Outline

What is it and Why is it an Issue?

What has happened?

What is NCDOT going to Do?
What is the Technical Issue?

Traffic signals go through various phases, and as one phase is ending, the approaching traffic sees the GREEN light extinguish, and the YELLOW light is illuminated for a period of time. Once the change interval ends the YELLOW light extinguishes and the RED light is illuminated, and at this point all vehicles approaching the intersection from this approach are required to stop.

What is the length of this yellow light in seconds? And how is it determined?

North Carolina uses an ALL RED clearance interval, how long is it and how is it determined?
MUTCD Requires

Section 4D.26  Yellow Change and Red Clearance Intervals

Standard:

01  A steady yellow signal indication shall be displayed following every CIRCULAR GREEN or GREEN ARROW signal indication and following every flashing YELLOW ARROW or flashing RED ARROW signal indication displayed as a part of a steady mode operation. This requirement shall not apply when a CIRCULAR GREEN, a flashing YELLOW ARROW, or a flashing RED ARROW signal indication is followed immediately by a GREEN ARROW signal indication.

02  The exclusive function of the yellow change interval shall be to warn traffic of an impending change in the right-of-way assignment.

03  The duration of the yellow change interval shall be determined using engineering practices.

Short version of SHALL statement

- A YELLOW indication must follow GREEN
- The YELLOW function is to warn of impending change
- The duration of YELLOW must follow engineering practices.
MUTCD Requires

Guidance:

14 A yellow change interval should have a minimum duration of 3 seconds and a maximum duration of 6 seconds. The longer intervals should be reserved for use on approaches with higher speeds.

15 Except when clearing a one-lane, two-way facility (see Section 4H.02) or when clearing an exceptionally wide intersection, a red clearance interval should have a duration not exceeding 6 seconds.

Short version of the SHOULD

• A YELLOW should be 3 to 6 seconds in length
• An ALL RED should non exceed 6 seconds
MUTCD Requires

Guidance:
05 When indicated by the application of engineering practices, the yellow change interval should be followed by a red clearance interval to provide additional time before conflicting traffic movements, including pedestrians, are released.

Standard:
06 When used, the duration of the red clearance interval shall be determined using engineering practices.

Support:
07 Engineering practices for determining the duration of yellow change and red clearance intervals can be found in ITE’s “Traffic Control Devices Handbook” and in ITE’s “Manual of Traffic Signal Design” (see Section 1A.11).

Short version of the SHOULD and SHALL statements

• The YELLOW should be followed by an ALL RED, if applicable to your engineering practices.

• IF YOU CHOOSE to use and ALL RED, the duration of the ALL RED shall be determined by engineering practices.

• An example of engineering practices can be found at ITE.
Engineering Practices

*Engineering Practices May Differ even though the natural laws are consistent*

*Engineering Practice requires engineering judgement and training, and this engineering judgement shows there are more than one way to successfully solve problems.*

The various States and jurisdictions developed different practices over the years.

- Many have gravitated around the ITE recommended practice.
- The design values differ from state to state.
- Some jurisdictions engineering practice was to set a single duration for all cases, some chose to vary by speed limit, some chose to apply calculations.
The “old” ITE Practice

The old ITE practice for determining YELLOW.

\[ Y = t + \frac{v}{2a+2Gg} \]

Where:
\( Y \) = yellow interval duration (sec)
\( t \) = reaction time (typically 1 sec.)
\( v \) = design speed (ft./sec.)
\( a \) = deceleration rate (typically 10 ft./sec.\(^2\))
\( g \) = acceleration due to gravity (32.2 ft./sec.\(^2\))
\( G \) = grade of approach (percent/100, downhill is negative grade)
Real World Variables NOT in the equation

- Individual drivers’ preferences for actual travel speed -- all speed studies have speed distributions

- Individual drivers’ preferences for decelerating – some choose lower decel rates, some people go through a set of brake shoes every year.

- Individual vehicle characteristics that affect deceleration and accelerations, large trucks take more time and distance to stop.

- Individual drivers’ physical capabilities, perception time, reaction time, visual capabilities.

All of these if known can be calculated; however, from a design point the designer does not know who or what is in the vehicle fleet at the moment when the light changes. Design values are nothing more than design values.
Red Light Running Crashes
Some Saw Photo Enforcement as a Solution to Red Light Running Crashes
Photo Enforcement

Unfortunately, photo enforcement has been given a bad reputation. Not by the people who hate photo enforcement but by the communities that have used photo enforcement as a revenue generator.

Overall, photo enforcement has shown positive outcomes in reducing crashes, injuries, and driver behaviors that contribute to these crashes.

However, the indiscriminate use of this tool has provided too many examples where citizens are victimized by ridiculously low tolerances, and as a result the safety value of this strategy is ignored.
Considering the ALL RED time and the start up time, setting a tolerance below 1 second will have negligible effect on overall safety of the intersection, but will create a lot of citations.

