THE TROUBLE WITH TRAFFIC CONTROL DEVICES

Greg Mauz

TRAFFIC SIGNALS

The Manual on Uniform Traffic Control Devices (MUTCD) states: "Traffic signal installations, even though warranted by traffic and roadway conditions, can be ill-designed, ineffectively placed, improperly operated or poorly maintained. The following factors can result from improper or unwarranted signal installations:

1. Excessive delay may be caused.
2. Disobedience of the signal indications is encouraged.
3. The use of less adequate routes may be induced in an attempt to avoid such signals.
4. Accident frequency (especially the rear-end type) can be significantly increased."

Add to the above problems: wasting time, money and gas, while unnecessarily creating more pollution. Improperly timed signals can also contribute to road rage.

"The legitimate role of traffic control devices is to control traffic in a manner that safely expedites traffic," says Jim Baxter, President of the National Motorists Association. "Using traffic control devices for revenue generation, commercial profit, confusing or distorting traffic or any other purpose that contradicts the safe expedition concept is a perversion of the objectives of all traffic control devices."

There occurs nationwide "perversion" in the engineering of traffic control devices. There is an epidemic of malpractice in the setting of speed limits in virtually every state in this country. See "Speed Limit Signs" later on in this chapter. To a lesser - but still disturbing - extent, traffic signal mismanagement abounds.

What American driver has not encountered the following scenario? You are sitting at a red-light. Observing the intended travel path, straight ahead, reveals several more traffic signals in the next half mile or so. Finally, your light turns green. You drive only 3 blocks before encountering another red signal at the next traffic light. Repeating the process results in a trip taking 6 minutes to complete, instead of 2 minutes. Not only do improperly synchronized traffic signals waste time, money and gas, they cause more crashes and violations.

How many drivers must sit at solid red-lights at 3 AM, while nobody is out on the streets? The traffic light should be blinking yellow on the main street, while flashing red on the side street, for the designated ultra low traffic period, say 12 AM-6 AM. Although the MUTCD (Section: 48-18) requires all traffic signals to contain flashing capabilities, many cities neglect to perform this simple, reasonable programming of their signals. Some people, as recorded in Boca, stop for the solid red, look both ways for headlights, then safely proceed. Since cameras operate 24 hours a day, cities will be even less inclined to provide flashing lights during the quiet night hours.

One day, while approaching a green left turn arrow, on Glades Road in Boca, the amber illuminated. I could have safely proceeded left through a just-turned-red but chose to stop. I watched the clock. Over 4 minutes elapsed before the green arrow reappeared. This remains an unacceptable amount of time to sit at a traffic light.

Broward County, Florida contains a plethora of traffic signal mismanagement. This problem surfaced in several Sun-Sentinel articles. Turning left requires deft reflexes as most arrows last only 5 seconds, legally allowing only 4 cars through the intersection, while up to 10 others suffer and wait. The ludicrously short light durations often force motorists to sit through 2 or 3 complete signal revolutions to proceed. "Disobedience...is encouraged." Ironically, a representative from this county proposed a camera bill. Many Palm Beach County signals also program these ridiculously short green arrows. Signal Timing Standards obtained from Palm Beach County Department of Engineering and Public Works show that the MINIMUM green for left turns is 5.0 seconds. Although not stated, this minimum duration should logically apply to a low volume intersection in a rural or semi-rural area. With Broward and Palm Beach counties each exceeding one million residents, there are almost no low volume signalized intersections even for left turn actions. Traffic engineers concur that most people take 2 seconds just to react to the green, leaving a scant 3 seconds (plus amber) to turn left. These tiny arrow durations create dangerous situations leading to crashes. I would recommend a 10 second minimum or 7.5 seconds followed by a solid green.

Another problem in Florida, and most other states, concerns the following statement. "The Yellow and All Red times are determined based on the posted speed limit and the width of the intersection." This Palm Beach Standard follows the recommendations of the Institute of Transportation Engineers (ITE), August, 1994.

Well, sort of. ITE Traffic Engineering Handbooks, July, 1989 and August, 1994, permit using the posted speed but in a politically correct accommodating way. "It may be possible to use the posted speed limits as the approach speed. Such a policy may not be unreasonable given that drivers approaching at higher speeds are violating the law. Care should be taken to ensure that the speed limit is reasonable." Columbo would have a hard time finding a reasonable, properly engineered speed limit in most states.

