

CHAPTER 3. HEAD PLACEMENT CHARTS**3. HEAD PLACEMENT CHARTS**

In this chapter, signal head placement charts are introduced on the following pages. The primary consideration in signal head placement is clear visibility. Drivers approaching an intersection shall be given a clear and unmistakable indication of their right-of-way assignment. The number and placement of signal faces shall conform to the requirements of the MN MUTCD. Overheads should be located as near as practicable to the line of the driver's normal view. The size of lenses shall be as stated in the MN MUTCD. A handout of the MUTCD is included at the end of this chapter.

In general, vehicle signal faces should be placed and aimed to have maximum effectiveness for an approaching driver located a distance from the stop line equal to the distance traveled while reacting to the signal and bringing the vehicle to a stop at an average approach speed. Visors, shields, or visual delimiting should be used to help in directing the signal indication to the approaching traffic, and to reduce sun phantom resulting from external light entering a signal lens.

A red ball or arrow indication is a directive to drivers that they must not enter the intersection. A yellow ball or arrow indication is a change interval and a notice to drivers that they may enter the intersection only if they are too close to safely/comfortably stop. A green arrow informs drivers that they have an unrestricted (by vehicles and pedestrians) movement and may enter the intersection. A green ball indication informs drivers that they may make a permitted left, through or right movement while yielding to conflicting vehicles and pedestrians.

The signal faces layouts on the following pages are not definitive, and should be considered the minimum arrangements. These figures do not cover every possible condition; they may need to be adapted to fit the situation.

Horizontally arranged and vertically arranged signal faces may be used on the same approach provided they are separated to meet the lateral separation spacing required in Section 4D.15 of the MN MUTCD (see the end of this chapter).


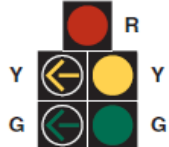


The figures are defined for low speed (see Section 3.1) and high speed (see Section 3.2) approaches. High speed is considered to be 45 mph and above. There is also a section on Flashing Yellow Arrow signal head arrangements (see Section 3.3). The following abbreviations are used on the figures:

The 2009 Federal MUTCD, Section 4D.13 states:

“For new or reconstructed signal installations, on an approach with an exclusive turn lane(s) for a left-turn (or U-turn to the left) movement and with opposing vehicular traffic, signal faces that display a CIRCULAR GREEN signal indication should not be post-mounted on the far-side median or mounted overhead above the exclusive turn lane(s) or the extension of the lane(s).”

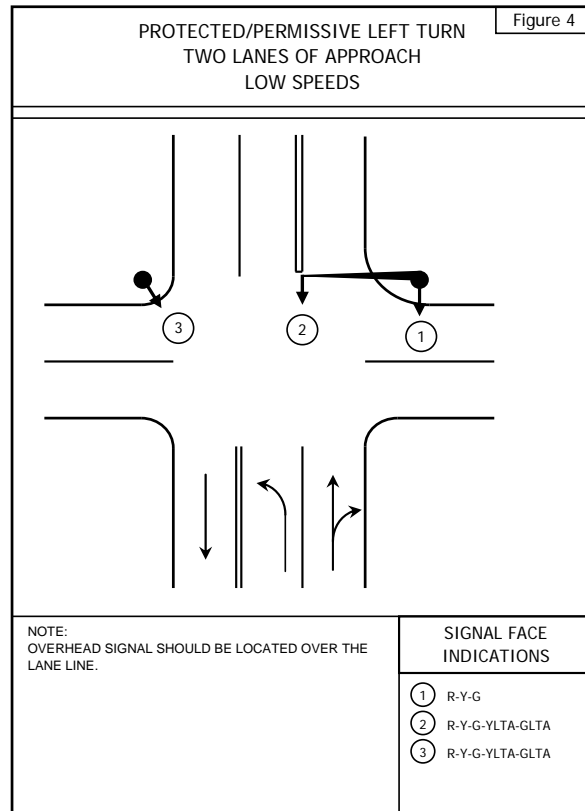
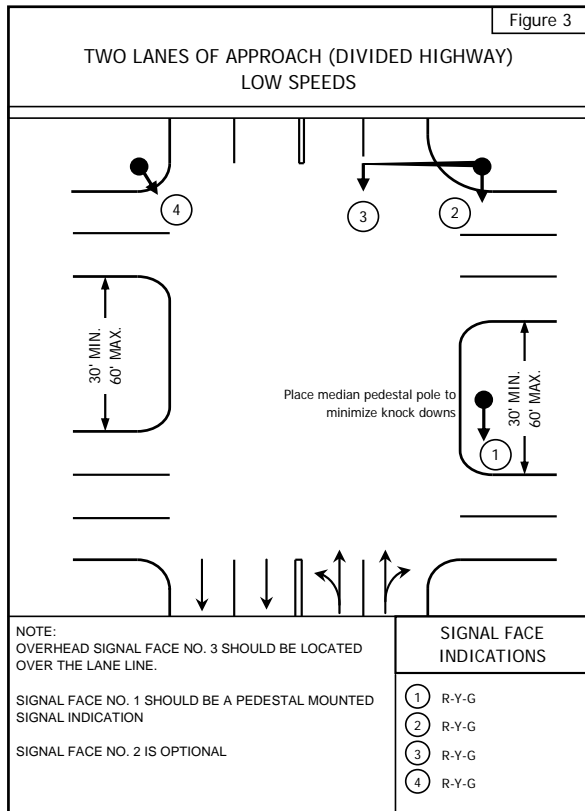
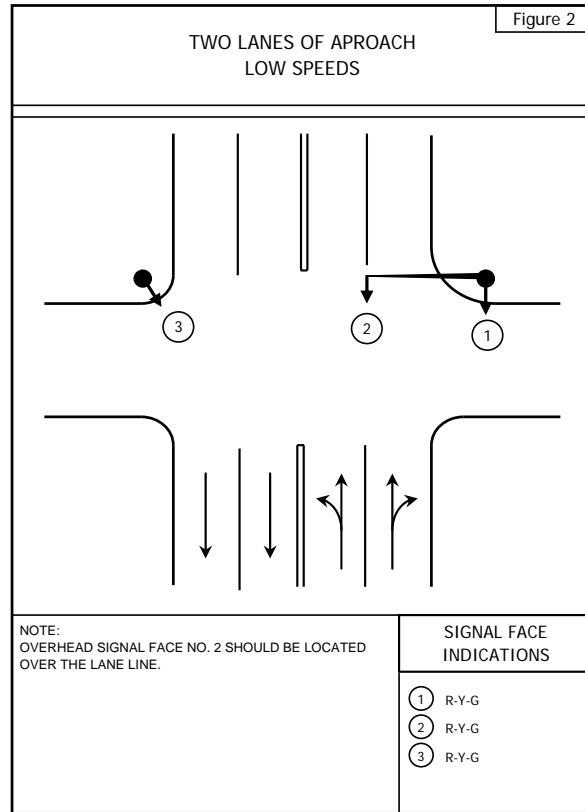
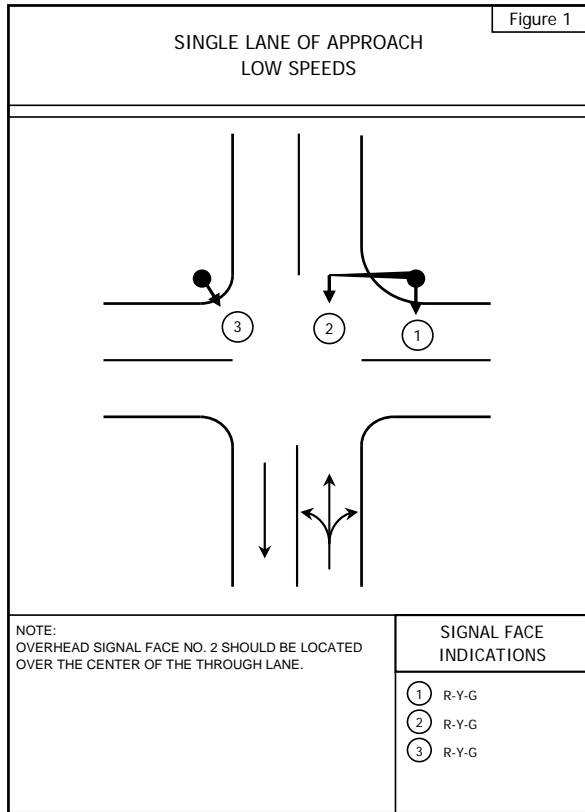
For a permissive left, the use of a Flashing Yellow Arrow indication should be considered. See Section 3.4.

CHAPTER 3. HEAD PLACEMENT CHARTS

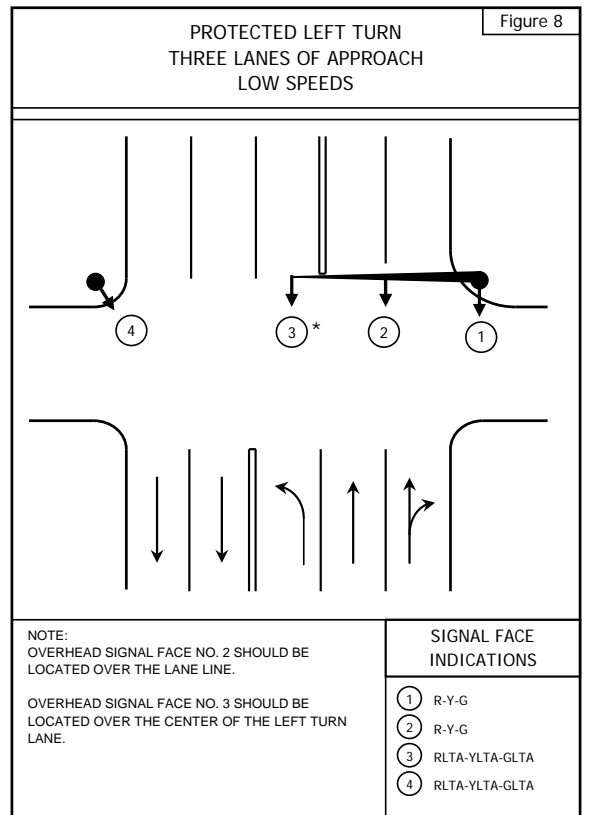
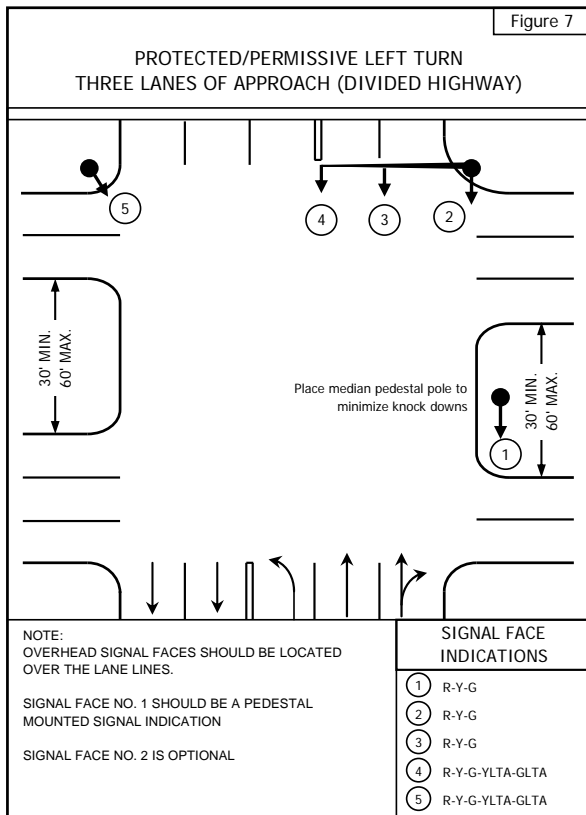
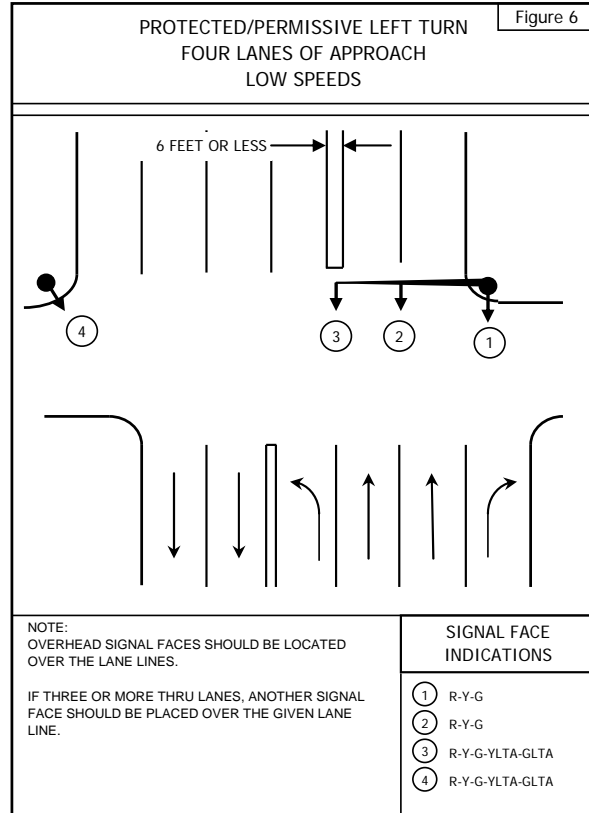
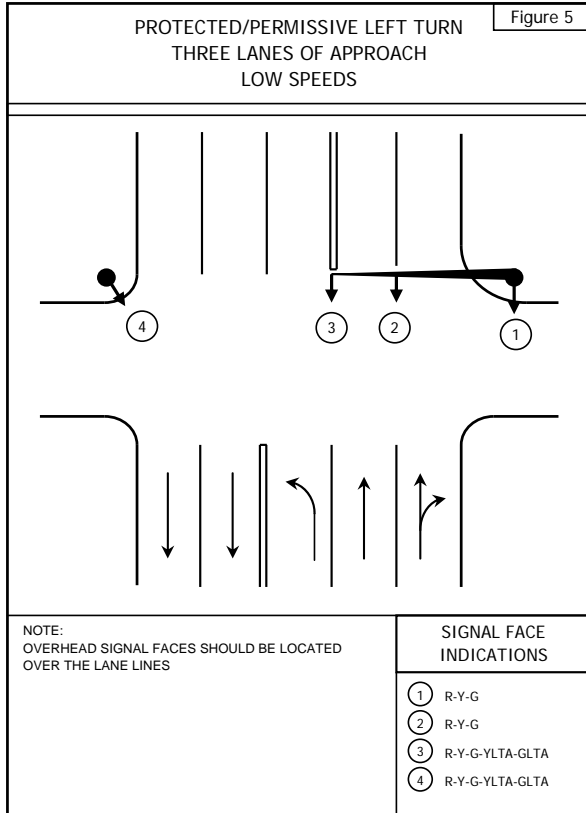
Abbreviation	Description	Arrangement
R-Y-G	Three-Section Red, Yellow, Green Ball	
R-Y-G-YLTA-GLTA	Five-Section Red, Yellow, Green Ball and Yellow, Green Left Turn Arrow	
RLTA-YLTA-GLTA	Three-Section Red, Yellow Green Left Turn Arrow	
RLTA-YLTA-FYLTA-GLTA	Four-Section Red, Yellow, Green Left Turn Arrow and Flashing Yellow Left Turn Arrow	 <p>* Shall not be displayed when operating in the protected only mode</p>

