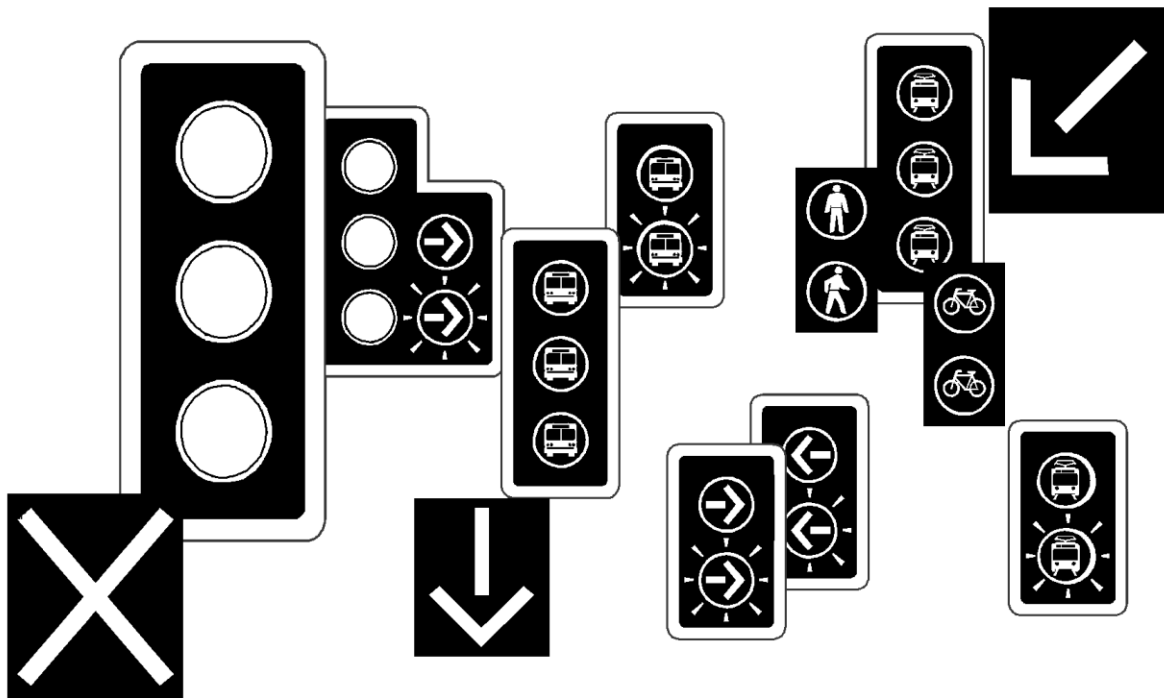


SOUTH AFRICAN ROAD TRAFFIC SIGNS MANUAL

VOLUME 3: TRAFFIC SIGNAL DESIGN

DIGITISED VERSION – May 2012

PART 3 TRAFFIC SIGNAL MANAGEMENT



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CHAPTER 23: RESPONSIBILITIES AND DUTIES

23.1 INTRODUCTION

- 1 South African road authorities have powers and functions to provide and monitor roads and streets to promote mobility as well as economic development and to ensure efficient and safe operation of the road network. Traffic signals form an integral part of the transportation system and road network and are therefore the responsibility of the relevant road authority, or the designated authority to which the responsibility has been delegated.
- 2 A fundamental responsibility of a road authority is to ensure that traffic signal systems operate as efficiently and safely as possible. Traffic signals that are not properly installed, operated and maintained will severely affect traffic flow and could lead to an increase in traffic accidents.

