State of Wisconsin
Department of Transportation

Traffic Signal Design Manual

ORIGINATOR Director, Bureau of Traffic Operations	6-1-11

CHAPTER 6	Signal Infrastructure Design
SECTION 1	Permanent Signals
SUBJECT 11	Monotube Signal Arms and Pole Structures

The following is a set of guidelines related to the use and placement of monotube signal arm assemblies for traffic signals. It is to be used by Regional Traffic Engineers and consultants for the design (or design review) of a signalized intersection.

1. Monotube arm assemblies **shall** be used on any approach with two or more through lanes for reconstruction projects with a PS&E date of January 2012 or later, AND all permit projects beginning design on January 2012 or later. (State owned signals only.)

2. Monotube arm assemblies *should* be used on any approach with two or more through lanes for resurfacing, pavement replacement, and reconditioning projects (when feasible based on available right-of-way) with a PS&E date of January 2012 and later. (State owned signals only.)

3. Monotube arm assemblies *should* be used on any approach with two or more through lanes for all projects with a PS&E date (or beginning of design date for permit projects) sooner than January 2012 when feasible based on right-of-way availability and project design status at the time of this publication. (State owned signals only.)

4. If one approach of a state owned signalized intersection utilizes monotube signal arms, all remaining approaches to the intersection **shall** also use vertically mounted heads for uniform head orientation. This *may* be accomplished with monotube arms, vertically mounted heads on trombone arms, or post mounted signals. (Two heads *may* be vertically mounted on a trombone arm if the far head placement does not exceed 22' from the pole.)

5. Signal heads *should* be mounted in such a way that they are centered over their respective receiving lane. Engineering judgment *should* be used to determine the appropriate location for each head when the roadway is skewed or other

unusual geometrics cause a shift between the approach lanes and receiving lanes.

6. Poles with monotube arm assemblies *may* be installed in “pork chop” divider safety islands and in median islands. A raised median is defined as having a minimum width of 6’ face to face (although 8’ is desirable).

7. Poles with monotube arm assemblies are not required to be shielded; however, engineering judgment *should* be used to determine a reasonable offset from any adjacent travel lanes since the bases are non-breakaway.

8. Reverse mounted monotube arm assemblies *may* be used.

9. Ideal pole placement *may not* facilitate proper ADA push button placement, therefore additional poles for pedestrian push buttons *may* be required.

10. Monotube arm assemblies with a signal head positioned for each lane *may* be utilized for single or multiple left turn lane designs however are not required.

11. A luminaire can be mounted above the monotube arm, 180-degrees from the monotube arm, or in both locations.

12. For typical design information, see Standard Detail Drawings 9E8, 9E9, and 9E10.

13. The concrete base **shall** be further extended above ground when the ground elevation at the base is lower than the high point of roadway elevation. See Standard Detail Drawing 9E11 for construction information.

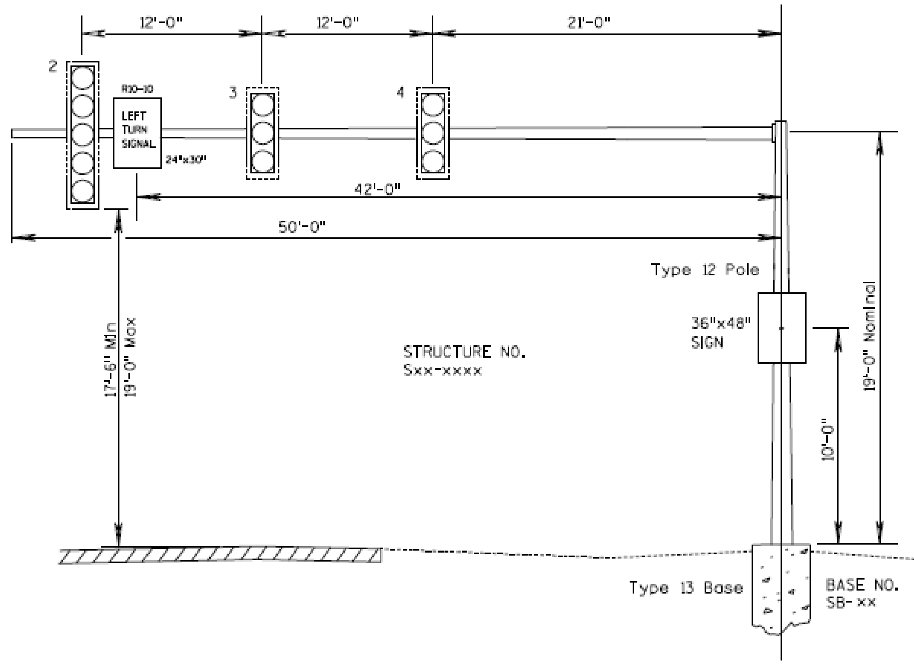
14. Each monotube arm assembly and pole structure **shall** be assigned a structure number (by the Region). This number **shall** appear on the traffic signal plans and will be identified in the field on each pole. Regional electricians **shall** work directly with their Regional Signing Coordinator to place an order in Work Director for each identification plaque. Installation of the plaques **shall** conform to the guidance in Standard Detail Drawing 12A4.