The preferred and best method to determine the yellow and all-red timing is to determine the approach speed based upon the 85th percentile speed. "The speed is generally taken to be that represented by a locally chosen percentile of approach speeds, usually the 85th percentile."

Palm Beach County employs the "Rule-of-Thumb" method to determine the yellow change interval length as outlined in the August, 1994, ITE publication, "Determining Vehicle Signal Change and Clearance Intervals."

Left Turn Movements = 4 seconds
Thru Movements (45 MPH or less) = 4 seconds
(50 MPH or more) = 5 seconds
Approach Speed = Posted Speed Limit

ITE says, "Some believe that uniform yellow change interval lengths are wrong and even dangerous." Many engineers prefer the Kinematic Model, which bases amber timing on a complicated formula determined by driver reaction time, velocity, deceleration, grade and speed of approach (generally the 85th percentile) and intersection width. The "generally assumed" driver reaction time is only one second.

Since most speed limits remain underposted, the amber change interval length and all-red phases are set incorrectly. For example: a Palm Beach County approach speed, based upon a 40-45 MPH speed limit, will provide a 4 second amber phase. However, the real approach speed (85th percentile) likely exceeds 50 MPH. Therefore, the amber elapsed at least one second sooner than needed to provide enough stopping distance or minimum time for safe clearance of the intersection. Appropriate amber for this common situation should be at least 5 seconds, not the prescribed, inadequate 4 seconds. These timing shortfalls create red-light violations and more accidents.

Yellow Timing is Everything

"Determining Vehicle Signal Change Intervals" ITE Journal, July 1989, states, "Many engineers believe that change interval timing is a major determinant of the accident potential of a signal controlled intersection." The yellow change interval length (timing), when properly set, reduces accidents and red-light violations. Conversely, improper yellow timing - usually too little - increases crashes and RLVs.

"The amber time provided to drivers is the only traffic control feature that separates a driver from a citation," notes Gene Quinn, Traffic Safety Researcher from Virginia.

David Feber, Transportation Engineering Manager for AAA Michigan, agrees on the importance of amber (yellow) timing. "What we're finding is that not all motorists are running red-lights because they are aggressive. Some intersections are DESIGNED (my emphasis) so motorists tend to violate the red -- we can reduce that through engineering rather than enforcement."

"There's an optimal length of the amber phase where people can make that decision (to stop) safely. If it's too short or too long you get more red-light violators."

A study, by Howard S. Stein, "Traffic Signal Change Intervals: Policies, Practices and Safety" (Transportation Quarterly, July 1986) found that improperly timed signal change intervals (yellow timing) increased crashes.

"The duration of yellow-traffic-signal timing has been found to influence red-light running at urban intersections. Therefore, yellow signal timings at the camera sites were checked against an ITE proposed recommended practice and found to be adequate." The statements, by IIHS, refer to the Fairfax, Virginia camera enforcement program.

Both the IIHS and the ITE concur that too little yellow time, especially at higher speed intersections, creates a dangerously short dilemma zone where drivers can "neither stop safely

nor legally proceed into or through the intersection." Motorists are forced to race against the impending red signal, causing a false perception of aggressive red-light running behavior.

Everyone agrees -- researchers, engineers, ITE, MUTCD and even the IIHS -- that yellow timing is everything in regards to safety and red-light compliance.

The dirty little secret behind the scenes is that amber times are being unethically shortened, below minimum standards, to create more red-light violations.

Gene Quinn explains:

> "In addition to cameras, something else has been peddled for the last several years and that is the reduction of yellow warning time at traffic signals. The result is that more and more people run red-lights as a consequence, a necessary precursor to justifying camera installations. It should be no surprise that more and more drivers run red-lights when the lights change red prematurely due to this new and dangerous practice of stealing away yellow time. It also should be no surprise that the frequency of accidents and their severity are increasing dramatically as more and more jurisdictions get on board and reduce the yellow time at their signals. The smell of the money that comes with cameras is sweet perfume to those who will benefit but is a stench of considerable proportion for those who must confront the tragic consequences."

When comparing the ITE 1989 versus 1994 reports, subtle changes suggest that Quinn's statements are absolutely correct.