CHAPTER 3. HEAD PLACEMENT CHARTS

3.1 LOW SPEED CHARTS

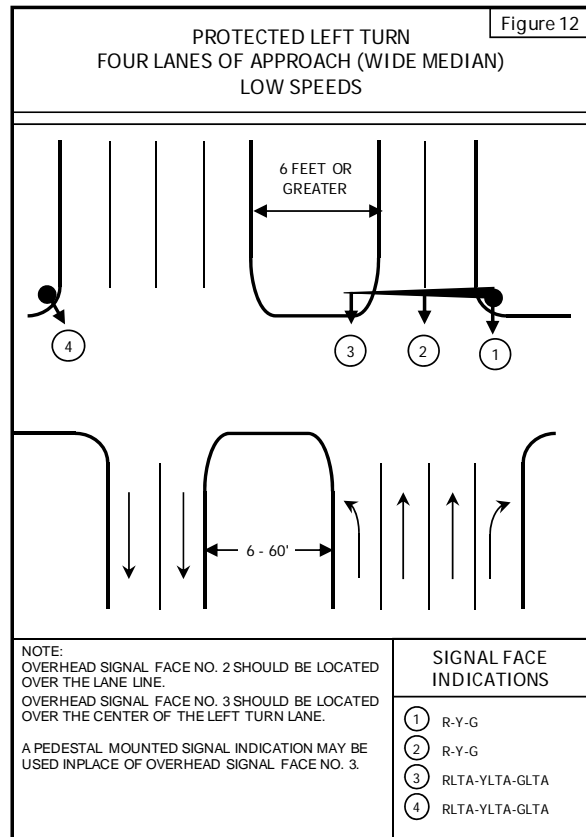
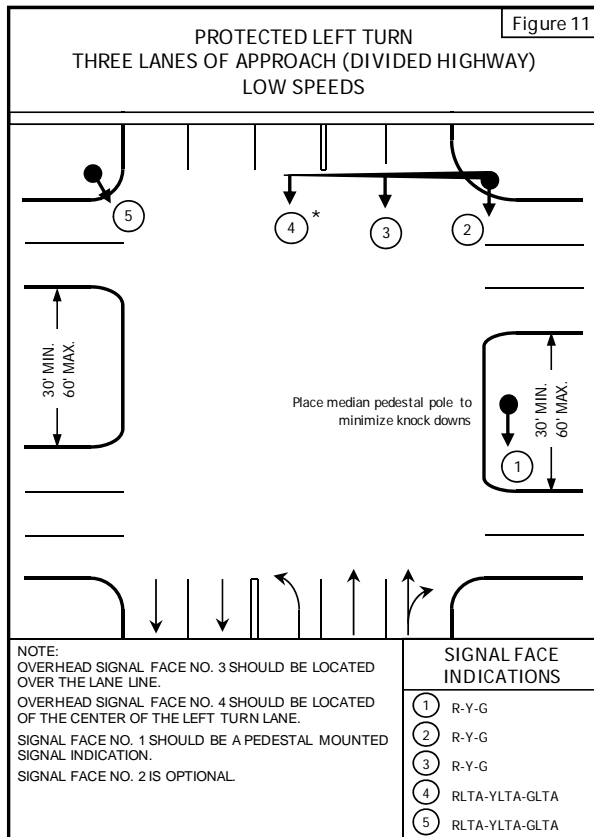
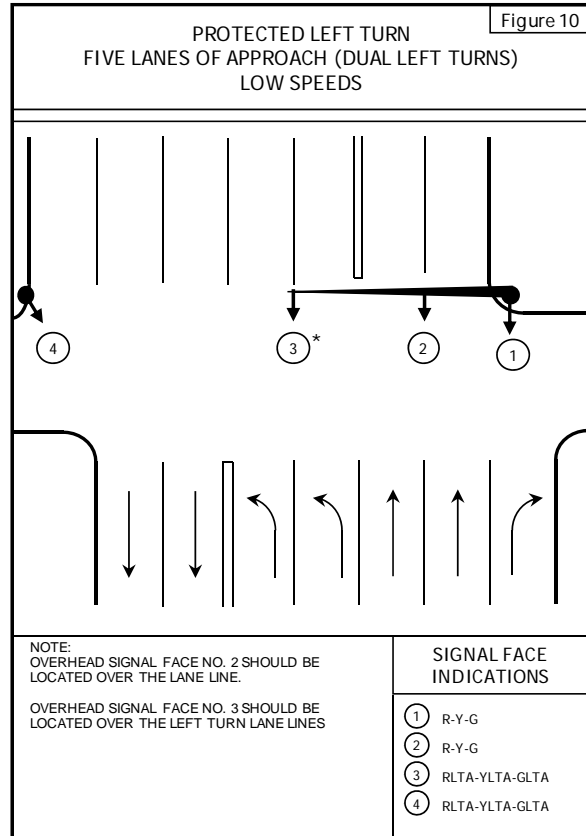
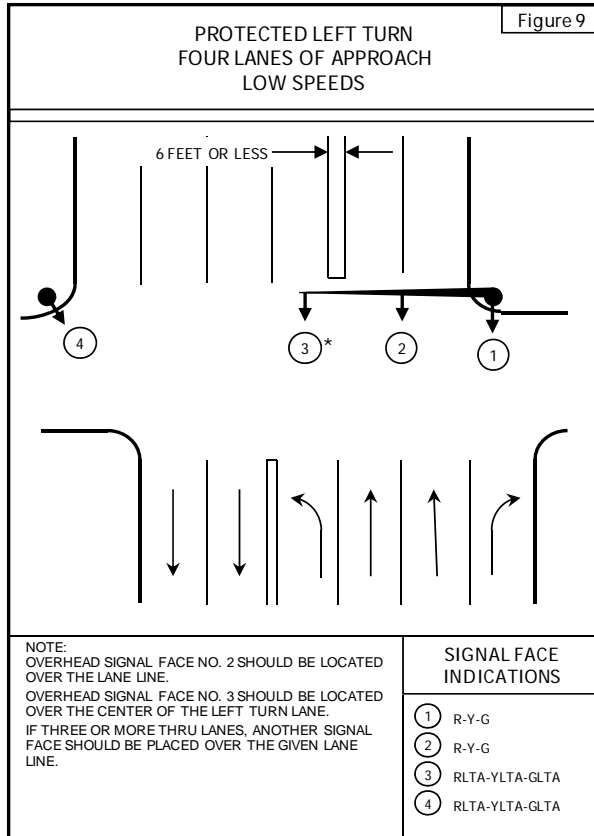


