

## MUTCD Comments

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Comments are submitted by Gilbert Chlewicki PE. Mr. Chlewicki was the last chair of the TRB Intersection Joint Subcommittee and Alternative Intersection Work Group before the subcommittee was merged into the TRB Roundabouts and Other Intersection Design and Control Strategies. For follow-up on any comment, he can be reached at [gchlewicki@divergingdiamond.com](mailto:gchlewicki@divergingdiamond.com).

Comments are organized by section. Most comments are for revisions in the next MUTCD, but some comments discuss research needs and/or further examination to include in a following revision.

### Section 1B.06 Experimentation –

Experimentation should be easier as experimentation is the best way to develop innovative ways to improve traffic control devices. State DOTs and tolling authorities should be granted a limited ability to approve certain experimentation. This section is hard to enforce as is anyways and many states are making their own signs and pavement markings anyway.

### Section 1C.01 Definition of Headings

For 32. Circular Intersection, it is inaccurate to describe an intersection as circular as defined in 106 of this section. An intersection is a location of two or more roadways meeting with one or more closely space conflict points. When an intersection becomes a roundabout (or other circular form), it is creating a circulatory roadway to break up a large intersection into smaller intersections. Better to define as Circular Roadway Forms or just use Circular Roadway, from 33, for the description. Redefine Circulatory Roadway as a roadway that serves as a junction for multiple roadways to intersect.

Note that other newer “intersection” forms, such as continuous flow intersections, superstreets, J-Turns, along with what might be described as older alternative intersections, such as jughandles and Michigan Lefts (Median U-Turns) use the same strategies as roundabouts in that they break up a large intersection to a strategic series of smaller intersections to improve operations and/or safety.

For 103. Interchanges, a better definition would be two interconnecting roadways that are grade-separated and connected with a combination of connecting ramps and/or intersections. Interchanges hold different forms such as diamonds, cloverleafs, and system. It is okay to define specific interchange forms, including single point urban interchanges and diverging diamond interchanges.

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### Section 2A.12 Standardization of Location –

Signs should be located so that they:

G. Meet the proper decision sight distance needs for the message of that sign. – Drivers need to be able to see the signs at the proper distance to process how that sign affects their driving behavior. For many signs, the proper decision sight distance will be extremely short, such as for DO NOT ENTER signs, but for other signs like guide signs, decision sight distance will be significant for the driver to see the sign and for when the driver ultimately has to make the decision.

H. Receive the proper attention of the driver without competing with other driving requirements. – Based on human factors research, certain signs should be discouraged on tighter horizontal curves and/or locations with a lot of conflicts.

### Section 2A.13 – Overhead Sign Installations

Guidance:

Overhead signs should also be considered on all roadways near interchanges or intersections that are either complex and/or have high turning volumes. This is not just freeways and expressways.

### Section 2A.19 – Excessive Use of Signs

Delete or significantly revise paragraph in regards to vanity signs. Vanity signs are generally not a concern for sign clutter. As mentioned these signs are only being looked for by a small select amount of

drivers at a time and generally these drivers are not concerned about some of the other signs. The rest of the drivers are concerned about the other signs and not the vanity signs.

We need to also keep in mind that the primary purpose of our roads and transportation system is to support the economic needs of our society by providing reliable and safe forms of moving people and goods for an economic purpose. Our roads should be supporting economic activity and not discourage vanity signs unless it is very clear that they cause a safety problem.

#### Section 2A.22 – Median Opening Treatment for Divided Highways

Add to this section, the use of J-Turns (a.k.a. Restricted Crossing U-Turns, RCUTs) where the side street traffic is restricted from going straight or right due to a median blocking those movements but still allowed left turns from the divided highway. A figure of an RCUT

(<https://safety.fhwa.dot.gov/intersection/innovative/uturn/>) under Figure 2A-5 (A) would be appropriate.

#### Section 2B.04 – STOP Sign and ALL-WAY Plaque

R1-3P ALL-WAY W4-4aP TRAFFIC FROM LEFT DOES NOT STOP and W4-4bP ONCOMING TRAFFIC DOES NOT STOP should be added to Figure 2B-1.

#### Section 2B.05 – YIELD Sign

Add and Plaques to title

Add paragraph in this section for NO MERGE AREA plaque and add plaque to Figure 2B-1.

Revise R-1-2bP to state TO TRAFFIC FROM LEFT. Telling the driver to yield to traffic from circle is problematic because some drivers might not realize that they are entering a circle roadway and other drivers might be looking out for traffic from all directions of the circle. Each leg of a traffic circle or roundabout should be treated as an individual intersection in terms of signing needs.

#### Section 2B.06 General Consideration

Support text that states roundabouts and traffic circles are not traffic control devices. Roundabouts and traffic circles are simply an engineering choice to break up a larger intersection to a group of smaller intersections. Other innovative intersections do the same thing.

In guidance for selecting a form of intersection control include:

H. Expected crash experience – This would include things like CMFs, SPFs, and contextual elements

I. Operational effects of design – This would include delay, number of stops, emissions, queues, etc.

J. Costs

Keep in mind that the available forms of intersection controls has grown substantially since 2009. This includes, J-Turns, superstreets, median u-turn intersections, continuous flow intersections, quadrant roadway intersections, various hybrids of innovative intersection elements, and grade-separated elements within intersections.

#### Section 2B.07 Determining the Minor Road for Unsignalized Intersections

Delete A. A roadway intersecting a designated through or numbered highway. – This is essentially saying that a State highway is always more important than a Local highway. There are plenty of cases where this is simply not true. There are also plenty cases that due to the context of an intersection (particularly in regards to pedestrians and cyclists), it would be safer to control the State highway instead of the Local highway. This provision is simply a political warrant and has no engineering basis.

For last paragraph when two roadways are relatively equal, add that the avoidance of deciding a minor road can be done by considering a roundabout as the intersection control.

#### Section 2B.08 Right-of-Way Intersection Control Considerations

Rephrase opening paragraph by replacing the term “a more restrictive form of right-of-way control” to “higher cost geometric changes”. Making significant geometric changes does not necessarily require additional right-of-way and/or more restrictions. This is especially true with roundabouts and J-Turns. But it will cost more to make some of these changes instead of minor intersection improvements.

#### Section 2B.09 No Intersection Control

There should be separate factors when dealing with 3-legged intersections vs 4-legged intersections. With considerably fewer conflict points in a 3-legged intersection along with the usual assumption that a vehicle from the minor street will yield, the volume threshold may be significantly higher to not control the intersection.

#### Section 2B.10 Yield Control

Under the 1<sup>st</sup> Guidance, there should be a separate factor when approaching a one-way street. This could include a divided highway where each direction is acting as a one-way street at the intersection. In cases of one-way streets, approaching multiple lanes in a direction would still be acceptable for a yield control as long as the approaching leg is just one lane.

#### Section 2B.11 Minor Road Stop Control

As a research need, there should be a focus on minor road stop control on a 4-legged intersection where the minor street has significant traffic approaching the intersection at the same time causing safety issues with which approach from the minor street has the right-of-way and how drivers deal with the decision making of finding gaps along the major road while also negotiating with traffic across the street. In some of these cases, a minor road stop control may not be appropriate and may need another intersection control.

#### Section 2B.17 All-Way Stop Control Warrant E: Other Factors

Include:

D. Where higher-volume truck traffic would have difficulty finding safe gaps. – The combination of a larger vehicle and slower movement makes it significantly more difficult for trucks to find safe gaps in traffic. Often trucks will force their way into an unsafe gap, which requires the major road traffic to slow down or stop. All-way stops can be very appropriate in these conditions.

#### Section 2B.18 STOP Sign or YIELD Sign Placement

YIELD sign placement is not “uniform” when it comes to roundabouts. There should be some research to determine if crosswalks at roundabouts are really in the appropriate locations. Placing crosswalks at least a car length of the circulatory roadway is really a vehicle-focused decision to stop fewer vehicles. It penalizes pedestrian operations by forcing pedestrians to walk longer distances to crossings. Pedestrians don’t always comply with going longer distances anyway, which creates a bigger safety concern with unexpected pedestrians in the roadway outside of crossings.

There is also non-uniformity in the use of the YIELD sign when it comes to the availability of a merge area. This is not just an issue for ramps at interchanges. It is also at intersections where acceleration lanes are available. There is a theory that a factor in why multi-lane roundabouts have a higher crash rate is partially due to the misunderstanding of drivers that the YIELD sign does not mean that there is an acceleration lane. For uniformity, consider only placing YIELD signs in locations where there is NO MERGE AREA. In situations where there is an acceleration lane, considered using just LANE ENDS and MERGE signs. If there are situations where some drivers may want to yield and others may want to use an acceleration lane, like at an intersection where some drivers may want to get into the far lane immediately while others can be in the near lane, separate lanes will be needed on the approach for each control.

