



NOTES FOR STUDIES

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Unit -III.

Traffic Operations and Control: (i) Traffic regulations and various means of control. (ii) One way streets- advantages and limitations. (iii) Traffic signals- isolated signals, coordinated signals, simultaneous, alternate, flexible and progressive signal systems. Types of traffic signals, fixed time signals, traffic actuated signals, speed control signals, pedestrian signals, flashing signals, clearance interval and problems on single isolated traffic signal.

TRAFFIC REGULATION,

Traffic regulation deals with the control of vehicles, drivers and road users. The control of vehicles deals with the registration, weight, size, design, construction and maintenance. Driver regulation deal with the licensing and other aspects of operation of vehicles by drivers. Regulation of other road user deals with the rules regarding pedestrians, cyclists and motor cyclists. In India Traffic is mixed in character, and this brings in the need to regulate the movement of animal drawn vehicles, cycle rickshaws and hand carts.

ONE WAY STREET-

A one way street only allows vehicles to move in one direction along the road. One way signs are used to prevent vehicles travelling the wrong way along the road, and sometimes road junctions are redesigned to make it difficult to turn against the flow of traffic. For traffic travelling in the correct direction, arrow signs are used to show it is a one way street.

Advantages

- Can prevent vehicles using the road as a short cut / rat run.
- Can create more road space for car and cycle parking. □ Can help traffic to move more freely.

Disadvantages

- Likely to increase vehicle speeds.
- Motor vehicles and emergency vehicles may need to travel greater distance to get to their destination.

Effectiveness

If a road is currently a narrow two way street where motor vehicles need to slow down to pass each other, changing the road to a one way street will increase vehicle speeds. Vehicle drivers may also be tempted to drive faster because they do not expect any oncoming vehicles.

SIGNAL PROGRESSION

The objective of a signal system is to provide continuous movement of vehicles and/or minimize the delay along an arterial or throughout a network of major streets.

This requires:

- **Coordination among the signal controllers**
- **Signal timing plan**
- **Compatible equipment**
- **Typically, equal cycle times**
- **Adequate and appropriate signalized intersection spacing.**

I. COORDINATION- There is a number of traffic signal control systems that can provide the necessary coordination to achieve signal progression.

A. Non-interconnected system. This is the simplest system control of all. Appropriate offsets of the beginning of green phases for the sequence of signals can be measured and set with a stop-watch.

B. Time-based Coordinated System. Non-interconnected controllers are coordinated using time-based offsets, which enables that the proper phase supplied feature to keep the accurate.

Coordination of signal timing plans can be achieved accurately.

C. Interconnected Pretimed System. The signal controllers of the signalized intersections on the facility are hard wired to a master controller, which is one of the intersections controllers.

D. Traffic Responsive System. An interconnected system that responds to the information at some traffic detectors to determine which cycle lengths is used.

E. Digital computer Signal Control System. A central computer facility receives, analyzes and develops the appropriate signal timing patterns with cycle times, offsets, and phasing. It then communicates them to the local controllers

SIGNAL PROGRESSION – DEFINITIONS

A. System cycle - A specified cycle length is imposed throughout the system under the timing plan.

B. Split - The proportion of the cycle that is green for the arterial at each intersection.

C. Offset - The time that the green phase at an intersection begins after the beginning of green of the major control intersection or the reference signal.

D. Band width - the width of the green through band in seconds, which indicates the amount of green time where traffic can flow with progression.

E. Band speed - The slope of the green through band on the time space diagram is the speed of progression for the platoon.

SIGNAL SYSTEM TIMING

A. Simple System these are primarily used with signals that are pretimed.

1. Simultaneous- All signals show the same indication at the same time. • Provides efficient timing • Increases speeds • Reduces space (Best suited to short -500 ft.) or very long blocks, and locations where major street can have most of the green time.

2. Alternate System –

a. Single Alternate. Every other signal shows the same indication.

b. Double Alternate. Every other pair of signals shows the same indication.

c. Requires 50-50% cycle split. d. Not well-suited for unequal block spacing. e. Double alternate reduces the through band width by 50%. f. Best suited for downtown areas with square blocks and low speeds. g. Timing 1) Select desired speed 2) Compute time required to travel one block V (fps) Block length $TT = 3$) Select signal system and cycle time based on round trip time.

• Single alternate - round trip to second intersection

• Double alternate - round trip to third intersection

• Triple alternate - round trip to fourth intersection Example: 400 ft. long blocks; 25 mph =10.9 sec., say 11 sec.

$36.7 \times 400 \times TT = \text{Signal Progression}$

Progressive Systems- A signal system in which the vehicles receive a green indication as they arrive at the intersection.

A. One-way street progressive systems can provide a band width of 100% of green regardless of the block spacing

b. Two-way street progressive systems can provide progression in both directions with equal block spacing, as shown with single alternate and double alternate systems.

c. Two-way streets with unequal block spacing may not be able to achieve progression in both directions, or it may be inefficient with poor speeds of progression on small band widths. Optional Signalized Intersection Spacing. The optimum spacing for the signals that dictate the progression speed and band width can be determined based on these concepts.

