

GENERAL INFORMATION

1.1 CONCEPT

The objective of this chapter is to define the fundamental elements which need to be considered when designing a traffic control signal. By definition, a traffic control signal is any power-operated traffic control device, whether manually, electrically, or mechanically operated, by which traffic is alternately directed to stop and permitted to proceed. From an application standpoint, traffic control signals are used to assign vehicular or pedestrian right-of-way at an intersection or mid-block location where passive devices (signs and pavement markings) do not provide an adequate level of safe and efficient operation.

As computer technology and solid-state electronics have been applied by the traffic control signal industry, traffic control signals have become quite flexible in their range of traffic control. Therefore a great deal of influence on traffic flow, both advantageous and disadvantageous has resulted. It is necessary that the proper application, design, installation, operation, and maintenance of traffic control signals be exercised to ensure safe and efficient traffic flow.

1.2 CONDITIONS

The design for traffic control signals shall be in conformance with the current edition of the Manual On Uniform Traffic Control Devices, as published by The U.S. Department of Transportation, Federal Highway Administration. The following should be used as design standards as applicable to a project.

- A. The U.S. Department of Transportation - Federal Highway Administration - "Traffic Control Device Handbook".
- B. Jurisdiction Design Standards and Construction Standards.
- C. Iowa Department of Transportation (IDOT) and the Federal Highway Administration (FHWA) in regards to the design of traffic control signals.
- D. The Institute of Transportation Engineers - "Manual of Traffic Signal Design" and "Transportation and Traffic Engineering Handbook".

In case of a conflict between the above design standards, the Jurisdictional Engineer should be contacted for clarification.

1.3 DEFINITIONS

- 1. Amplifier: The electronic portion of a detector. See detector.
- 2. Cabinet: An outdoor enclosure for housing the controller unit and associated equipment.
- 3. Cable: A single or group of separately insulated wires contained within a single sheath or jacket.

4. CPU: Central Processing Unit
5. Combination Pole: A pole which supports both traffic control signal indications and safety lighting fixture(s).
6. Conflict Monitor: A device used to detect and respond to improper and conflicting signal displays and improper operating voltage in a traffic control signal. Also referred to as a Malfunction Management Unit.
7. Controller Unit (controller): A complete electrical device mounted in a cabinet for controlling the operation of a traffic control signal which is devoted to the selection and timing of signal displays.
8. Controller - Actuated: A type of controller unit in which means are provided for traffic or pedestrian solutions on one or more approaches to the intersection and which the allocation of time per approach is based upon the detected traffic demands.
9. Controller - Isolated: A controller unit installation for operating signal displays at a single intersection which is not under master or central computer supervision.
10. Controller - Pretimed: A type of controller unit for the operation of traffic control signals with; fixed cycle lengths, fixed interval durations, and fixed interval sequences.
11. Controller - System: A controller unit installation for operating traffic signals under the supervision of a master controller assembly.
12. Controller - Master: A controller unit installation for supervising a system of secondary controller units or a central master assembly supervising several systems of secondary controller units.
13. Controller - Master/System: A controller unit installation for both supervising a system of local controller units and operating as a controller unit.
14. Controller - Local: A controller unit which is supervised by a Master/System controller unit.
15. Coordination: The control of controller units in a manner to provide a relationship between specific green indications at adjacent intersections in accordance with a time schedule with the intent to permit continuous operation of groups of vehicles along the street at a planned speed.
16. Cycle: The time required for one complete sequence of signal indications. In an actuated controller unit a complete cycle is dependent upon the presence of vehicles on all phases.

17. Cycle Length: The time period in seconds required for one complete cycle.
18. Demand: See detector.
19. Demand Operation: See Controller - Actuated.
20. Density: A measure of the concentration of vehicles, stated as the number of vehicles per lane per mile.
21. Detection:
 - 1) Advisory detection - The detection of vehicles on one or more intersection approaches solely for the purpose of modifying the phase sequence and/or length.
 - 2) Passage detection - The ability of a vehicle detector to detect the passage of a vehicle moving through the zone of detection and to ignore the presence of a vehicle stopped within the zone of detection.
 - 3) Presence detection - The ability of a vehicle detector to sense that a vehicle whether moving or stopped, has appeared in the zone of detection.
22. Detector: A device for indicating the presence or passage of vehicles or pedestrians. Types of detector function include: Bidirectional, Calling, Classification, Directional, Extension. Detector mechanisms include: Infrared, Light-sensitive, Loop, Magnetic, Magnetometer, Nondirectional, Pedestrian, Pneumatic, Pressure Sensitive, Radar, System, Side-fire, Sound sensitive, Ultrasonic.
23. Detector - Delay:
 - 1) Extension output - The ability of a detector to continue its output for a predetermined length of time after the vehicle has left its zone of detection.
 - 2) Delayed output - The ability of a detector to delay its output for a predetermined length of time after a vehicle has entered its zone of detection.
24. Detector Failure: Any condition where a detector fails to sense the presence of a vehicle in its zone of detection or a pedestrian actuated input; or, improperly outputs a signal(s) in the absence of a vehicle or pedestrian.
25. Detector Mode: A term used to describe the operation of a detector channel output when a presence detection occurs.
 - 1) Pulse mode - Detector produces a short output pulse when detection occurs.
 - 2) Controlled output - The ability of a detector to produce a pulse that has a predetermined duration regardless of the length of time a vehicle is in the zone of detection.
 - 3) Continuous Presence mode - Detector output continues if any vehicle(first or last remaining) remain in the zone of detection.