#### Section 2B.19 Yield Here To Pedestrians Signs and Stop Here For Pedestrians Signs

Like the changes here that requires yield or stop lines to be placed in advance of crosswalks. Also like eliminating the use of STATE LAW legend.

Is there research in regards to rear-end crashes at these signs? Of particular interest is if rear-end crashes happen at the STOP HERE signs when no pedestrians are present due to drivers misinterpreting the sign to mean to stop at all times. It may make sense to eliminate the STOP HERE sign and only include YIELD HERE, since we are only talking about pedestrians and cyclists in the crosswalk and YIELD should theoretically have the same meaning as STOP.

The placement of these signs should be either at the crosswalk or slightly beyond the crosswalk. They should not be placed in advance of the crosswalk.

#### Section 2B.20 In-Street and Overhead Pedestrian and Trail Crossing Signs

May want to eliminate all references of STATE LAW on sign itself since it may imply that other signs are not due to state laws or any laws.

#### Section 2B.21

Like the elimination of shall include speed distribution of free-flowing vehicles to determine speed limits. In some circumstances this is very appropriate, in others it is not.

Replace “urbanized locations within rural regions” to “rural towns”. This maintains consistency with the AASTHO Green Book.

Do not agree that a rural posted speed limit should be within 5 mph of the 85<sup>th</sup> percentile speed. What if the top 15%-20% of drivers drive incredibly fast but the remaining drivers are significantly slower? What if posting a speed limit at the 85<sup>th</sup> percentile then causes those drivers to increase their speeds by an additional 5-15 mph? What if the higher posted speed limit causes sight distance problems at stop or yield controlled intersections along the corridor? The goal of a posted speed limit should be to get the differential of speeds within the road as small as possible. Crashes occur when speeds are not close to uniform. Desired speed limits also need to account for the intersections along the roadway and its safety effects.

If signal spacing is less than 1 mile apart, shouldn't this section of roadway be considered suburban or rural town? Wouldn't other factors be important in determining the posted speed than a speed study, such as intersection needs, clearance time needs, dilemma zone issues, etc.?

#### Section 2B.23 Night Speed Limit Plaque

Should this plaque also have an option for other atmospheric conditions such as FOG, WET, and WINDY (on long bridges) conditions?

#### Section 2B.24 Minimum Speed Limit Plaque

Minimum speeds should be limited to high-speed roadways.

Should Minimum Speed plaques be encouraged/required on highways with posted speeds of 65 or higher to try to get more uniform speeds on this highways?

#### Section 2B.26 Movement Prohibition Signs

Additional guidance is needed for the use of movement prohibition signs at a Diverging Diamond Interchange (DDI). A reverse U-Turn sign is commonly used at many DDIs. NO TURNS signs are often substituted on the side of a restricted turn where if the turn was still made, it would not result in a wrong-way movement.

A little more guidance would be appreciated on when a supplemental movement prohibition sign is recommended or not at signalized intersections. Does the location/posting of signal heads affect the decision? Does the size or shape of the intersection affect the decision? When will supplemental signs cause sign clutter and be counterproductive?

#### Section 2B.27 Intersection Lane Control Signs

Figure for lane control at roundabouts is still Figure 2B-5.

#### Section 2B.28 Mandatory Movement Lane Control Signs

The R3-7 sign should not only not be mounted on the far-side of the intersection, it should not be mounted on the near-side of the intersection either. R3-7 should be only used for the approach to the intersection. At the intersection itself only R3-5 should be used. The reason is that at the intersection, there are too many items for a driver to process and shouldn't include a five-worded sign.

Support other changes.

#### Section 2B.29 Optional Movement Lane Control Sign

Rephrase last sentence in standard section. "To affect" is the proper use if want to keep phrase, but still might not give understood guidance to all.

#### Section 2B.34 Reversible Lane Control Signs

Included in this section should also be Variable Lane Control Signs, where the lane assignments at intersections may change based on time of day. These are being considered and used in several locations and will likely increase in usage as CAVs penetrate the market.

Stating that reversible lane control signs SHALL be overhead causes two issues. In locations where hurricanes and tornadoes (like coasts along Florida) make overhead signs very expensive, reversible lanes are less likely to be used. In locations where there are ordinances limiting overhead signs (like Washington DC), this will also be an issue. Might consider making this a SHOULD statement and discuss options of when overhead signs are not feasible.

#### Section 2B.35 Jughandle Signs

A study should be conducted to improve jughandle signs. There have been several occasions where I have missed the appropriate jughandle to use because it was not clear enough which street the jughandle was for (and I am an expert on these designs). Signing may want to be more like interchange signing along arterials.

Additional signing guidance is desperately needed for other innovative intersections such as superstreets (aka RCUTs), Median U-Turn intersections, Continuous Flow Intersections, and Quadrant Roadway intersections (or use of network to relocated certain movements), where turning movements occur prior or after the main intersection. There are currently hundreds of each of these intersection types now open or in consideration in the US. Could be part of this section or inserted as additional section(s) afterwards.

Please feel free to contact me for more details on these comments in particular.

#### Section 2B.38 Slower Traffic Keep Right Sign

The R4-3 sign should also not be used on an approach to a roundabout or signalized intersection, i.e. higher volume intersections with left turning movements. In these contexts, slower traffic may need to be in the left lane for turning movements. A recommendation for the distance on the approach would also be helpful (1/2 mile seems reasonable) with a caveat that operational and safety contexts could extend or shorten the approach recommendation.

#### Section 2B.40 Keep Right and Keep Left Signs

Additional guidance would be helpful when the opposing directions of the roadway are not parallel. This always occurs at DDIs, but also occurs at other intersections such as when two one-way streets join at an intersection to become two-way or complex intersections due to horizontal and/or vertical alignments. At what point should these signs not be used or altered?

#### Section 2B.45 ALL TRAFFIC Sign

The standard that the ALL TRAFFIC sign shall not be used to substitute for the Keep Right signs is contradicted by the lower left example in Figure 2B-11. This statement needs a slight revision.

#### Section 2B.46 Selective Exclusion Signs

No Pedestrian and No Bicycle signs should only be allowed in locations where their use is explicitly illegal or dangerous. Examples would be along high speed roadways where there is no sidewalk, shoulder, or dedicated bike lane to separate these vulnerable users from dangerous vehicles. No pedestrian signs should not be used at locations within intersections that do not have crosswalks unless there are other physical barriers (like a fence or wall) preventing a pedestrian from crossing. In many cases, these restrictions create an even more dangerous condition for pedestrians and cyclists by either exposing

them to more conflict points or having them cross despite the signs. Furthermore, No pedestrian and No Bicycle signs should not be permitted if no alternative route is available and accessible.

#### Section 2B.47 DO NOT ENTER Sign

Please include figure (for all signs) and text specifically for DDIs. Use Chapter 7 of the recently released 2<sup>nd</sup> Edition of the DDI Guide (NCHRP 959 <http://www.trb.org/Publications/Blurbs/181562.aspx>) as a starting point for guidance.

#### Section 2B.50 ONE WAY Signs

There is no text regarding the use of ONE WAY signs along divided highways at driveways. While these signs are not needed at all driveways, there are locations where ONE WAY signs are beneficial, such as locations where a driver may be motivated to make a short-distance wrong-way movement as a short cut or in close proximity to where a divided highway begins/ends.

#### Section 2B.58 Pedestrian Crossing Signs

The CROSS ONLY AT CROSSWALKS sign should be more restricted in its use. In some states, this sign has become an excuse to limit pedestrian accessibility and/or cause unnecessary pedestrian movements that could have been easily resolved if a crosswalk were installed. This sign should only be used if there is an inherent safety concern for pedestrians crossing at certain locations regardless of whether a crosswalk is marked or not.

#### Section 2B.60 Traffic Signal Signs

The standard that starts with CROSSWALK-STOP ON RED (R10-23) should refer to a full signal just for a pedestrian crossing. Only the R10-23a should be used just for PHBs.

#### Section 2B.61 NTOR Signs

E. Replace the word “accidents” with “crashes”.

F. The skew angle from their left (turning right) or right (turning left). Needed for LTOR at one-way streets.

A “G.” should be added that states multiple lanes are making the same turning movement. When there are double (or triple) rights (or lefts), a NTOR may be advisable for all lanes due to various safety reasons including sight distance issues with adjacent vehicles, lane balancing concerns, and/or weaving concerns to an upstream intersection.

There should be a note in this section that turns on red from a DDI ramp terminal do not inherently fit one of these conditions. Most of the 100+ DDIs open in the US do not restrict turns on red and the safety performance has been excellent. Yet, some agencies are reluctant to allow turns on red despite evidence showing it is better for operations without impacting safety.

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#### Section 2C.13 Vehicle Speed Feedback Sign

Not allowing the changeable portion of the sign to flash or change colors will make the use of this sign very limited. Most agencies use this sign to inform drivers if they are going over the speed limit and then to encourage those speeders to slow down by informing them. If there is research that shows that flashing or changing colors can cause problems, there needs to be an alternative message to the driver to slow down. Perhaps, simply allowing another message below the feedback speed that simply states SLOW DOWN.

