Transportation Systems Management & Operations (TSM&O) Traffic Signal Training Module A – Introduction to Traffic Signals.

Welcome to the TSM&O Traffic Signal Training Module A - Introduction to Traffic Signals.

This course provides training on traffic signals. The training focuses on standard practices throughout Florida, with emphasis on state roads. The intended audience is DOT personnel, county staff and officials, city staff and officials, planners, contactors, developers, consultants, and other transportation stakeholders who are involved in traffic signals, or who just want a better understanding of traffic signals.

The training course consists of 6 modules: introduction to traffic signals, traffic signal warrants, traffic signal design, traffic signal timing and coordination, multimodalism, and traffic signal controllers. This computer based training will focus on Modules A and B only. The rest of the Modules (C thru F) will be in-person classroom based training.

The overarching objective of this course is to gain basic knowledge of traffic signals regarding design, construction, and signal timing. On a more granular level, you will gain an understanding of the advantages and disadvantages of traffic control signals, you will perform a partial traffic signal warrant analysis, you will be able to identify various traffic signal components used in the field, and you will understand common traffic signal timing and phasing terminology. Lastly, we'll discuss how traffic signals can be designed and operated to accommodate various modes of transportation.

In this module, introduction to traffic signals, we'll discuss terminology you will learn, governing standards (local, state, and federal), the purpose of traffic signals, traffic signal advantages and disadvantages, and budgeting and costs. Now that we've given a thorough introduction, let's jump into the material.

Of course, we're not able to cover all of the terminology you'll encounter in the world of traffic signals. The terms listed here are some of the more common terms.

Actuated Operation

Controller

Cycle Length

Detector

Flashing Yellow Arrow

Maximum Green, Minimum Green

Manual on Uniform Traffic Control Devices

Signal Phase and Timing (SPaT)

Permissive/Protected Phase for Left Turns

National Electrical Manufacturers Association

Adaptive Signal Control Technology (ASCT)

Coordination

Communications

Priority

Pre-emption

Closed-Loop System

Intelligent Transportation System

At-grade crossing

Uninterruptible Power Supply

Light Emitting Diode

Approved Products List

Flash Mode

As you can see, there are also several acronyms. I'll try to always provide the full definition of an acronym as I go through the training modules.

The Florida Department of Transportation has adopted and published several guides and manuals to standardize certain aspects of traffic signals within the state. The first we'll discuss is the Traffic Engineering Manual. This document provides references to adopted criteria and standards.

Chapter 3 of the Traffic Engineering Manual, commonly referred to as the TEM, covers traffic signals. The topics in the TEM are very specific, such as guidelines for left turn treatments, scheduling traffic signal studies and funding arrangements, standardization of yellow change and red clearance intervals, and marked pedestrian crosswalks at midblock and uncontrolled approach locations, to name a few.

FDOT Design Standards, FDOT Design Manual, also referred to as the FDM (previously known and the Plans Preparation Manual), and standard specifications for road and bridge construction, cover most of the material you would need to design and construct a traffic signal. These documents cover everything from plans organization to design criteria and construction materials. The Design Standards and PPM have been combined to establish the FDOT Design Manual.

Lastly, the Manual on Uniform Traffic Studies or MUTS covers FDOT procedures for some of the studies we will discuss in this training such as traffic signal warrant analyses.

National governing standards are used by the state to establish the state standards. As a general rule, states must abide by national standards, but may enact more stringent standards. The Manual on Uniform Traffic Control Devices, commonly referred to as the MUTCD, is organized and published by the Federal Highway Administration (FHWA). Traffic signals are covered in Chapter 4. We'll discuss the purpose and content of the MUTCD in the next few slides.

The MUTCD defines a traffic control signal as: any highway traffic signal by which traffic is alternately directed to stop and permitted to proceed. Traffic is defined as pedestrians, bicyclists, ridden or herded animals, vehicles, streetcars, and other conveyances either singularly or together, while using for the purposes of travel any highway or private road open to public travel.

Traffic signals are used to assign the right of way using green and red lights in conjunction with yellow change and red clearance intervals. By assigning the right of way, we can improve intersection safety by reducing the frequency of the most dangerous collision types such as angle crashes and left turn crashes. We can also improve efficiency by allocating green time to the heaviest volume movements. Often times, safety and efficiency should be balanced in the world of traffic engineering and good judgement should be used.