ITE 1989 subsection, "Measure of Effectiveness (of Yellow Change Intervals)" states, "When the percentage of vehicles...which enter on red, exceeds that which is locally acceptable (many agencies use a value of 1 - 3%), the yellow interval should be lengthened until the percentage conforms to local standards."

Later in the report, an Australian, Mr. Hulscher suggests a new enforcement technique to deter drivers who enter on red intentionally - cameras. This is the subtle set-up.

Here's the punch line. The same subsection in 1994 states, "When the percentage of vehicles that enter on a red indication exceeds that which is locally acceptable, the yellow change interval may be lengthened (or shortened) until the percentage conforms to local standards, or ENFORCEMENT (my emphasis) can be used instead." Camera enforcement working 24/7 is inferred. Also note the addition of the word "shortened" in regards to yellow timing.

Enforcement to correct engineering deficiencies? Since several ITE members, including Retting (IIHS), actively promote and profit from cameras, there certainly appears to be a conflict of interest here. An engineers job should not involve promoting enforcement to cover for their job performance malpractice.

The MUTCD asserts that yellow timing shall range from 3 seconds minimum, up to 6 seconds for higher speed roads. However, ITE "suggests that the yellow change interval length not exceed approximately 5 seconds."

"The selection of appropriate value for vehicle speed is very important," states ITE Report, August 1994. As previously revealed in South Florida, the "Rule of Thumb" method and using the posted speed limit as the vehicle approach speed fails to provide "an appropriate value" for determining enough yellow time for safe passage or stopping. While the method itself may technically be legal, many speed limits are posted so low that they violate Florida Statutes 316.189. Hence, in many cases, illegal speed limits provide unlawful and incorrect approach speed values which dangerously diminish the yellow change interval lengths. This leads to more accidents and violations and not just at intersections. See "Speed Limit Signs."

Problems surfaced in Virginia as well. Quinn studied the Code of Virginia, gathered the necessary equipment and proceeded to analyze intersections across northern Virginia.

Quinn records and measures yellow time at each signal. He calculates the required yellow time using contemporary methods, making required adjustments for intersection characteristics. Quinn determines the minimum required yellow time specific to the intersection and a comparison to the actual yellow time is made. To be conservative, he uses the speed limit in making his evaluations even though the prevailing speeds of traffic are greater than the posted speed limit in most cases.

The results unveiled a very disturbing safety problem. "Amber Time Measurement Analysis" (April 18, 2000) studied fifty-six traffic signal yellow warning intervals. Only one site had the minimum required amount of yellow time. Fifty-five signals failed to provide the minimum yellow time required for safe passage of the intersection. Sixteen sites contained over one full second of shortfall. Even more distressing, nineteen signals did not provide enough amber time to stop safely before the onset of red, a condition that greatly increases the likelihood of violating the light.

ALL camera enforced signals failed, including the five intersections in Fairfax, which are showcased in the chart on the following page.

It should be noted that Quinn sent his research to all appropriate authorities, including the Governor, local authorities, the Virginia Department of Transportation and even to the Federal Highway Administration. The town of Vienna, Virginia made corrections. Other jurisdictions are re-evaluating their signal times and the Federal Highway Administration announced a new effort with the Institute of Transportation Engineers to re-examine all engineering countermeasures to red-light running, including signal timing methods.

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AMBER TIME MEASUREMENT ANALYSIS
FOR VARIOUS INTERSECTIONS IN VIRGINIA
(SHOWING AMBER TIME DEFICIENCIES)