#### Section 2C.24 DEAD END, NO OUTLET, and ROAD ENDS

The DEAD END sign has been retired by many jurisdictions as it is not a good description of a road ending and has other negative connotations. Consider retiring DEAD END signs and use just NO OUTLET. (Note, NO THRU STREET signs have seemed to be retired, so this would not be without precedent for similar messages.)

#### Section 2C.36 Advance Traffic Control Signs

These signs should also be considered when a control device has not been seen for an extended distance and time. This is a human factors issue where a driver will not be expecting a traffic control

device and be less prone to recognize approaching one even if its within an appropriate decision sight distance in normal circumstance.

These signs may also be considered when there is an existing and/or anticipated safety concern of drivers not following the appropriate traffic device up ahead.

#### Section 2C.39 NEW TRAFFIC PATTERN and NEW SIGNAL OPERATIONS

Add the word NEW to the title and Guidance paragraph.

May also want to consider another related sign that provides a message that the signal operation may change throughout the day. For example, with the more common use of Flashing Yellow Arrows (FYA), it is possible to have a left turn protected-only during certain hours and permissive-protected during other hours. There are also cases where a left turn phase could be lag some parts of the day, lead other parts, and/or lead and lag during the same cycle. Sign might say SIGNAL OPERATIONS MAY VARY with an optional plaque below that says THROUGHOUT DAY or BETWEEN XX PM – XX PM.

#### Section 2C.40 Reduced Speed Limit Ahead Signs

Reduced speed limit signs should also be considered when there is a significant change in context even if the speed reduction is just 5 mph. This has become a recurring issue in many suburban and rural contexts where, for example, the roadway enters a significantly higher pedestrian zone, but because the driver does not get a warning of a lower speed limit (and may be driving 5-10+ mph above the posted speed already), the driver may not get the message that the speed limit dropped. Even with just a 5 mph drop, this message can be extremely valuable in a pedestrian context (and other contexts too, such as sight distance issues and/or complex intersections ahead).

#### Section 2C.44 Traffic Signal Oncoming Extended Green Signs

A guidance section should be added here that explains that this use is to inform drivers of “yellow trap” where a driver may anticipate that they can make a left turn during a yellow phase with the expectation that oncoming traffic will also stop. Although this sign is necessary to inform drivers of the “yellow trap”, strong consideration should be given to find other ways to eliminate the yellow trap such as phase changes or the use of FYA.

#### Section 2C.46 Added Lane Signs

More guidance should be given as to how long the added lane needs to be in existence before being dropped. In some jurisdictions, W4-3 is being used when the added lane ends in about ¼ mile, which seems to be an inappropriate use. Recommend that the added lane must continue for at least ½ mile from when the lane was added.

#### Section 2C.47 Lane End Signs

Do not understand why W9-2 LANE ENDS MERGE LEFT is being removed. The sign is still very useful and the message is concise and more informative. Unless there was some research that clearly showed this sign could result in more crashes (perhaps by encouraging drivers to merge immediately whether it was safe or not), recommend keeping sign. Note that W9-2 still appears in Figure 2E-23.

#### Section 2C.50 RIGHT LANE FOR EXIT ONLY

A legend may also be added to indicate location of the exit, for instance “AT ROUTE 19” or “AFTER NEXT SIGNAL” or “BEYOND BRIDGE/CURVE/HILL” (where there might be a sight distance issue).

#### Section 2C.64 Advance Street Name Plaque

There lacks a uniform standard for advance street name signs. When used as a plaque, the sign is yellow. But when used as a stand-alone, the sign is green. Perhaps the stand-alone (green) should be eliminated and all advance street name signs should have an INTERSECTION AHEAD or SIGNAL AHEAD sign with it. Or perhaps all street name signs, including plaques should be green. In this case, street name signs will stand out more, which is very helpful since these signs are often the most useful to drivers. In addition, all other street name signs are in green, so this will help with uniformity. The only question is whether the aesthetics of green under yellow be distracting to a driver.

#### Section 2C.65 Traffic Does Not Stop Plaque

Consideration should also be given to use this plaque if it could cause cyclists and/or pedestrians to misinterpret the intersection.

#### Section 2D.08 Arrows

Could the Type E arrow (with possible small modifications) be used for a “forward” jughandle, J-Turn, or Median U-Turn Intersection? That could be very useful for drivers that are unfamiliar with how these innovative intersections work. If they can't be used, a Type F (or more) should be developed for these intersection designs that are becoming more commonplace.

#### Section 2D.09 Numbered Highway Systems

Guidance notes that “overlapping numbered routes should be kept at a minimum.” Yet off-interstate business routes have the same route number without any auxiliary sign to make a clear distinction between the interstate and business route. No changes are recommended for this section, but making this comment in support of next comment.

#### Section 2D.11 Design of Route Signs

The Off-Interstate Business Route (M1-2, M1-3) is prohibited/not used in some states. Reasons for this include: Message confusion between interstate and business route with same route number, green background not appropriate for route sign, confusion of identifying the proper business routes with same name in same state/region/county, fear of higher speeds on off-speed business routes that are signed very similar to interstates or soon-to-be interstate ramps.

Therefore consider the following revisions for M1-2 and M1-3:

- a) While shield shape could remain the same, background should be white, with black lettering/numbering. Alternatively, might consider a different shape/symbol such as an American flag, US Capitol, or outline of continental US.
- b) The word BUSINESS should not be on the shield. Instead an auxiliary M4-3P BUSINESS sign should always be placed on top. Consider a green background for M4-3P for this situation only to highlight that the route is a business route and provide some similarity with the existing condition.
- c) The word LOOP or SPUR should be located in larger font at the top portion of the shield where BUSINESS is currently located on existing signs.
- d) Use a unique name for each off-interstate business route within the state. This can be done with a prefix number (i.e. “1-”), a suffix number (i.e. “-1”), or a suffix letter (i.e. “A”). A numbering convention could use even numbers for loop routes and odd numbers for spur routes to match other interstate numbering convention. Any numbered prefix/suffix should be accompanied by a dash to indicate the interstate “parent” route. Prefixes/Suffixes could be at smaller font.

Numbers in State Route Signs need to have a minimum font size that is large enough to be seen and distinguished from an acceptable distance. Some states (ex. Washington State) have a hard time fitting numbers at a proper size within their symbol.

#### Section 2D.13 Junction Auxiliary Plaque

More guidance is needed for the appropriate use of JCT. Misuse has been seen where JCT plaque is used on a road that does not intersect the route but is within a short distance once a driver potentially turns. Also seen both JCT and TO auxiliary plaques on top of a route sign, which should not happen. There is also confusion of whether the use of a JCT plaque is appropriate for a major route if a minor intersection occurs between the JCT plaque and the actual intersection/interchange with the route. This is very common when approaching interchanges, for example. In my opinion, JCT plaques should still be allowed, but other engineers disagree.

#### Section 2D.21 TO Auxiliary Plaque

More guidance is needed for the appropriate use of TO (M4-5P). The TO plaque should only be used when guiding a driver towards a route, but the driver still has the option of going a different route. For example, if a ramp forces a driver to have no choice but enter that ramp, a TO plaque should not be used.



But if a driver must turn on to a different road before entering the ramp, a TO plaque should be used. I've seen misuse of the TO plaque in both cases.

#### Section 2D.26 Advance Turn Arrow Auxiliary Plaques

Additional advance turn arrow plaques are needed for jughandles (forward and reverse) and u-turn intersections (Median U-Turns, Superstreets, J-Turns). For u-turn intersections, if there is a concern about showing a left arrow when the driver needs to turn right, consider a modification of M5-3P where there is a right arrow, followed by a dashed line to show the completion of the movement. The current selection of signs are adequate for other types of innovative intersections, such as continuous flow intersections, continuous-T intersections, quadrant roadway intersections, and diverging diamond interchanges.

#### Section 2D.29 Route Sign Assemblies

Not totally clear what Paragraph 9 is. Rephrase or delete.

In Figure 2D-9, change SR 4 JCT sign to US 4 JCT sign.

#### Section 2D.34 Trailblazer Assembly

A figure should go with this section as the wording is not very clear and the term "trailblazer" can be interpreted in several ways.

#### Section 2D.37 Overhead Arrow-Per-Lane Destination Guide Signs

Diverging Diamond Interchanges (DDI) should not be characterized as complex or unusual (nor should any other innovative/alternative geometric design). DDI signing uses the same types of destination guides as can be found on many freeways at major junctions.

There does need to be more guidance in the MUTCD on DDI signing. In particular for this section, there is a question about proper overhead destination guide signs on the approach to the DDI (i.e. approaching first crossover). The issue is that an overhead sign as shown in Figure 2D-11 is not appropriate at this location because there is a signalized intersection (at the crossover intersection) before the lane split. So this sign could be confused with what should be happening at the intersection instead of the ramp diverge point. Better guidance is needed here, with no clear answer to date.

