TRAFFIC SIGNAL EQUIPMENT

In designing a traffic control signal it is important that the signal indications are clearly visible to motorists and pedestrians for which they are intended and that the signal poles are located to minimize the impact on utilities. It is also important that the resultant location of poles, cabinet and any other appurtenances do not block visibility between pedestrians and approaching vehicles.

A **principal signal head** should normally be located in line with, or to the right of, the far-side centerline of an undivided two-way road for each direction of travel. Secondary signal heads may then be located according to the most feasible span arrangement. However, signal heads for any one approach must be mounted no less than 2.5 m (8') and no more than 6 m (20') apart, measured horizontally and perpendicular to the line of approaching traffic. When a signal face is meant to control a specific lane(s), its position should make it readily visible to drivers making that movement, such as with exclusive left turn control. In addition to span wire, masts and mast arms may also be used to support signal heads. Signal head locations should be coordinated with overhead sign locations.

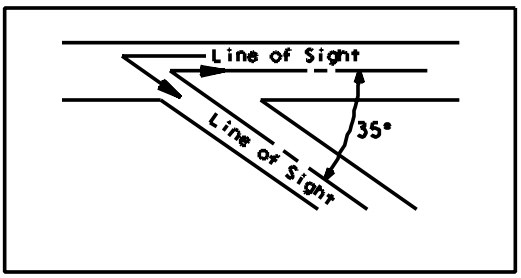
Signal head location has an effect on accident potential and traffic efficiency. Signal heads should be placed for optimum visibility during critical pedestrian vehicular movements. Head placement should not cause motorists to look up rather than in front and to the side. Pedestrians should be able to see the indications intended for their use. Studies have suggested that high-mounted signal heads located in the far-right quadrant and at, or beyond, the far curb line of the intersecting street will accomplish this.

Through movement signal indications should be located to the right of opposing through traffic lanes. An auxiliary indication may be located left of the centerline if the intersection geometry restricts visibility to the principle signal face. Far side signal faces are preferred. It is desirable that left turn signal faces be visible up to the point where the turn is executed. Span wire signal faces should be combined to provide the least number of signal heads at any intersection to reduce clutter.

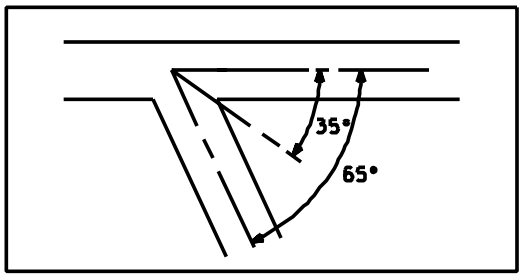
Signal faces should be readily identifiable with the approach to which they apply. When streets intersect at flat angles, signal faces should not be combined into signal heads if conflicting signal faces are readily visible. The signal faces in these situations should be such that it results in spacing that clearly indicates which head belongs to each approach. Tunnel visors and/or louvers can usually complete the screening. If louvers are required, the characteristics of both straight vane louvers and cut-off louvers should be considered. Where there is a separately controlled left-turn lane with a separate turn signal that should be shielded, hooded, or louvered so that the signal combination is not confusing to approaching drivers, cut-off louvers should normally be used. **The guidelines on the following page may be used to determine screening types.**

Measure the angle between lines of sight for approaching vehicles.

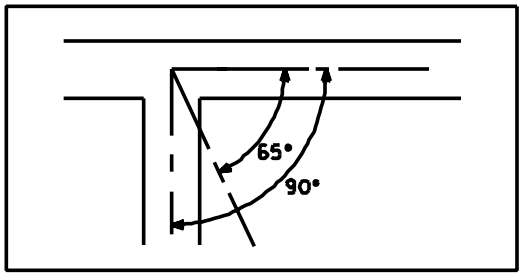
I. Use tunnel visors with louvers on both approaches if angle is less than 35°.



