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RAMP PROBLEMS ON THE DETROIT FREEWAY SYSTEM

By

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We currently have 137 ramps as part of 57 interchanges in operation on the Detroit freeway system. Most of these were planned and designed previous to 1950 and some have been in operation for nearly 10 years. It's very difficult, in an urban freeway complex, to isolate ramp problems from the other considerations--such as interchange spacing, lack of adequate lane balance, or multiple weaving situations. An additional factor which has become very apparent in recent years is the matter of freeways operating at possible capacity during peak hours. It appears, at this stage at least, that, regardless of how many miles of an urban freeway are built, they are full of traffic during the peak hours almost upon completion. This, then, means that we should be designing these freeways on a possible-capacity basis and, in fact, try to approximate the design of a hydraulic system. I am certain that were our current design hours at or below a design-hour volume of 1500 vehicles per lane per hour, most of our problems would not exist.

We find, for example, that in one of the situations you will see today, no problem exists until the total freeway volumes exceed 2,000 vehicles per lane per hour. In another situation, the peak volumes exceed 2,200 vehicles per lane per hour. Congested, it is true, but they keep moving by a point at this rate. On the other hand, we have an example which, due to being on an upgrade and involving trucks, the figure of 1700 vehicles per lane per hour is actually the stagnation point.

I have prepared a film for you showing seven ramp situations in the Detroit freeway system representing three basic types of problem. The first three examples represent operational problems rather than capacity problems. The next example represents a problem with trucks, and the last three examples represent problems in ramp location. One thing I would like to emphasize, before starting the film, is that no attempt has been made to illustrate some of the many areas in which the freeway operates smoothly, even during peak hours. In addition, of course, during off-peak hours, the entire freeway system operates very well.

1. Eastbound Edsel Ford at Livernois (Obsolete Design)

This is one of several parclo interchanges on the Detroit freeway system. Peak volumes approaching this interchange are 1800 vehicles per lane per hour with 500 exiting at Livernois. This is not a capacity problem.

The loops, of necessity, are tight being compounded from a 400 to a 200 to a 100-foot radius. The designers felt that the ramp exit should be on the near side of the structure. They were so constructed but with a narrow lane separator between the freeway lane and the ramp lane. It has been difficult to keep vehicles from straddling the separator, running over it, hitting it, or otherwise getting confused.

In addition, the separate decelerating lane has not eliminated a number of run-off-roadway accidents at the approaches to the innerloops. Also, hidden backups contribute to the difficulty here.

We have recently constructed a rolled curb two feet high on the outside of these loops in an effort to keep the vehicles on the ramp.

There are a number of different methods for improving these ramps. The gore problem would be a matter of constructing a wider separator which can be easily seen and actually give the driver the feeling of being separated from the freeway lanes. The approaches to the innerloops represent a typical problem and probably are accentuated since most of the ramps on Detroit freeways are of the diamond type. In cases where loops are necessary, more attention must be given to preparing the driver for the situation ahead.

2. Eastbound Edsel Ford - DuBois Off-Ramp (Obsolete Design)

Traffic approaching this exit is coming down a three-per-cent grade and then climbing a four-and-one-half-per-cent grade on the off-ramp and traveling around a 150-foot radius curve. The problem at this location has been primarily vehicles traveling too fast for the curve.

One vehicle didn't make the curve at all, went straight off the end of the ramp, crossed over the lane separator, the sidewalk, went through the railing, and landed on the freeway below.

We have installed additional plate guardrail on this curve and have effectively eliminated this problem. However, note the dents in the guardrail which would indicate that some of the people still don't believe that this curve is so tight. This is one more example of tight, hidden curvature which appears unreasonable to approaching drivers.