#### Section 2D.38 Combination Lane-Use/Destination Overhead Guide Sign

This sign is not just for "complex intersections". It is also for locations where the approach lane assignments isn't typical for the corridor and/or a major intersection due to high turning volume and/or a high volume of unfamiliar drivers. Please be cautious of using the phrase "complex intersections".

There is no example of the use of D15-1 in Figure 2A-5 or any other figure. Please add figure.

#### Section 2D.39 Destination Signs at Circular Intersections

Straight left arrows for destinations at roundabouts are undesirable. While some engineers might want to think of a roundabout as just one intersection, it is really 4 mini-intersections from a practical standpoint and should be treated as such. (This is especially important at mini-roundabouts where it can be very easy to physically make a direct left turn, instead of circling the roundabout.) Therefore, a destination to the left should either be the curving M5-3 left arrow or the M5-1/Type C arrow. (See signs for Amity or Davenport in Figure 2D-13.)

#### Section 2D.40 Destination Signs at Jughandles

As previously commented, destination signs at jughandles are currently not conveying the message to drivers properly.

#### Section 2D.41 Destination Signs at Intersections with Indirect Turning Movements

Sheet 1 of Figure 2D-14 is incomplete. The entrance to CR 66 East and CR 66 West should be shown in figure. Unclear where U and LEFT TURNS signs should be located. Please orient figure so the main direction of traffic is up the page for ease of understanding (and consistency with other figures).

Sheet 2 of Figure 2D-14 should include an option for advanced signs that are posted instead of overhead. Right turn only pavement markings should be shown on roadway. Roadway figure should include location of u-turn and directional signs at that location. The 1<sup>st</sup> advanced overhead sign for the left lane is incorrect; should be US 41 SOUTH TO Vestal Road West. Only the mounted sign on the left is appropriate since drivers coming from the east leg of Vestal Rd still need to know how to get to US 41 South. This sign should still say TO Vestal Road, since drivers will not yet be on Vestal Road when making the u-turn. If the mounted sign is not at the u-turn location, a straight left arrow is not appropriate and should be replaced with either a u-turn arrow or M5-1/Type C arrow. Signing should also be shown for the US 41 approach to Vestal Road.

Another example/sheet should be shown after this sheet with a J-Turn single lane approach to US 41 that does not have a direct movement into a u-turn lane. This signing is significantly different enough to be shown separately even though the stick-figure geometry is practically the same.

Sheet 3 of Figure 2D-14 should be labeled "Continuous Flow Intersection", not "Displaced Left Turn" since all of these examples have the left turn "displaced". Place right turn only pavement marking between the R4-21R signs. A KEEP RIGHT (R4-7) sign should be optional on the opposite side of the RIGHT TURN ONLY sign in the median, if that median is narrow and the angle is greater than 45 degrees. There seems to be confusion for why the inset is needed. If kept, include an option for mounted-only signs. A posted SR 68 WEST left arrow sign should be mounted in place of the ALL TRAFFIC sign. Since this intersection will almost always be signalized, the signal heads will give the necessary guidance. Signing should also be shown for "side road" approach which is a little different than most other intersections.

Another sheet is needed for signing within a Quadrant Roadway Intersection, where left and right turns use a roadway on one (or more) quadrant(s) instead of a direct left.

More guidance and options needs to be added to this section. Minimally, this section should have more guidance than the circular intersection section since signing here is more complex.

#### Section 2D.49 Signing on Conventional Roads on Approaches to Interchanges

In Figure 2D-16, the advance sign for I-57 North with the straight up arrow could be mistaken by a driver to think that by going straight, they will automatically be on I-57 North. It is therefore inconsistent with other signs with a straight arrow unless it is accompanied with a TO sign. The straight arrow could also be replaced with LEFT / 1/4 MILE in a yellow (or white) box. Similar issues with almost all figures between 2D-17 and 2D-22.

Figure 2D-22 should simply be called, and referred to in the section as, a Diverging Diamond Interchange, not "Transposed-Alignment Crossroads". This figure needs significant improvement. There should be overhead signing options. SR 24 East needs to be displayed at the diverging point so drivers understand where thru movements should be heading. There should also be an additional figure showing how to sign a DDI if there is a choice lane for the left exit ramp. Ramp signing would also be beneficial, possibly in another figure. If those figures are placed in another location, they should be referenced in the section text.

While it is nice to show a lot more detail of the SPUI in Figure 2D-23, it is inconsistent with the previous 7 figures attached to this section. (It's also not a great SPUI, with the opposing ramp left turns overlapping each other.) It may make sense to show less detail in this Figure and then show this additional information where appropriate later in the MUTCD (along with more details for the other interchange types). There should also be an option for ground-mounted signs instead of overhead signs for a SPUI.

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#### Section 2E.07 Designation of Destinations

While understanding that the point of Figure 2E-1 is to show how designations could be different in opposite direction of travel, guide signs should always include a route and/or road name. There is nothing more confusing for an out-of-town driver that can't figure out what road a ramp is leading to because the

guide sign only says the name of the near-by town. Therefore, add route numbers to the streets and guide signs to this figure and other figures in Section 2E.

#### Section 2E.15 Amount of Legend on Guide Signs

Disagree that “a city name and street name on the same sign should be avoided.” In cases where there is only one interchange serving the city/town/community, both the street name and the city are important pieces of information to an unfamiliar driver. It let’s the driver know what town there are entering and what street they are about to be on. The name of the street and town are often not superfluous (which should be corrected in the support) and in many cases can actually cause confusion when the street name has a different town name that is farther away associated with it. In cases where the street name and town name are redundant, it is still useful to have both the street name and destination for consistency and clarity purposes. At no time should a guide sign state just the destination without a street name or route number.

#### Section 2E.18 Arrows for Interchange Guide Signs

Guidance may be needed here and/or other sections throughout the MUTCD on how arrows should be positioned if the freeway is on a horizontal curve. Additionally, there should be some guidance in general of placement of signs when roads have horizontal curves in terms of human factors of identifying and reading signs properly.

#### Section 2E.21 Interchange Guide Signs

While Figure 2E-2 is for typical sequence, it may be useful to provide additional guidance in this section, perhaps in the text, of what signs can be removed (i.e. post-interchange distance sign) and what signs can be moved to other locations (i.e. service signs) when the 2.5-mile spacing shown in this figure between ramps is not available.

#### Section 2E.22 Interchange Exit Numbering

Should Figure 2E-4 have I-358 and not I-368?

In Figure 2E-7, the insets do not have the correct interchanges and/or route numbers. Additionally, shouldn’t I-103 ideally be at the southern end of the state and I-303 be at the northern end? This often can’t be done practically, but ideally the spur digit would go in ascending order from south to north (or west to east).

#### Section 2E.23 Advance Guide Signs

The last guidance in this section correctly notes the correct use of the LAST EXIT BEFORE TOLL plaque. When a toll is only collected in one direction of traffic and not the other, many states also warn drivers in the non-toll direction about the last exit before the bridge/toll/state line/etc. so that most drivers understand that once they pass that exit, if they want to turn back, they will need to pay a toll. Guidance should be provided here that discusses this type of plaque option.

#### Section 2E.29 Signing by Type of Interchange

For Figure 2E-27, show an inset or additional figure showing signing on a ramp for a DDI and SPUI. Note that by the time this version of the MUTCD gets published, there will likely be over 150 operational DDIs across the US, with over 2/3 of states having at least one. There are over 100 operational SPUIs in the US as well. The DDI needs to be a standard interchange in the MUTCD as it is becoming the diamond interchange of choice in many suburban and some rural contexts.

#### Section 2E.41 Design of Freeway and Expressway Diagrammatic Guide Signs for Option Lanes

Support all advance signing for option lanes. However, at the gore, do not support the use of EXIT ONLY panel below the choice lane that just diverged off. It can be confusing for the driver that may think that this choice lane suddenly became a drop lane. (It’s happened to me before and I am supposed to be an expert at this.) It can also be confusing for the driver in the drop lane to accidentally move into the choice lane by paying more attention to the sign than the pavement marking. The use of the EXIT ONLY panel should only apply to drop lanes. Either keep the EXIT ONLY panel for the dropped lane(s) or do not use the panel at all at the gore area.

#### Section 2E.48 Post Interchange Travel Time Sign

This sign in Figure 2E-53 is not very meaningful without knowing what the typical travel time is for each destination. So there is almost no value in this sign for unfamiliar or somewhat familiar drivers. Distances should accompany all destinations in this sign. The distance should be in miles and use only whole numbers. This way a driver can quickly deduce whether travel times are fairly normal, and if they are not, between what points might congestion begin. The driver can then consider alternate routes, turn on their GPS, and/or prepare for slower traffic ahead.