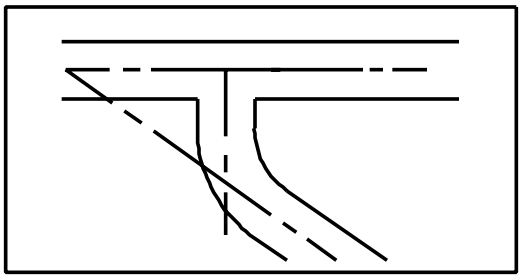
II. Use tunnel visors on both approaches if angle is between 35° and 65°



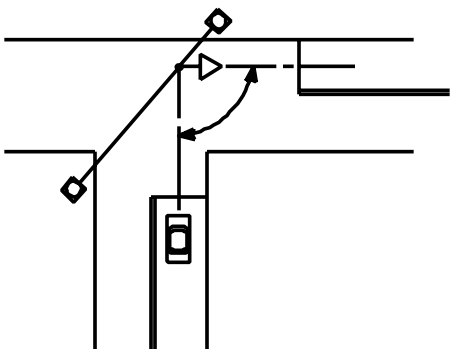
III. Use cap visors on both approaches if angle is between 65° and 90°.

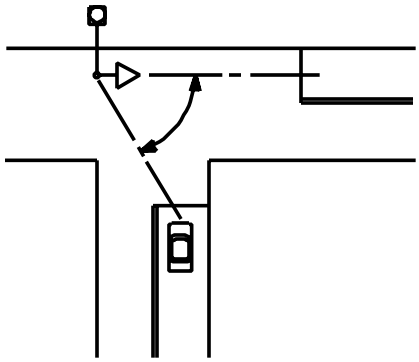


IV. Use tunnel visors with louvers or tunnel visors or cap visors on artery as noted in I, II or III.



Consider the angle between lines of sight for vehicles at the stop bars. Note the difference in angle for a diagonal span vs. far side heads. Use criteria as shown above.





All signal heads for an approach should have similar visors.

FIG15X18.DGN

Visibility limiting signals, which are **optically programmed signals** or **geometrically programmed louvers,** are also an acceptable method of screening, by restricting signal visibility to the traffic in a specific lane. Unlike conventional louvers and visors, optically programmed heads do not reduce the light intensity of the display. Optically directed lenses provide an optical cut-off of the indication, both vertically and horizontally as needed. Geometrically programmed louvers provide a sharp cut off, through the use of a series of louvers, but do not effect visibility to the indication which can sometimes occur from the slats in conventional louvers. Satisfactory operation of both types of visibility limiting signals depends on correct alignment. Therefore, the signal face should usually be mounted on a rigid support rather than a span wire. With the use of either an optically programmed signal or geometrically programmed louvers, a sight triangle must be shown on the signal design plan to indicate the cone of visibility to the indication.

Signal heads may be mounted horizontally to provide greater visibility through underpasses. Horizontally mounted signal heads may be suspended at lower than normal signal mounting heights when the obstruction sets the minimum vertical clearance for the roadway.

In some circumstances, where either vertical or horizontal sight line to the overhead signals is restrictive, pedestal mounted signals can provide added visibility. The pedestal-mounted signals are usually provided in addition to the two overhead signals.

Signal face locations should normally be within the range of 12 m to 24 m (40 ft. to 80 ft.) from the stop line. At intersections where multi-lane cross streets or other conditions make it physically impractical, signal faces may be located up to 46 m (150 ft.) from the stop line. Where the width of the intersection requires that the nearest signal face be placed in the 24 m (80 ft.) range from the stop line, a supplemental near-side signal face may be located at or past the stop line. Refer to Page 4D-24 of the MUTCD for signal head placement. Signal face numbers and detector numbers should correspond to the appropriate phase where possible.

Stop lines must be located to facilitate movements by vehicles turning from other streets. Whenever it is important that a vehicle should stop further from an intersection than is customary, the signal faces for that approach should be located so that vehicles are kept at the proper stop position and a "Stop Here on Red" sign may be needed.