The problem is red light crashes, not the lack of signal violations.
Red Light Running Crashes
Crashes involving people running red lights is a problem; however, setting the tolerances where there is not a chance of creating a crash has destroyed the public perception of this tool.

Twelve percent (12%) of people entering the intersection after the onset of RED entered the intersection after the light has been RED for a full second or longer, some greater than 5 seconds. NCDOT Study
Why all this Discussion

The entire discussion about Change and Clearance Intervals came up as a **LEGAL DEFENSE** to red light running citations.

The individuals who are making these legal defenses have done an excellent job in researching, analyzing, presenting counter arguments to convince others that there are major errors in the process that make it impossible for some drivers to avoid running the red light.
Legal Defense

The legal defense was well polished, well documented, and presented exceptionally well.

Much of the profession did not agree with the argument with the exception of some discussion on turning movements.
Excellent Legal Argument

International ITE started a process that involved national practitioners and somehow MADE EVERYTHING WORSE.

Mixing legal arguments and academic situations with developing engineering practices does not solve problems, it creates them. Only thing worse is a hypothetical question.
What is Wrong?

The recently published ITE Guidelines for determining YELLOW times

(Many) PRACTITIONERS’ OBJECTIONS
• Failed to follow the standard ITE process.
• What was finalized looked completely different than what was voted on.
• It produces unusually long yellows (and then arbitrarily capped).
• Made the practice less practical.

LEGAL DEFENSE OBJECTIONS
• While it recognized some of the turning movement issues, the “proposed” practice arbitrarily caps the maximum based on WHAT?
• Fails to consider all the other arguments presented on why the initial process was lacking.
• If the new process was developed because the science was violated, yet the final rule continues to violate the SCIENCE
49% of these values are outside the allowable range of the MUTCD, what engineering study has demonstrated that these variances are appropriate?

This creating a process that produced a large percent of “impractical” values.
What is North Carolina Going to DO?

We will organize a team similar to what we did in 2005, working with NCSITE and Municipalities to develop a North Carolina Practice. We will also reach out to our neighboring states to see if they would like to participate in the discussion.

We will make sure that we cover the primary purpose of YELLOW.

“The exclusive function of the yellow change interval shall be to warn traffic of an impending change in the right-of-way assignment.”
What is North Carolina Going to DO?

We will document our decisions.

Where we believe it can be done safely, we are willing to test the hypothesis that increasing YELLOW times reduces the proportion of drivers entering after the RED.

Is it behavior or choice? Or are we setting up people to fail?

Theoretically, if we were to extend the YELLOW 1s at these sites and our process was failing the drivers, then we should see only see targeted frequency entering.
What is North Carolina Going to DO?

We will follow good engineering practices to develop a practice for North Carolina, employing all knowledge types used by engineers.

<table>
<thead>
<tr>
<th>Knowledge type</th>
<th>Description</th>
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<tbody>
<tr>
<td>1. Theoretical tools: Math-based, and conceptual</td>
<td>Mathematical methods and structured knowledge, scientific, engineering and phenomenological theories, intellectual concepts. ‘Engineering science’ consists of specific combinations of math and science around particular engineering domains.</td>
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<tr>
<td>2. Fundamental design concepts: Operational principles and normal configurations</td>
<td>Operational principle describes ‘how [a device’s/technology’s] characteristic parts fulfill their special function in combination to an overall operation which achieves the purpose’—in essence, how the device (technology) works. Normal configurations describes what is typically taken for the shape and arrangements for a particular class of devices (technologies).</td>
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<tr>
<td>3. Criteria and specifications</td>
<td>Technical criteria appropriate to a class of devices (technologies), including numerical performance criteria. (e.g., impact performance criteria in the automotive sector, pressure vessel standards in the chemical industry).</td>
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<td>4. Quantitative data</td>
<td>Physical properties and quantities required in formulas and required to demonstrate device performance. Understanding of procedures and processes for generating such properties and quantities.</td>
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<td>5. Practical considerations</td>
<td>Tacit knowledge (typically learned on the job) generally not codified. In addition, rules of thumb and heuristics (this category was called ‘Design Considerations’ by Vincenti [7]).</td>
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<td>6. Process-facilitating strategies</td>
<td>Knowledge of tools and strategies for project management, leadership, teamwork, communications and management.</td>
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<td>7. Contextual knowledge (NSPE, NAE, Kroes)</td>
<td>Knowledge of values (personal, professional, cultural). Knowledge of norms (what is acceptable behavior, what is expected behavior). Knowledge of contexts, and contextual factors that constitute the artifact’s aesthetic.</td>
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After we discuss with our neighboring States, we will put a call out to NCSITE and Municipal Traffic Engineers to develop a team to proceed.
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