#### Section 2E.49 Comparative Travel Time Sign

It has been my experience that comparative travel time messages (as shown in Figure 2E-54) are often incorrect, misleading, or not useful. The problem is that the shorter travel time should theoretically be chosen by most drivers trying to get to the destination if all else is relatively equal (i.e. no toll, no stops). If the message is correct, it can potentially create an overload of traffic for the quicker route, which then becomes the slower route. This message is also sometimes used to encourage drivers to use a bypass route over a direct route even though the direct route is really faster. There should be some discussion on the proper use of this sign and consider not using this sign when some of the conditions mentioned here can happen. A fully dynamic message sign or modifications to this sign may be more appropriate in various contexts.

#### Section 2E.55 Eisenhower Interstate System Signs

See previous comment regarding interstate business route signs.

Research should be explored into providing different background colors for toll facilities, toll lanes, and/or managed lanes. There is often confusion about when a highway becomes or stops becoming a toll facility. There can also be confusion with managed/toll lanes whether separated or not. Perhaps, the top panel should be purple along these facilities.

#### Section 2E.57 Signs for Intersections at Grade

Should exit signs and numbering really be used for at-grade intersections? It is confusing for a driver to see exit signs and then hopefully realize that to access the road, they need to turn instead of using a ramp. The signing can also encourage higher speeds where pedestrians and cyclists can be present. Recommend not use freeway signing when a highway temporarily becomes an arterial or city road. Perhaps major intersections can still be numbered but instead of being called an EXIT, it can be called a JCT.

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#### Section 2F.10 LAST EXIT BEFORE TOLL Warning Plaques

As mentioned in previous comment: When a toll is only collected in one direction of traffic and not the other, many states also warn drivers in the non-toll direction about the last exit before the bridge/toll/state line/etc. so that most drivers understand that once they pass that exit, if they want to turn back, they will need to pay a toll. Guidance should be provided here that discusses this type of plaque option.

#### Section 2F.12 Toll Facility and Toll Plaza Guide Signs- General

In Figure 2F-5 on Sign "C" (right side), the NO TOLL plaque should not have a yellow background. Yellow backgrounds denote a warning to driver. This is not a warning. The background should be white here. If there is a desire to differentiate the toll with no toll with a colored background, then there should be a TOLL plaque with yellow background on the route where a toll needs to be paid. (Figure 2F-13 has similar issue.)

Some toll facilities have toll lanes now that are credit card or toll card (like a transit card) only. Signs and symbols should be developed for these options as well in this section and figures.

#### Section 2F.13 ETC Signs - General

In Figure 2F-13, the NO TOLL plaques should not have a yellow background. Yellow backgrounds denote a warning to driver. This is not a warning. The background should be white here. If there is a desire to differentiate the toll with no toll with a colored background, then there should be a TOLL plaque with yellow background on the route where a toll needs to be paid.

When ETC facilities vary toll based on travel length and/or time of day, it is very hard to convey to the driver what the actual toll rate is for their route when it is not to the one, or on rare occasions, two destinations shown on a sign. (Sheets on Figure 2F-12 have these pricing signs.) For the benefit of drivers who need to know more precise pricing, as well as plain transparency purposes, there should be a requirement of a driver getting the information of every toll point at some point. Recommend having signs similar to destination signs, where the top line would show the toll to the next access point and the bottom line would show the toll for either the end of the route or the next major destination. An optional middle line could show the price for an intermediate access point. These signs should continue to occur on a continuous toll route whenever a driver will be charged more for the next access point.

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#### Section 2G.05 Preferential Lane Operation Signs

Would be nice to provide a dynamic panel option to HOV lane signs. This is mostly for the time of day option which would give agencies to extend the restrictions in cases where congestion is still lingering, reduce the restriction time when congestion clears earlier/seasonal adjustments, and eliminate the restriction during holidays or seasonal reasons (snow, vacation season, etc.). A dynamic element could also be placed on the number of occupants required in the vehicle. This could be useful when the occupant requirement could be changed based on time of day, ex. +3 during peak hours, +2 during other hours.

#### Section 2G.18 Regulatory Signs for Priced Managed Lanes

In Figure 2G-18, is the reason that the word TOLL (next to TollPass in R3-48a) does not have a yellow background is because there is a non-toll option here too if a vehicle is HOV 2+ compliant? If so, there should probably be a mention of this in the text, so engineers don't think that the word TOLL is usually in a white background. If not, then add a yellow background behind the word TOLL.

#### Section 2G.20 Signs for Part-Time Travel on a Shoulder – General

In Figure 2G-32, Sheet 1, in the variable operation (A), the TRAVEL ON SHOULDER ENDS ½ MILE (R3-52a) is not an accurate sign when travel is not allowed on shoulder. This could lead to aggressive drivers using the shoulder temporarily to pass in this ½ mile segment. Ideally, this sign should be dynamic. Otherwise, message should be different.

On Sheet 2, the ramp merging on to the shoulder with no merge area is a very dangerous situation with the current signing. Many drivers on the ramp do not clearly understand where the shoulder is when entering the highway. Signing should be treated to reflect the driver's perspective more clearly on the ramp. A NO MERGE AREA plaque under the YIELD sign would be appropriate with perhaps a 6 AM – 10 AM MON-FRI underneath. Another option is to not allow a YIELD condition here and instead use STOP. Yet another option could be to have a variable control sign for YIELD/STOP or a variable plaque below the YIELD for NO MERGE AREA.

#### Section 2G.26 Variable Speed Limits for Active Traffic Management on Freeways and Expressways

A dynamic option should be allowed to inform drivers of a reduced speed ahead. One option is for the full speed limit sign to be variable so that it can change the message from SPEED LIMIT XX to REDUCED SPEED AHEAD. Another option would have a dynamic plaque below the speed limit that can say AHEAD to indicate that the speed limit of 35 is ahead. This dynamic AHEAD plaque would typically appear a ½ mile before the official speed limit change.

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#### Section 2H.01 Scope

In Figure 2H-1, advance turn/directional arrow sign options should also include arrows for roundabouts and u-turn intersections.

#### Section 2H.14 Alternative Fuels Corridor Signs

Consider another word than "Alternative" to describe these fuels. As more vehicles use various "fuels" in the fleet, these fuels will become more common. The term "alternative" also denotes unusual or non-standard, which should be avoided. Do not use a "negative" term, like "non-oil based".

EV – CNG – LNG may not be well understood abbreviations and might need to be spelled out on a separate plaque.

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#### Section 2I.02 General Service Signs for Conventional Roads

In Figure 2I-1, advance turn/directional arrow sign options should also include arrows for roundabouts and u-turn intersections. Plaques should also be developed that spell out various fuel options.

#### Section 2I.09 Radio Information Signing

Is telephone information really safe? Aren't we trying to discourage cell phone use when driving? Should rethink the policy of 511 while driving.

A more useful and safer information sign could be to alert drivers to turn on their GPS when there may be unexpected traffic conditions. May also consider the use of vehicle apps or technology being used in CAVs.

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#### Section 2J.01 Eligibility

For food eligibility, supermarkets (including stores with a large selection of packaged food) should be eligible. There are many people who have dietary restrictions that prohibits them from eating at many restaurants. The reasons could include allergies, religious beliefs, vegan, strict vegetarian, etc. Packaged foods at supermarkets are often their only source of food on the road.

Should a public telephone really be a consideration for eligibility these days? Consider removing.

#### Section 2J.02 Application

There have been research studies that have shown that up to nine services (3 X 3) can be displayed on a sign effectively. Drivers have no problems getting the information needed quickly from these signs. More information that can be conveyed to drivers safely is preferable for both the driver and the businesses. Minimally, consider loosening the standard from "shall" to "should" for 6 sign panels.

Signs adjacent to loop ramps or other tight horizontal curves are difficult for drivers to identify and properly get all the needed information (See NCHRP Report 600 on Human Factors). In Figure 2J-2, the service sign in the loop ramp is in a poor location. The service sign should occur before the diverge point (with an arrow point towards the ramp) or after the merge point of the ramp (i.e. on the crossroad).

General comment mentioned earlier to not reference Paragraphs in a section. If referencing a point is too difficult, consider numbering standards, guidance, options, and support within each section.

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#### Section 2L.04 Design Characteristics of Messages

This section is concentrating just on highway guide signs. Changeable Message Signs can be use in many other contexts as well (on freeways, ramps, arterials, streets, etc.) The MUTCD should recognize this and allow all backgrounds, signs, and plaques as long as it follows the principals provided within the MUTCD for each use.

#### Section 2L.07 Travel Time Messages

Strongly support the text that states that "Travel times are only helpful to the road user if they have a general understanding of the length of the road segment the travel time is related to so that they can compare that to the time it take(s) them to travel a similar distance on a highway without congestion." This supports comments made earlier that did not follow this principal.

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#### Section 2M.08 Placement of Recreational and Cultural Interest Area Symbol Signs

An arrow on a Cedar Springs sign in Figure 2M-4 is facing the wrong direction.

