

## **CHAPTER 14: TRAFFIC SIGNAL STANDARDS**

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## 14.00 INTRODUCTION AND GOALS

The purpose of this chapter is to outline the City's review process for traffic signal plans and highlight basic design requirements for traffic signal installations and / or modernizations. This chapter outlines plan and design requirements for the various stages of review and also discusses some basic design elements the City requires on traffic signal projects.

This chapter highlights key points of the City of Champaign Traffic Signal Design Manual and is not intended to be used in its place. The Traffic Signal Design Manual goes into detail regarding the design items discussed in this chapter and includes a list of specifications for traffic signal equipment and related appurtenances in the City of Champaign. For traffic signal projects, design engineers are required to obtain a copy of the City of Champaign Traffic Signal Design Manual prior to the start of the design phase.

Traffic signal technology changes at a rapid pace; the City reserves the right to change the traffic signal standards and specifications at any time without advance notice.

## 14.01 ADMINISTRATION

### A. Requirements for Traffic Signals:

1. *Signal Warrants:* For the installation of traffic signals to be considered, the location must satisfy the warrants outlined in the most recent edition of the MUTCD. In high growth areas where significant changes in traffic conditions are expected due to the development of the area, hourly volumes for 5 years after full build-out should be estimated and compared with the MUTCD signal warrants. The growth rate utilized to estimate the future traffic volumes is subject to the review and approval of the City Engineer prior to its use. The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic signal. The City Engineer shall make the final recommendation regarding the location of any new traffic signal.
2. *Engineering Study:* An engineering study will be required for all proposed traffic signal installations. The engineering study shall evaluate the effects of the proposed traffic signal on progression. The engineering study shall include the estimation of future volumes and an analysis of the progression of traffic through the signal system, as defined by the City Engineer. The evaluation shall include any planned future traffic signal installations. The analysis shall be submitted to the City Engineer for review and shall include capacity analysis (using Synchro, HCM Cinema or other software as approved by the City Engineer), as well as time-space diagrams of the signal system.
3. *Signal Spacing:* Signalized intersections shall be located to maintain progression of traffic along arterial streets. This normally entails relatively uniform spacing and sufficient distances between signals to allow vehicles to travel at reasonable speeds.

Optimal spacing of traffic signals is always the desire of the City. The optimal spacing is a function of the cycle length and the progression speed of traffic along the major street as illustrated in Standard Attachment 14.01. New signal locations shall be subject to the spacing requirements depicted in Standard Attachment 14.01. Proposed signal locations not adhering to this spacing will be reviewed on a case by case basis. The spacing requirements may be waived if the City Engineer determines that the proposed traffic signal will not significantly hinder the

progression traffic along the major street. If the proposed location is rejected, The City Engineer may require either the relocation of the proposed signal location, to better accommodate progression, or the evaluation of other alternatives, for management of the traffic generated by the side street / private access.

4. *Private benefit signals*: Private benefit signals provide signalized access to private streets or developments. These signals are generally required when the property owners must improve access from their site onto the major street or facilitate movement between developments on opposite sides of the street. Private benefit signals are subject to the requirements outlined in the previous sections (14.02-A-1-3).
  - a. **Financial Responsibility**: The installations, subsequent modernizations, maintenance and energy costs shall be the responsibility of the property owner(s). The City shall maintain the signals with full reimbursement from the property owner(s). The City may require the removal of the signals for any sufficient reason upon 30 days' written notice. Improper use, failure to reimburse maintenance or energy costs, or failure to modernize the signals when required by the City shall be considered sufficient reason to require removal. Removal may result in the installation of alternative measures to enhance the safe movement of traffic through the intersection.
  - b. **Required Installations**: If the Traffic Impact Study (as required in Chapter 9) for a new development indicates that a traffic signal will be warranted within 10 years of full build-out, the City Engineer may require the inclusion of a traffic signal as a part of the development plan. The financial responsibility for these signals shall be the same as outlined in the previous section. The timeframe for installation is dependent on the traffic projections and subject to the discretion of the City Engineer. The site development plans will not be approved until provisions for the installation of the traffic signal or other alternative measures to enhance the safe movement of traffic through the intersection are included in the plans.
- B. Designer Prequalifications**: The design staff for any firm supplying traffic signal plans to the City Engineering Division must be prequalified with IDOT and shall be familiar with the traffic signal design procedures used by the City. These procedures are outlined in this Chapter and in the Traffic Signal Design Manual. At the request of the City, the design engineer may be required to provide copies of their most recent traffic signal design and / or modification projects to the Engineering Division prior to their being assessed as qualified.
- C. Intersection Design Study (IDS)**: An IDS must be prepared for any intersection that is proposed for the installation or modernization of traffic signals. Engineering work associated with the IDS will include topographical surveys, preparation of a base map, roadway geometric design, traffic signal layout and traffic signal phasing. The IDS shall include the traffic signal warrant study, detailed preliminary intersection and signalization design to meet present and future traffic needs, a list of needed rights-of-way, and a total project cost estimate suitable for budgeting purposes.