LOCATION	PE?	JUR	VEHICLE MOVEMENT	DATE	% GRADE	POSTED SPEED LIMIT (MPH)	W= CLEAR. DIST. (FT)	AMBER TIME PROVIDED	MIN AMBER FOR STOP R=1SEC V=SPEED LIMIT	AMOUNT OF AMBER TIME OVER/INDER SAFE STOP TIME (SEC)	MIN AMBER FOR CLEAR R=1SEC V=SPEED LIMIT	AMBER TIME SHORTFALL FOR CLEARANCE (SEC)	RATING
US50 WESTBOUND @ LEE HWY (FAIRFAX CIRCLE)	YES	FAIRFAX CITY	THRU ON US50	04/15/00	1.04	35	54	3.37	3.48	-0.11	3.68	-0.31	F-FAILED
MAIN ST (RT236) EASTBOUND @ UNIVERSITY	YES	FAIRFAX CITY	THRU ON MAIN	04/15/00	-4.69	25	65	3.39	3.16	0.23	4.40	-1.01	F-FAILED
CHAIN BRIDGE RD (RT123) SOUTHBOUND @ EATON PLACE	YES	FAIRFAX CITY	THRU ON CBR	04/11/00	-1.57	30	74.75	3.34	3.32	0.02	4.31	-0.97	F-FAILED
CHAIN BRIDGE RD (RT123) SOUTHBOUND @ EATON PLACE	YES	FAIRFAX CITY	THRU ON CBR	04/15/00	-1.57	30	74.75	3.40	3.32	0.08	4.31	-0.91	F-FAILED
CHAIN BRIDGE RD (RT123) NORTHBOUND @ NORTH ST	YES	FAIRFAX CITY	THRU ON RT123	04/15/00	-3.65	25	66	3.40	3.08	0.32	4.38	-0.98	F-FAILED
US50 (LEE HWY) EASTBOUND @ CHAIN BRIDGE RD (RT123)	YES	FAIRFAX CITY	THRU ON US50	04/15/00	0.00	35	88	3.38	3.57	-0.19	4.39	-1.01	F-FAILED

FAILED MEANS THE AMBER TIME PROVIDED IS BELOW THE MINIMUM AMOUNT REQUIRED BY CODE OF VIRGINIA

PASSED MEANS THE AMBER TIME PROVIDED MEETS OR EXCEEDS THE MINIMUM AMOUNT REQUIRED BY CODE OF VIRGINIA

FOR THRU MOVING VEHICLES ONLY

This whole situation borders on fraud -- deceit for gain. Camera data from Boca, Arlington and Australia shows that from 50%, to as high as 79% or more, of red-light violators disobey the signal by less than one second. These RLVs result, primarily, from inappropriately short amber timings or honest human error. Government malpractice in setting amber times unethically and sometimes illegally, creates "red-light runners" out of safe, reasonable drivers. Then states, like Virginia, violate their motorists Fifth, Sixth and Fourteenth Amendment rights - under the guise of "safety" - by mailing these people tickets. In a letter to the Governor, Quinn requested that all camera enforcement revenues be returned to the ticketed individuals.

Quinn sent a letter to Mayor Rudolph Guiliani regarding signal timing in New York City. DOT Commissioner Iris Weinshall's office responded on February 2, 2001. "In general we use 3 second amber and 2 second all-red clearance intervals." These yellow timings are worse and more dangerous than Virginia's shortcomings, plus New York allows only a 0.3 second delay before flashing the cameras. Remember, New York officials made NO efforts to educate, inform or place warning signs when they set-up the camera program. Like Virginia, this whole situation borders on fraud.

Signal timing deficiencies were discovered in Beaverton, Oregon by KOIN-TV (Portland). News presented on February 14, 2001 revealed that several red-light camera enforced intersections provided only 3 seconds of yellow warning time. Equivalent intersections, without cameras, provided over 4 seconds of yellow. Like New York and Virginia...

To further exacerbate the problem, Virginia, like Florida, inappropriately uses the speed limit as the approach speed. Plus, amber durations everywhere are based upon a one second driver reaction time. Quinn's research states, "Minimum amber time requirements are calculated based upon the 53rd percentile reaction time, which means that 47% of drivers are predisposed to failure before they ever start their engines."

A yellow signal warns drivers of an impending red. However, there occurs no warning before the onset of a yellow light. The American Association of State Highway and Transportation Officials (AASHTO) research recommends that a 2 ½ second reaction time be allowed for perception, decision and response. A study by Hooper and McGee (TRR 904, 1983, Transportation Research Board) insists that 3.2 seconds should be provided for reaction time. Other research claims 1.9 seconds is sound. Yet, despite all this, the formulas to calculate the change intervals allow only one second.

Amber timing calculations contain other inherent problems as well. The theoretical minimum stopping distance times are so aggressive that Quinn challenges anyone to grab a stop-watch and attempt to duplicate the times. See ITE figures. Yellow interval lengths reflect dry conditions only. Wet pavement requires longer stopping distances. Inclement weather also reduces driver reaction times.

Approach Speed MPH 85th Percentile	Minimum Time to Stop Seconds
25	1.84
35	2.57
45	3.31
55	4.04
65	4.78

Yet, Quinn observed camera bulbs flashing in the rain.