CHAPTER 3. HEAD PLACEMENT CHARTS



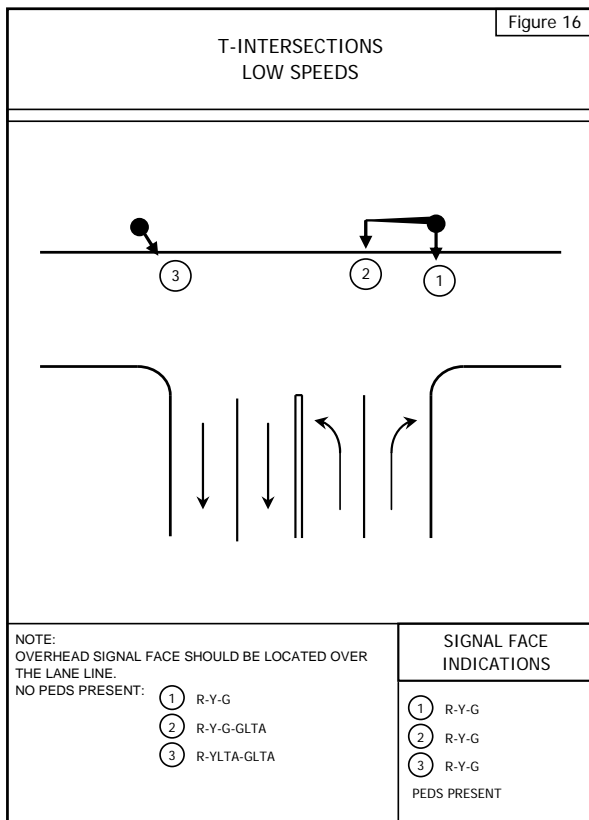
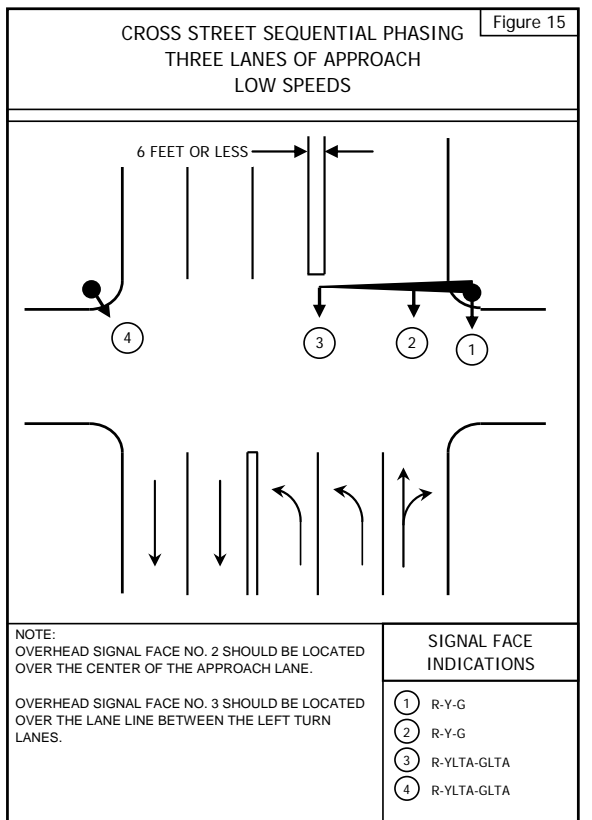
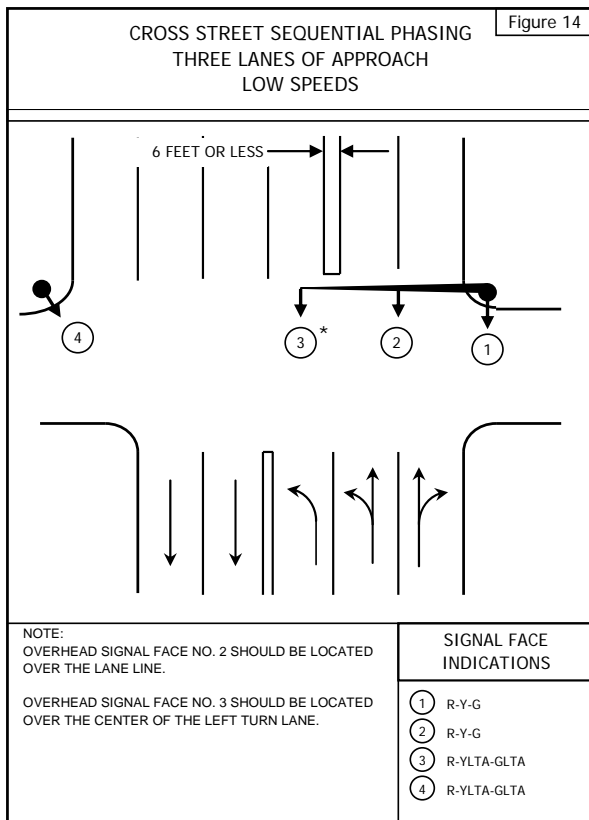
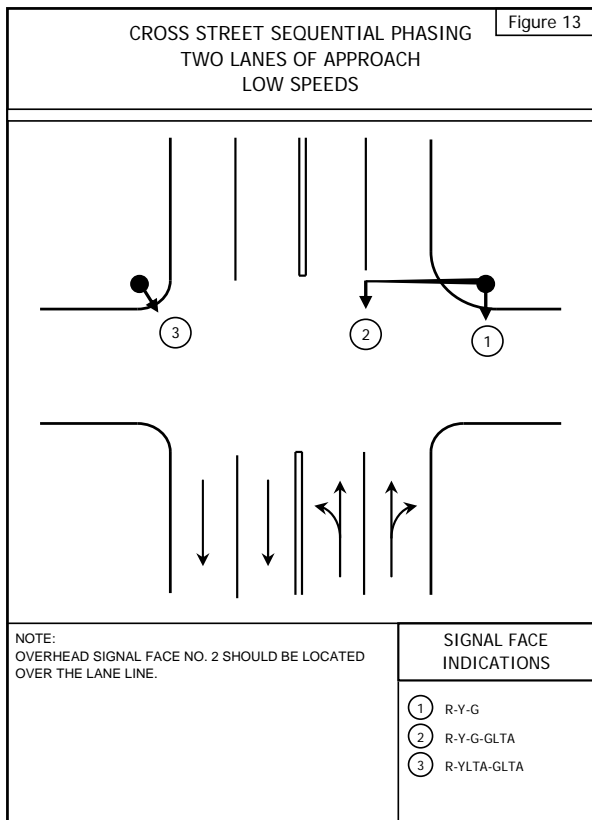
* ensure that opposing left turn heads do not block each other

CHAPTER 3. HEAD PLACEMENT CHARTS



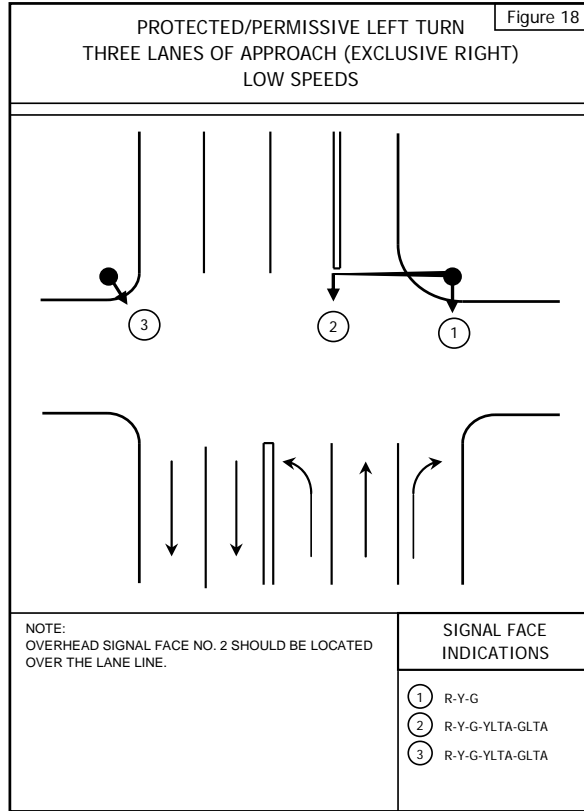
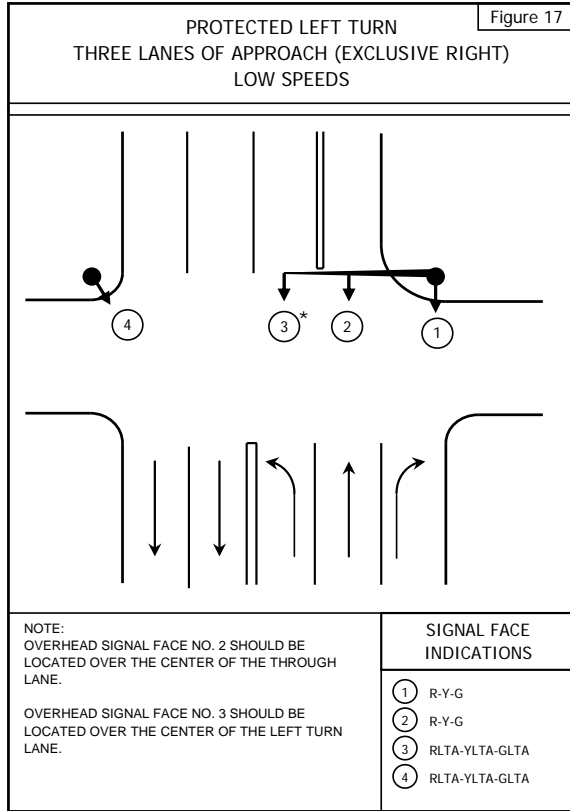
* ensure that opposing left turn heads do not block each other

CHAPTER 3. HEAD PLACEMENT CHARTS



* ensure that opposing left turn heads do not block each other

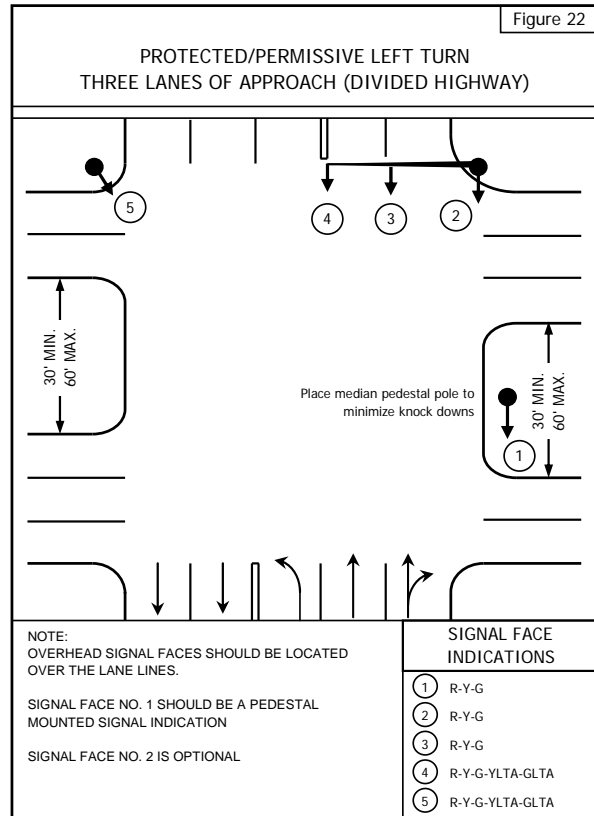
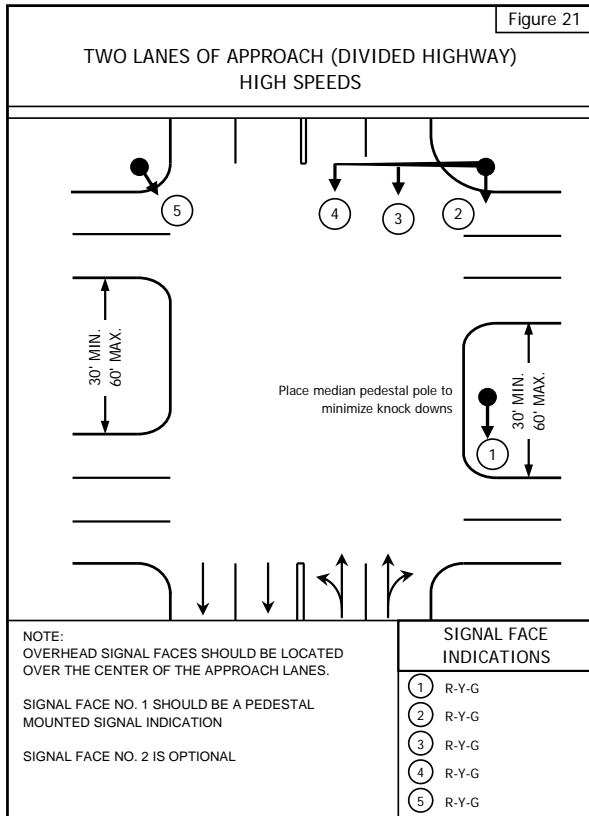
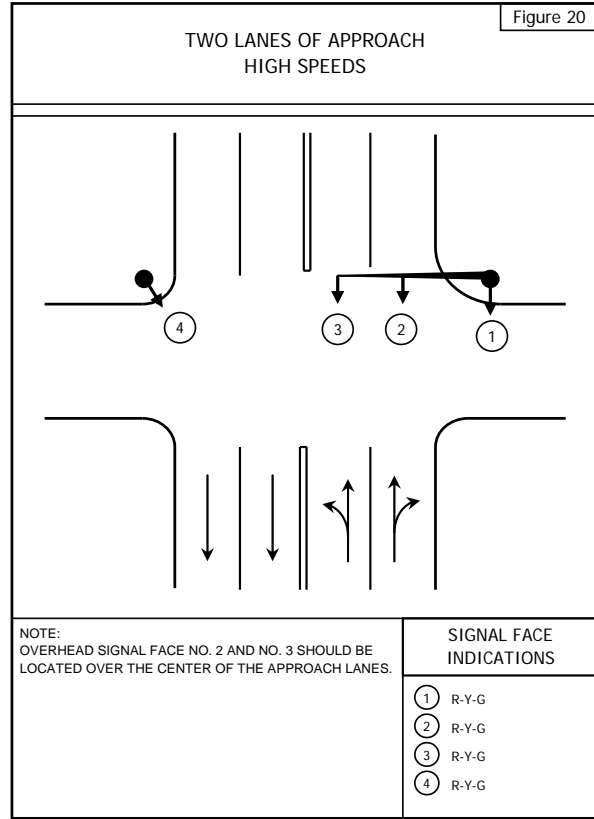
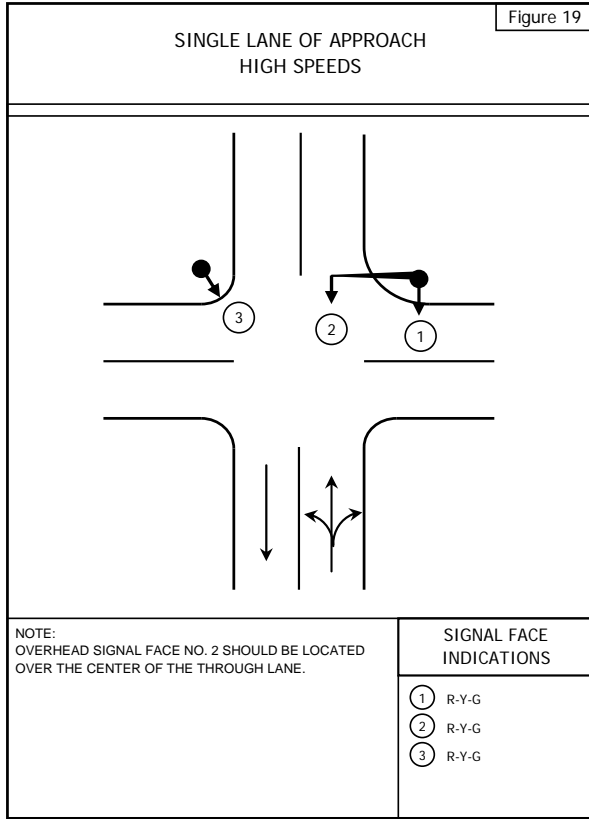
CHAPTER 3. HEAD PLACEMENT CHARTS



