates many more problems for which the traffic engineer has no solution to offer.

6.4 Laws

It should be manifestly obvious that operating according to the rules of the road for drivers of vehicles is by far the best system for bicyclists. The other choice, when operating on the roadway, is disobeying the rules of the road, which is manifestly dangerous. The argument is false that operating according to only a part of the rules, that part applying to the edge of the roadway or the bike lane, keeps cyclists safe. It is false because that system leads inevitably to disobeying the other rules, if only from the incompetence produced by pretending that competence is unnecessary.

This discussion has ignored, up to this moment, the exceptions written into the FTR and bike-lane laws. These exceptions were written into these laws because they would otherwise require, for example, that bicyclists turn left from the edge of the roadway or from the bike lane, which is obviously dangerous. Suppose that that were the actual law. A motorist driving along the roadway would be responsible for colliding with a bicyclist who stuck out his left arm and turned left in front of him. Can't have that, can we? Similar arguments apply to the other exceptions.

However, the American public knows full well that the intent of the FTR and bike-lane laws is to keep bicycle traffic out of the way of motorists. The result is that the list of exceptions is never sufficient and gets more complicated as time goes

on, and the exceptions are interpreted only under the overwhelming principle that bicyclists should stay out of the way. The complications have made this everyday law into a legal farce, contributing to the harassment of lawful bicyclists and the miseducation of the not-yet-lawful bicyclists.

Obedying the rules of the road for drivers of vehicles is also better than obeying the pedestrian rules on sidewalks or sidepaths. Operating so has two disadvantages. It delays bicyclists by the limited safe operating speed and additional delays, and it puts bicyclists among pedestrians, which is dangerous for both.

It should also be manifestly obvious that the special laws for bicyclists have no other effect than prohibiting normal operation according to the rules of the road for drivers of vehicles. For proof, those laws fail to provide any new and safer operating rules; they do nothing but prohibit. Whether these laws were intended for the convenience of motorists or the safety of bicyclists, that conclusion is inescapable.

7 Conclusions

7.1 Present Situation

For seventy years or so, American society has instructed its traffic engineers to expect that bicycle traffic will largely be operated in an incompetent manner. Traffic engineers have had no design to accommodate incompetent operation, indeed such a design is practically and politically impossible. Because American society did not request that traffic engineers provide that impossible design, traffic engineers never had to demonstrate the impossibility. Therefore, American society continued in the false belief that incompetent bicycle operation was safe and acceptable. Traffic engineers had to accept that as the political fact under which they worked, even though they had no design for making incompetent bicycle operation safe.

The situation did not change when American society decided that a bikeway program be created to physically enforce this system of incompetent operation. Physically enforcing the system of incompetent operation did no more than to increase the social, legal, and learning difficulties of those bicyclists who recognized the value of operating according to the rules of the road for drivers of vehicles.

The present political policy of advocating a great increase in incompetent bicycling does not

change the physical situation or increase the ability of traffic engineers to accommodate incompetent operation, and it increases the social and learning difficulties of those who would operate properly according to the rules of the road for drivers of vehicles.

7.2 Possible and Desirable Action

There is far too much political force behind the bikeway program for traffic engineers to stop it. Traffic engineers may be able to divert it away from its most dangerous aspects, such as bike lanes in door zones, but even that is speculative.

Traffic engineers have to accept that a considerable portion of bicycle traffic will be operated in an incompetent manner. American society has thoughtlessly demanded that this be so.

However, traffic engineers have the distinct possibility of decreasing the proportion of incompetent operation and increasing the proportion of competent operation, which would be an entirely desirable result. It is the special bicycle laws that, in the political and social senses, are seen to prohibit proper operation in accordance with the rules of the road for drivers of vehicles. The special bicycle laws are not necessary for safe operation on plain roadways, on roadways with bike lanes, or on roadways with sidepaths. All they do is to hinder proper operation.

Under the limited scope of action permitted them, the best action for traffic engineers is to work for repeal of the three special bicycle traffic laws that inhibit the proper and desirable operation of bicycles. That is the only means now permitted traffic engineers to actually improve the operation of bicycle traffic. Engineering ethics demand that traffic engineers act to improve the safe and convenient operation of traffic, and encouraging bicyclists to operate by the rules of the road for drivers of vehicles is the best course available to them.