4) Limited Presence mode - Detector output continues for a limited period of time if vehicles remain in the zone of detection.

- 26. Detector Zone of Detection: That area of a roadway within which a vehicle will be detected by a vehicle detector system.
- 27. Dilemma Zone: The portion of the roadway in advance of the intersection within which the driver is indecisive as to stopping or proceeding into and through the intersection at the onset of the yellow change interval.
- 28. Direct Wire: A communication medium which utilizes hardwire interconnect between the transmission and reception points.
- 29. Dual Entry: A mode of controller unit operation in which two allowable simultaneous phases are called by the controller even if only one of the phases is being called for by vehicle detection.
- 30. Emergency Vehicle Preemption: The transfer of the normal control of signals to a special control mode for emergency vehicles.
- 31. Force-off Command: A system command that forces the termination of a phase of a traffic signal.
- 32. Interconnect: The communication network connecting the master/system controller unit with local controller units.
- 33. Interval: A discrete portion of the signal cycle during which the signal indications remain unchanged.
- 34. Interval Sequence: Specifies the order in which the various intervals are displayed.
- 35. Interval Timing: The passage of time which occurs during an interval.
- 36. Lead/Lag Left: Lead left occurs when left turn movements from one approach or opposing approaches move on an arrow indication prior to the through movement. Lag left occurs when the left turn movement(s) follow the through movement.
- 37. Measures of Effectiveness (MOEs): Indices of the effectiveness of the system in improving traffic flow. Common bases of comparison include congestion, density, lane occupancy, stops, delays, queue length, accident rate, and vehicles per hour.
- 38. NEMA: National Electrical Manufacturers Association. Developed to define standards of designing, interface and interchangeability of controllers and auxiliary devices.
- 39. Occupancy: The percentage of roadway occupied by vehicles at an instant in time. In general use, it is a measurement based upon the ratio

of vehicle presence time (as indicated by a presence detector) over a fixed period of total time.

40. Offset: The time difference or interval in seconds or percent(%) between the start of the green indication at one intersection as related to the start of the green interval at another intersection or from a system time base.
41. Offset Selection: Choosing one of several possible offsets either manually or automatically either by time-of-day or in response to some directional characteristic of traffic flow.
42. Overlap: A right-of-way indication that allows traffic movement when the right-of-way is being assigned to more than two non-conflicting traffic phases.
43. Permissive Left Turn: A left turn movement that must yield right-of-way to opposing traffic.
44. Phase: A part of the traffic signal time cycle allocated to any combination of traffic movements receiving right-of-way simultaneously during one or more intervals.
45. Phase Sequence: The order in which a controller cycles through phases.
46. Preemption: The term used when the normal signal sequence at an intersection is interrupted and/or altered in deference to a special situation such as the passage of a train, bridge opening, or the granting of the right-of-way to an emergency vehicle.
47. Protected Left Turn: A left turn movement is given an arrow indication assigning right-of-way exclusively to that movement.
48. Real Time Control: The processing of information or data in a sufficiently rapid manner so that the results of the processing are available in time to influence the process being monitored or controlled.
49. Recall: An operational mode for an actuated intersection controller unit whereby a phase, either vehicle or pedestrian, is displayed each cycle whether demand exists or not. Useful in a temporary or emergency situation. Examples include; maximum, minimum, pedestrian, and soft.
50. Relay: An electromagnetic switching device, having multiple electrical contacts, energized by electrical current through its coil. It is used to complete electrical circuits.
51. Responsive Mode: A system operation wherein the selection of system timing plans is based on current traffic data as input by vehicle detectors within the system.

- 52. Skip Phasing: The ability of a controller to omit a phase from its cycle of operation in the absence of demand or as directed by a master control.
- 53. Speed: May refer to either the posted speed limit or the 85th percentile speed as measured in a speed study.
- 54. Speed Trap: Two or more sensors strategically positioned and spaced to permit the computation of vehicle speed by measuring the time between detection as a vehicle passes from one detector to another.
- 55. Split: A percentage of the cycle length allocated to each of the various phases in a signal sequence.
- 56. System Timing Plans: A unique set of traffic parameters (cycle, split, and offset) associated with each signalized intersection within a predefined group of intersections (a system or subsystem).
- 57. Time-Base Coordination: Traffic signal coordination based upon an internal electronic clock in each controller unit rather than an interconnect.
- 58. Time-of-Day Plans: System timing plans selected according to the time of day.
- 59. Transceiver: A communications device used to both transmit and receive information. A transmitter and receiver on a common chassis.
- 60. Yield: The action of allowing a semi-actuated controller, or an actuated controller operating in the semi-actuated mode, to terminate the main street phase so as to begin satisfying existing cross-street demand.