All traffic signal heads, pedestrian signal heads and pedestrian pushbuttons will be dark green.

All signal lenses, except for exclusive pedestrian indications, are circular. There are two sizes for circular lenses, 200 mm (8 in.) and 300 mm (12 in.).

300 mm (12 in.) **lenses will normally be used.**

200 mm (8 in.) lenses may be used under the following conditions:

1. For pedestrian indications when crossing on side street green. An effort should be made to pedestal or pole mount those indications for better visibility by the pedestrian.

2. Based on engineering judgment due to the geometric configuration, such as for minor private driveways or in residential or historical areas for aesthetic reasons.

3. When signals are installed at two closely spaced intersections, every reasonable effort must be made to provide simultaneous yellow indications followed by simultaneous red indications. If that cannot be reasonably accomplished, ensure that the approaching driver can distinguish the heads on the "outside" approach from those on the "inside" approach; 300 mm (12") lenses on the "outside" approach and 200 mm (8") lenses on the "inside" approach may provide this contrast.

Signal indications and pedestrian indications are usually illuminated by light emitting diode (L.E.D.) lamps. Conventional incandescent lamps consume up to 150 watts of power and require routine maintenance due to filament burn out. LED lamps are now in use to conserve energy and reduce maintenance costs. An LED is a current operated, semiconductor light source. Power requirements are considerably less than incandescent lamps. The life expectancy of an LED lamp is 45,000 hours or 10 years of operation.

A **span pole** is a pole to which span wire is attached for the purpose of supporting the signal heads. A **mast arm** is a cantilever structure that permits the overhead installation of the signal faces without overhead messenger cables and signal wiring, which is run inside the arm structure. Supports must be strong enough to sustain the signal load and tall enough to provide for minimum signal housing clearances of 4.9 m to 5.5 m (16 ft. to 18 ft.) from the road surface. Support poles are not to be designed as breakaway.

Signal support poles are considered fixed objects. When considering side slopes, signal supports are usually located closer to the roadway on downward sloping embankments than on upward sloping ground. Poles should be set behind any protective device used at an intersection. The pole should be beyond the deflection limit of the protective device. Where right-of-way will allow, the poles should be set outside the clear zone, if possible. (Refer to reference 2 - Guidelines for Highway Design, for recommended clear zone distances.) Signal supports at the side of a street with curbs shall have a horizontal clearance of not less than 0.6 m (2 ft.) from the face of a vertical curb. Where there is no curb, supports shall have a horizontal clearance of not less than 0.6 m (2 ft.) from the edge of a shoulder, within the limits of normal vertical clearance. A signal support should not obstruct a crosswalk or sidewalk.

Signals often can be spanned from a utility pole that may be at an intersection. Luminaires may be located on a combination signal pole eliminating a fixed object at the intersection. Prior approval from the utility company must be obtained if the illumination is not state-maintained.

The following should be considered in the location of signal supports or attachment to existing utility poles:

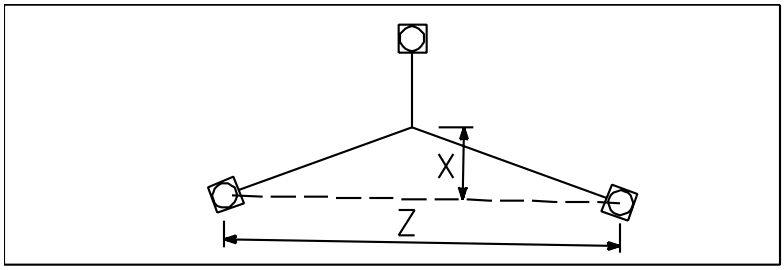
1. Locate a minimum of 3 m (10 ft.) from the nearest utility appurtenance.

2. Make sure steel span pole/mast arms do not conflict with underground or overhead utilities.

3. When attaching to utility poles, the span must be a minimum of 300 mm (12 ") from secondary lines and 1000 mm (40") from communications lines. Right-of-way must be sufficient for guying.

