CHAPTER 12: SIGNALS AT ROADWORKS

12.1 INTRODUCTION

1 Temporary traffic signals may be provided at roadwork construction sites for the following purposes:

(a) to successively give right of way to two-way traffic approaching from opposite directions, along a single traffic lane, in place of a manually operated STOP-GO sign; or

(b) to control the movement of traffic, including site vehicles, where a public road enters or crosses a road that is under construction, or haul road; or

(c) as an interim measure to control traffic where a permanent traffic signal is to be provided, altered or replaced as part of a roadworks project.

2 Temporary traffic signals should be installed and operated only where warranted as follows:

(a) at a road junction or pedestrian crossing where traffic flow and delay conditions would otherwise warrant a permanent installation; or

(b) where there is undue delay or danger to public traffic at the junction of a public road and a road under construction or a haul road, as a result of construction operations, provided that the overall disbenefit to public traffic does not exceed the benefit to construction traffic; or

(c) where the control of two-way traffic on a single traffic lane is warranted; or

(d) where it would otherwise be necessary to exercise manual control by means of a STOP-GO sign during hours of darkness.

3 Temporary traffic signals should preferably not be operated for longer periods than 6 months. If required for longer than 6 months, the installation of permanent signals should be considered.

4 The principles of traffic signal control at permanent installations apply equally to temporary installations. This means that the numbers and locations of signal faces, the compulsory provision of background screens (backboards), sight distances, etc. also apply to temporary traffic signals. The speed limit at the traffic signals shall also not exceed a maximum of 80 km/h.

5 It is recommended that three yellow retro-reflective strips be provided on the signal posts and that white retro-reflective borders be used on backboards. Temporary traffic signals are often used in locations with poor background lighting and where they may be more subject to failure than permanent signals. The signals are also often used in locations where traffic signals would not normally be expected by drivers. It is therefore important that more attention should be given to the visibility of the signals.

6 Precaution should be taken to ensure the uninterrupted operation of the signals, by securing them against theft and vandalism, and by providing an effective power source. Lights and plant should wherever possible be securely anchored down and cables should be buried.

7 Warning signs should be provided in advance, but the signs should be concealed or removed while the signals are not operative.

8 Details of the use of temporary traffic signals at roadworks are given in Chapter 13 of Volume 2 of the Road Traffic Signs Manual.

12.2 VEHICLE-ACTUATED CONTROL

1 Depending on the anticipated traffic pattern, a manual or a vehicle-actuated traffic control signal with temporary actuation loops is likely to be more efficient than fixed time signals.

2 The operation of temporary vehicle-actuated signals at junctions does not differ significantly from that of permanently installed signals, and the same principles may be applied. The only difference would be in the use of temporary detection loops. Use can also be made of microwave detectors that do not require installation of loops in or on the road surface.

3 Vehicle-actuated control is particularly important in the control of two-way traffic on a single lane of traffic. Loops are not only needed on the approaches to such a lane, but can also be provided on the lane with the purpose of extending the all-red period just sufficiently for vehicles to clear the lane. This type of control is discussed below.

12.3 TWO-WAY TRAFFIC IN A SINGLE LANE AT ROADWORKS

12.3.1 General

1 Temporary traffic signals are often used for the control of two-way traffic in a single lane, particularly when the length of the lane is long. The signals are used to successively give right of way to the two-way traffic from opposite directions.

2 At least two traffic signal faces of type S1 shall be provided on a two-way single lane road at roadworks, one on each side of the road, at a position not less than 6 m (but preferably not less than 10 m) beyond the stop line RTM1. However, where the traffic signal is manually operated, only one such signal face may be provided.

3 The stop line must be suitably located on the wider part of the road so that opposing traffic can pass vehicles waiting at the stop line.

4 Portable equipment may be used in the signal installations. At least two sets of traffic signals will be required, each set consisting of:

(a) Signal faces mounted on a yellow post, fitted with backboards (preferably with retro-reflective borders and strips).

(b) A signal controller, equipped with a radio module, and if necessary a manual remote control unit.

(c) A set of vehicle detectors (preferably microwave detectors).

(d) Power pack of batteries and/or generator.

(e) Spare equipment, particularly spare lamps.

5 The controller may allow for two-phase operation only. Each side of the lane has a separate controller, one of which must be switched to “master” operation and the other to “slave” operation. The controller must provide that, in the event of failure or a loss in radio communications, the signals revert to flashing red mode.

6 Vehicles can be detected by means of temporary induction loops, but microwave detectors could be more appropriate. Detectors can be installed on the approaches to the single lane, and also on the lane itself. Detectors on the approaches are used for the extension of the green interval and the detection of demand, while detectors on the lane itself may be used for adjusting (extending) the all-red interval.

7 When the signals are located relatively close together, a cable may be used to link the two controllers. In cases where the two signals are spaced very close together, one controller can be used to drive both sets of signals.