23.2 INSTITUTIONAL RESPONSIBILITY

- 1 Road authorities in South Africa have permissive powers to maintain and repair roads and streets, although there is no specific obligation on an authority to undertake such duties. This, however, does not exempt a road authority, undertaking such duties, from the responsibility to ensure a safe road environment.
- 2 Traffic signals are specifically controlled by the National Road Traffic Regulations as well as the Road Traffic Signs Manual. Non-compliance to these regulations as well as the requirements contained in the manual can increase the risk of litigation in cases of loss of property, or injuries arising from accidents.
- 3 It is particularly important that standards and guidelines must be applied professionally and objectively, without undue influence by outside factors. Changes to standards that cannot objectively be quantified would increase the risk of litigation.
- 4 Road authorities should also introduce risk management programmes with the aim of reducing the possibility of litigation. Such programmes would encompass a variety of actions to ensure that standards are appropriately applied and to identify limitations in a system.
- 5 Road authorities also have the responsibility to ensure that traffic signal installation and maintenance are undertaken and controlled by professionals with appropriate levels of skills and knowledge. Failure to do so would be a failure of the duty of the authority.

23.3 INSTITUTIONAL CO-OPERATION

- 1 Traffic signal systems have become highly complex and intricate, requiring increasingly wider and more specialised skills of personnel involved with such systems. The complexity can be expected to evolve even more in the future, which will further increase the required skill levels. Such skill levels can more easily be provided when different road authorities co-operate institutionally, providing an integrated signalisation service.
- 2 In many cases, traffic signal operations can be expected to extend across several jurisdictions, which makes it imperative that different road authorities should co-operate in the field of traffic signalisation. The utility and efficiency of signals can be improved by integrating traffic signal systems.
- 3 **Co-operation is particularly important amongst smaller road authorities. Where road authorities control less than 200 traffic signal installations, it is strongly recommended that, where possible, such road authorities co-operate and fund a combined traffic signal division. Even larger road authorities should co-operate where it is possible to provide an integrated traffic signal system.**
- 4 High priority should be given by all road authorities to institutional co-operation. Such co-operation can easily be achieved, with a minimum of investigation and research.

23.4 SIGNAL MANAGEMENT

- 1 Communication within a road authority and with outside entities is an important management function. Good relations with the public are also essential, particularly when problems arise with traffic signalling.
- 2 Each authority should establish an ad-hoc traffic signal committee with the purpose of managing all aspects related to traffic signals, including applications or requests for new traffic signal installations.
- 3 The traffic signal committee should consist of the following members:
 - (a) Manager of the traffic signal division.
 - (b) Representatives of the traffic police.
 - (c) Representatives of road and transportation departments, particularly those involved with the planning and design of roads.
 - (d) Representatives of any other department that provide a service or who may be affected by traffic signals.
- 4 The traffic signal committee would be responsible for overseeing the traffic signal division and to ensure that traffic signals are installed and maintained with the highest level of proficiency and responsibility. The committee may also assist with funding and budget control.
- 5 **The committee should also review the geometric designs of all new road and junction proposals in order to ensure adequate provision is made for possible future signalisation.**

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CHAPTER 24: RISK MANAGEMENT

24.1 INTRODUCTION

- 1 Road authorities undertake work that carries a substantial risk of litigation resulting from cases of loss of property and injuries arising from accidents (collisions). It is therefore imperative that risk management procedures should be introduced in order to minimise the potential for accidents, thereby reducing the risk of litigation and being held liable for damages.
- 2 In South Africa, road authorities have permissive duties to provide, maintain and repair roads and related facilities, but are under no obligation to do so. There can thus be no liability for damages occasioned by non-performance of powers which are merely permissive. Where, however, a road authority undertakes such work, it would be liable for any damages caused by its negligence, even where no obligation rests on the authority to undertake such work.
- 3 A road authority has an active duty to guard against introducing a new source of danger when undertaking work on a road or street. The condition after completion of work should not be more dangerous than before the work was undertaken.
- 4 An important consideration is that a road authority cannot ensure absolute safety to the user of the road system. There is a limit to the measures that can be introduced to improve road safety and the road user also has some responsibility in this regard.
- 5 In the United States of America, all liability suits are founded in a particular area of law, called *tort* law. A tort is a private or civil wrong that results in injury or loss caused by the *tortious* acts of a person or a legal body. In South Africa, the delictual liability for damages caused by a person's actions is governed by common law.
- 6 In South Africa, liability suits have thus far been less common than in the United States. The outcome of liability cases in South Africa depends on the facts of each case and cannot be predicted with certainty as applicable laws and principles develop and change over time. However, although cases to date have not been unreasonable in their verdicts, it is apparent that a road authority that does not adhere to legislation and guidelines leaves itself open to expensive liability suits.

