# CHAPTER 29: SIGNAL TIMING UPDATING

## 29.1 INTRODUCTION

1 The timing and phasing of traffic signals will inevitably become outdated due to changes in traffic demand or improvements to the road network. Traffic signal settings therefore need to be reviewed periodically to ensure that the traffic operations are optimal.

2 Methods for timing and phasing traffic signals are described in Chapter 5 of this manual (Volume 3). The purpose of this chapter is to discuss a management system that would ensure that traffic signals are updated when needed.

## 29.2 NEED FOR UPDATING

1 Traffic signal timings only need to be updated when changes have occurred. In situations where the road network is unchanged and traffic patterns do not vary much, regular updates are not required. The management system should therefore be orientated towards identifying those signals where changes have occurred since the previous timing update and establishing whether the signals require updating.

2 Generally, priority will be given to updating traffic signal timings when new traffic signals have been installed or where physical changes have been made to a junction:

(a) The installation of new traffic signals often affects traffic patterns in an area. This will require updating of traffic signal timings once the traffic patterns have been stabilised. At least one month should be allowed for traffic to stabilise.

(b) Traffic signal timings will have to be updated when the geometry of a junction has been improved or the allocation of lanes to turning movements has been changed. If such changes are likely to affect traffic patterns in the area, it would be preferable to allow at least one month for traffic to stabilise.

3 At other junctions, priority would be given to junctions that are operating at high levels of saturation AND where high levels of traffic growth are being experienced. Junctions are less in need for updating when they are operating at lower levels of saturation OR where traffic growth is low.

4 An indication of the required signal timing updating cycle is given in Table 29.1. According to this table, signal timings should be updated every 1 or 2 years when traffic growth rates are high or when the signals are operating at a high degree of saturation. When traffic growth rates are average or when traffic signals are not operating at a high degree of saturation, signal timings should be updated every 2 or 3 years. A 3 to 5 year updating cycle would be acceptable when traffic growth rates are low or when the signals are operating at lower degrees of saturation.

5 The signal updating cycles given in Table 29.1 are not precise and can be adjusted according to specific circumstances and the availability of funds.

6 The table also presupposes that there is information available on traffic growth rates and degrees of saturation at signals. Other approaches and other updating cycles may be required when such information is not available or cannot readily be estimated.

## 29.3 DATA REQUIREMENTS

1 A traffic signal timing update management system should be based on a properly structured information collection and record keeping system. This system should, at a minimum, provide for the following basic information requirements:

(a) Record keeping of the date on which a traffic signal was last updated, the traffic counts used for such an update and the maximum degree of saturation calculated for the signal.

(b) A procedure should be instituted within an authority whereby the traffic signal design division is informed i) of any changes to the road network and ii) any new developments that could affect traffic patterns in an area. In fact, the division should form part of all decision making processes related to road network improvements and new developments.

(c) Traffic information is also required whereby changes in traffic patterns and volumes can be identified or growth rates estimated.

**TABLE 29.1: SIGNAL TIMING UPDATING CYCLE (YEARS)**

| Traffic growth rates per annum | | Degree of saturation | | |
|---|---|---|---|---|
| | | < 0,60 | 0,60 - 0,80 | > 0,80 |
| **Low** | **0 - 3%** | 3 - 5 | 3 - 5 | 2 - 3 |
| **Average** | **3 - 5%** | 3 - 5 | 2 - 3 | 2 - 3 |
| **High** | **5 - 8%** | 2 - 3 | 2 - 3 | 1 - 2 |
| **Exceptionally high** | **> 8%** | 2 - 3 | 1 - 2 | 1 - 2 |

2 The collection of traffic information is an important component of the signal timing updating management system. Such traffic information collection can be orientated towards the updating of signal timings only, but often it forms part of a broader traffic information system.