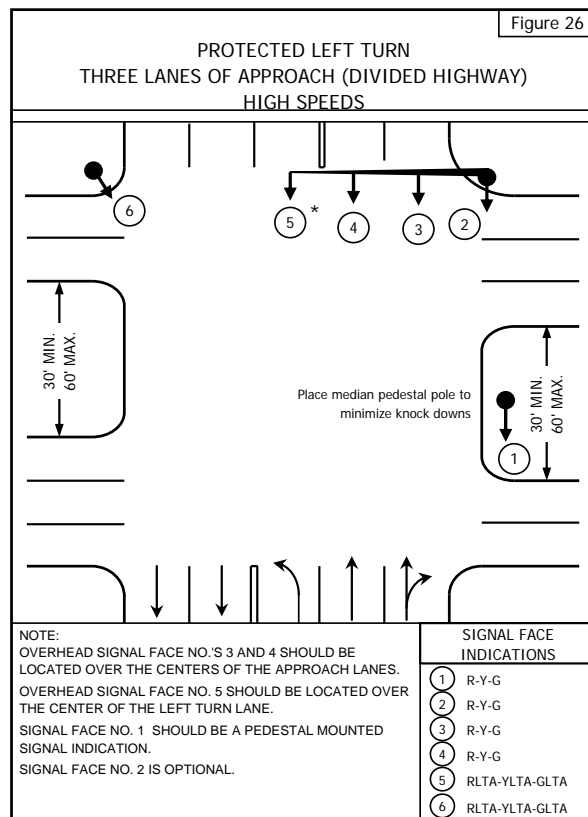
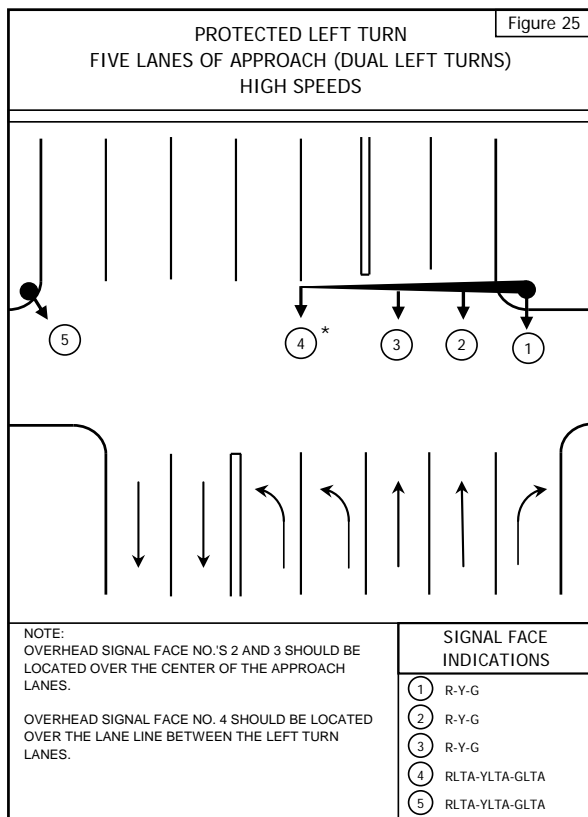
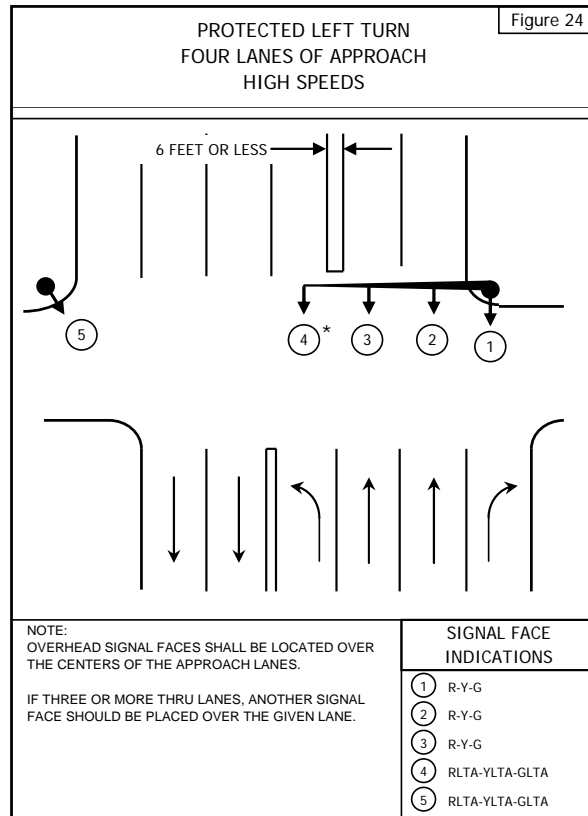
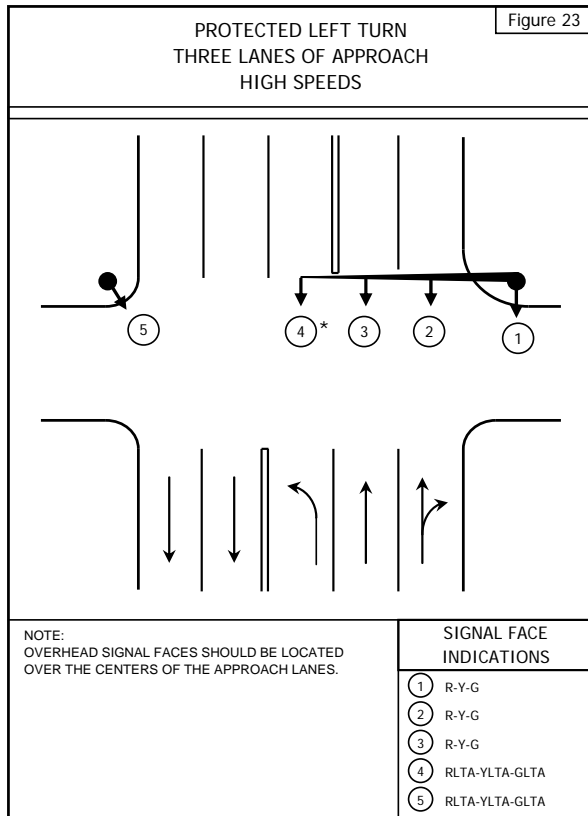
* ensure that opposing left turn heads do not block each other

CHAPTER 3. HEAD PLACEMENT CHARTS

3.2 HIGH SPEED CHARTS

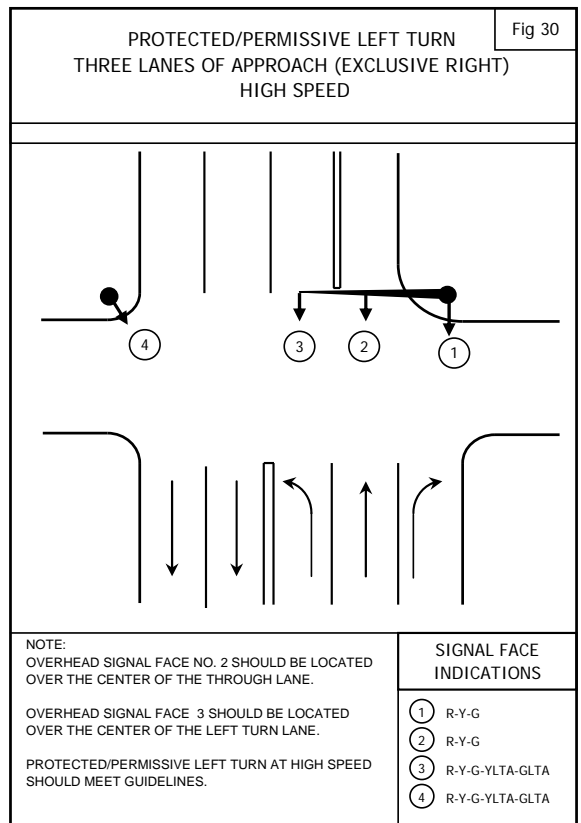
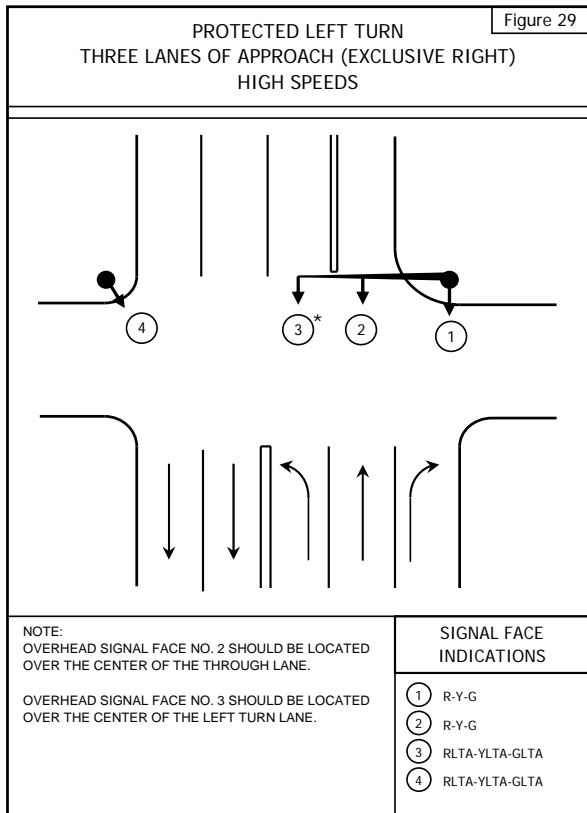
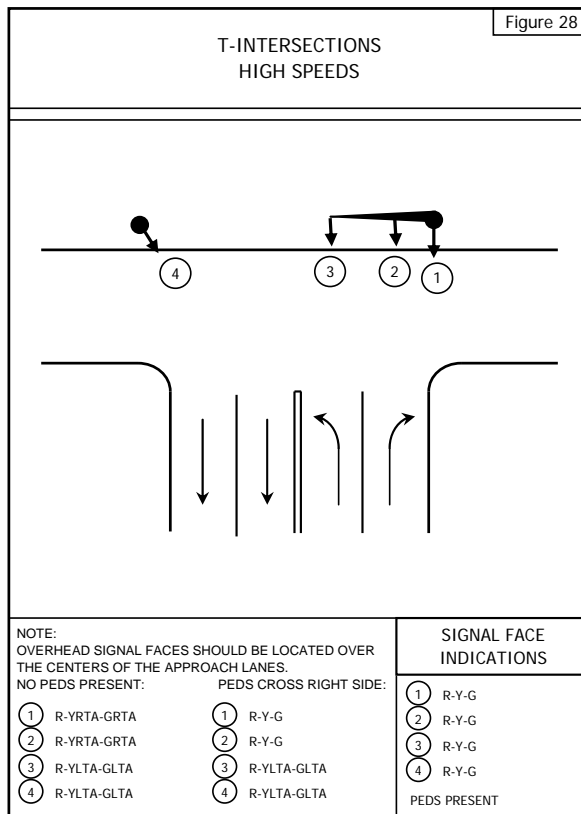
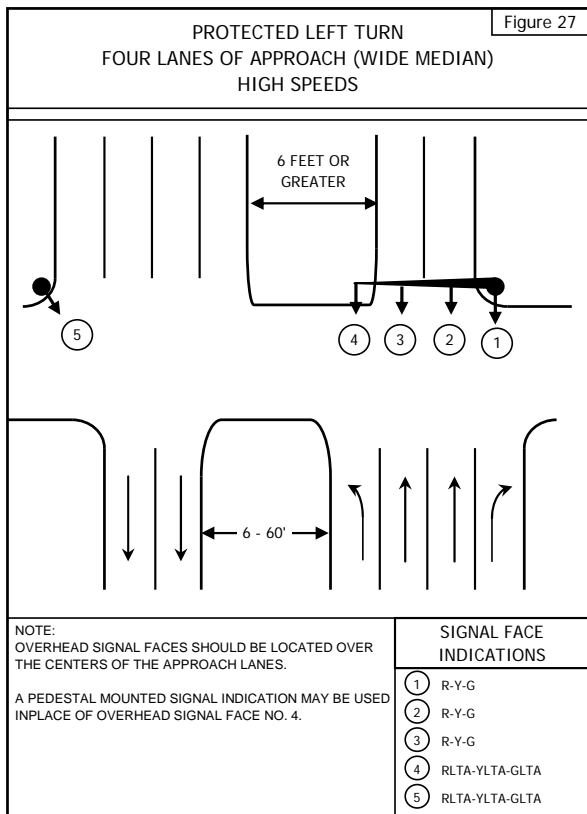