None of the formulas consider trucks. There remain no national guidelines to determine what constitutes a high enough percentage of trucks, in the vehicle mix, to require increasing the yellow warning length. Some intersections inspected by Quinn, although located on designated truck routes, failed for cars.

ITE Journal (1989) admits, "Truck braking performance does not compare favorably with that of automobiles during abrupt stopping maneuvers." As a professional truck driver, that is an understatement. "Longer yellow warning interval times may be required on approaches that have a high percentage of truck traffic."

The proliferation of areas employing an all-red interval at traffic lights showcases the crux of the yellow deficiency problems. An all-red interval keeps all the intersection signals red for 1 - 2 seconds between conflicting green lights. This allows for an extra measure of clearance time. Unfortunately, this extra time is often stolen away from the all-important yellow. ITE Journals (1989 and 1994) state, "If the yellow change interval length is too short, vehicles will still be in the area of conflict even if the red clearance interval length is correct." Virginia, South Florida and Melbourne, Australia all utilize red clearance intervals. The Monash University Study found that 93% of their observed RLVs occurred during the all-red interval. The Virginia and Florida data show similar results.

The stealing away of yellow time, while replacing it with an all-red clearance interval, generally provides safe passage of the intersection. The problem being: The entry into and safe passage often occurs on the red signal, instead of the yellow, technically creating "red-light runners." These motorists, although driving safely, unethically become targets for traffic citations and public scorn.

In an "article" entitled, "Arizona has Deadliest Red-Light Runners," USA Today failed to provide a counterpoint. Not one word was published about traffic signal timing deficiencies or rights violations. The NMA and I asked for equal time. No dice. However, the story irresponsibly provided a sounding board for the IIHS propaganda machine. Free advertisement for cameras.

Richard Retting claimed, "Red-light running is one of the most dangerous forms of aggressive driving."

Julie Rochman reiterated, "It's simply aggressive behavior that's turning into a public hazard."

Before the proliferation of all-red intervals came into vogue in the late 1980s, FHwA and ITE Engineering Handbooks from 1960 through the early 1980s accurately called the "yellow change interval" the yellow CLEARANCE interval. Language changes, like those demonstrated between ITE 1989 and 1994 Journals, reflected the reduction in yellow times, change to all-red "clearance" intervals and the introduction of enforcement cameras.

ITE Journal (1989) reveals the language/procedure changes. "If it is the policy to provide clearance time, the traditional practice has been either to add the time to the yellow warning interval, or to use what has previously been called the 'all red interval', herein referred to as the red clearance interval. When clearance time is provided, it should be in the form of a red clearance interval (additional details are elsewhere in this proposed recommended practice)."

To spotlight the serious nature of the problem, Gene Quinn provides a comparative example of past versus present yellow interval lengths, determined by the Kinematic Formula. Using a level intersection, 100 feet across with an approach speed of 35 MPH, the 1976 yellow time would be 5.05 seconds. The 1999 yellow time calculates to only 3.57 seconds. This equates to 1.48 seconds less yellow time than before, a reduction of 29.3 percent.

ITE's Traffic Engineering Handbook (December 1999) page 481 basically reiterates the recommended practices from 1989 and 1994. However, the book admits, "If the interval (yellow) is too short, rear-end collisions may result."

In this age of political correctness to please everyone, ITE and MUTCD Handbooks make no commitment to any particular method of determining signal change intervals. Virtually all methods contain "limitations" or flaws. However, the Kinematic Models remain more accurate than the Rule of Thumb and Uniform Value, which utilizes the same yellow time for every intersection.

Virtually all the methods program a certain amount of driver disobedience into the traffic signal. Gene Quinn explains, "The idea is to increase (or decrease) the amber time until some level of tolerable driver failures occur. As is clear, the amber time setting is like a driver failure (and hence violation) switch. Turn amber time down and driver failures increase. Turn amber time up and driver failures decrease. It is as simple as determining just how many failures (and therefore citations) one wants to achieve."

The following outline reviews the multitude of documented problems concerning traffic signals.

The Trouble With Traffic Signals
Documented Problems

- Unwarranted installations.
- Series of signals lacking synchronization.
- Flashers not being employed during slow hours.
- Inappropriately short green arrow durations followed by solid red-lights.