24.2 STANDARDS AND GUIDELINES

- 1 Traffic signals are specifically controlled by National Road Traffic Regulations as well as the Road Traffic Signs Manual. Non-compliance to these regulations as well as the requirements contained in the manual will increase the risk of litigation and the possibility that the road authority will be found in neglect of its duty.
- 2 Non-compliance with the National Road Traffic Regulations is a criminal offence and may lead to criminal prosecution being instituted against a road authority.
- 3 Standards and guidelines must be applied professionally and objectively, without undue interference by outside influences. It is unlikely that the standards and guidelines will be questioned, as well as deviations that were justified objectively. Arbitrary deviations that cannot be justified objectively, however, would increase the likelihood of an authority being found in neglect. On the other hand, "going by the book" may not be sufficient and additional consideration may be required to ensure safety over and above that provided by the minimum prescribed standards.
- 4 A particularly important requirement of the National Road Traffic Regulations is that a professional engineer or technologist must approve traffic signal installations. It must furthermore be designed in accordance with the regulations and the Road Traffic Signs Manual. Non-compliance with the regulations could be interpreted as an abuse of the duty of the road authority and could create liability.
- 5 A road authority can use its discretion in selecting amongst alternative solutions, as long as all the alternatives meet the required standards and guidelines.
- 6 Even if the standards and guidelines have been properly followed when the traffic signal was installed, it is the duty of road authorities to ensure that a design does not become manifestly dangerous following its adoption. Road authorities may not have an ostrich-like approach in which problems are ignored with the hope that they will disappear.
- 7 At traffic signals, it is imperative that operations should be reviewed immediately after installation, or after any changes that materially alter the operations of signals, to determine if the changed conditions have not inadvertently resulted in dangerous conditions. Failure to do so would increase the risk of liability.

24.3 NOTICES OF DEFECT

- 1 Knowing about a problem means that a road authority has been given notice that a problem exists. A notice of a problem creates the duty for the road authority to remedy a defect or face liability risk when operations are continued without addressing the problem. Negligence stems from notice of a defect and the subsequent failure to safeguard against the consequences of the defect.
- 2 A road authority may receive *actual* or *constructive* notices of a defect. An *actual* notice occurs when an authority has received communications from the public or its own employees. A *constructive* notice occurs when the authority should have known of a defect.
- 3 A particularly important constructive notice is an actual notice that was given to an authority, but which was not handed over to the traffic signal division. It is unlikely that internal communication problems would be treated as a mitigating consideration - it is the responsibility of authorities to ensure that such communication problems do not exist amongst departments or divisions. A local authority is treated as a legal entity, but not its internal departments. Passing blame from one department to another will not assist a case – in most cases, it will aggravate the matter as it shows the lack of proper management and care.
- 4 A constructive notice would also occur when an employee of the traffic signal division has been in a position to observe a problem. In such a case, it would not even be necessary for the employee to have notified the road authority about the problem, since this would be treated as an internal communication problem that should have been addressed by the authority.
- 5 Constructive notice can also arise if the road authority has allowed a problem to exist for an unreasonable period of time without taking action. It may be found that the road authority had sufficient time to discover the problem if they were acting in a reasonable prudent manner. An unreasonable period of time would among other things, depend on the nature of the problem, the extent of the danger to the public and the financial situation of the authority.
- 6 Constructive notice also occurs when the road authority did not follow required standards and guidelines, even if they were not aware of the existence of such standards and guidelines. It is incumbent on a road authority that it is aware of the latest standards and guidelines. The authority has created the problem, therefore they have constructive notice and they could be negligent in this regard.
- 7 *Repeat accidents*, particularly if of a similar nature, can also be construed as constructive notice of a defect at a traffic signal installation. Accident statistics should be reviewed on a regular basis with the purpose of identifying signal installations where such repeat accidents occur.