For example, on a 6-lane arterial with posted speed limit of 55 miles per hour and moderate volumes, it would be more efficient to implement a permissive left turn phase as opposed to protected-only so that left turning vehicles could proceed when opposing traffic permits. However, judging the speed of oncoming traffic to identify a sufficient gap to cross 3 lanes of traffic may present safety concerns in certain instances. Here is where safety and efficiency need balance.

Now that we've established the purpose of traffic signals, let's talk about some of the advantages and disadvantages. We'll start with the advantages. Traffic signals that are properly designed, located, maintained, and timed can provide for the orderly and efficient movement of people, maximize the number of vehicles served at the intersection, reduce the frequency and severity of certain types of crashes, and provide accessibility for pedestrians and bicyclists.

Some of the disadvantages are explicitly addressed in the MUTCD. The MUTCD states that when traffic signals are ill-designed, ineffectively placed, improperly operated, or poorly maintained, they can result in excessive delay, disobedience or illegal maneuvers, complete avoidance of the particular intersection, or increased crash frequency.

So how is it decided that we need to install a traffic signal at a particular location? The process usually starts with a request. Who initiates such a request?

Here are some of the entities that typically initiate a traffic signal request. A developer may think that a traffic signal is needed to serve a driveway to a shopping center or to a large subdivision so the developer may make a request to install a traffic signal. A City or County representative may have data or experience indicating that a traffic signal should be installed at a particular intersection.

Sometimes elected officials receive complaints from constituents about an intersection and the elected official makes a request to install a signal. Other times, individuals may bypass their elected official and make a request directly. Lastly, the state may make a request through the findings of a study or state officials may make a request directly to an approving agency.

As you can see, requests to install a traffic signal may come from many different sources. One thing that's common to every request is that a traffic signal warrant analysis must be conducted to determine if a signal is warranted. We'll talk much more about the warranting process in the next module.

Budgeting and costs are important considerations when installing and operating traffic signals. New traffic signals can be expensive to install and operations and maintenance costs recur over and over. Two common types of signal structures you might encounter are 4 pole box or diagonal span signals or mast arm signals.

With both types of signals, a big portion of the cost is the structural supports. The variation in the number of poles, number of lanes, Right of Way availability, wind speed criteria, soil types, and structural loads has a significant influence on the costs. These factors can vary greatly from region to region and from intersection to intersection.

A standard Traffic Signal Maintenance and Compensation Agreement or TSMCA has been implemented across all districts to provide for the maintenance and operation of traffic signals. The most common agreement structure is between the state and a local agency such as a city or a county. In this arrangement, traffic signal equipment on state roadways are owned by the state, but are operated and maintained by local agencies under the TSMCA.

The TSMCA defines several aspects including but not limited to:

- Traffic Signals and Devices,
- Device Compensation Unit Rates,
- Preventive and Periodic Maintenance, and
- Damage Reimbursement.

You can find a link on the Resources page to the TSMCA form number 750-010-022.

Aside from the state-owned, local agency maintained arrangement, many cities and counties own, operate, and maintain their own traffic signal equipment on non-state roadways.

It is important to plan budgets conservatively so that maintenance activities can occur on a consistent basis. Maintenance costs will escalate over time as equipment wears and requires replacement. For

the state-owned, local agency maintained arrangement that is TSMCA, the state has established standard compensation rates to reimburse local agencies.

It’s important to understand the typical service life of various signal assets. The service life varies greatly from location to location. For example, a steel mast arm assembly along A1A in Ft. Lauderdale may have a reduced service compared to a mast arm assembly in Tallahassee. This is due to the increased winds along the South Florida coast and the salty air and ocean spray. This table provides an example of an engineer’s estimate of service life for each traffic signal component. Take a minute to look over the table and when finished, select the continue button or press Shift+N on your keyboard to go to the next slide.

In this module, we covered common traffic signal terminology, governing standards, the purpose of a traffic signal, some common advantages and disadvantages, and budgeting and costs.

This concludes Module A – Introduction to Traffic Signals. Please continue to Module B – Traffic Signal Warrants.