A sign for water fountains should be included in Figure 2M-7.

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#### Section 2N.03 Evacuation Route Signs

Guidance, and a possible figure, would be helpful to show how often evacuation signs should be displayed along a roadway. When signs are not displayed often enough, drivers sometimes think they are not on the correct route anymore.

Consideration should also be given to using CMS for evacuation route signs. This could allow a change in route if the standard route is congested or blocked. It could also allow that sign to be used for another good purpose during non-emergency times, even if it is as simple as displaying the route number.

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#### Section 3A.01

Okay with deletion of the Functions and Limitations section as long as information is shown elsewhere in the chapter. The 2<sup>nd</sup> paragraph is very important. Many engineers don't realize the limitations of markings and can rely a little too much on it in design.

#### Section 3A.03 Colors

Green should also be allowed for bicycle markings.

#### Section 3A.04 Functions, Widths, and Patterns of Longitudinal Pavement Markings

Broken lines on toll facilities sometimes have different dimensions. For example, the New Jersey Turnpike has 30-foot line segments and 10-foot gaps. These broken lines are useful as a distinction between toll facilities and general use facilities. It also encourages drivers to stay in their lane more, which antidotally appears to be the case. Various broken line dimensions should be considered for toll facilities and possibly other managed lanes.

Figures with dimensions would be useful for this section.

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#### Section 3B.01 Yellow Center Line Pavement Markings

For a 3-lane section, would be good to add that in the direction of the 2 lanes, passing shall not be permitted over the yellow line in the same direction.

#### Section 3B.06 White Lane Line Pavement Markings

There should also be example of the use of white lane lines for bike lanes in this section. Do not rely just on a separate section for bike lanes. By adding bike lanes here, an engineer may be reminded to consider a better bicycle facility on their project.

#### Section 3B.09 Edge Line Pavement Markings

There should be special reference here to DDIs (including a figure) that white edge lines remain on the right and yellow edge lines remain on the left. There could be an argument that a solid yellow line should be on the right side of the travel way between the crossover intersections of a DDI because the opposing traffic is not on the right side. But convention should consider the roadways within a DDI as one-way streets.

There is also be a need to show edge line pavement markings (including a figure) on the displaced left turn section of a continuous flow intersection that makes clear that the displaced left section is acting as a one-way street.

#### Section 3B.11 Application of Pavement Markings Through Intersections or Interchanges

Figure 3B-13 is missing Sheet 1. I hope this figure will include an intersection with skewed angles to show how markings should look.

Guidance should be provided in this section of when pavement markings through intersections should be applied. The application should be used more often, particularly when lanes subtly shift through an intersection. Would recommend applying lane markings through intersections on any curve or any lane shift greater than 1 ft.

#### Section 3B.12 Lane Reduction Transitions

Guidance should be added if lane droppings are occurring on horizontal curves or shifts. The driver's views of vehicles in adjacent lanes changes considerably in these conditions.

#### Section 3B.14 Raised Pavement Markers – General

Figures would be very beneficial to illustrate the various guidance for the raised pavement markers sections.

#### Section 3B.18 Curb Markings for Parking Regulations

A figure would be useful for this section.

#### Section 3B.19 Stop and Yield Lines

A figure should show example of stop lines for intersections and unsignalized crossings.

Yield lines SHOULD be accompanied by a YIELD HERE sign, but it shouldn't be an absolute requirement (i.e. SHOULD instead of SHALL) unless it's a multi-lane approach. Yield lines can be beneficial on its own and should still be used in cases where a sign cannot be installed in an ideal location. It can also be beneficial when the only sign is at the crosswalk to show a pedestrian crossing with an arrow plaque. (If this ped crossing sign is used, the sign should not block the sight of a potential pedestrian and should be considered to be placed at the far-side corner of the crosswalk.)

The placement of yield (and stop) lines from a uncontrolled crosswalk should be based on operating speed and number of lanes needing to yield (or stop) in the same direction. If it is just one lane yielding (or stopping), the yield (or stop line) should be 4-5 feet from the crosswalk. If it is two or more lanes, the distance should be based on stopping sight distance, which accounts for a dynamic sight distance possibility of vehicles in lanes to the left or right also blocking the view. A figure should be provided to show the different scenarios and required distances.

There should also be guidance of when yield or stop lines should be used in front of crosswalks. Are they only appropriate at mid-block crossings? Could they be used at intersections?

There should also be a figure (or two) showing how yield lines should be used at an intersection if there isn't a crosswalk. It should show a standard intersection of neighborhood streets, an interchange ramp with no merge area, and it should also show a roundabout. The placement of the yield line should be consistent in all scenarios.

Yield lines should not be used when there is a merge area beyond the yield point, including cloverleafs and similar scenarios with a short merge section.

#### Section 3B.22 Symbol Pavement Markings

Additional guidance is needed for the use in an option lane. At many interchanges, agencies are only showing the route for the exit on the option lane and not the thru movement. This is a particular issue within DDIs where option lanes are very common. Guidance should say here that all route choices should be marked on option lanes if symbol pavement markings are used. If the street does not have a route number, there should be an option of providing the street name as a marking in a rectangular shape with a green background and white lettering with two lines maximum. Guidance should also be provided to what route should be displayed first in an option lane. Recommend that the route for the dominant movement in the highest peak hour be displayed first. A figure should show the options of symbol pavement markings in an option lane, possibly in a DDI for arterial use and a major freeway interchange along the freeway.

#### Section 3B.23 Lane-Use Arrows

Lane use arrows that just use raised pavement markers (along with all lane markings that are replaced with just raised pavement markings) are often difficult to see. Would be very useful if there was an option to place a border around these arrows (and other markings). Could also be useful if the quality of these raised pavement markers were better.



### Section 3B.24 Wrong Way Arrows

Would be very useful to show a figure with a DDI example that uses wrong ways arrows at the crossover intersections as well as confirmation arrows beyond the intersection to tell drivers they are in driving in the correct direction. A similar figure would be useful of a major city intersection of one-way streets with wrong way and confirmation arrows in the correct locations. In this case, wrong way arrows may need to be placed behind turning arrows. Lastly, a figure with the proper location of a wrong way arrow along a ramp would be very useful.

### Section 3B.31 Markings for Diamond Interchange with Transposed Alignment Crossroad

I believe this is a section for DDIs, but hard to tell, especially since Figure 3B-29 is missing. See comments throughout Section 3B regarding DDIs. Probably better to show DDI figures for each section element separately and then use this section for a summary and possibly a summary/complete figure. These can be called DDIs in the MUTCD and a reference can be made for similar configurations.

A section should also be shown in 3B for markings in CFIs. It can simply be a summary section with a summary figure that also references specific needs from other sections.

A section for u-turn-type intersections (superstreets/J-Turns, Median U-Turn Intersections/Michigan Lefts, and jughandles) should be considered as well. These sections probably don't need to be elaborate and might not need figures. But they might need to be acknowledged simply so an engineer can find a reference to it within the MUTCD.

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### Section 3C.01 General

The initial standard and support is confusing for a section labeled as "General". In general, crosswalks should be provided at all potential crossings of pedestrians and cyclists (if no designated bicycle facility) along a leg of an intersection.

### Section 3C.02 Application of Crosswalk Markings

There needs to be more discussion about when to apply crosswalk markings. More crosswalk markings are needed, especially in residential and suburban contexts. Crosswalks should be required within 500 feet of a transit stop in most cases if the transit route is not a loop route. This is because pedestrians will need to cross the street to get to/leave from the stop. Many pedestrian fatalities are occurring near transit stops along suburban arterials that have no crosswalks nearby. State and local agencies are often reluctant to put in a crosswalk because of the ADA issues they perceive comes along with it. Complying with ADA should not be a reason to not put in a crosswalk and it's also a misconception that every crossing has to be fully accessible if they is a reasonability issue and/or a reasonable alternative path that is accessible.

For criteria to consider a crosswalk, add expected pedestrian volumes with a crosswalk, lack of crosswalks along a pedestrian facility within a ¼ mile, and vicinity of transit stops. Expected pedestrian volumes are a needed criteria because the pedestrian volume may increase significantly with a crosswalk that won't be noticed with existing pedestrian volumes. Lack of crosswalks within a ¼ mile is needed because pedestrians will tend to cross at unsafe locations with no crosswalks nearby. Some pedestrian advocates might want a shorter distance, but until there is more research in suburban and residential contexts, a ¼ mile should be a good to start to at least get engineers to consider the consequences of not having a crosswalk in longer stretches.