Signal Spacing- Signalized intersections should be spaced to minimize delays and disruptions to through traffic. The optimum spacing of signals is dependent on the speed, cycle length, traffic volumes and efficiency of signal

progression. Extensive research has been performed to determine the relationship among speed, cycle length and signal spacing.

Concepts of signal coordination

For signals that are closely spaced, it is necessary to coordinate the green time so that vehicles may move efficiently through the set of signals. In some cases, two signals are so closely spaced that they should be considered to be one signal. In other cases, the signals are so far apart that they may be considered independently. Vehicles released from a signal often maintain their grouping for well over 335m.

Factors affecting coordination

There are four major areas of consideration for signal coordination:

Benefits

- Purpose of signal system
- Factors lessening benefits
- Exceptions to the coordinated scheme

OPERATIONS AND CONTROL

Pre-timed Control

Pre-timed control is ideally suited to closely spaced intersections where traffic volumes and patterns are consistent on a daily or day-of-week basis. Such conditions are often found in downtown areas. They are also better suited to intersections where three or fewer phases are needed (3). Pre-timed control has several advantages. For example, it can be used to provide efficient coordination with adjacent pre-timed signals, since both the start and end of green are predictable. Also, it does not require detectors, thus making its operation immune to problems associated with detector failure. Finally, it requires a minimum amount of training to set up and maintain. On the other hand, pre-timed control cannot compensate for unplanned fluctuations in traffic flows, and it tends to be inefficient at isolated intersections where traffic arrivals are random.

Modern traffic signal controllers do not explicitly support signal timing for pre-timed operation, because they are designed for actuated operation. Nevertheless, pre-timed operations can be achieved by specifying a maximum green setting that is equal to the desired pre-timed green interval and invoking the maximum vehicle recall parameter described below.

Semi-Actuated Control

Semi-actuated control uses detection only for the minor movements at an intersection. The phases associated with the major-road through movements are operated as "non-actuated." That is, these phases are not provided detection information. In this type of operation, the controller is programmed to dwell in the non-actuated phase and, thereby, sustain a green indication for the highest flow movements (normally the major street through movement). Minor movement phases are serviced after a call for their service is received.

Semi-actuated control is most suitable for application at intersections that are part of a coordinated arterial street system. Coordinated-actuated operation is discussed in more detail in Chapter 6. Semi-actuated control may also be suitable for isolated intersections with a low-speed major road and lighter crossroad volume.

Semi-actuated control has several advantages. Its primary advantage is that it can be used effectively in a coordinated signal system. Also, relative to pre-timed control, it reduces the delay incurred by the major-road through movements (i.e., the movements associated with the non-actuated phases) during periods of light traffic. Finally, it does not require detectors for the major-road through movement phases and hence, its operation is not compromised by the failure of these detectors.

The major disadvantage of semi-actuated operation is that continuous demand on the phases associated with one or more minor movements can cause excessive delay to the major road through movements if the maximum green and passage time parameters are not appropriately set. Another drawback is that detectors must be used on the minor approaches, thus requiring installation and ongoing maintenance. Semi-actuated operation also requires more training than that needed for pre-timed control.

Fully-Actuated Control

Fully-actuated control refers to intersections for which all phases are actuated and hence, it requires detection for all traffic movements. Fully-actuated control is ideally suited to isolated intersections where the traffic demands and patterns vary widely during the course of the day. Most modern controllers in coordinated signal systems can be programmed to operate in a fully-actuated mode during low-volume periods where the system is operating in a "free" (or non-coordinated) mode. Fully-actuated control can also improve performance at intersections with lower volumes that are located at the boundary of a coordinated system and do not impact progression of the system (1). Fully-actuated control has also been used at the intersection of two arterials to optimize green time allocation in a critical intersection control method.

There are several advantages of fully-actuated control. First, it reduces delay relative to pre-timed control by being highly responsive to traffic demand and to changes in traffic pattern. In addition, detection information allows the cycle time to be efficiently allocated on a cycle-by-cycle basis. Finally, it allows phases to be skipped if there is no call for service, thereby allowing the controller to reallocate the unused time to a subsequent phase.

The major disadvantage of fully-actuated control is that its cost (initial and maintenance) is higher than that of other control types due to the amount of detection required. It may also result in higher percentage of vehicles stopping because green time is not held for upstream platoons.