CHAPTER 3. HEAD PLACEMENT CHARTS



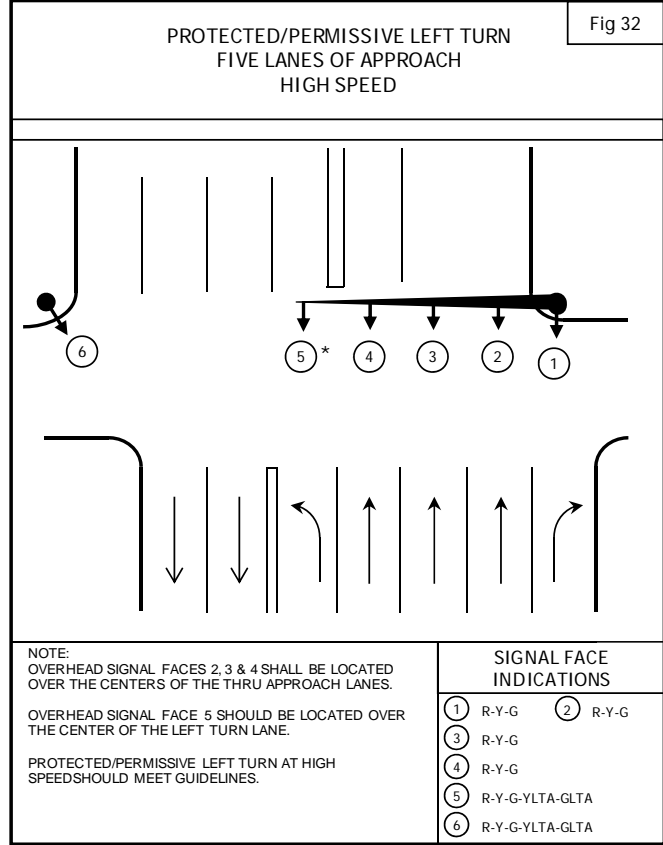
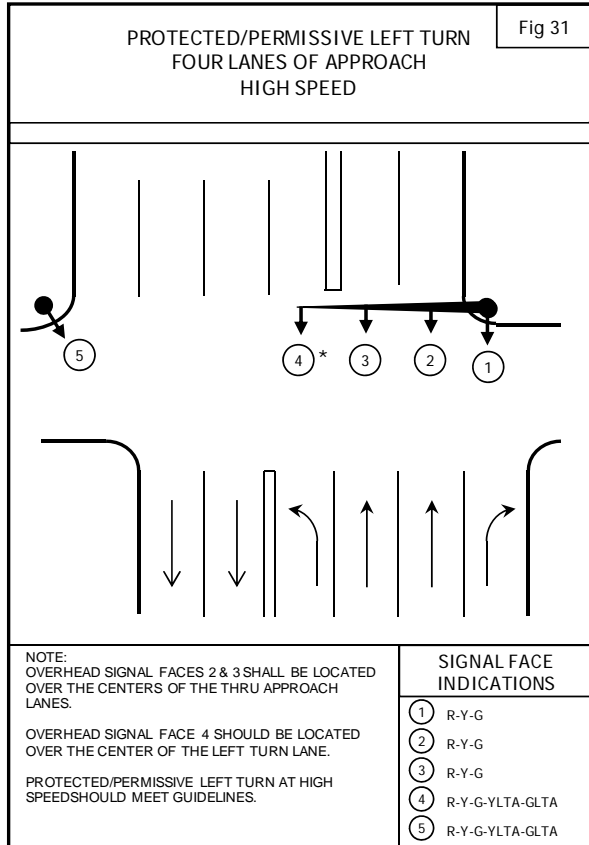
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CHAPTER 3. HEAD PLACEMENT CHARTS



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CHAPTER 3. HEAD PLACEMENT CHARTS**3.3 FLASHING YELLOW ARROW CHARTS****3.3.1 Flashing Yellow Arrow Notes**

In December of 2009, the FHWA released an updated Federal Manual on Uniform Traffic Control Devices (MUTCD). This version of the MUTCD includes language on the use of the flashing yellow arrow for permitted left turns. The federal MUTCD states:

“Vehicular traffic, on an approach to an intersection, facing a flashing YELLOW ARROW signal indication, displayed alone or in combination with another signal indication, is permitted to cautiously enter the intersection only to make the movement indicated by such arrow, or other such movement as is permitted by other signal indications displayed at the same time.

Such vehicular traffic, including vehicles turning right or left or making a U-turn, shall yield the right-of-way to:

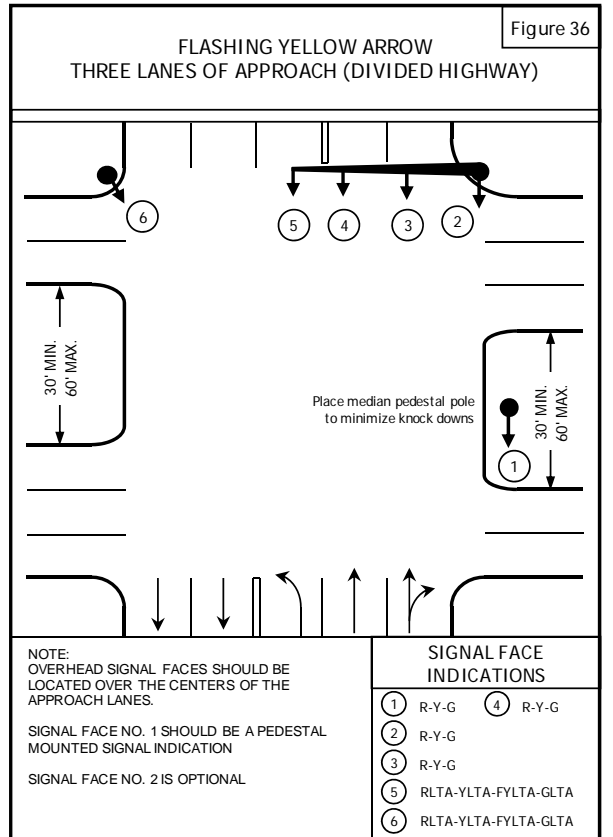
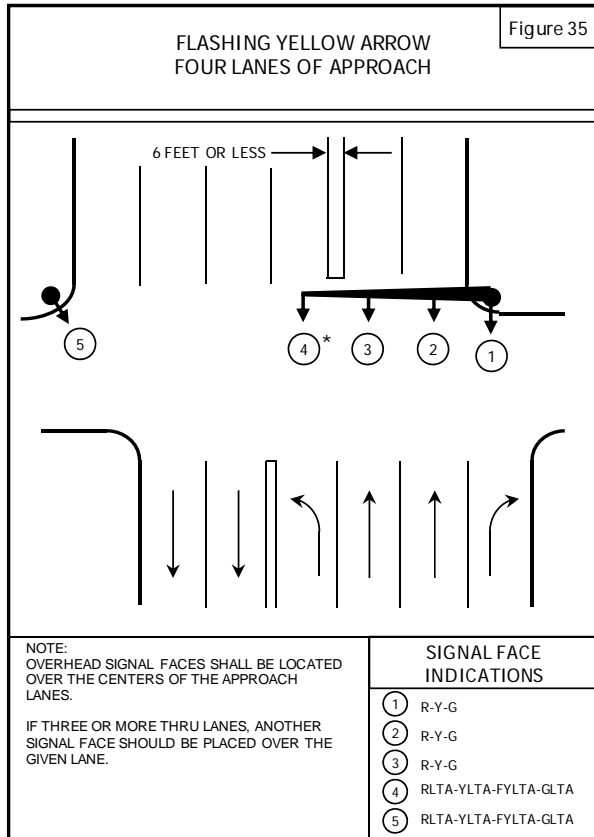
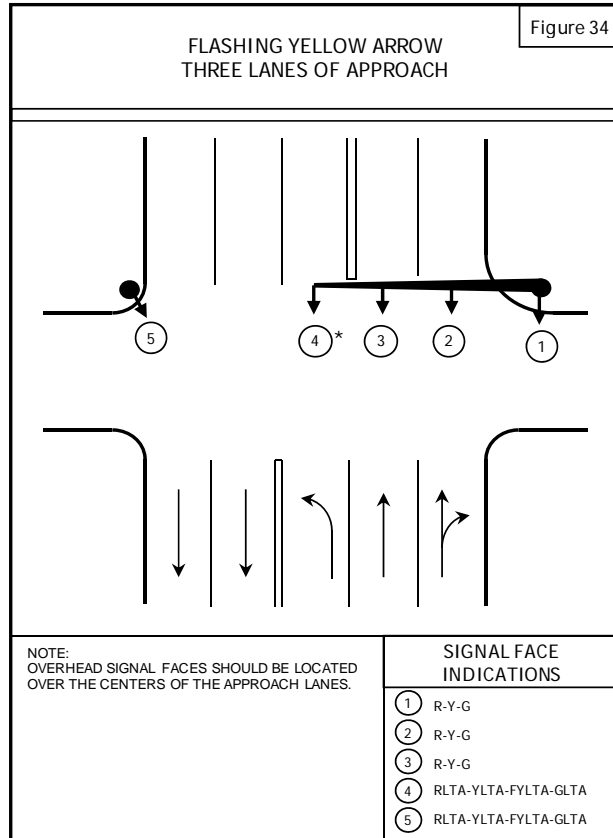
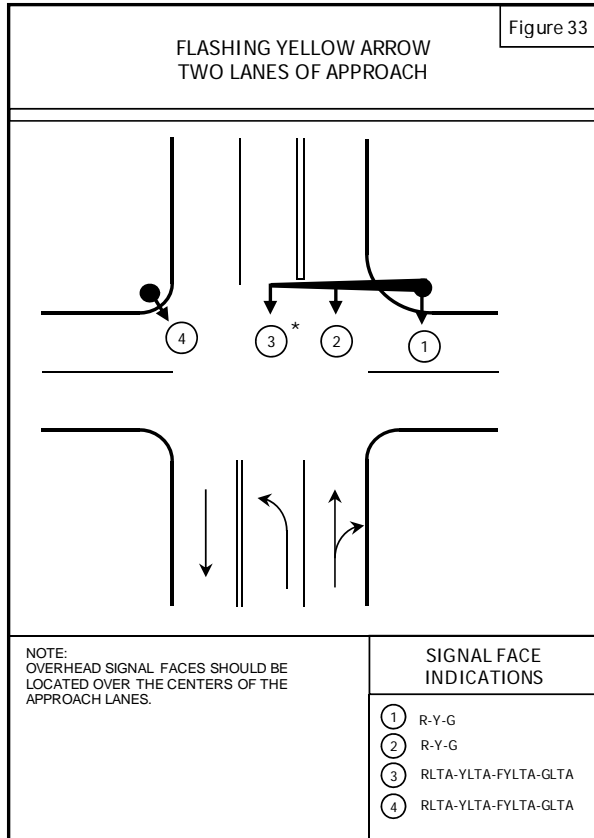
- (a) Pedestrians lawfully within an associated crosswalk, and
- (b) Other vehicles lawfully within the intersection.