3. Westbound Edsel Ford at Michigan Exit (Obsolete Design)

Freeway volumes approaching this ramp are 1500 per lane per hour in the afternoon peak. Eight hundred vehicles leave on the ramp during this period, leaving a little over 1200 per lane per hour on the freeway lanes beyond the ramp. The ramp was actually designed as a major connection and is two lanes wide. Note that the exit is on almost the same tangent as the approaching freeway lanes and that the freeway curves to the left and is somewhat hidden at this point. Most vehicles exit from the right lane at this ramp.

Trucks are also required to keep to the right on Detroit freeways. Some vehicles exit from the center lane because of the ramp tangent alignment, the two-lane exit, or failure to see the sign which is hidden behind the structure. Some trucks enter the center lane previous to this exit in order to avoid any conflict with vehicles exiting from the center lane. Failure to use this defensive maneuver occasionally creates a conflict between trucks on the right lane and vehicles exiting from the center lane.

The volumes currently using the ramp indicate that a one-lane exit is sufficient. One inexpensive solution to this problem would be to reduce the exit to one lane. This solution, in itself, may not solve anything in that the ramp will still appear straight ahead. A better solution would be to rebuild the ramp alignment by starting it part way around the curve on the freeway. This exit would then be one lane wide and would look like any other ramp. This example does confirm the basic geometric criteria of establishing the freeway or major-route continuity before introducing an exit or other decision point.

4. Eastbound Edsel Ford at Beaubien On-Ramp (Problem With Trucks)

This location has a series of considerations, all of which contribute somewhat to the problem. The Beaubien on-ramp is one of the heavier on-ramps in Detroit and approaches a weaving area 950 feet in length. The exit ramp, at the end of the weave, carries relatively minor volumes, 300 vehicles per hour maximum. The entering traffic from Beaubien is 1200 vehicles per hour making a total weaving volume of 1500 vehicles per hour. This is the heaviest weaving volume in Detroit but, in itself, operates fairly well.

The biggest contribution to backups here is a 2,000-foot section of elevated freeway. Immediately beyond the end of the weaving section, freeway drivers are in a three-per-cent upgrade. Freeway volumes approaching the weaving section are 1400 vehicles per lane per hour. The three-per-cent upgrade beyond the weaving section carries 1700 vehicles per lane per hour and is congested. Trucks traversing the upgrade are the major problem here. During this congestion period backups develop, clear out, and then develop again. During all this time, the heaviest weaving volume is taking place. You can see how complicated the situation gets.

The peak volumes of 1700 vehicles per lane per hour are far below peak volumes for the remainder of the Detroit freeway system. It is true that 1700 vehicles is above the design capacity of 1500 vehicles per lane per hour; but, by comparison, some portions of Detroit freeways carry as much as 2200 per lane per hour.

A solution to this problem would have been to construct a fourth lane initially to minimize the affect of trucks on this heavy upgrade.

This same elevated structure is four lanes for the westbound direction, due to the need for an accelerating lane required by an on-ramp in the bridge approaches. These westbound lanes carry almost the same amount of traffic during the same periods, some 1400 vehicles per lane per hour. The extra lane provides sufficient additional capacity to make a completely free-flowing situation.

5. Northbound John C. Lodge at Chicago On-Ramp (Ramp-Location Problem)

The Chicago Avenue interchange is a typical diamond type. The entrance northbound is a problem every day. This is due to the freeway being in a curve to the right, both preceding and following the ramp approach; the accelerating lane being too short; no weaving lane between the entrance and the exit; an exit ramp 1600 feet beyond the entrance nose; and, most importantly, in excess of 2000 vehicles per lane per hour on the freeway preceding the ramp approach.

Every day, during the afternoon rush hour, the 200 vehicles entering on the ramp cause sporadic breakdowns. A single vehicle approaching the freeway from the ramp generally can find a gap without causing any appreciable disturbance in the heavy freeway volumes. However, any time that two or more vehicles approach together on the ramp, they tend to create turbulence, either by lack of gaps, or by creating freeway headways so short that when drivers attempt to regain normal spacing, a slowup is created, or in some cases, complete breakdown occurs.