24.4 CONSTRUCTION AND REPAIR

- 1 The construction and repair of a facility are considered to be a simpler operation than design, and it is therefore more likely that a road authority will be found in neglect for deficiencies during the construction or repair of a signal installation, even if the driver was mostly to blame for an accident.
- 2 Lapses in the provision of appropriate protective measures during the construction or repair of a traffic signal installation would probably result in a relatively simple negligence suit. It would be simple because the elements of the suit would be easy to prove, particularly that the breach of duty owed to the road user by a road authority, was the proximate cause of the accident, even if a driver had some duty to take due care.
- 3 Road authorities should be aware that in the employment of contractors, their basic responsibility to maintain roads in a reasonably safe condition can not be contracted away. The road authority should implement appropriate procedures to ensure that contractors abide by safety requirements. Contractors should be treated as if they are contracted employees.

24.5 RISK MANAGEMENT STRATEGY

- 1 A risk management strategy should address possible risks of failure resulting from all phases over the full life cycle of a project (planning, construction, maintenance and operations). It is particularly important that appropriate standards and guidelines be complied to, while steps should be instituted to ensure that faults and defects are speedily attended to.
- 2 **The most important method of reducing the risk of litigation is by employing personnel with the required skills and knowledge to ensure the safe operation of traffic signals.**
- 3 Good records are the foundation of any good risk management programme as they can provide a good defence for actions against a road authority. However, the same records can be used against the road authority when appropriate responses have not been taken or when notice of a defect is observed in the records. Such notice would indicate that the authority had knowledge of a defect, and that it failed to eliminate a known defect.
- 4 A good risk management programme would include appropriate preventative procedures for the identification of possible defects, either in the design or in the operation of traffic signals. The preferred procedure is one which seeks out problems by inspection and which does not rely entirely on complaints from the public or the police. This programme should not only seek out the problems, but should also address the need to rectify the problems.
- 5 Where there is a priority list for repairs or improvements, it is important that a road authority should not deviate from this list when there is no rational reason for such deviation. The priority list should also be established using rational and objective criteria.

- 6 Provision should be made for a 24-hour response to rectify emergency faults. It is not necessary to repair a fault immediately, as long as steps have been taken to safeguard a situation or to erect adequate warning signs. It must, however, be understood that temporary measures cannot be left indefinitely and that permanent repairs should be completed within a reasonable period of time. An authority leaving a traffic signal in flashing mode for days on end could find itself open to claims in the event of accidents.
- 7 An essential aspect of fault response procedures is to institute procedures whereby complaints are received and passed through appropriate channels. Appropriate records should be kept of such complaints as well as the responses to the complaints.

24.6 PERSONAL LIABILITY

- 1 Employees of road authorities are normally protected against liability suits while working within the scope of their employment. However, where gross negligence can be proven, it may be possible that such protection will fall away, or that the road authority itself could institute litigation against the individual concerned.
- 2 In the private sector, consulting engineers and contractors are most vulnerable. They have none of the protection available to employees of the public sector. Under these circumstances, there is a definite need for consulting engineers and contractors to obtain liability and professional indemnity insurance. A road authority should, in fact, insist on such insurance as part of the contract between the authority and the consultant or contractor.
- 3 Alternatively, a road authority can agree to indemnify consultants and contractors from any claims once traffic signals have been commissioned and approved by the responsible engineer or technologist of the road authority. Such indemnity should be part of the contract between the road authority and the consultant or contractor.

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CHAPTER 25: MANPOWER REQUIREMENTS

