

October 28, 1998

LEFT TURN PHASING SELECTION

Installing an exclusive left turn phase at a signalized intersection is appropriate under a variety of conditions:

- 1.) Left turn traffic **volumes are heavy** and not having a separate left turn phase would result in substantial queuing and delay in the left turn lane. Not having a separate phase when left turn traffic is heavy could also increase the potential for left turn accidents.
- 2.) There are **few gaps** in the opposing traffic stream, making it difficult for motorists to turn left. This could cause substantial queuing and delay in the left turn lane, even if left turn volumes are not particularly heavy. Not having a separate phase when gaps are scarce could also increase the potential for left turn accidents.
- 3.) A **sight restriction** exists and a separate left turn phase is needed to safely convey left turning motorists across the intersection. In this case, a protected-only left turn phase is appropriate.
- 4.) **Dual left turn** lanes are present. In this case, protected-only phasing must be used since permissive left turn movements (turns made on the green ball) have been shown to be quite dangerous if made from dual lanes.
- 5.) A documented traffic **accident pattern** exists that involves left turning vehicles.
- 6.) The intersection is **staggered** such that left turning vehicles on opposing approaches would hit each other head-on if one of the approaches did not have a separate left turn phase. In this case, lead-lag left turn phasing must be used and the leading left turn phase must be protected-only.
- 7.) The left turn movement crosses a **railroad track** (after the turn has been made) and railroad preemption phasing is being used to keep this movement from occurring during the train crossing interval. In this case, a protected-only left turn phase is the typical treatment. An alternative is to use protected/permissive phasing with a blank-out NO LEFT TURN sign. The sign is activated only during the train crossing interval.

If a left turn phase is installed under one of the first two conditions, then a decision must be made regarding the use of either protected-only phasing (left turns allowed only during a green arrow indication) or protected/permissive phasing (left turns allowed during a green arrow indication and, if gaps in the opposing traffic stream permit it, also during a green ball indication).

Protected-only phasing is generally safer than protected/permissive phasing since all left turns proceed during their own exclusive phase. Accidents due to poor driver judgment in picking a safe gap in the opposing traffic stream are eliminated. However, the use of protected-only phasing instead of protected/permissive phasing generally results in lower intersection capacity and increased motorist delay since motorists are not allowed to turn left on the green ball. The over-use of protected-only phasing can also result in driver frustration if opposing traffic volumes are light and motorists feel that they could easily turn left through the opposing traffic stream.

The appropriate left turn phasing to use at a given signalized intersection can be a subject for considerable debate. Some jurisdictions desire to minimize motorist delay by keeping the number of signal phases to a minimum. These jurisdictions prefer to use permissive or protected/permissive left turn operation. Other jurisdictions are more conservative, putting more of an emphasis on the safety benefits of protected-only left turn phasing. Arguments can be made for both points of view, but who is right?

Although there are a variety of left turn phasing "warrants" in the traffic engineering literature, they all have drawbacks and none of them can be considered universally applicable. At this point, it is still a judgment call as to whether protected/permissive or protected-only operation should be used at a given intersection (assuming there is no sight restriction, dual turn lanes, or other factor that would require protected-only phasing). An additional complication is that it is difficult to predict whether or not a given intersection will pose an accident problem if protected/permissive phasing is used instead of protected-only phasing. Every so often, a left turn accident problem arises at an intersection where protected/permissive phasing has been used, and it then becomes necessary to replace the protected/permissive phasing with protected-only phasing. Is there any way to spot such a location in advance, before a problem occurs? I believe there is.

Having spent many years timing traffic signals and observing their operation in the field, I have identified the following two conditions that will contribute to a left turn accident problem if protected/permissive left turns are allowed:

Condition 1: There are opposing left turn lanes and, during some period of the day, both of these lanes have a substantial volume of traffic that leads to queues forming in both lanes.

Condition 2: The left turn lanes are offset somewhat and the queues block the view of motorists attempting to turn left during the permissive interval.

Under these two conditions, the first motorist in the queue feels "pressure" from other motorists in the queue to turn as soon as possible. However, it is difficult to turn because the queue in the opposing turn lane obscures the view of oncoming traffic. If the turning motorist must cross many lanes and the approach speed of opposing traffic is high, then the situation is even worse. These conditions are summarized in Figure 1. Under these conditions, there is a real chance that the first motorist in the queue will pull in front of an oncoming vehicle, resulting in an accident.