8 Where the signals are located further apart, radio communication would be the more desirable method of linking the two controllers. Care should be taken that such a radio would be able to communicate reliably over the distances required.

12.3.2 Manual operations

1 The traffic signals may be operated in manual mode. For such operations, a remote control unit should preferably be provided. This remote unit can be connected to the signal controller with a cable. The use of the remote unit allows the operator to be located safely in a position where the approach is clearly visible (but preferably in a position where both approaches are visible).

2 In manual mode, the operator controls the duration of all-red and green intervals, but not that of the yellow interval that is predetermined. Minimum periods may be set for the green and all-red intervals. The controller must prevent green accidentally being displayed in both directions.

3 The operator should view both approaches and switch the signals accordingly. When this is not possible, an assistant should be provided who is in radio contact with the operator. This assistant will inform the operator when vehicles are approaching or waiting to be served at the other end of the single lane, and when the queue of vehicles has departed from the approach.

4 The operator should provide only sufficient green for the waiting queue of vehicles to depart from the signal, except when there is no demand at the other end of the single lane. An adequate all-red period must be provided to allow the last vehicle to exit from the single lane.

5 In the absence of traffic demand on any of the approaches, the operator should rest the signal in all-red. This will allow a green light signal to be provided soon after a vehicle has arrived on either side of the single lane.

12.3.3 Fixed time operations

1 In fixed time operation, green and all-red intervals are predetermined and there is no response to vehicle demands. This type of operation is not very efficient, but it has the advantage that it is less costly to operate and maintain.

2 In fixed time mode, the maximum 15-minute traffic demand that is likely to occur must be established and sufficient green provided. The duration of the green intervals can be established as for a normal fixed time controlled junction, except that a longer all-red period is provided.

3 The all-red interval should provide sufficient duration for slow moving traffic to clear the single lane before the onset of the opposing green. This should be established based on the 15^{th} percentile free-flow speed on the lane (judgement may be required to establish whether this would be adequate). The all-red period may not be less than 2 seconds.

4 When sufficient sight distance is provided, a shorter all-red may be used, and a flashing red light signal provided to indicate that drivers can proceed after stopping if the way ahead is clear.

12.3.4 Vehicle-actuated operations

1 Vehicle-actuated operations allow signals to automatically respond to vehicle demands. The signals will change in response to the registered demand as vehicles actuated the detectors.

2 The vehicle-actuated controller will only provide green until a gap is detected on the approach, and a demand has been registered on the other side of the single lane. When a gap is detected, the signal will change to the next phase, subject to the provision of minimum green intervals.

3 Vehicle detectors can also be provided on the lane itself, which will allow for the adjustment (extension) of the all-red interval. These detectors should be spaced at constant distances, and an extension time provided which will allow a vehicle travelling at the 15^{th} percentile speed to reach the next detector (and finally the stop line) within the extension time provided. A minimum all-red period equal to this extension time must be provided to allow departing vehicles to reach the first detector along the single lane. Extensions must be provided for both directions of movement.

4 The adjustment of the all-red interval can significantly reduce unnecessary delays when roadworks occur over long distances. Assuming a 15^{th} percentile speed of about 12,5 m/s (45 km/h), a single lane of 1 km would require an all-red interval of about 80 seconds (1000 m/12,5 m/s = 80 s). If the last vehicle departing from green travels at a higher speed of 20 m/s (72 km/h), only 50 seconds of travel time would be required. This would mean that vehicles would be waiting unnecessarily at the other side for 30 seconds while all vehicles have already cleared the lane.

5 Suppose three extension detectors are provided along the lane at 250 m distance intervals. This would require an all-red extension time of 20 seconds (250 m/12,5 m/s = 20 seconds).

6 A minimum all-red period of 20 seconds is provided on termination of green. If the last vehicle to depart is travelling at a speed of 20 m/s, this vehicle would reach the first detector after 12,5 seconds, or 7,5 seconds ahead of the minimum all-red period. The first detector extends the all-red period by 20 seconds to a total of 12,5+20 = 32,5 seconds.

7 The vehicle reaches the second detector 25 seconds after it had left the stop line. The all-red period is extended by 20 seconds to a total of 25+20=45 seconds. At the third and last detector, the all-red period is be extended to the final total value of 37,5+20 = 57,5 seconds.

8 The vehicle travelling at 20 m/s will be exiting from the lane after 50 seconds. This then means that vehicles will only wait unnecessarily for about 7,5 seconds, which is significantly less than the 30 seconds without detectors.

9 The above delays are directly related to the length of the single lane. A single lane of 2 km would double the delays, while a lane of 10 km would cause 10 times as much delay.

10 In the absence of any demand, the signals should revert to all-red, until a vehicle is detected. This feature ensures that the signals are then able to give right of way to the first approaching vehicle with minimum delay. This is a further important advantage of vehicle-actuated control.