3 Once a signal has been identified for updating, the signal should first be inspected during peak hours and a visual check made to establish whether the changes cannot be made by slight timing adjustments (using fine tuning techniques), or whether a full update is required. If a full update is required, traffic counts will be required for the updating.

## 29.4 TRAFFIC COUNTING SYSTEMS

### 29.4.1 General

1 The cost of traffic counts can be relatively high, particularly when it is necessary to update a number of traffic signal plans operating on different days of the week. The system described below can reduce the cost of traffic counts while maintaining a relatively high quality of information. The system uses a combination of automatic and manual traffic counts. Automatic traffic counts are taken on road links while manual traffic counts are taken at junctions.

2 The automatic traffic counts are used to establish broader traffic patterns and for the identification of areas where traffic patterns have changed significantly. Traffic growth rates can also be established from the counts and used in the estimation of signal timing updating cycles. Manual counts are required for establishing the traffic signal settings.

3 An advantage of the automatic traffic counts is that the counts normally cover the seven days (and nights) of the week. It is thus possible to identify changes that may occur only during particular days of the week. For instance, traffic patterns may be changing on Saturdays due to the development of shopping centres, while patterns may remain constant for the rest of the week.

4 The seven-day counts can also be used to identify design periods for each traffic signal timing plan. Manual counts can then be limited only to these periods, thus reducing the cost of such counts.

### 29.4.2 Automatic traffic counts

1 Automatic traffic counts are undertaken on road links rather than at junctions. The counts are taken at either permanent or coverage counting stations.

2 At permanent automatic counting stations, traffic is counted for 365 days of a year. These long-term counts are used primarily for the estimation of expansion factors that is used for expanding short-term traffic counts to an Annual Average Daily Traffic (AADT). The counts can also be used for the identification of exceptional traffic patterns caused by incidents that disrupted traffic flow in an area. Only a few counting stations, however, are normally required for these purposes since additional information can also be obtained from coverage counting stations.

3 Coverage automatic traffic counts are taken over a period of seven ***normal*** days of the week. These counts are used to supplement counts obtained from permanent counting stations to establish typical weekly traffic patterns and traffic growth rates in an area. In a traffic signal timing updating management system, they would be used to assist with the identification of traffic signals that require updating.

4 It is not necessary to count traffic annually at all coverage stations. On roads with low growth rates, traffic can be recounted once every two or three years. On roads with a high traffic growth, counts may have to be taken annually. A shorter counting cycle would also be required on the higher classes of roads, while lower classes of roads can be recounted less often.

### 29.4.3 Manual traffic counts

1 The manual counting method is used for counting traffic at junctions. Although significant developments have occurred in the field of automatic traffic counts, turning movement counts cannot readily be counted automatically.

2 Manual counts can be taken by using simple tally sheets, or by means of tally counters. Traffic counts are collected in 15-minute intervals (or shorter) and recorded on count forms. The counts can further be processed manually by means of a computer spreadsheet program or specialised computer software.

3 The disadvantage of manual traffic counts is that they become costly when undertaken over extended periods of time. At signals where counts are required for a number of timing plans, counting periods should be carefully selected to reduce the extent of the counts. The counting periods are often selected based on traffic patterns obtained from automatic counting stations.

4 The following are a number of practical aspects that need to be considered when manual traffic counts are conducted:

(a) Traffic counts should not proceed on those days when exceptional events occur. One of the counting team members (preferably the supervisor) should be on the lookout for such events. Counts should be discontinued if such exceptional events occur.

(b) At heavily congested junctions, it may also be necessary to observe queue lengths with the purpose of adjusting the traffic counts to account for growth or decay in queue lengths.

(c) A system of quality control is essential. A supervisor should be available to undertake spot checks on a regular basis.

(d) Recording of traffic counts at the end of each interval requires a finite amount of time. During this time, vehicles entering a junction may not be counted.