4. Steel span pole/mast arm calculations must reflect the information on the standard installation detail sheets.

5. When designing a Y-type span, the distance X must be at least 5% of the distance Z.



6. Refer to PUCA Regulations reference 12.

7. When designing a mast arm, it is necessary to have a roadway cross section, along the arm profile to ensure proper mounting height. For design information see the next page. For drafting information see pages 119 & 133.

SIGNING AND PAVEMENT MARKINGS

The extent of lane use signing and pavement marking should be kept to a minimum while being consistent with State Traffic Commission Regulations, the Manual on Uniform Traffic Control Devices (latest edition) and that required for safe and efficient operation at the specific location. Unusual geometric conditions, signal phasing, specific signing needs and operations peculiar to a specific location may suggest other treatments.

In general, movements that are obvious, consistent with basic motor vehicle law, and consistent with driver expectancy do not require redundant expression.

It is desirable to place signs so that they have the greatest target value for the driver. In areas with sheltered turn lanes, the "turn only" sign should be placed overhead. It is also preferable to place "No Turn On Red" signs overhead. Signs which are no larger than 24 in. x 24 in. can be span-mounted. With mast arm designs, larger signs should be considered.

When post-mounted lane-use control signs are used, one should be placed in the vicinity of the stop bar and another should be placed sufficiently in advance of the intersection so that the driver may select the appropriate lane. Supplemental, post-mounted, lane-use signs may be used with overhead lane-use signs.

Pavement marking arrows may be used to supplement the lane-use control signing. They are generally used for specific turn lanes. When used, the first arrow, closest to the intersection, should be placed 12 m (40 ft.) from the stop bar. The specific turn arrow marking will suffice, the word "Only" is not used.

Sign Face Sheeting

Type I Reflective Sheeting (examples: enclosed lens, engineering grade)
Type III Reflective Sheeting (examples: encapsulated lens, high intensity)
Bright Wide Angle Retroreflective Sheeting (example: diamond grade)

Sign Type	**Item**
Silver background side/post mounted signs (other than Stop and expressway Do Not Enter & Wrong Way signs)	Sign Face Sheet Aluminum – Type I Reflective Sheeting
Yellow, green, blue and brown backgrounds and all overhead mounted signs	Sign Face Sheet Aluminum – Type III Reflective Sheeting

Sign Type	Item
Stop signs and all associated sub-plates, expressway Do Not Enter and Wrong Way signs	Sign Face Sheet Aluminum – Bright Wide Angle Retroreflective Sheeting
Non-expressway Construction Signs	Construction Signs – Type III Reflective Sheeting
Expressway Construction Signs	Construction Signs – Bright Fluorescent Sheeting

AUXILIARY SIGNS AND SIGNALS

Auxiliary signs and signals must be considered when the visibility to the signal heads is unsatisfactory for pedestrians or vehicles. A signal should be visible to the driver of an approaching vehicle for the minimum sight distance as described in section 4D.15 of the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD). Pedestrians should be able to determine which approach (or approaches) has the right-of-way in order to make their crossing at the correct time.

"Signal Ahead" warning signs may be erected for all major street approaches to an intersection if sight distances are less than those stated in the MUTCD. Flashing lights may be installed on these signs to emphasize the message. Special warning signs may be developed to indicate driver action in adverse situations. An internally illuminated sign with the flashing message "Stop Ahead" is one possible option, however, these signs should be avoided in residential areas. In other locations side mounted fixed message "When Flashing Stop Ahead" signs with flashers are an option. Other signs may indicate the distance to a signal.

An auxiliary face may be located left of the centerline if the intersection geometry restricts visibility to the principal signal face. Dual indications should still be provided right of the centerline.

As discussed earlier in circumstances where either vertical or horizontal sight line to the overhead signals is restrictive, pedestal/post mounted signals can provide added visibility. The pedestal mounted signals are usually provided in addition to the two overhead signals.