In addition, vehicular traffic turning left or making a U-turn to the left shall yield the right-of-way to other vehicles approaching from the opposite direction so closely as to constitute an immediate hazard during the time when such turning vehicle is moving across or within the intersection.”

The FYA does allow flexibility in the operation at the signal. If there is an exclusive left turn lane and a left turn phase, consider the use of the FYA.

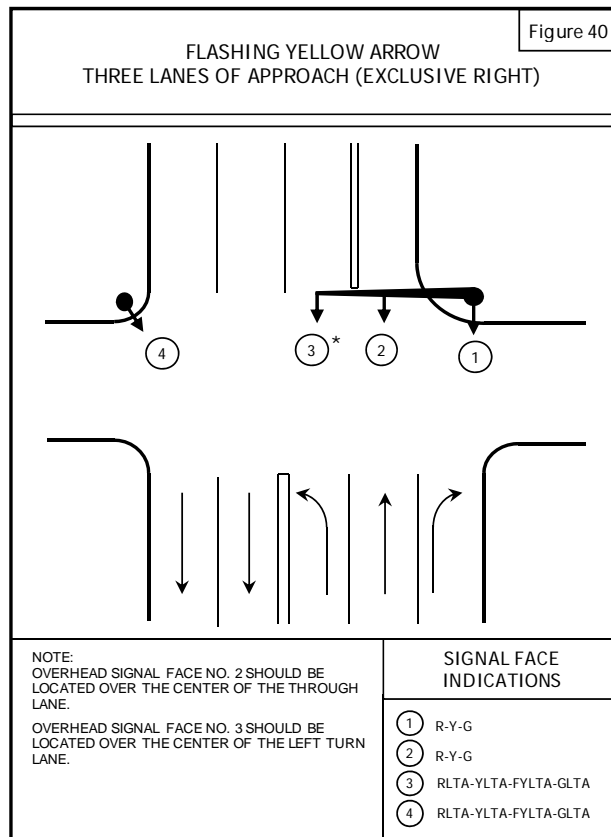
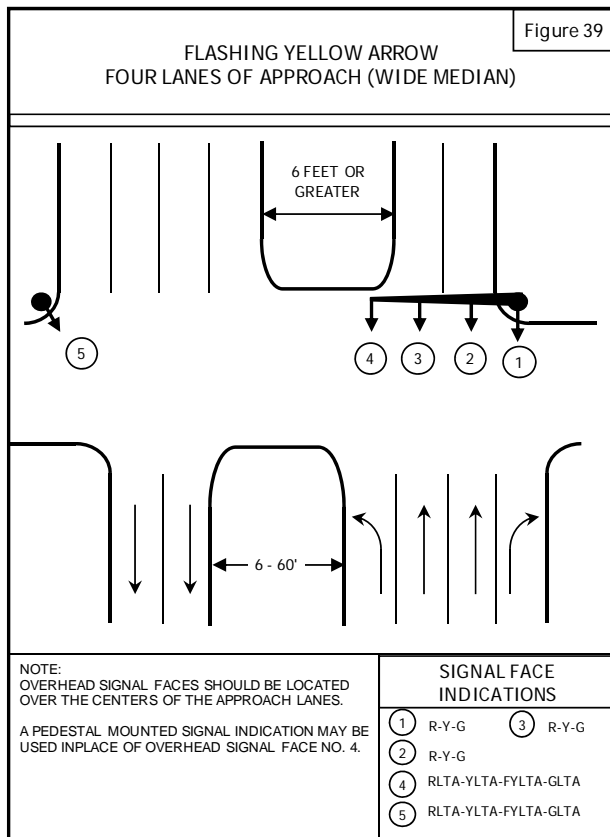
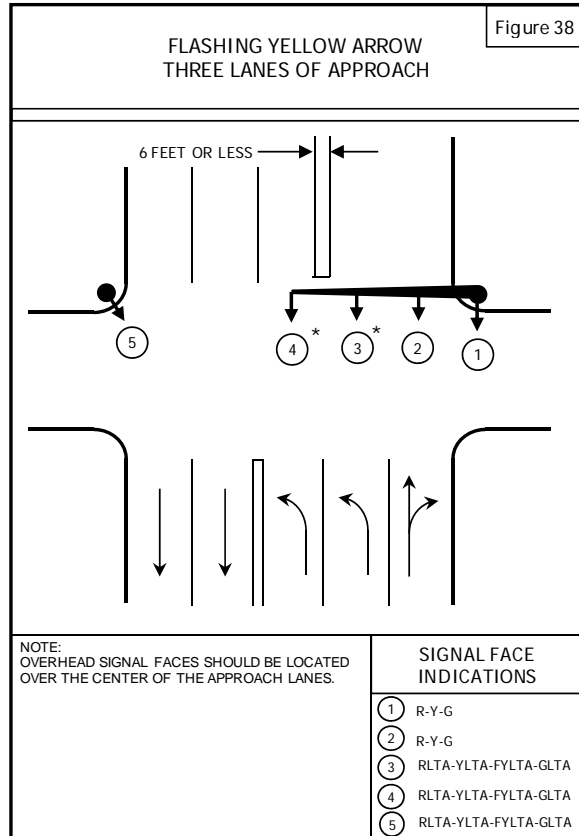
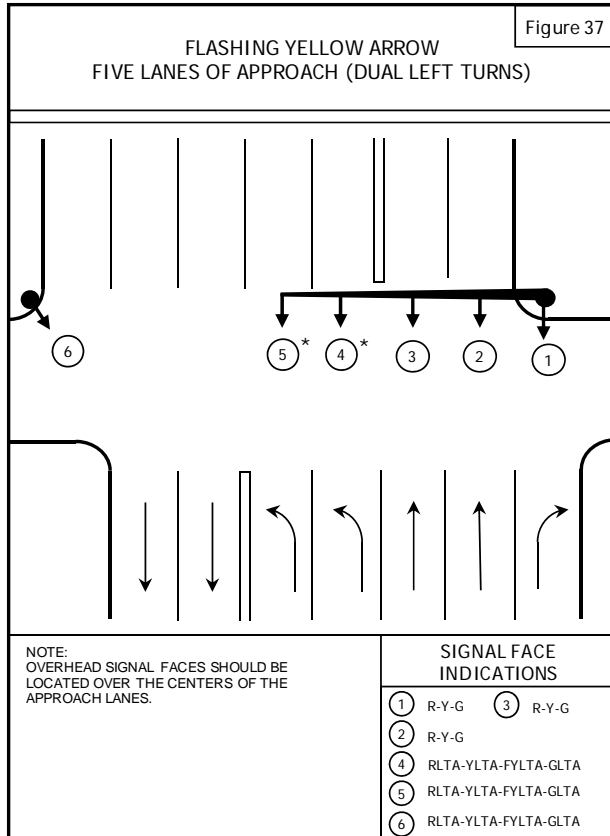
Mn/DOT encourages the use of FYA whenever appropriate.

CHAPTER 3. HEAD PLACEMENT CHARTS



* ensure that opposing left turn heads do not block each other

CHAPTER 3. HEAD PLACEMENT CHARTS

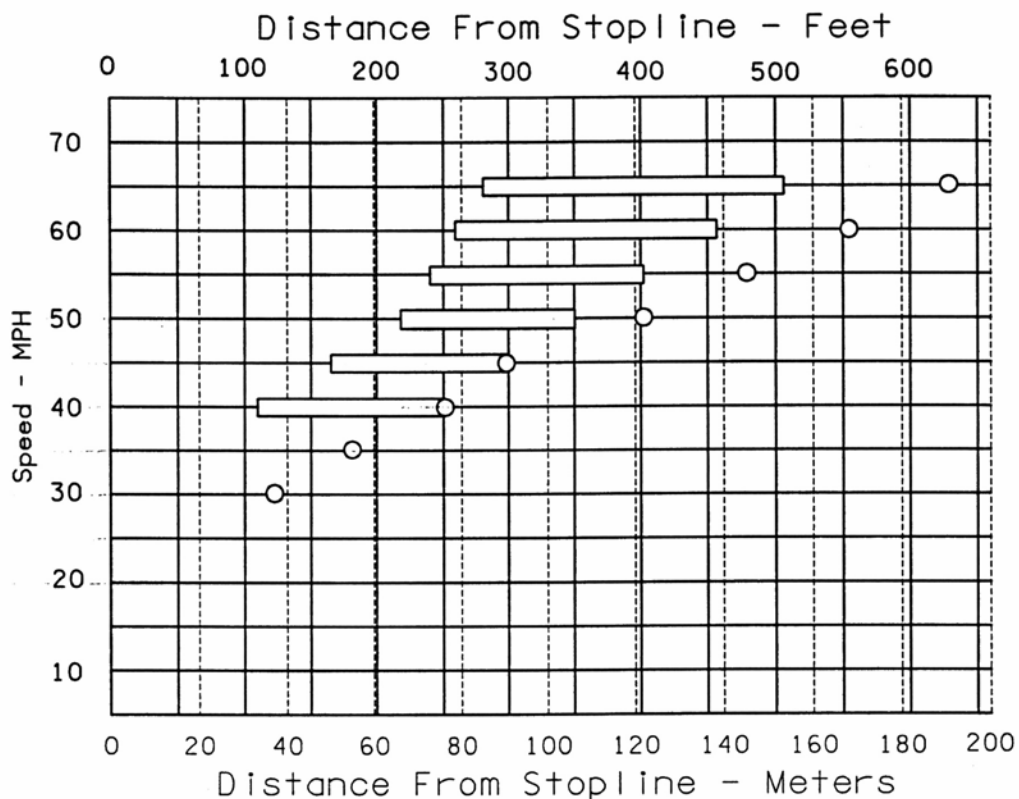


* ensure that opposing left turn heads do not block each other

CHAPTER 4. DETECTION

4.2 DETECTOR CHARTS

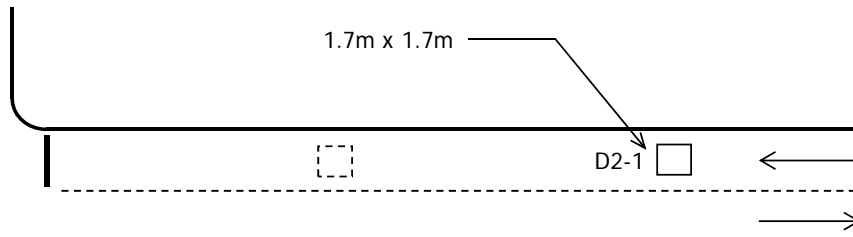
DETECTOR PLACEMENT CHART DECISION ZONES



- DETECTOR PLACEMENT
- DECISION ZONE

NOTE: Grades and other factors may require adjustment from normal placement.
 Detector spacing outside the limits shown may require additional detectors.