- All formulas (Kinematic, Rule of Thumb and Uniform Value) to determine signal change intervals contain the following limitations:
  - Too short duration for driver reaction - one second.
  - Dry weather conditions only.
  - Truck guidelines not available or established.
  - Minimum stopping distance times too aggressive.

- Using the posted speed limit as the approach speed fails to provide an accurate value for determining amber change intervals.
- Illegal approach speed value documented in Florida.
- Illegally short yellow timing documented in Virginia.
- Driver disobedience purposely programmed into signals.
- Proposals to unethically shorten yellow times.
- All-red intervals stealing away yellow time for clearance.

As proven in this chapter, traffic signals do not even remotely resemble the "infallible devices" asserted by camera proponents. As outlined, there occur at least 15 distinct problems that can be associated with signals.

The majority of "red-light running" results from government malpractice, created by programming unethical and illegal traffic signal timing deficiencies, NOT "aggressive driver behavior." Furthermore, the overwhelming majority of RLVs occur less than 2 seconds into the red-light or during the all-red clearance intervals and are not dangerous actions threatening public safety.

Even proper engineering of traffic signals is not an exact science. Therefore, it remains hypocritical for local governments to micro-manage the actions of ordinary drivers who would need to outperform the honed reflexes of professional race car drivers just to avoid violating an improperly timed light. But, to publicly demonize the pre-programmed failure of reasonable drivers and violate their rights by issuing camera based citations is unconscionable.

"Crash Reductions Related to Traffic Signal Removal" (IIHS, 1996) states, "Recent crash analyses of signal removals at 199 low-volume intersections in Philadelphia reported an overall crash reduction of 24 percent." Other studies concur.

AAA Foundation for Traffic Safety funded the re-engineering of 4 dangerous intersections in Detroit, Michigan. David Feber, Transportation Engineering Manager for AAA Michigan explains the simple low cost changes in the Progress Report article, "AAA Michigan Program Prevents Crashes, One Intersection at a Time." "For traffic lights, 'we go from 8" to 12" lenses so they're 50 percent larger. We re-stripe left turn lanes with pavement markings, re-time the traffic signals and add something called an all-red clearance interval, where you leave both sides red for a second or two while the signals are changing.' Intersections also get better signs and improved pedestrian signals and parking that can block drivers' ability to see oncoming traffic is eliminated."

The results were called "astonishing". After 27 months, "crashes decreased by 47% with a 50% reduction in injuries." The approximate cost for these impressive safety improvements: a mere $35,000 per intersection. This is less than the cost of one ineffective camera.

The larger, more readily visible signal heads helped improve motorists acknowledgment of forthcoming traffic lights. The re-timing of the amber signal change intervals produced a 50% reduction in red-light violations! These results far exceed any positive RLV reductions allegedly produced by camera enforcement. Proper engineering produced a 47% reduction in crashes with 50% less injuries. RLVs diminished by 50%. Yet, there occurs even more good news as explained in the article. "The biggest savings is really from a societal perspective, from the reduced injuries." Feber says. "As the severity of an injury gets worse the insurance costs get less and the societal costs get higher." The estimated societal savings of the AAA seed projects is $100 million, Feber says.

By comparison, RLCs produce more crashes, more injuries and more fatalities. And only rarely -- under ideal circumstances -- do cameras significantly reduce RLVs. God only knows the extent of added societal costs from the negative safety effects of photo enforcement.

Police Lieutenant, Terry Campbell, relates a similar result observed in Omaha, Nebraska. An intersection on L Street incurred a high rate of accidents. Enforcement -- the predominant response of most government officials -- failed to reduce the incidence of traffic collisions. The Lieutenant surprisingly suggested that city engineers investigate the problem. The traffic signals were re-timed and accidents declined to insignificant levels. Problem solved.

"Can We Make Red-Light Runners Stop? Red-Light Photo Enforcement in San Francisco, California," by Jack Fleck and Bridget Smith in Transportation Research Record 1693, TRB, admits that "experience shows that engineering solutions should be considered first." As mentioned earlier, the study could not honestly prove any crash reductions related to cameras, but allegedly, RLVs diminished by about 40%.

A random act of stupidity collision, at an intersection near San Francisco State University in 1994, inspired the RLC program. A typical case of emotion over objectivity.