15. The Designer **shall** be responsible for calculating the overturning and twisting factors associated with each monotube arm assembly and pole structure layout to ensure that they have not exceeded the maximum loading. The table of maximum values for these factors (and an example calculation) can be found in Figure 1. The designer’s calculations *should* be made available to the Regional Traffic Engineer or State Traffic Signal Systems Engineer upon request. A few items to note when using these equations:

    - <u>No</u> additional calculations are required to account for the luminaire and luminaire arm on the Type 10 & Type 13 poles.

- Signs and signals that are mounted perpendicular to the face of the monotube arm do <u>not</u> need to be included in the calculations.
- Effects of push buttons are considered negligible and therefore do <u>not</u> need to be included in the calculation.
- Square footage information for standard signal equipment is as follows:
  - 5 section signal head – 13.33 sq. ft.
  - 4 section signal head – 11.00 sq. ft.
  - 3 section signal head – 8.67 sq. ft.
  - 1 section pedestrian head – 2.0 sq. ft.

Figure 1 -- How to check loading on a monotube signal/sign structure



This example shows how to check the ability of a monotube traffic signal structure to carry a proposed loading. The number of traffic signal attachments, signs, and their dimensions are for illustrative purposes only. The calculations for any given installation will vary by the specific number of traffic signal attachments, signs, and their dimensions and positioning for that specific installation.

Given: Type 12 pole, 50' arm, loading with signals and signs, positioned and dimensioned as shown in illustration.

Determine: Adequacy of Type 12 pole with 50' arm to carry proposed attachments

Calculate overturning and twisting factors (mv) & (mh):

mv = sum (each attachment area X distance from arm attachment point to the bottom of the upright)

mh = sum (each attachment area X distance from the center of each attachment to the center line of the upright)

area of 5-head signal on arm = 2' X 6.67' = 13.33 sq.ft.

area of directional sign on arm = 2' X 2.50' = 5 sq.ft.

area of each 3-head signal on arm = 2' X 4.33' = 8.67 sq.ft. each

area of sign on pole = 3' X 4' = 12 sq.ft.

mv = [(13.33 sq.ft. + 5 sq.ft. + 8.67 sq.ft. + 8.67 sq.ft.) X (19 ft. nominal)] + [12 sq.ft. X 10 ft.] = 797.73 ft^3

mh = (13.33 sq.ft. X 45 ft.) + (5 sq.ft. X 42 ft.) + (8.67 sq.ft. X 33 ft.) + (8.67 sq.ft. X 21 ft.) + (12 sq.ft. X 0 ft.) = 1278.0 ft^3

Enter table for checking loading using the row for a 50 ft. arm length:

Overturning factor = MV = 1733 ft^3 maximum

Twisting factor = MH = 2151 ft^3 maximum

The proposed loading of signal and sign attachments on the Type 12 pole with a 50 ft. arm is acceptable since mv = 798 ft^3 is less than MV = 1733 ft^3 and mh = 1278 ft^3 is less than MH = 2151 ft^3.

Table for checking loading on a monotube traffic signal structure

Arm length (ft)	MV (maximum) (ft^3)	MH (maximum) (ft^3)
15	834	295
20	1007	416
25	1007	594
30	1007	771
35	1560	1168
40	1560	1477
45	1733	1792
50	1733	2151
55	1733	2510