LOOP DETECTOR PLACEMENT MAJOR APPROACH



SPEED	LOCATION	OPTIONAL 2	FUNCTION
30	37m (120')		1
35	55m (180')		1
40	76m (250')		1
45	92m (300')	46m (150')	1
50	122m (400')	61m (200')	1
55	145m (475')	75m (240')	1
60 *	168m (550')	84m (275')	1
65 *	191m (625')	96m (315')	1

LOCATION = DISTANCE FROM STOP BAR TO LOOP DETECTOR

* ONLY APPLY TO DIVIDED 4-LANE ROADWAY

LOOP DETECTOR FUNCTIONS

1 = CALL AND EXTEND

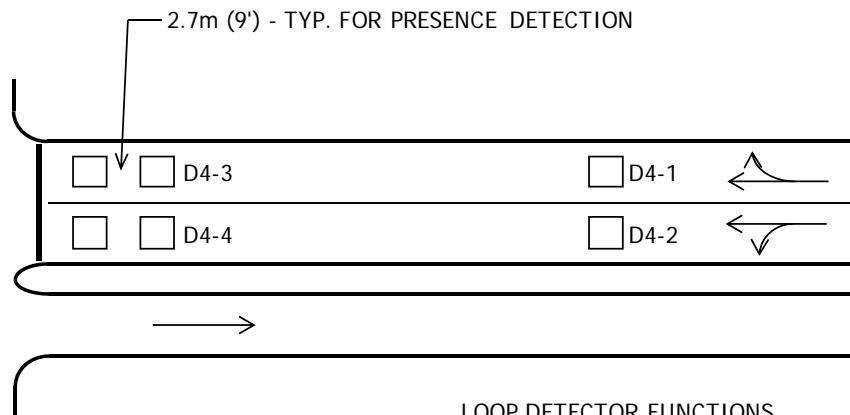
NOTES:

- 1) THE LOOP DETECTOR FUNCTION IS CALL AND EXTEND.
- 2) ONE LOOP FOR EACH APPROACH LANE. AN EFFORT TO EXTEND TURN LANES BEYOND DETECTOR LOCATIONS WILL ENHANCE OPERATIONS EFFICIENCY.
- 3) IF USING MID-POINT DETECTORS, ENSURE THE LEFT AND RIGHT TURN POCKETS BEGIN
- 4) CONTROLLER PHASE SHALL BE ON VEHICLE RECALL.
- 5) CONTROLLER PHASE DENSITY FUNCTION (ADDED INITIAL GREEN) SHALL BE USED.
- 6) OPTIONAL 2 POINT SPACING MAY BE USED FOR 2 LANE ROADWAY WITH SPEED LIMITS OF 45
- 7) OPTIONAL STOP LINE DETECTION MAY BE CONSIDERED FOR SHORTENED MINIMUM GREEN

FIGURE 1

LOOP DETECTOR PLACEMENT

MINOR APPROACH



LOOP DETECTOR FUNCTIONS

- 1 = CALL AND EXTEND
- 3 = EXTEND ONLY
- 7 = DELAY CALL - IMMEDIATE EXTEND
- 8 = STOP BAR
- 9 = STOP BAR WITH DELAY CALL

LOCATION = DISTANCE FROM STOP BAR TO LOOP DETECTOR

SPEED	FRONT LOOP	BACK LOOP
30	1.5 & 6m (5' & 20')	37m (120')
35	1.5 & 6m (5' & 20')	55m (180')
40	1.5 & 6m (5' & 20')	76m (250')
45	1.5 & 6m (5' & 20')	92m (300')
50	1.5 & 6m (5' & 20')	122m (400')
55	1.5 & 6m (5' & 20')	145m (475')

NUMBER	FUNCTION	SIZE
D4-1	3	1.7 x 1.7m (6' X 6')
D4-2	1	1.7 x 1.7m (6' X 6')
D4-3	7 OR 9	2 - 1.7 x 1.7m (6' X 6')
D4-4	1 OR 8	2 - 1.7 x 1.7m (6' X 6')

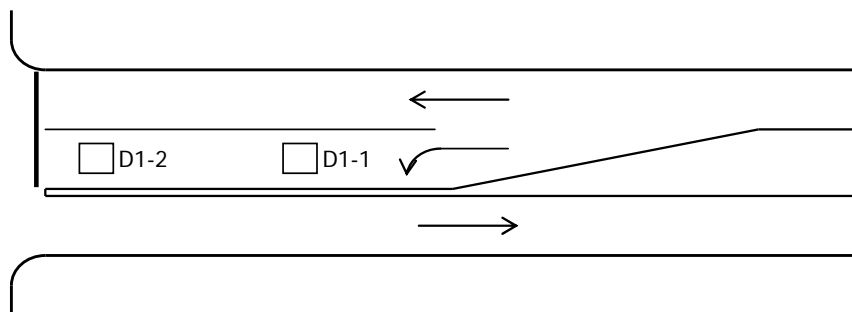
NOTES:

- 1) THE ADDED INITIAL DENSITY FUNCTION IS NOT NECESSARY BECAUSE OF FRONT DETECTORS. THE GAP REDUCTION DENSITY FUNCTION MAY BE CONSIDERED.
- 2) CONTROLLER PHASE AND DETECTOR FUNCTION SHALL BE NON-LOCK MEMORY WITH NO
- 3) PROVIDE GOOD COVERAGE FOR FRONT DETECTION FOR VARIABLE STOPPING LOCATIONS. USE
- 4) IF USING NMC LOOP, MAY COMBINE DUAL LOOPS.
- 5) ADVANCED DETECTION IS OPTIONAL.
- 6) USED WITH PRESENCE DETECTION.

FIGURE 2

LOOP DETECTOR PLACEMENT

PROTECTED LEFT TURN LOCK OPERATION - RAISED MEDIAN



LOCATION = DISTANCE FROM STOP BAR TO LOOP DETECTOR

LOOP DETECTOR FUNCTIONS

1 = CALL AND EXTEND

FRONT LOOP LOCATION	BACK LOOP LOCATION
3m (10')	12m (40')

NUMBER	FUNCTION	SIZE
D1-1	1	1.7 x 1.7m (6' X 6')
D1-2	1	1.7 x 1.7m (6' X 6')

NOTES:

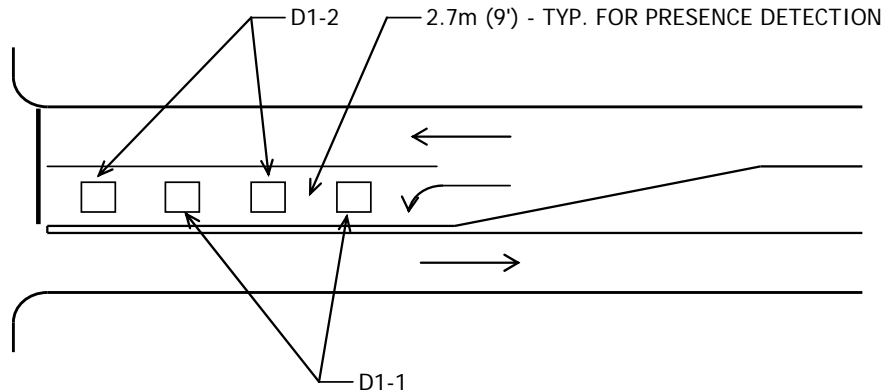
- 1) NO DENSITY FUNCTIONS ARE USED.
- 2) THE DESIGN SPEED IS 25 MPH.
- 3) EACH NUMBERED LOOP DETECTOR SHALL HAVE SEPARATE LEAD-IN CABLE AND SEPARATE AMPLIFIER.
- 4) LOCKING MEMORY SHALL BE USED BY PHASE OR DETECTION FUNCTION. NO CONTROLLER RECALL.

FIGURE 3

LOOP DETECTOR PLACEMENT

PROTECTED LEFT TURN

NON LOCK OPERATION - PAINTED & NON-RAISED MEDIAN



LOOP DETECTOR FUNCTIONS

1 = CALL AND EXTEND

NUMBER	FUNCTION	SIZE	LOCATION
D1-1	1	2 - 1.7 x 1.7m (6' X 6')	6m (20') & 15m (50')
D1-2	1	2 - 1.7 x 1.7m (6' X 6')	1.5m (5') & 11m (35')

LOCATION = DISTANCE FROM STOP BAR TO LOOP DETECTOR

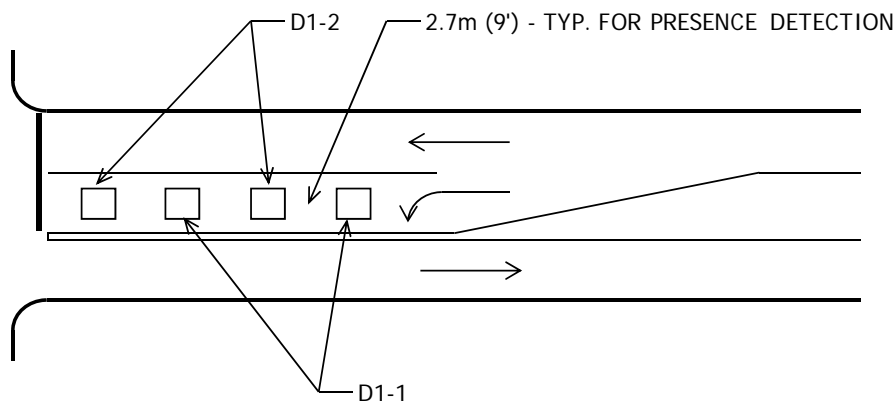
NOTES:

- 1) **USE IN LOCATIONS WHERE VEHICLES PUT IN FALSE CALLS DUE TO CROSSING OVER DOUBLE YELLOW LINES.**
- 2) NO DENSITY FUNCTIONS ARE USED.
- 3) THE DESIGN SPEED IS 25 MPH.
- 4) EACH NUMBERED LOOP DETECTOR SHALL HAVE SEPARATE LEAD-IN CABLE AND SEPARATE AMPLIFIER.
- 5) IF LOOPS ARE USED FOR COUNTING, ONE LOOP ON D1-1, THREE LOOPS ON D1-2
- 6) IF USING NMC, MAY COMBINE DUALS AS LARGER LOOPS.
- 7) THE CONTROLLER PHASE AND DETECTION FUNCTIONS SHALL BE ON NON-LOCK WITH NO RECALL.