Arizona Transportation Research Centers Document Review of TRR 1693 says, "After traffic engineers modified the signal progression, red-light running virtually stopped at this location. Preliminary data from other pilot intersections suggest that engineering solutions often can reduce red-light violations significantly. Several pilot locations are undergoing engineering improvements such as increasing the yellow light interval..."

The Andreassen study discovered that some of the few RLC intersections where crashes declined actually resulted from traffic engineering changes to signals such as adding green arrows for right-thru turns (left turn, U.S.) and improved signal phases (yellow timing).

As documented under "Traffic Signals" and proven in the previous examples. Proper traffic signal engineering, including longer yellow interval durations, greatly enhances safety and seriously diminishes red-light violations. Over 70% of RLVs result from traffic signal engineering malpractice or honest human error, often attributed to the signal timing deficiencies.

Fixing the RLV problem requires an engineering solution. Problem intersections can generally be corrected - less accidents and reduced RLVs - by increasing the amount of yellow time on the traffic lights. Simple, proven effective and costs nothing. Already employed County Engineers perform the work.

Other problems, unrelated to yellow timing need to be universally identified and corrected. Remove unwarranted signals and convert to stop/yield signage. All communities should employ flashers during early morning hours where appropriate. And guidelines requiring -- under penalty of law -- the proper synchronization of signals along busy thoroughfares should be mandated if officials really care about people, smooth traffic flow and safety.

A theoretical example: Main Street contains about six traffic lights per mile. Motorists traveling in the 50th-85th percentile speed group should be able to traverse all six intersections under a green signal. Furthermore, on busy boulevards or highways, the average motorist should be able to cruise even as far as several miles between red lights. Technology allows the programming of special timing patterns to help expedite traffic during rush hours. There are no more excuses. Properly synchronized traffic signals save time, gas, money and reduce pollution. Plus, accidents, road rage and RLVs decrease.

In a press release on November 7, 2000, "Federal Highway Administration Applauds Success of Local Efforts to Stop Red-Light Running," the ITE and FHwA acknowledged the need "to identify engineering countermeasures that can contribute to reductions in red-light running." This book provides the answers.

Proper engineering of traffic signals is the key to safety and reducing red-light violations. All ITE endorsed formulas -- Kinematic, Rule of Thumb and Uniform Value -- to determine signal change intervals contain problematic limitations. Therefore, we need to reform the guidelines and correct the inherent flaws.

The option for communities to use the Uniform Value formula needs to be eliminated. Many engineers believe this method is "wrong and even dangerous." This formula allows the yellow change interval length to be the same -- usually 4 - 4.5 seconds -- for every intersection, regardless of travel speeds, width, or approach grades. Any intersection, where travel speeds exceed 45 MPH, drivers are denied necessary yellow time for safe stopping or clearance. The timing shortfall also creates "red-light running" and more accidents. Like with the National Maximum 55 Speed Limit, the one size fits all approach remains a failure. This dangerous method for determining amber time needs to be abolished.

The other two methods -- Kinematic and Rule of Thumb -- can be improved with some simple changes. Yellow timing is everything. Since almost all speed limits remain underposted, using posted speed limits as approach speed values shortchanges amber signal phases, even for the most competent drivers. The formulas need to require using the 85th percentile speed to accurately determine the best yellow signal duration. Maybe this requirement will provide engineers needed leverage to bypass political opposition to setting proper speed limits. To reiterate the seriousness of the current malpractice: Underposted speed limits cause more accidents and deaths already. To further exacerbate the negative safety implications, unrealistic (too low) approach speed values lead to significant yellow timing deficiencies, which cause more accidents and fatalities at signalized intersections. It is imperative, for public safety, that 85th percentile speed limits are established nationwide and 85th percentile speeds determine yellow timing at traffic lights.

The other major contributor to not enough yellow timing results from all formulas requiring only one second of driver perception/reaction time. As Gene Quinn pointed out, 47% of drivers cannot react this quickly. AASHTO recommended 2 ½ seconds to allow almost everyone to be able to react. Can we at least settle on providing 2 seconds of DPRT to accommodate about 85% of motorists who traverse our nations signalized intersections? Add a second of reaction time or an extra second of yellow. Either way, much of the problem is diminished since a multitude of signals contain at least one second of shortfall.