PHASE INTERVALS AND BASIC PARAMETERS

A phase interval is defined in the NTCIP standard as a period of time during which signal indications do not change. Various parameters of the length of a phase interval depend on the phase type. For example, a pedestrian walk interval (the time period during which the Walking Person signal indication is displayed) is generally controlled by the single user-defined setting for the walk parameter. The vehicular green interval, on the other hand, is generally controlled by multiple parameters, including minimum green, maximum green, and passage time. This section describes guidelines for

setting basic parameters that determine the duration of each interval associated with a signal phase. These intervals include:

- Vehicular Green Interval
- Vehicle Change and Clearance Intervals
- Pedestrian Intervals

Type of Traffic Signal

CLASSIFICATION OF TRAFFIC SIGNALS

Traffic signals are the control devices which alternately direct the traffic to stop and proceed at intersections using red and green traffic light signal automatically.

The signals are classified into the following types:

- Traffic Control Signals
- Fixed time signals
- Manually operated signals
- Traffic actuated (automatic) signals
- Pedestrian signals
- Special traffic signals



1. TRAFFIC CONTROL SIGNALS

Traffic signal

These are provided with three colored light glows facing each direction of traffic flow.

Red light indicates STOP

Yellow amber light indicates the clearance time for the vehicles which have entered the intersection area by the end of green signal

Green light indicates GO

A typical traffic signal showing the arrangement of three light glows is shown in this fig.

Traffic control signal are further classified into the following 3 types.

A.FIXED TIME SIGNALS

These signals are set to repeat regularly a cycle of red, amber yellow and green lights. Depending upon the traffic intensities, the timings of each phase of the cycle is predetermined. Fixed time signals are the simplest type of automatic traffic signals which are electrically operated.

Draw backs of the signals: The cycle of red, yellow and green goes on irrespective whether on any road, there is any traffic or not. Traffic in the heavy stream has to stop at end phase.

B.TRAFFIC ACTUATED SIGNALS

In these signals the timings of the phase and cycle are changed according to traffic demand.

In semi-actuated signals, the normal green phase of a traffic stream may be extended upto a certain period of time for allowing the vehicles to clear off the intersection.

In fully-actuated signals, computers assign the right of way for the traffic movement on turn basis of traffic flow demand.

C.MANUALLY OPERATED SIGNALS

In these types of signals, the traffic police watches the traffic demand from a suitable point during the peak hours at the intersection and varies the timings of these phases and cycle accordingly.

2. PEDESTRIAN SIGNALS

When the vehicular traffic remains stopped by red or stop signal on the traffic signals of the road intersection, these signals give the right of way of pedestrians to cross a road during the walk period.

3. SPECIAL SIGNALS OR FLASHING BEACONS These signals are used to warn the traffic.

When there is a red flashing signal, the drivers of vehicles must stop before entering the nearest cross walk at the intersection or at a stop line where marked.

Flashing of yellow signals are used to direct the drivers of the vehicular traffic to proceed with caution.

TRAFFIC SIGNAL

Mandatory Signs

Stop



Give way



No straight ahead



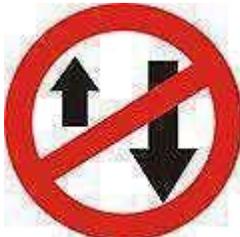
No entry



One-way traffic



One-way traffic



No vehicles in both directions



All motor vehicles prohibited



No motorcycles



No bicycles



No heavy vehicles



No bullock carts



No pedestrians

No left turn

No right turn



No U-turn

No overtaking

Speed limit



Weight limit

Height limit

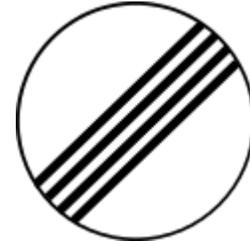
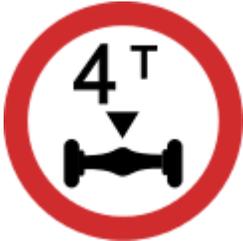
Length limit



Axle weight limit

Horn prohibited

End of all restrictions



No parking

No stopping

Turn left



Turn right

Proceed straight ahead

Keep left



Keep right

Turn left ahead

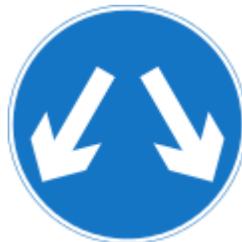
Turn right ahead



Roundabout

Pass either side

Bicycles only



Cautionary Signs

Left curve



Right Curve



Narrow Bridge



Narrow road



Roundabout ahead



Traffic signals ahead



Level crossing with barrier ahead



Level crossing without barrier ahead



uneven road



PUBLIC TELEPHONE



PETROL PUMP



HOSPITAL



FIRST AID POST



EATING PLACE



LIGHT RECREATION

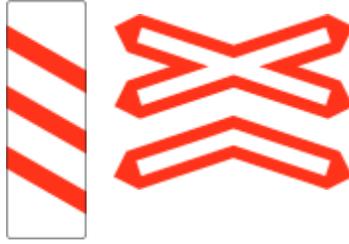


RESTING PLACE

Single level crossing



multiple level crossing



Level crossing countdown (150 m)

Level crossing countdown (100 m)



Level crossing countdown (50 m)



INFORMATION SIGNS