Speed should not be a criteria (Criteria C) for not putting in an uncontrolled crosswalk. FHWA's guide on unsignalized crossings has criteria for what can be done on various facilities where speeds are greater than 40 mph

([https://safety.fhwa.dot.gov/ped\\_bike/step/docs/STEP\\_Guide\\_for\\_Improving\\_Ped\\_Safety\\_at\\_Unsig\\_Loc\\_3-2018\\_07\\_17-508compliant.pdf](https://safety.fhwa.dot.gov/ped_bike/step/docs/STEP_Guide_for_Improving_Ped_Safety_at_Unsig_Loc_3-2018_07_17-508compliant.pdf), pg 23, Table 1). When speed becomes a factor in placing crosswalks,

what it is really doing is ignoring a problem where pedestrians are going to cross anyway. Engineers should do whatever they can to improve safety even when conditions aren't ideal for all users.

Crosswalks improve safety in higher speed corridors too in rural and suburban contexts. Having all of these crossings controlled can be impractical at times and also present a safety problem for other users.

### Section 3C.03 Design of Crosswalk Markings

There should be consideration of varying the design of crosswalk markings based on the right-of-way of pedestrians within the crosswalk. There are basically 3 cases: (1) a crosswalk in front of a stop sign where the pedestrian can cross immediately without waiting and have the right-of-way, (2) a crosswalk in front of an uncontrolled crossing, where the pedestrian is responsible for finding an adequate gap in traffic before crossing, and (3) a crosswalk in front of a controlled crossing where a pedestrian is required to wait during certain periods but will have the right-of-way during other periods (i.e. walk phase). If different crosswalk markings were shown for each case, it could provide a better message to both pedestrians and drivers on what the correct action is supposed to be when coming to that crosswalk.

### Section 3C.09 Crosswalk Markings at Circular Intersections

Change standard from "shall not" to "should not". Crosswalk to or from the central island do occur on circular intersections. Dupont Circle is a famous example in Washington DC, along with other DC circles (that are not always signalized). They can also be found in rural town centers with circular intersections that may or may not be defined as roundabouts. While crossings to center islands are undesirable for most traditional modern roundabouts, it is not out of the realm of possibility to have them. In a more-pedestrian focused context with low-to-moderate vehicle traffic, direct crossings into the center of a roundabout could be possible if controlled and/or sufficient sight distance. The main reason crossings into the center of the roundabout were not desired was due to a vehicle-centric approach to always give vehicles priority within the circular roadway. If a vehicle needs to stop within the roundabout, it will not gridlock the roundabout, just potentially delay more movements.

### Section 3C.10 Crosswalks for Exclusive Pedestrian Phases that Permit Diagonal Crossings

Would be nice to show all examples of permissive markings for diagonal crossings. Would also be nice to see guidance on when more markings are appropriate.

### Section 3C.11 Crosswalks at Diamond Interchanges with a Transposed Alignment Crossroad

This section should be deleted or significantly altered to be based solely on skewed intersections/crosswalks. Crosswalks at DDIs are no different than any other skewed intersection of one-way streets. (Other pedestrian elements may be slightly different in DDIs, but not crosswalks.)

All three paragraphs for support are completely inaccurate. In the first paragraph, crosswalks do not always occur at crossover points. In some DDIs, pedestrians remain on the outside throughout and only cross ramps. In the second paragraph, pedestrian crossings on ramp terminals do not violate driver expectations and these crosswalks are no different than what is found on any other diamond or loop ramp. HAWKs and RRFBs can be helpful in these settings and in fact are being implemented where appropriate. The third paragraph is completely inaccurate that some pedestrians with disabilities will be disoriented and no pedestrian ever crosses the same ramp twice. Design to help guidance for disabled pedestrians in DDIs can be found in NCHRP 948 and NCHRP 959.

It may be useful to have a section on skewed intersection and show how crosswalks can be placed "parallel" to the roadway, "perpendicular" to the cross road, or a hybrid of both. Can explain the advantage of parallel crosswalks giving pedestrians the most direct route and more useful in controlled crossings, while perpendicular crossings give the shortest pedestrian exposure to traffic (if used by the pedestrian) and are very beneficial in uncontrolled crossings. Having something like this with figures of a skewed urban intersection and a DDI crossover intersection could be very useful. Could also show an example of a skewed crosswalk which are common at superstreets (also known as signalized RCUTs).

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### Section 3D.01 General

For Figure 3D-1, may want to rethink whether crosswalks should be 20 ft minimally from the circulatory roadway. Roundabouts are the only intersection type where crosswalks occur before the actual intersection. It is not uniform with every other intersection in existence. If roundabouts are not supposed to be considered a control device in itself, which is the correct approach, then every leg of a roundabout should be considered its own intersection. The intersections are just strategically located to optimize operations and/or safety in the form of a roundabout. Placing the crosswalks farther away from the

intersection forces pedestrians to go in an indirect route (if they follow to begin with) and exposes them to higher vehicular speeds, particularly when exiting the roundabout. It does not meet driver expectations of where a crosswalk should be compared to any other intersection. And the main justification for distancing the crosswalk from the circulatory roadway is vehicular-centric to try and prevent vehicles from queuing into other parts of the roundabout. But this only works if one vehicle is queued. Any more, and the same blocking of thru traffic exists. But blocking of thru traffic happens at all intersections with turning movements into a crosswalk. If engineers focus more on pedestrian needs, the argument for crosswalks to be away from the intersection get very weak.

At least one of the figures of the multi-lane roundabouts should show the alternative lane markings of “strong” dashed lines.

#### Section 3D.04 Yield Lines for Roundabouts

Why are yield lines defined differently for roundabouts than for any other intersection form? Yield lines are a series of triangle shapes attached to each other in a line, not a marking to indicated the perimeter of a circulatory roadway. Redefine the requirement here. If actual yield lines are required in multi-lane roundabouts (which is a good idea to help with sight distance from an outer lane), they should be shown on all figures from this section and not be optional.

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#### Section 3E.02 Longitudinal Markings

When movements are permitted between general use lanes and preferential lanes, it might be helpful to alter the spacing for the broken lines separating the lanes. For example, instead of 10-30 spacing, go with 15-25 or 20-20 spacing. This would stand out more for drivers to indicated a difference in lanes and perhaps discourage a few drivers who may accidentally want to go into the preferential lane when they don't belong.

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#### Section 3F.02 Longitudinal Markings

Could use a figure here showing appropriate markings based on approaching lanes, number of toll gates, types of toll gates (cash, coin, ETC, credit), and merging lanes. Guidance for lane markings leaving the toll gates would be particularly useful in a figure or two.

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#### Section 3H.06 Green-Colored Pavement for Bicycle Facilities

Appreciate the addition of green-colored pavement into the MUTCD. Could go further into whether green pavement and/or markings are allowed through intersections and how they should be treated at certain driveways.

Would also look to see more on lane markings in general for bicycles. How should bike lanes be separated from vehicle lanes? What are options for buffered bike lanes? What options are there for separated bicycle facilities. Should bicycle crossings have different markings than pedestrian crossings, such as in “protected intersections”? Should a whole chapter in Part 3 be devoted to bicycle markings?

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#### Section 4A.04 Meanings of Flashing Vehicular Signal Indications

In some countries, flashing green is used for a “stale green” that is about to turn yellow. These are generally useful in high speed corridors where there are dilemma zones during the yellow phase. The flashing green gives the driver a little more time to decide whether to slow or continue at the intersection.

While I am not suggesting allowing flashing green, I am suggesting that existing or new traffic control devices could improve issues with dilemma zones which could reduce both red-light running and rear-end crashes. Consider experimental use of traffic control devices that are used in other countries such as the flashing green (UK) or green light countdown (China).

For a flashing YELLOW ARROW (FYA), add that an upward arrow shall not be allowed. FYAs only refer to turning movements.

#### Section 4A.05 Meaning of Bicycle Signal Indications

Figures are needed.

For B., There should be a reference that an engineering study should determine the length needed for a yellow bicycle signal based on clearing the intersection safely when unable to stop.

For C., a bicyclist should generally not be allowed to make a left turn on red (LTOR) from a one-way street to another one-way street. First, not all states allow LTORs legally from a one-way street to another. But more importantly, a cyclist would only be able to safely make the maneuver if it was in the left-most travel lane at the start and finish. A bicycle signal presumes that there is a separate bicycle facility (bike lane or separated path) that will most likely be on the right side of the road of a one-way street. That presents a dangerous situation of a bicyclist needing to make a left turn from the right lane. There will only be a few unique situations where a LTOR would be considered safe. Better to not mention LTOR for cyclists in the MUTCD.

Are there NTOR signs specifically developed for bicyclists? Could see situations when a NTOR is needed for cyclists but not vehicles, such as when the bicycle facility on the cross road is not on the right-hand side of the roadway. How would this sign be designed so that there is no confusion between motorists and bicyclists (and other non-motor vehicles that might be allowed to act like a bicyclist)?