25.1 INTRODUCTION

- 1 The availability of knowledgeable and skilled professionals and technicians is an important prerequisite for effective and safe traffic signalisation. Traffic signal installations have become highly complex and their impact can impede traffic operations substantially. It is therefore important that priority should be given to ensuring that the highest levels of skill be employed by road authorities.
 - 2 In this chapter, minimum skill levels and educational requirements are discussed for professionals involved with traffic signals. Attention is also given to minimum staffing requirements and the utilisation of consulting engineers and contractors.
 - 3 Differentiation is made between the two main professional disciplines involved with traffic signals, namely traffic and electrical/electronic engineering. The traffic engineering discipline is involved with traffic operations and the setting of traffic signals, while the electrical and electronic engineering discipline is more involved with the installation, wiring and maintenance of the signals.
 - 4 A third discipline not covered in this chapter is the civil engineering discipline. At a signalised junction, this discipline would be involved with all work related to aspects such as the provision and construction of the road pavement, drainage structures, earth works, road signs, etc.
 - 5 The traffic and electrical/electronic disciplines directly involved with traffic signalisation should preferably be located within one traffic signal division. There is a definite need for a close relationship between the two groups.
 - 6 Larger road authorities are probably in a position where they can employ some of the professionals required from both professional disciplines, although they may have to supplement their own staff levels by appointing consulting engineers or contractors. Smaller road authorities, however, would not have sufficient numbers of traffic signals in operation to warrant the employment of such a range of professionals, and would therefore have to rely on consulting engineers and contractors to supply the necessary services.
- 2 Distinction can be made between the following three levels of professionals involved with traffic engineering work:
 - (a) Professional engineers.
 - (b) Professional engineering technologists.
 - (c) Support personnel such as technicians, computer programmers, CAD (computer aided design) operators and administrative staff.
 - 3 Both the professional engineers and the professional engineering technologists should have received specialist training specifically in the discipline of transportation and traffic engineering, and should preferably have postgraduate qualifications in this discipline.
 - 4 Professional engineers would normally be responsible for functions such as:
 - (a) Management and control of the traffic signal department or division (including the electrical and electronic section).
 - (b) Development of methods, procedures and standards and the investigation of new or alternative traffic signalisation techniques.
 - (c) Overall control of functions such as signal design, intersection layout, traffic data collection, etc.
 - (d) Provide guidance in the design of more complex signal installations, central control, signal co-ordination, non-standard intersection layouts, etc.
 - (e) Prepare and review traffic management plans, including traffic impact studies.
 - 5 Professional engineering technologists would normally be involved with the functions of signal design, intersection layout, traffic data collection, traffic signal configuration, etc. In addition to these, technologists can also become involved with the other functions identified above.
 - 6 The work of the traffic signal division would include tasks such as:
 - (a) Overall management of the traffic signal division, including budget control and reporting.
 - (b) Traffic data collection, including traffic volumes, speeds, saturation flows, accident rates, etc.
 - (c) Conceptual design and layout of signalised junctions.
 - (d) Design of traffic signal layouts, timings, phasing, and the co-ordination of traffic signals.
 - (e) Warrant studies for the installation of new traffic signals.
 - (f) Prioritisation of new installations and upgrading of existing installations.
 - (g) Investigations into new traffic signal control systems.
 - (h) Development of methods, procedures and standards.

25.2 TRAFFIC ENGINEERING

- 1 Traffic engineering professionals are those skilled in ensuring the safe and efficient flow of traffic through a signalised junction or crossing. These professionals would normally be involved with tasks such as warranting signal installations, the design and layout of signalised junctions and crossings, establishing traffic signal timing and phasing, signal co-ordination, and the collection of traffic data.