If government officials and engineers truly want to maximize safety, why endorse and program only the minimum requirements for determining signal change intervals? As discovered in Virginia and Florida, yellow timings at many signals fail to meet even the minimum calculations, as prescribed by law or recommended practice. Officials need to stop blaming drivers and correct these engineering related malpractices.

Regardless of the method, more yellow time must be added to most -- especially higher speed -- intersection traffic signals. Yellow - instead of red - must resume it's former role as the

clearance interval. All-red intervals would still be employed. Palm Beach County, Florida and numerous other communities worldwide, utilize the Rule of Thumb Method to determine yellow change intervals. The two most common variations are charted below, followed by my recommendations for safer theoretical minimums.

ITE Rule of Thumb		Palm Beach County Rule of Thumb	
Approach Speed (85th % or Posted Speed Limit)	Yellow Interval (Seconds)	Approach Speed (Posted Speed Limit)	Yellow Interval (Seconds)
up to 35 M.P.H.	3.0	up to 45 M.P.H.	4.0
35 to 50 M.P.H.	4.0	50 M.P.H. plus	5.0
50 M.P.H. plus	5.0		

Mauz Recommended Minimums

Approach Speed (85th Percentile)	Yellow Interval (Seconds)
Up to 35 M.P.H.	4.0
40 M.P.H.	4.5
45 M.P.H.	5.0
50 M.P.H.	5.5
Over 55 M.P.H.	6.0

My research indicates that 4.0 seconds should be the minimum yellow time, with very few exceptions, whether employing Kinematic or Rule of Thumb. Kinematic reigns as the superior method because it addresses the signal change interval needs specific to each intersection. It accounts for driver PRT (1 second), approach speed, average deceleration, acceleration due to gravity, grade of approach (level, uphill, downhill or railroad tracks), vehicle length (20 feet) and intersection width.

However, all methods encourage using only 5 seconds of yellow (ITE), even when more is needed. All-red clearance intervals replace the extra yellow needed for safe clearance of the intersection. This policy creates red-light violations. The 6 second maximum, recommended by the MUTCD, should be reinstated and endorsed by the ITE as outlined in the Mauz recommended minimums. These minimums must be realistically determined by the 85th percentile approach speed, not the usually underposted speed limit. Or, if using the posted limit, add at least 0.5 seconds to the interval. Example: 85th at 40 MPH = 4.5. Posted limit at 40 MPH = 5.0 - 5.5. Again, realistic 85th percentile speed limits are imperative to safety and compliance on both fronts -- streets and intersections. As Nike says, "Just do it!"

Engineers at the ITE and around the globe should make every conceivable effort to implement signal timing improvements to increase compliance, safety and efficiency. National guidelines should be established for signal change intervals to accommodate trucks - at least along busy trucking routes. Every effort should be made to eliminate unnecessary delays due to short signal durations, such as the ludicrously brief 5 second, left-turn, green arrows common in South Florida.

Safeguards (non-interference clauses) should be established that allow engineers to properly perform their jobs, without being thwarted or harassed by sometimes well-meaning but usually ignorant or misinformed politicians. We must work together to eradicate ignorance by educating officials and the public about REAL traffic safety. Camera enforcement should be publicly denounced and removed from our streets. Cameras increase crashes and fatalities, while violating due process, illegally reversing the burden of proof and denying an American's right to face his/her accusers (Fifth, Sixth and Fourteenth Amendments). Whether well-intentioned or not, those who endorse cameras have placed power and money above human welfare.

Both the so-called "speeding" and "red-light running" problems result primarily from government malpractice, not driver behavior. The vast majority of RLVs (70%) derive from improperly timed traffic signals. The super majority (80-85%) of "speeding" violations arise from illegitimately underposted speed limits.

It's time to quit falsely blaming and punishing reasonable drivers for their pre-programmed failure resulting from the illegitimate timing or setting of traffic control devices. Fixing the "problem" requires fixing the traffic control devices.

If officials truly care about safety -- not just money -- we need to implement a balanced approach, with engineering improvements being the top priority. Properly engineered traffic signals and posting legitimate 85th percentile speed limits significantly increase driver compliance, while reducing crashes and fatalities. Real education follows as the second most effective tool for improving traffic safety. After honest engineering and education improvements are completed, enforcement -- by live police officers -- may be legitimately directed at the actual small minority of truly dangerous drivers.