Vehicles must sometimes be controlled at a point in advance of an intersection due to geometric situations. Examples would be an intersection preceded by a sharp break in grade, sharp horizontal curve, sight line obstruction located close to the roadway, or in advance of railroad tracks close to the intersection. The signal heads located in advance of an intersection should stop all traffic with a clearance interval provided between that point and the intersection to clear any vehicles before the customary intersectional heads display yellow and red.

MERRITT PARKWAY GUIDELINES

Green signal heads will be used for all signals installed or replaced at Parkway interchanges.

Span poles will be selected to be as unobtrusive as possible. Existing utility poles will be used for supports where feasible. Galvanized steel poles will be the standard pole when utility poles are not available and depending on the setting, either charcoal gray or dark green painted poles will be used when galvanized poles are not appropriate for the environment.

Signing and pavement marking will follow normal state practice.

FLASHING STOP AHEAD SIGNS

When a flashing "Stop Ahead" sign is needed, a dummy phase is used to provide the clearance time. If the controller phasing is sequential, include a technical note to ensure the clearance phase always follows the parent phase. If the controller phasing is quad, illustrate in the phasing diagram which phase can and cannot be skipped. In the example shown, a flashing sign is needed on only one approach (Phase 6). If Phase 6 does not terminate, the clearance phase is skipped.

"Clearance Time" should be determined by measuring the distance from 50 feet in advance of the sign to the stop line then dividing by the posted speed limit in feet per second. Engineering judgment should be considered.

Caution Notes: Pre-empt call will cause the controller to skip the clearance phase; therefore, program yellow and red clearances in the parent phase.

Sequential Phasing

NONE								FLASHING SIGN CLEARANCE PHASE					
					1 2	4 3		4 3			5 6		
NTOR		PHASE 1			PHASE 2			PHASE 3			PHASE 4		
	FLASH	GRN	CL	CL	GRN	CL	CL	GRN	CL	CL	GRN	CL	CL
1	Y				G	G	G	G	Y	R	R	R	R
2	Y				G	G	G	G	Y	R	R	R	R
3	Y				G	G	G	G	Y	R	R	R	R
4	Y				G	G	G	G	Y	R	R	R	R
5	R				R	R	R	R	R	R	G	Y	R
6	R				R	R	R	R	R	R	G	Y	R
						YIELD							
FLASHING SIGN					OFF				ON				
						CLEARANCE TIME							
MODE		OFF			MIN-RECALL			NON-LOCK			NON-LOCK		

Technical Note :
Phase 3 to always follow Phase 2.

FIG6X6.DGN

Quad Phasing

NONE					FLASHING SIGN CLEARANCE PHASE		MOVEMENT DIAGRAM					
NTOR		PHASE 1			PHASE 2			PHASE 3			PHASE 4		
	FLASH	GRN	CL	CL	GRN	CL	CL	GRN	CL	CL	GRN	CL	CL
FACE # 1	R	←	↓	R	R	R	R	R	R	R	R	R	R
FACE # 2	Y	R	R	R	G	G	G	G	Y	R	R	R	R
FACE # 3	R	R	R	R	R	R	R	R	R	R	G	Y	R
FACE # 4	R	R	R	R	R	R	R	R	R	R	G	Y	R
FACE # 5	R	R	R	R	R	R	R	R	R	R	R	R	R
FACE # 6	Y	R	R	R	R	R	R	G	Y	R	R	R	R
FLASHING SIGN		←							ON				
						← YIELD							
MODE		NON-LOCK			MAX-RECALL			NON-LOCK			NON-LOCK		

PHASE 5			PHASE 6		
GRN	CL	CL	GRN	CL	CL
R	R	R	R	R	R
R	R	R	R	R	R
R	R	R	R	R	R
R	R	R	R	R	R
←	↓	R	R	R	R
R	R	R	G	G	G
		→	OFF	← ON →	
				← YIELD	
NON-LOCK			MAX-RECALL