25.3 ELECTRICAL AND ELECTRONIC ENGINEERING

- 1 Electrical and electronic engineering professionals are those skilled in the electrical and electronic aspects of traffic signals. Most modern traffic signals involve the use of digital electronic devices and advanced telecommunication and data transmission systems; the installation, maintenance and repair of which require specialist knowledge in the discipline of electronics. All electrical work at a signal should also only be carried out by a qualified electrician.
- 2 It would normally not be necessary to involve professional engineers in the electrical or electronic side of signals. The following skill levels would typically be required for this purpose:
 - (a) Professional engineering technologists.
 - (b) Qualified electricians.
 - (c) Electronic technicians.
 - (d) Line workers.
 - (e) Worker assistants.
 - (f) Administrative staff.
- 3 The professional engineering technologists should be qualified in the disciplines of electrical and electronic engineering. The technologists will be responsible for the management and control of the electrical and electronic side of traffic signals.
- 4 The electricians will be responsible for the maintenance and repair of electrical components while electronic technicians will be responsible for electronic components of traffic signals. Line workers will undertake tasks such as lamp replacement, cleaning of lenses, painting of posts and alignment of signals. All three groups may be assisted by worker assistants.
- 5 The task of the electrical and electronic section includes:
 - (a) Management, supervision and control of all aspects related to the electrical and electronic side of traffic signals.
 - (b) Management and control of personnel, material, spares and tools.
 - (c) Keeping of records of all activities and inventory controls.
 - (d) Budgeting for new installations, maintenance and repair as well as controlling such budgets.
 - (e) Installation, maintenance and repair of all traffic signal equipment, including controllers and computers.
 - (f) Planning and scheduling of traffic signal installation, upgrading, modification, maintenance and repair.
 - (g) Management, supervision and control of installation and maintenance contracts undertaken by private contractors.
 - (h) Inspection of installations during various stages of completion and final acceptance on contract completion.
 - (i) Investigations into new developments in the discipline of signalisation.
 - (j) Providing advice to traffic engineers on the capabilities and limitations of traffic signal equipment.

- (k) Planning and implementing maintenance and upgrading programmes. Developing procedures for the establishment of maintenance and upgrading priorities.
- (l) Training of personnel in all electrical and electronic related aspects of traffic signals.
- (m) Appearing as expert witnesses in litigation involving the electrical and electronic aspects regarding operation and maintenance of traffic signals.

25.4 STAFFING LEVELS

- 1 In this section, broad guidelines are provided on staffing levels required to run a traffic signal division. Exact and detailed guidelines cannot be provided since the required staffing levels depend on a variety of factors, such as the number and age of traffic signal installations, the utilisation of Area Traffic Control (ATC) systems, the complexity of traffic patterns in an area as well as skill levels of available personnel. It is thus not possible to compare staffing levels of two road authorities, even if they control exactly the same number of signalised junctions.
- 2 A general indication of desirable staffing levels is given in Table 25.1 in terms of work-hours per signalised junction or crossing. The staffing levels for a particular road authority can be estimated by means of the following formula (in which it is assumed that a person works 1760 hours per annum):

$$\text{Staffing level} = \frac{\text{Work hours} \times \text{No of Signals}}{1760}$$
- 3 A road authority does not have to employ all the personnel indicated in Table 25.1, but can opt to appoint consulting engineers and contractors on a contractual basis.

TABLE 25.1: DESIRABLE STAFFING LEVELS

Qualification	Work-hours per signal
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Traffic engineering discipline

Manager/ Professional traffic engineers	8,0
Professional traffic engineering technologists and technicians	24,0
Traffic engineering administrative staff	4,0

Electronic and electrical engineering discipline

Manager/Foremen	6,0
Qualified electricians	20,0
Electronic technicians	6,0
Line workers	12,0
Worker assistants	40,0
Administrative staff (including operators of fault report telephone)	6,0

- 4 **Road authorities controlling 200 or more signal installations should have a traffic signal division and employ the full complement of staff, including at least one professional traffic engineer and one professional electronic and/or electrical engineering technologist.**
- 5 **Smaller road authorities should where possible co-operate with each other and form a combined traffic signal division, with the full complement of staff as discussed above. Even larger road authorities may co-operate and provide a combined traffic signal division with the purpose of sharing resources.**
- 6 Where it is not possible to combine resources, small road authorities controlling 50 signal installations or less, may utilise a qualified electrician for general low-level maintenance of traffic signals. Such road authorities would rely on consulting engineers and contractors to provide the other required services.
- 7 Road authorities controlling between 50 and 200 signal installations should employ at least one professional traffic engineering technologist and one qualified electrician with specialist knowledge of traffic signals.
- 8 Even if a road authority has an adequate staffing level, it is recommended that traffic engineering consultants be employed to provide expert advice. Authorities should always be aware of the danger of stagnation within the signal divisions, and should implement measures that would ensure that personnel are always informed of the latest available methods and technology.