FIGURE 4

LOOP DETECTOR PLACEMENT

PROTECTED/PERMISSIVE AND FLASHING YELLOW LEFT TURN SEPARATE LEFT TURN LANE



LOOP DETECTOR FUNCTIONS

1 = CALL AND EXTEND

NUMBER	FUNCTION	SIZE	LOCATION
D1-1	1	2 - 1.7 x 1.7m (6' X 6')	6m (20') & 15m (50')
D1-2	1	2 - 1.7 x 1.7m (6' X 6')	1.5m (5') & 11m (35')

LOCATION = DISTANCE FROM STOP BAR TO LOOP DETECTOR

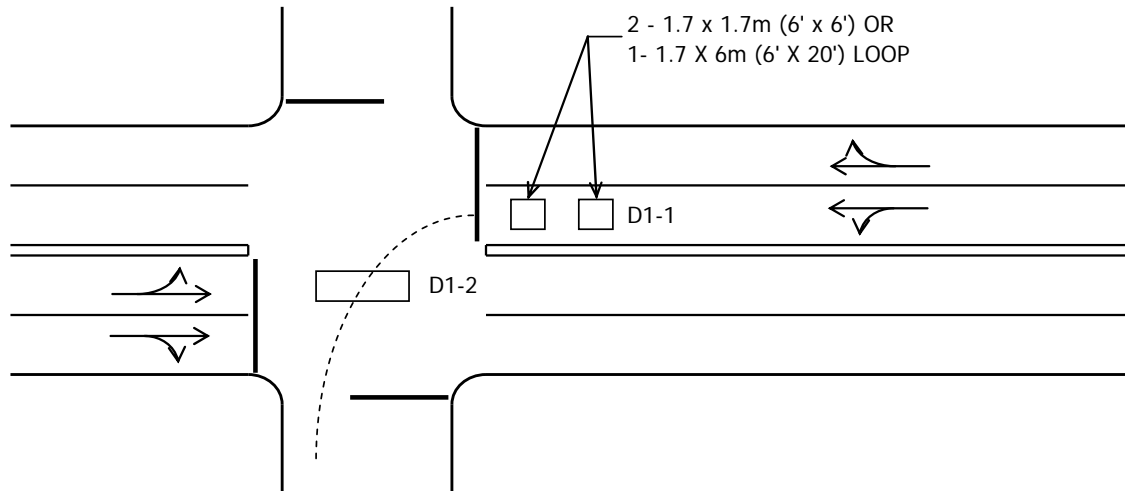
NOTES:

- 1) CONTROLLER PHASE AND DETECTOR FUNCTION SHALL BE NON-LOCK MEMORY WITH NO RECALL.
- 2) USE BACK UP PROTECTION TO PREVENT LEFT TURN TRAP IF THERE ARE OPPOSING LEFT TURNS.
- 3) DESIGN SPEED IS 25 MPH.
- 4) EACH NUMBERED LOOP DETECTOR SHALL HAVE A SEPARATE LEAD-IN CABLE AND SEPARATE AMPLIFIER.
- 5) IF USING NMC LOOPS, A SINGLE LARGER LOOP CAN REPLACE THE DUALS.
- 6) DETECTOR CROSS SWITCHING MAY BE USED.
- 7) USE THIS FIGURE IF INSTALLING A FLASHING YELLOW ARROW (FYA).

FIGURE 5

LOOP DETECTOR PLACEMENT

LEADING PROTECTED/PERMISSIVE LEFT TURN FROM A THROUGH LANE



LOOP DETECTOR LOCATION:

D1-1 IS LOCATED 1.5m (5') FROM STOP BAR.

D1-2 IS LOCATED OPPOSING THROUGH LANE, CENTERED IN THE TURNING RADIUS OF LEFT TURNING VEHICLES.

LOOP DETECTOR FUNCTIONS

3 = EXTEND ONLY

5 = DELAY CALL ONLY

NUMBER	FUNCTION	SIZE
D1-1	5	2 - 1.7 x 1.7m (6' X 6')
D1-2	3	1.7 x 6m (6' X 20')

NOTES:

- 1) LOOP D1-1 SHALL HAVE A 1 - 2 SECOND DELAY, 2 SECOND STRETCH (EXT.), AND IS ONLY ACTIVE DURING PHASE RED.
- 2) LOOP D1-2 WILL ONLY EXTEND IT'S OWN PHASE (GREEN ARROW).
- 3) USE BACK UP PROTECTION TO PREVENT LEFT TURN TRAP IF THERE ARE OPPOSING LEFT TURNS.
- 4) CONTROLLER PHASE DENSITY FUNCTIONS SHALL NOT BE USED.
- 5) CONTROLLER PHASE AND DETECTOR FUNCTION SHALL BE ON NON-LOCK MEMORY.
- 6) THE DESIGN SPEED IS 20 MPH.
- 7) IF NO OPPOSING LEFT TURN, NOTE 3 IS NOT NECESSARY.

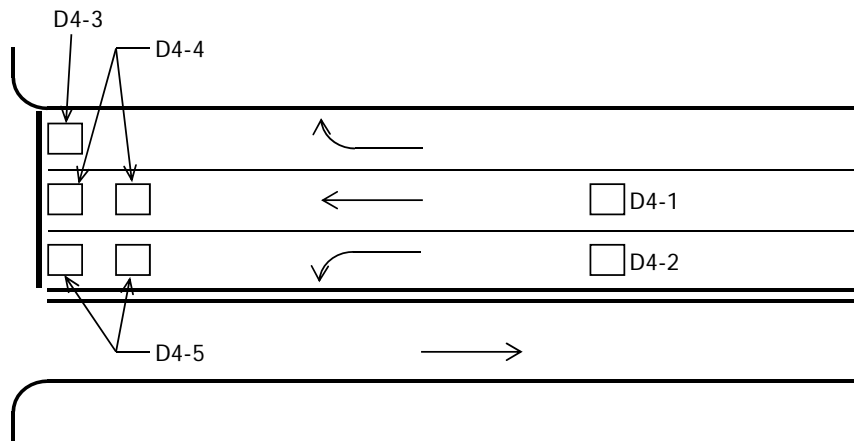
FIGURE 6

CHAPTER 4. DETECTION

LOOP DETECTOR PLACEMENT

MINOR APPROACH

WITH RIGHT TURN LANE (RTOR ALLOWED)



LOCATION = DISTANCE FROM STOP BAR TO LOOP DETECTOR

SPEED	LOCATION
30	37m (120')
35	55m (180')
40	76m (250')

LOOP DETECTOR FUNCTIONS

1 = CALL AND EXTEND
7 = DELAY CALL - IMMEDIATE EXTEND

NUMBER	FUNCTIO	SIZE
D4-1	1	1.7 x 1.7m (6' X 6')
D4-2	1	1.7 x 1.7m (6' X 6')
D4-3	7	1.7 x 1.7m (6' X 6')
D4-4	1	2 - 1.7 x 1.7m (6' X 6')
D4-5	1	2 - 1.7 x 1.7m (6' X 6')

NOTES:

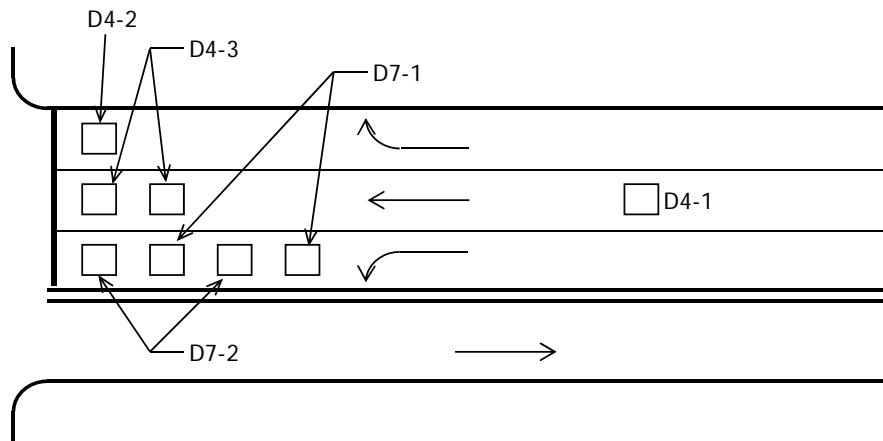
- 1) CONTROLLER PHASE CAN OPERATE IN NON-LOCKING MODE.
- 2) DETECTOR D4-3 COULD BE LARGER (6' X 10', 6' X 12', ETC.) TO ACCOUNT FOR LARGER RIGHT

FIGURE 7

CHAPTER 4. DETECTION

LOOP DETECTOR PLACEMENT

MINOR APPROACH PROTECTED/PERMISSIVE LEFT 1 THROUGH LANE & RIGHT TURN LANE (RTOR ALLOWED)



LOCATION = DISTANCE FROM STOP BAR TO LOOP DETECTOR

LOOP DETECTOR FUNCTIONS

1 = CALL AND EXTEND
7 = DELAY CALL - IMMEDIATE EXTEND

SPEED	D4-1 LOCATION
30	37m (120')
35	55m (180')
40	76m (250')

NUMBER	FUNCTION	SIZE	LOCATION
D4-1	1	1.7 x 1.7m (6' X 6')	SEE LEFT
D4-2	7	1.7 x 1.7m (6' X 6')	1.5m (5')
D4-3	1	2 - 1.7 x 1.7m (6' X 6')	1.5 & 6m (5' & 20')
D7-1	1	2 - 1.7 x 1.7m (6' X 6')	6m (20') & 15m (50')
D7-2	1	2 - 1.7 x 1.7m (6' X 6')	1.5m (5') & 11m (35')

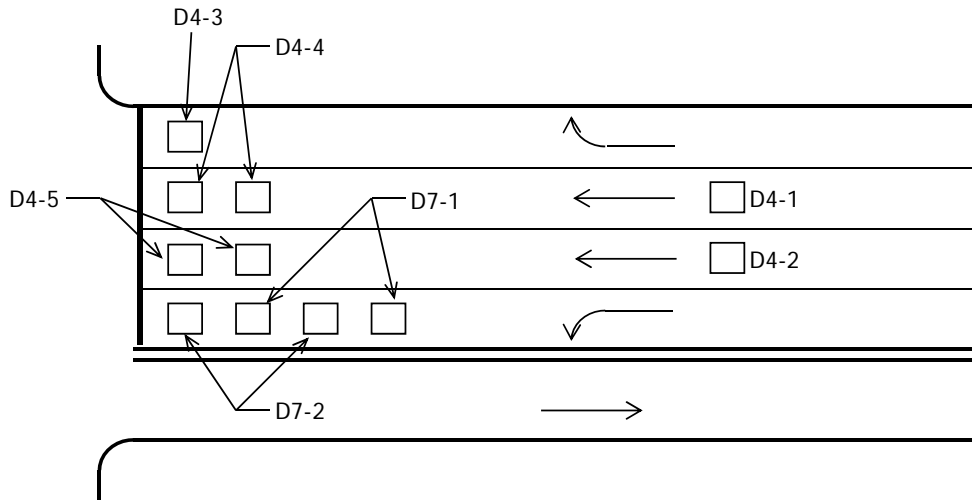
NOTES:

- 1) CONTROLLER PHASE CAN OPERATE IN NON-LOCKING MODE.
- 2) THE LEFT TURN LOOPS WILL CROSS SWITCH WITH THE THROUGH PHASE.
- 3) SEE FIGURE 5 FOR ADDITIONAL NOTES ON PROTECTED/PERMISSIVE OPERATION.
- 4) DETECTOR D4-2 COULD BE LARGER (6' X 10', 6' X 12', ETC.) TO ACCOUNT FOR LARGER RIGHT

FIGURE 8

LOOP DETECTOR PLACEMENT

MINOR APPROACH PROTECTED/PERMISSIVE LEFT 2 THROUGH LANES & RIGHT TURN LANE (RTOR ALLOWED)



LOCATION = DISTANCE FROM STOP BAR TO LOOP DETECTOR

LOOP DETECTOR FUNCTIONS

1 = CALL AND EXTEND
7 = DELAY CALL - IMMEDIATE EXTEND

SPEED	D4-1 LOCATION
30	37m (120')
35	55m (180')
40	76m (250')

NUMBER	FUNCTION	SIZE	LOCATION
D4-1	1	1.7 x 1.7m (6' X 6')	SEE LEFT
D4-2	1	1.7 x 1.7m (6' X 6')	SEE LEFT
D4-3	7	1.7 x 1.7m (6' X 6')	1.5m (5')
D4-4	1	2 - 1.7 x 1.7m (6' X 6')	1.5 & 6m (5' & 20')
D4-5	1	2 - 1.7 x 1.7m (6' X 6')	1.5 & 6m (5' & 20')
D7-1	1	2 - 1.7 x 1.7m (6' X 6')	6m (20') & 15m (50')
D7-2	1	2 - 1.7 x 1.7m (6' X 6')	1.5m (5') & 11m (35')

NOTES:

- 1) CONTROLLER PHASE CAN OPERATE IN NON-LOCKING MODE.
- 2) THE LEFT TURN LOOPS WILL CROSS SWITCH WITH THE THROUGH PHASE.
- 3) SEE FIGURE 5 FOR ADDITIONAL NOTES ON PROTECTED/PERMISSIVE OPERATION.
- 4) DETECTOR D4-3 COULD BE LARGER (6' X 10', 6' X 12', ETC.) TO ACCOUNT FOR LARGER RIGHT

FIGURE 9