5 The recording of traffic counts at the end of each interval may result in the under-reporting of traffic volumes. This is not a major problem when traffic volumes are low, but it could become an issue during peak hours. The problem can be addressed by employing more personnel. An alternative method is to provide for a short break of about one minute at the end of each 15 minute counting period for the recording of the counts (counts are then only taken over 14 minutes).

### 29.4.4 Queue length adjustments

1 A traffic count is not always an indication of traffic demand. A low traffic volume could indicate congested conditions rather than a low demand. If this occurs, queues of vehicles at traffic signals should be observed and the traffic counts adjusted for changes in the queue lengths. These queues may be forming at the signal or signals being investigated or at other upstream bottlenecks in the system. In such cases, the traffic demand should be estimated at such bottlenecks and projected through the road network.

2 Queues at a bottleneck may rapidly build up during congested conditions. During saturated conditions, vehicles cannot move through the bottleneck during the 15-minute counting interval, resulting in a residual queue at the interval. The traffic count should therefore be adjusted accordingly.

3 The traffic demand can be estimated by observing this increase in the residual queue. For example, suppose the queue length at the start of a 15-minute interval is 25 vehicles, and this increases to 65 vehicles at the end of the interval. In such a case, the traffic demand is increased by the difference in the queue lengths, or by 40 vehicles in 15 minutes. This increase in demand should be projected through the entire signal network.

4 The converse is also true when a queue length decreases. If the queue length was 65 vehicles at the start of the interval and this reduces to 25 vehicles, the traffic demand is reduced by the difference, namely 40 vehicles.

5 When queue length adjustments are made at traffic signals, it is important that the queue length observations should be taken at one particular time in the signal cycle, preferably at the end of a green period. Queue lengths at signals can vary significantly over one cycle, and taking queue lengths at different times of the cycle could lead to the erroneous adjustment of traffic volumes.

6 The above adjustments would still probably under- or overestimate actual traffic demand due to traffic diverting to other routes in the network. Improvements of the road network and traffic signal settings may result in the traffic again redistributing throughout the network.

### 29.4.5 Normal and exceptional days

1 The issue of normal and exceptional days is an important consideration when traffic is counted. Normal days occur most often during the year, and traffic volumes are more constant and show fewer fluctuations than traffic on exceptional days.

2 The possibility of large counting errors can be reduced if traffic is counted on normal days when the traffic flow is relatively stable, unaffected by events such as traffic accidents, road closure, construction and inclement weather, and during schools terms. Exceptional days include public and school holidays, as well as days on which traffic patterns are abnormal due to events such traffic accidents, road closures, road construction, inclement weather, special sporting events, etc.

3 Exceptional days may be either unpredictable or predictable. The unpredictable days are days that cannot be predetermined and are typically caused by traffic accidents, construction and inclement weather. Predictable exceptional days are that can be predetermined and are known in advance, such as school and other holidays. Unpredictable exceptional days typically occur less often than predictable days.

4 Predictable exceptional days include public and school holidays, as well as other days which may be influenced by such holidays. A single public holiday in a week can affect traffic patterns during all the other days of the week, while a school holiday may affect traffic patterns for the full duration of the holiday as well as periods before and after the holiday.

5 It is more difficult to identify unpredictable exceptional days, with the result that counts taken on such days are probably the cause for some inappropriate traffic signal settings. It is therefore important that an effort should be made to establish whether an exceptional event occurs on the day traffic is being counted. If such an event occurs, the count is terminated and retaken on another day.

6 The following are examples of events that may result in exceptional traffic patterns:

(a) Road accidents at a junction, or at nearby junctions.

(b) Traffic signals out of order, either at the junction being counted or at a nearby junction.

(c) Rainfall that has a disruptive affect on traffic flow. Traffic flows are not likely to be affected when light rain occurs over a relatively short period of time, but flows can be affected during heavy thunderstorms.

(d) Road construction or the temporary closure of roads in the area.

(e) Special events, such as cultural, sport and political events.