During this same period, 227 vehicles are exiting on the next ramp to the north. This means there is a relatively small weaving volume of only 400 vehicles per hour between the Chicago and Webb ramps. The combination of these various deficiencies plus the weave creates this problem.

The answer, of course, would have been to construct a fourth lane through this weaving section for lane balance. You can see the kind of construction problems involved in attempting to do it now.

6. Southbound John C. Lodge - Edsel Ford to Forest and Forest Ramp Terminal (Ramp-Location Problem)

This situation involves ramps entering the freeway from both the right and left sides as part of a major interchange followed by an exit to a local interchange. Peak freeway volumes are 3900. The left entrance carries 1000, the right entrance carries 1700 making a total of 6500 vehicles per hour. The basic freeway width is three lanes with an auxiliary, or weaving, lane extending from the major interchange southbound to the Forest exit ramp. The additional, or fourth, lane appears to provide sufficient space for vehicles to maneuver and offsets any turbulence caused by weaving vehicles.

The Forest Avenue exit carrying 1100 vehicles in the peak creates the problem here. A signal on the crossroad ramp terminal backs traffic onto the freeway. Forest and Warren Avenues are a pair of one-way, cross-town streets. Under normal circumstances, a split-diamond interchange would have been constructed here with ramps providing for traffic to and from the north located in this position. The proximity of the Edsel Ford interchange immediately to the north, however, prevented this construction due to close ramp spacing; and these ramps, therefore, were placed at Forest. This creates a series of U-turning and weaving maneuvers.

Traffic exiting from the freeway has three possible maneuvers--straight through, down the service drive left turning onto Forest, or left turning on the U-turn bridge and, by the circuitious path shown, eventually winding up westbound on Warren Avenue. Also involved in this area is the normal left turn from Forest Avenue onto the freeway. Then, we have southbound service-road traffic turning left at the U-turn bridge and entering the freeway; and, finally, we have westbound Warren Avenue traffic, destined for the north on the freeway, which must turn south, turn around the U-turn bridge, and then enter the freeway on the northbound ramp.

You can see that a major weaving section is created involving southbound exiting traffic at this point and the various maneuvers which must make the U turn from the service drive.

Until recently, this exit ramp was one lane wide and approached a 30-foot service road on which these weaving maneuvers took place. We have now widened the exit ramp from 16 feet to 20 feet and have added an additional 10-foot lane in the weaving area. This widening provides additional weaving space as well as additional storage capacity to eliminate traffic backing out onto the freeway.

Even though this cross-town, one-way system carries heavy volumes and even though the peak exiting traffic represents close to practical capacity for the exit ramp, the problem at this location is that we are attempting to provide too many maneuvers in a small area. It's difficult to say what might have been a better solution to this problem. It may very well be that this is the best solution in spite of its drawbacks.

7. Edsel Ford Freeway at Lodge and Trumbull (Ramp-Location Problem)

This situation has a number of contributing factors resulting in a somewhat complex problem. They include left and right-entrance ramps approaching the westbound Ford Freeway from the Lodge Freeway. The left entrance includes heavy trucks which must weave to the right lane. Thirteen hundred feet west, a local ramp approaches the westbound Ford from Trumbull Avenue. A fourth lane has not been added from the Trumbull ramp westerly to the next exit, which would have provided lane balance. Just west of the Trumbull ramp, a series of wide structures going over the freeway create a

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A moderate volume of 700 vehicles approach the freeway from the Trumbull ramp in the peak hour. Combined with the freeway volumes of 5600 vehicles, total volume is 6300 vehicles or 2100 vehicles per lane per hour. This is where the backups begin.

Back at the Lodge Freeway approach ramps, the westbound Ford volumes are 1100 vehicles per lane per hour, right-entrance volumes are 1100 vehicles per hour, and left-entrance volumes are 1200 vehicles per hour. The combination of these circumstances and these volumes results in complete stagnation nearly every day.