If there is no opposing turn lane (such as at a T-intersection), or if the queue in one of the turn lanes is not very long, then the chance of this occurring is much less. Short queues are not as effective at blocking the vision of opposing drivers. In addition, motorists at the head of a short queue feel less pressure to turn during the permissive interval (see Figure 2).

When considering the appropriateness of protected-only versus protected/permissive left turn phasing, the above discussion should be kept in mind.

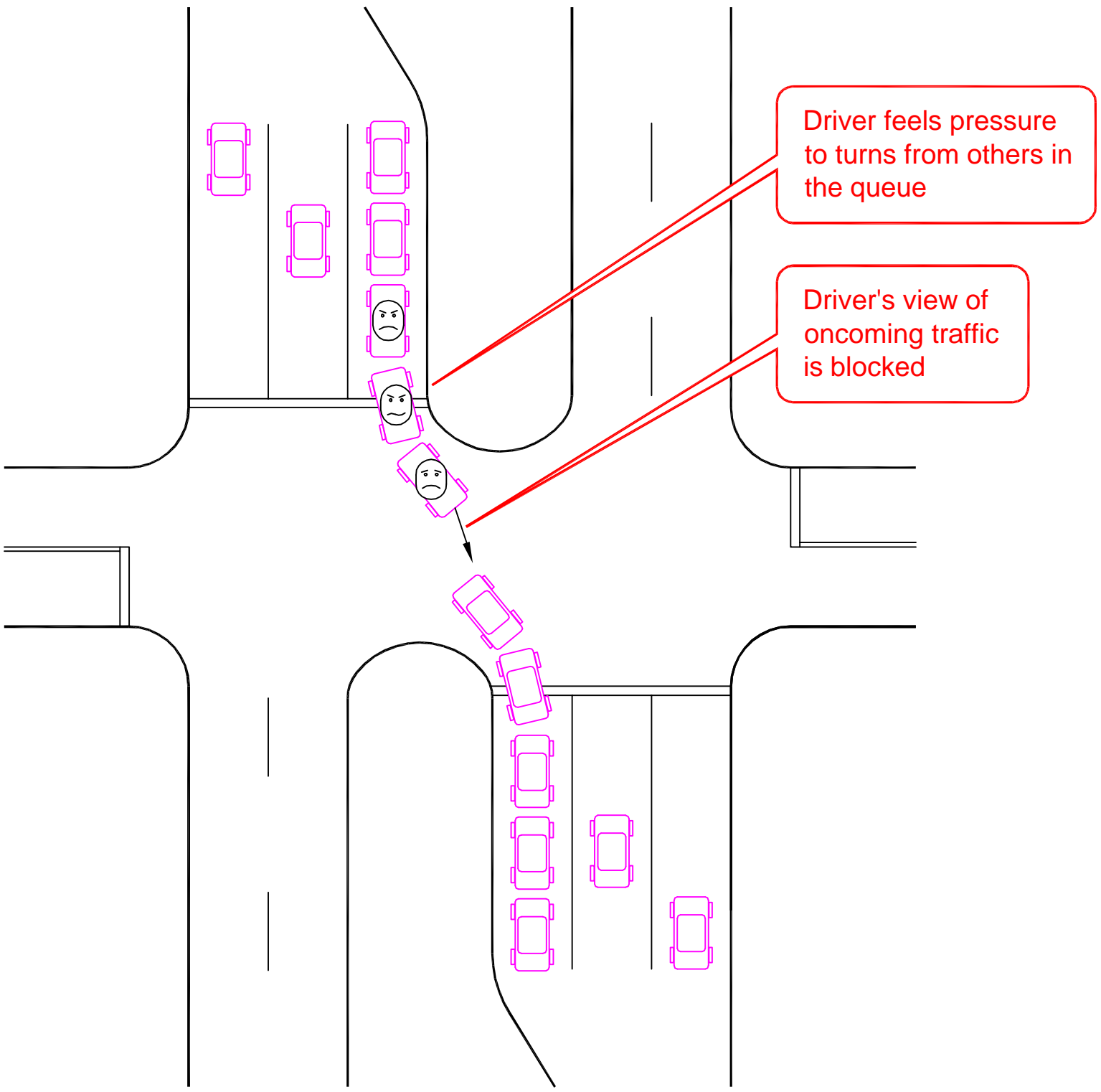


FIGURE 1

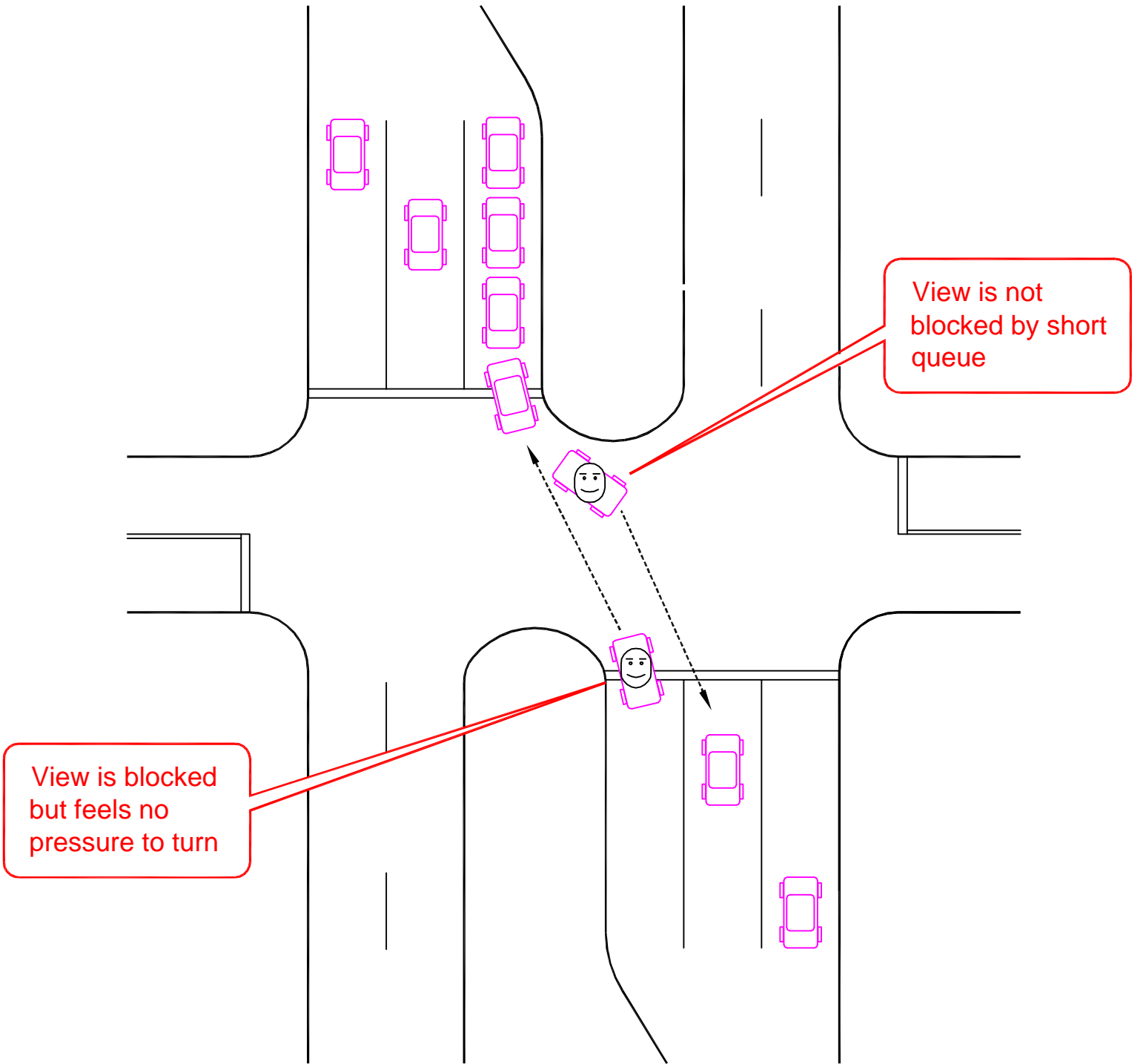


FIGURE 2