25.5 EDUCATION AND TECHNOLOGY TRANSFER

- 1 The continued education and transfer of skills and knowledge to personnel involved with traffic signals are of fundamental importance to ensure efficient and safe signal operations, and to allow personnel to be aware of the rapid development in the discipline of signalisation. Very high priority should be given to education and technology transfer.
- 2 Road authorities must be made aware of the levels of knowledge and skills necessary to perform the broad range of functions required and the consequence of not providing the requisite training and technology transfer programmes.
- 3 It is also the responsibility of road authorities to ensure that adequate training and technology transfer programmes are available to their personnel, consultants and contractors. Where necessary, road authorities can fund educational or other institutions for the development of such courses.

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CHAPTER 26: TRAFFIC SIGNAL INSTALLATION

26.1 INTRODUCTION

- 1 The installation of traffic signals requires a significant amount of planning and design by skilled and knowledgeable professionals. A high degree of attention to detail is required. Often, the cost of planning and design is high, compared with the cost of the traffic signal installation itself, but the benefits far exceed such cost.
- 2 Warrants for the installation of traffic signals are given in Chapter 2 of this manual. The installation is warranted when the traffic signals can a) meet all the *minimum requirements* as described in this manual, b) no viable and feasible *alternative solution* is available which, when implemented, would obviate the need for traffic signals and c) the traffic signals meet the minimum *queue length warrants*.
- 3 The investigation of signal sites and installation of traffic signals require the following tasks:
 - (a) Candidate site identification.
 - (b) Warrant study.
 - (c) Signal design.
 - (d) Signal installation.
 - (e) Commissioning.

The road authority accepts responsibility for traffic signal operations during the commissioning phase of the project.
- 4 Checklists are given in Appendix C to this manual that can be used for checking signal designs and for approving of traffic signals. The checklists should be signed by the responsible registered professional engineer or technologist of the road authority.

26.2 CANDIDATE SITE IDENTIFICATION

- 1 Candidate locations for the installation of traffic signals can be identified by means of a variety of methods. Many locations are identified following requests from the public or decision-makers. Traffic engineers and technologists in the employment of a road authority can also contribute in this regard.
- 2 The queue length warrant used for justifying the installation of traffic signals is a simple method of identifying possible locations for signalisation. Observations over a short period of time during peak hours at a junction or a pedestrian crossing would indicate the presence of long queues of vehicles.
- 3 A site should initially be inspected visually to establish whether it is likely that the installation of traffic signals would not be warranted. During this inspection, attention should be given to the minimum requirements for the installation of signals.

26.3 WARRANT STUDY

- 1 Once a candidate site for signalisation has been identified, a study should be undertaken to establish whether the installation of traffic signals would be warranted according to the requirements of Chapter 2 of this manual.
- 2 The study must start off by establishing whether a traffic signal can be installed without violating the minimum requirements for traffic signal installations as set out in this manual. The installation of traffic signals would not be warranted when any of the minimum requirements cannot be met.
- 3 The next step in the warrant study is to establish whether no viable and feasible alternative solution other than traffic signals is available which, when implemented, would obviate the need for traffic signals. Traffic signals would not be warranted if such a solution is available.
- 4 The final step in the study is to undertake a queue length study to establish whether the queue length warrants given in Chapter 2 will be met. A traffic signal installation would be warranted if the site passes this final test.
- 5 When a traffic signal is warranted, the site can be placed on a priority list until funds become available for the installation of the signal. Priority should be given to those locations with the longest queues (as measured during the warrant study).

26.4 SIGNAL DESIGN

- 1 Once a traffic signal has been warranted at a junction or crossing, the design of the signal can proceed. Traffic studies should be undertaken, the site must be surveyed and the traffic signal designed. Contract documents and specifications will also be required if a contractor undertakes the work.
- 2 A proper land survey should be made of the site showing all relevant information such as:
 - (a) Property boundaries and fences.
 - (b) Carriageways, kerbs, shoulders, islands, medians, existing road markings.
 - (c) Paved sidewalks, driveways.
 - (d) Drainage structures.
 - (e) Plants and vegetation (including location, size and spread of larger trees).
 - (f) Engineering services (telephone, electricity, water, sanitation, etc).
 - (g) Roadside furniture such as bus shelters, telephone booths, retaining walls, guard rails and light poles.
 - (h) Adjacent buildings together with any awnings, height above the kerb and distance back from the kerb face.
 - (i) Any other structures such as bridges, retaining walls, fills and cuts, etc.