#### Section 4A.06 Meanings of Pedestrian Signal Indications

For A., a flashing WALKING PERSON used to have meaning where it would indicate that vehicular traffic could be turning into the crosswalk, so be aware. This was useful, particularly when a driver was involved in a “turning hook” where due to human factors of sight distance and attention for gaps a driver would not be aware of a pedestrian crossing. Not sure if there were studies that showed this condition was unsafe, but my guess is if they were, they were only being considered in urban areas since the most common use of the flashing WALKING PERSON was in Washington DC. It’s possible that the flashing WALKING PERSON may be more useful in contexts of lower, moderate, or sporadic bursts of pedestrian volume where the presence of a pedestrian is less expected. Not suggesting change to this version of MUTCD, but consider experimental use of flashing WALKING PERSON for consideration in a future edition.

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#### Section 4B.02 Basis of Installation of Traffic Control Signals

Support the addition that signals should not be installed or operated for the purpose of penalizing drivers for speeding.

#### Section 4B.05 Alternatives to Traffic Control Signals

For M., do not add “to reduce vehicular conflicts”. Roundabouts should be considered an alternative to signals based on safety, operations, and/or costs.

Add an “O. Prohibit certain direct movements and strategically redirect those movements. These options may be considered in an Intersection Control Evaluation process.” The main non-signalized alternative would be to convert an intersection into a J-Turn where thru and left turn movements at the main intersection are physically prohibited through geometric features with those movements needing to use a downstream u-turn on the major road. But it could also include just prohibiting certain movements through signing (likely left turns, but sometimes thrus).

Add a “P. Reduce demand at the intersection by improving the surrounding network.”

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#### Section 4C.05 Warrant 4, Pedestrian Volume

The signal warrant for pedestrian volume needs to seriously be reevaluated. This warrant is almost never fulfilled for the simple reason that pedestrian volume cannot practically get that high if a crossing is uncontrolled. This warrant also does not take into consideration the pedestrian safety concerns. We want to prevent needing Warrant 7, Crash Experience, before crashes happen for pedestrians and bicyclists.

This warrant needs to be changed to consider projected pedestrian volume if a signal is installed. It also needs to consider lower but consistent pedestrian volume such as when pedestrian volume is primarily for getting to or from transit stops. It should also consider other pedestrian-specific safety issues, such as

vehicle speed, lanes to cross, crossing multiple directions of traffic flow, limited pedestrian sight distance, etc. It should also consider accessibility issues for disabled pedestrians.

There should also be consideration to include Bicyclist Volume to this warrant. This can particular be an issue along bicycle trails that cross or end at/near a street. Bicyclist can have unique needs where they shouldn't always be considered a vehicle or pedestrian in a count. Clearance time is one example. Sight distance needs is another.

Keep in mind that making it easier to meet a signal warrant does not necessarily mean that a signal will be installed. So making it easier to meet a pedestrian warrant due to future operations and safety for pedestrian/bicycle traffic is critical to help address pedestrian and bicycle crashes.

#### Section 4C.08 Warrant 7, Crash Experience

This warrant is fully reactive to safety problems that already exist. There should also be a proactive element to this warrant that enables a signal to be considered if there is sufficient evidence that a new, modified, or contextual changes to an intersection would likely lead to a crash experience warrant in the near future. The Highway Safety Manual could be a resource that helps determine this but there may be other ways too. A sufficient engineering safety study would be needed to meet a proactive warrant.

#### Section 4C.10 Warrant 9, Intersection Near a Grade Crossing Change to Intersection Near a RAIL Grade Crossing

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#### Section 4D.04 Number of Signal Face on an Approach

There should be a mention in this section that there are safety benefits to having one signal face per approaching lane (in a multi-lane approach) with each signal face providing information for that lane's movements.

There is also a benefit in providing a supplemental signal for all turning phases when only one lane is provided. The reasons for this are (a) it helps identify to proper phase for drivers behind larger vehicles that are blocking the view of the only signal indication, (b) it allows one signal head to still be viewed if the other signal goes out, and (c) assists color-blinded drivers that rely on various shades of green.

Figure 4D-1 should also show possible locations for a supplemental signal that is overhead prior to the intersection (i.e. along the mast arm that is primarily for the primary signal heads in the opposite direction.)

There should be another figure that shows examples of signal face locations on significantly skewed intersections. This goes for both intersections with two-way and one-way streets. A specific example of signal locations along a DDI would be very helpful, especially with consideration of signal heads for ramps and supplemental signal heads for each movement to improve decision sight distance.

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#### Section 4E.04 Positions of Signal Indications Within a Vertical Signal Face Shouldn't Flashing left/right-turn ARROWs be above a CIRCULAR GREEN?

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#### Section 4F.01 Application of Steady and Flashing Signal Indications during Steady (Stop-and-Go) Operation

Support adding in the option of using a straight-thru GREEN ARROW on an approach with unique geometric design that prohibits turns. Would add to this guidance that an example of this would be at crossover intersections of a DDI. That addition is important for someone who does a "Control-F/Find" in the MUTCD PDF for DDIs to find guidance for signal head use.

While agreeing with the standard that a CIRCULAR YELLOW with CIRCULAR RED should not be allowed, want to note that there are some countries (ex. UK) that do use this as an indication that the phase is about to turn green. This helps with the perception-reaction time for a phase change. Would be interesting to experiment possible ways to use traffic control devices in the US to improve perception-reaction time to phase changes without harming safety. Contact for possible options.

#### Section 4F.04 Signal Indications for Permissive Only Mode Left-Turn Movements in a Separate Signal Face

Left Turn yellow and red Arrows with Circular Red should be provided in Figure 4F-3, 5, and 7 for instances where that is the only legal movement from that approach (i.e. only signal face). This is needed to better see a red indication and is common at most ramps within DDIs and other one-way streets/ramps that terminate at a roadway. (Note that right turn arrows have a similar arrangement option too. See Figure 4F-9, 10, 12 and 14.) In this condition a FLASHING LEFT YELLOW ARROW shall not be allowed during a conflicting movement's green phase. FLASHING CIRCULAR RED shall not be allowed either during a conflicting movement's green phase. If in a state where LTOR is not legal unless signed for, better to use a CIRCULAR RED and sign to allow LTOR at that location, if safe to do so, rather than a FLASHING RED LEFT ARROW.

#### Section 4F.06 Signal Indications for Protected Only Mode Left-Turn Movements in a Separate Signal Face

While I generally agree that a separate left-turn signal face is not ideal for an approach that does not have an exclusive left-turn lane, there are contexts where this is still the best option. An example is urban locations with tight constraints such as 16<sup>th</sup> St and Irving St. NW in Washington DC (DC has several other examples including Connecticut Ave and Calvert St NW where TRB used to be held). The SB left-most lane is a thru-left choice lane but the left turn is protected only. Because of the intersection geometrics that include 15<sup>th</sup> St, a permissive left is a major safety hazard. But there isn't enough room for an exclusive left turn lane. Another example might be in a high-volume pedestrian context where permissive lefts present a significant safety hazard. Therefore, replace "SHALL" with "SHOULD" in the opening statement and move to a guidance section. State that in contexts where there is no better choice but have a protected-left signal without an exclusive left-turn lane, the left-turn signal face and circular signal face should be next to each other over the same lane. (Would be okay with a SHALL NOT in cases where the posted speed is over 30 mph, because then the risk of rear-end crashes causing injuries significantly increases.)

#### Section 4F.13 Signal Indications for Protected Only Right-Turn Movements in a Separate Signal Face

Similar to the comment directly above, a separate right-turn signal face SHOULD NOT (not SHALL NOT) be used for an approach that does not include an exclusive right-turn lane. The main case for when this condition could still be beneficial is for pedestrian or bicycle safety and a tight context does not allow for an exclusive lane. Would be okay with a SHALL NOT in cases where the posted speed is over 30 mph, because then the risk of rear-end crashes causing injuries significantly increases.

#### Section 4F.17 Yellow Change and Red Clearance Intervals

Include in section that consideration for clearance time for bicyclists should be considered when determining the proper clearance time. Bicycle clearance time is a major issue that is not being addressed at all. It would be great to minimally just get engineers to think about bicycle clearance time in this revision and then conduct research for the next edition on potential methods to calculate and what other countermeasures can be used to address this significant safety issue.

Engineering practices for determining yellow and red clearance intervals can also be found in NCHRP Report 731 Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections. There are slight differences between the ITE and NCHRP calculations.

#### Add Section 4F.21 Signal Indications for Reversible or Dynamic Lanes (probably better as Section 4F.17 with all other sections lower in order)

A short section should discuss signal heads that are for lanes that change movement assignments during the day. Sometimes that can be for a reversible lane. Sometimes that can be for a non-reversible lane adjacent to a reversible lane. And sometimes that can be for a lane with a dynamic lane assignment. Discussion should include whether a signal head can be blank during certain hours (it should not) and whether a special signal head with lane assignment can be used. Reversible and dynamic lanes are going to become more common in the future, particularly because of its distinct advantages with more CAVs being introduced to traffic.

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#### Section 4J.01 Application of Pedestrian Hybrid Beacons

Should not in this section that the signal warrant for pedestrians does not have to be met in order to install a pedestrian hybrid beacon.

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