We conducted an extensive study of this location last year and were able to obtain vehicle-volume counts and speeds by one-minute increments by lane. The situation was first studied with all ramps open to determine, in detail, what the situation actually was. The first experiment was reducing the left entrance from two lanes to one. The study conclusions indicate that reducing the ramp width actually increased the congestion in the freeway system as a whole and that it made no significant improvement in this area.

You will recall that the left and right-entrance ramps at this point approach the westbound Edsel Ford Freeway at approximately the same station. The second part of the study was to extend the left-entrance terminal by building an additional merging lane approximately 1000 feet in length. This additional lane has improved the situation by moving back a few minutes the time of the congestion or breakdown.

The third situation studied was to close the Trumbull on-ramp during the afternoon rush hour. Elimination of these 700 vehicles in the rush hour solved the problem by reducing the freeway volumes beyond Trumbull below the danger point.

These 700 vehicles are the straw that broke the camel's back. Experience gained at this and other locations on the Detroit freeway system indicates that a fourth lane should have been constructed from the Trumbull ramp westerly to the next exit. This would have provided adequate lane balance. This solution, of course, is not possible now.

Considering the complex of contributing factors here and what can physically be changed, the study concludes that the elimination of Trumbull on-ramp traffic during peak hours would solve the problem.

This problem, as well as the others you've seen, illustrates, in general, peak situations. It is during these periods that minor design flaws are magnified into major operating problems. Were these freeways operating with volumes below practical capacity, rather than up to possible capacity in most cases, we feel that most of these problems wouldn't exist.

CONCLUSION

I think that much of the material you have seen today is nothing new to most of you. You probably have examples in your own areas of similar problems. The first three examples labeled obsolete design indicate basic considerations. Hidden ramps have always given us a problem, and I think these examples merely outline some of the consequences if we fail to follow the basic principles. It is very obvious, at this stage, that drivers have difficulty traversing something they can't see, regardless of what the situation is. Adding signs doesn't necessarily help. It is only a minor percentage of drivers who get into difficulty at these locations anyway since most people using these freeways are repeat drivers. This is a recommendation to you that, in preparing plans, every effort should be made to carefully check relationships between profiles and curvature, particularly on ramps.

The third example, Edsel Ford at Michigan, illustrates a basic principle--that being that off-ramps should be avoided at points where the freeway turns. There is a tendency for freeway drivers to feel that the freeway goes straight rather than around the curve. This example also illustrated two-lane versus one-lane exits and some of the problems we get involved in with this type of design.

You have seen one example of the affect of trucks on a freeway traffic stream. This item is really nothing new but does, in fact, confirm policies and judgmants regarding the problem of trucks.

You have seen an example of attempting to introduce an on-ramp in the middle of one of the heaviest traffic streams in Detroit. This, along with the fact that the ramp is hidden in a curve to the right, the fact that the next exit beyond is hidden behind a wall, and that there is no fourth or weaving lane between the on-ramp and the off-ramp.

Lastly, you have seen the affect of local ramps being located fairly close to a major interchange. In these cases, particular attention must be paid to lane balance to eliminate backups and other turbulence.

I would like to repeat that we haven't shown you any footage of the miles of freeway which do operate well, even in the peak hours, nor have we made any attempt to illustrate how these various examples operate during off-peak hours. Generally, they operate well during those periods.

I would also like to emphasize again that Detroit freeways are full. They are carrying, in many cases, possible capacities; and we feel that, were they carrying practical capacities, most of these problems wouldn't exist.

In some cases, we attempted to illustrate how these problems could be solved or could have been solved by improved initial design; and I hope that you might be able to use some of these examples in your future designs to avoid certain features which cause difficulty to provide better-operating freeways.

I would like to invite any of you to request this film for your own people to see. We intend to put a sound track on it and it should be available within a month or so.