An IDS that has been reviewed and approved by the City Engineer is required prior to the submittal of traffic signal plans for review. If an IDS does not exist for the intersection, one shall be prepared as part of the project presentation stage of design (described in the following section). If an IDS exists and, at the discretion of the City Engineer, the traffic conditions at the intersection have significantly changed since the preparation of the IDS, an update of the IDS may be required.

**D. Project Reviews and Submittals:** Traffic signal design work shall be submitted to the City on a staged basis. The City will record the dates of the submittal of each stage. The design requirements of each stage must be met prior to submittal of the next stage and all review comments supplied to the designer shall be addressed prior to the next stage review. The review stages and their requirements are as follows:

1. *Stage I - Project Presentation:* For this stage, the designer shall present the scope of work as they understand it, the alternatives they have considered, and provide their recommendations for the extent and type of improvements. The following items shall be investigated and addressed by the design firm during this stage:

- a. Approved IDS or route design study
- b. Utility conflicts
- c. ROW parameters
- d. Geometric parameters and adjustments
- e. Drainage restrictions
- f. Emergency vehicle preemption
- g. Pedestrian indications
- h. Combination lighting for the intersection
- i. Parking impacts and signing agreements
- j. Illinois Power service location and type
- k. Signal interconnection and impacts to adjacent signals
- m. Proposed controller location
- n. Proposed phasing
- o. Mast arm and signal head locations
- p. Type of detection
- q. Signing requirements
- r. Pavement marking, layout and proposed materials
- s. Existing equipment – removal or usage
- t. Temporary signal requirements
- u. Sight restrictions – horizontal / vertical curves
- v. Sidewalks including vaults if present
- w. Abnormal conditions

2. *Stage II - First Review:* A full-size set of plans shall be submitted approximately 50% complete. The following items, however, shall be included in complete form:

- a. Copy of letter to the Illinois Power Area Engineer requesting service on behalf of the City and notifying them of the project
- b. Temporary signal design, if necessary
- c. Removal item listing and proposed disposition
- d. Existing and proposed geometric design
- e. Proposed pavement-marking plan
- f. Signal layout sheet
- g. Sequence of operation
- h. Preemption sequences
- i. Detection locations and proposed detection strategy

Depending on the amount of intersection reconstruction involved in the project, the 50% plans should also address major concepts for the following items:

- j. Pavement design
- k. Storm sewer system size and layout

- l. Consider the need for sanitary sewer rehabilitation or construction
  - m. Profile grade line
  - n. Sidewalk grade
  - o. All other parts of the infrastructure that may be impacted by the project
- 3. *Stage III - Second Review:* A full size set of plans shall be submitted together with specifications. The project shall be 95% to 100% complete. In addition to those items required in Stage II review, the following items must be included in this review:
  - a. Schedule / Summary of Quantities
  - b. Standard details and special details
  - c. Legends
  - d. Conduit sizes
  - e. System interconnect plans (as needed)
  - f. Pavement marking details
  - g. Cover sheet
  - h. Signing details
- 4. *Stage IV - Final Acceptance:* The fully complete traffic signal plans shall have incorporated all previous review comments from the City and shall be checked by the designer prior to submittal to the Engineering Division. The plan submittal shall include:
  - a. One full-size plan set
  - b. Two half-size plan sets
  - c. Three sets of specifications
  - d. Cost estimate with pay code item numbers, quantities, units, and item abbreviations
  - e. The designer shall retain original reproducible plans and shall produce copies of the plans at the request of the City, with the cost of reproduction paid by the City
  - f. Electronic Copies of plans and specifications on CD-ROM

## 14.02 STANDARDS

The latest recent editions following standards apply to the installation of traffic signals:

### A. Referenced Standards:

The State of Illinois Manual on Uniform Control Devices; The IDOT Standard Specifications for Road and Bridge Construction; the Standard Specifications for Traffic Control Items; The National Electric Code; The National Electrical Manufacturers Association's requirements; The Institute of Transportation Engineer's "Technical Report No. 1" (A Standard for Adjustable Face Vehicular Traffic Control Heads); The Supplemental Specifications and Recurring Special Provisions; the Illinois Vehicle Code; City of Champaign Traffic Signal Design Guidelines and Specifications

- B. Design:** The design of traffic signals under the jurisdiction of the City of Champaign shall conform to the requirements and specifications outlined in the Traffic Signal Design Manual. A copy of this manual can be obtained from the City of Champaign Engineering Division. Some of the basic elements contained in the Traffic Signal Design Manual are briefly described below:

1. *Traffic Signal Requirements:*
  - a. Proposed locations for traffic signal installations must be warranted under current conditions according to the Manual on Uniform Traffic Control Devices. For new development, traffic signals must be warranted upon a 5-10 year build-out. Installations that are not warranted by traffic conditions will not be considered.
  - b. Traffic signal layout shall conform to the Manual on Uniform Traffic Control Devices.
  - c. Combination mast arms and other equipment necessary to provide intersection lighting are considered part of a traffic signal installation and are required at all new traffic signal installations and modernizations.
  - d. Eagle traffic signal local and master controllers are required.
  - e. Pedestrian signals and pushbuttons shall be provided at the discretion of the City Engineer. The international symbols for 'walk' and 'don't walk' shall be specified for all pedestrian signal indications.
  - f. LED indications shall be specified for all red indications and "don't walk" indications. As other LED indications are approved by the FHWA, those will be required as well.
  - g. Video detection shall be required unless otherwise specified by the City Engineer.
  - h. Emergency vehicle preemption is required along emergency response routes.
  - i. Lower left or right signal faces are required for all east-west streets.
  - j. Signal indications on mast arms shall line up with the right lane line of the lane the indication is intended for. For example, the left turn indication on the mast arm will be lined up over the right lane line of the left turn lane.
2. *Traffic Signal System Requirements:*
  - a. The installation of a fiber optic interconnect is required between signalized intersections that are within 1/2 mile of one another or if analysis indicates that the signals would benefit from signal coordination. When an interconnect is required a master controller and phone connection must be installed as a part of the project if one does not exist already.
  - b. The City Engineer may require the installation of detection for the purpose of collecting traffic counts.
3. *Electrical Requirements:*
  - a. The traffic signal design shall conform to the National Electric Code.
  - b. Traffic signal equipment shall conform to NEMA standards.

- c. Fiber optic interconnect shall include a copper tracer in the conduit for locating purposes and the location of the fiber shall be marked periodically.
  - d. Power back up shall be provided, with the ability to provide flashing red control for up to one hour.
  - e. Combination mast arms shall be specified in order to provide intersection lighting. Intersection lighting shall be considered part of a standard traffic signal installation in the City of Champaign.
  - f. The traffic signal plan shall include a continuous grounding plan for the intersection.
  - g. Double handholes are required at all traffic signal cabinet locations.
  - h. Power disconnects shall be provided.
  - i. New power installations shall be metered for one month after activation to ascertain an average monthly cost for electricity at the location.
- C. Construction:** Traffic signal installations / modernizations shall be constructed in accordance with applicable sections of the IDOT Standard Specifications for Road and Bridge Construction and the IDOT Standard Specifications for Traffic Control Items.
- D. Materials and Construction Notes:** The specifications for traffic signal equipment and related appurtenances required by the City are contained in the City of Champaign Traffic Design Manual. A copy of this Manual can be obtained from the City of Champaign Engineering Division.

### 14.03 STANDARD ATTACHMENTS

Standard Attachment Number 14.01 – Signal Spacing Requirements

Most information that could be attached to this chapter is contained in the City of Champaign Traffic Signal Design Manual. A copy of the manual can be obtained by contacting the Engineering Division.

Standard Attachment 14.01 illustrates the relationship between cycle length, speed, and spacing. Cycle lengths for a signal system are typically determined by the largest or busiest intersection in the system. Progression speeds are typically assumed to be the speed limit. Please consult the City for these parameters prior to performing the study.