- 3 It is important that attention should be given to the possible geometric improvement of a junction during the design phase. Particular attention should be given to the provision of auxiliary turning lanes, particularly right-turn lanes, but also possibly left-turn lanes. Auxiliary straight-through lanes may also be required.
- 4 The site should be regularly visited and inspected during the design stage to ensure that the plan will be satisfactory. Checks should be made during such visits to ensure that the survey included all relevant information. **It is the responsibility of the design engineer or technologist to ensure that the survey was undertaken correctly.**
- 5 During the site visits, attention should be given to possible problems such as:
 - (a) Inadequate space for traffic signal placement.
 - (b) Available sight distances on all approaches and for all turning movements.
 - (c) Distance to adjacent traffic signal sites.
 - (d) Location of any nearby emergency services that may require priority.
 - (e) Most appropriate location for the controller.
 - (f) Condition of road pavement for installation of loop detectors.
 - (g) Source of supply of power.
 - (h) Parking spaces for signal maintenance vehicles.
- 6 It would be beneficial if a qualified electrician could also inspect the site to identify any possible electrical problems that may occur. The actual source and availability of power must be confirmed.
- 7 Proposed designs should be discussed with all parties with an interest in the design to ensure agreement. This includes the electronic and electrical engineers and other departments of the road authority. Where other authorities are also affected, it is particularly important that they should form part of the process from the outset of the project.
- 8 Design plans should contain full information on all details related to the traffic signal. Fewer problems can be expected during installation if sufficient care has been taken during the design phase. Designs should also take future maintenance needs into account. It may be possible to introduce a number of relatively simple design features that could reduce maintenance costs substantially.
- 9 The following design plans would normally be required:
 - (a) Junction or crossing design showing the geometric design, road signs and markings.
 - (b) Traffic signal layout plan showing the location of traffic signal faces, signal posts, overhead gantries of cantilevers, loop detectors and the controller.
 - (c) Duct diagram, indicating the position of ducts and draw boxes.
 - (d) Existing engineering services plan, indicating which services have to be relocated.
 - (e) Traffic signal timing and phasing diagrams.

26.5 SIGNAL INSTALLATION

- 1 Successful traffic signal installation depends on effective supervision and control during installation. A high degree of supervision is required to ensure that the signal is installed according to specifications.
- 2 Installation can either be done by the road authority or by private contractors. Larger road authorities that install traffic signals regularly would probably install signals departmentally. Smaller road authorities would need to appoint private contractors for such work.
- 3 The utilisation of qualified and experienced contractors can significantly reduce the possibility of installation faults. The possibility of future liability resulting from such faults should be an important consideration when selecting contractors. Preference should be given to contractors with the required experience, skills, knowledge and resources to complete a project.
- 4 A suitably qualified person should be assigned by the road authority to be responsible for direct supervision of signal installation contracts. Electrical work should be inspected and approved by a qualified electrician.
- 5 Before commencing with installation, the contractor should submit a detailed timetable or schedule in advance for approval by the project engineer or technologist. The typical installation sequence for traffic signal installations is:
 - (a) Civil engineering work
 - (b) Underground.
 - (i) Footings.
 - (ii) Ducts and draw boxes.
 - (iii) Cables, earthing and wiring.
 - (iv) Detector loops.
 - (c) Above ground.
 - (i) Signal posts and overhead installations.
 - (ii) Traffic signal heads.
 - (iii) Electrical wiring and conduits.
 - (iv) Cabinet and control equipment.
 - (v) Electrical connection.
 - (d) Testing of installed signals.
- 6 Particular attention must also be given to the **accommodation of traffic** during the installation. Traffic signal faces should be masked, and existing controls maintained at the junction. The possibility of liability claims resulting from accidents should always be a prime concern.
- 7 During the contract, adequate records must be kept of the progress with the installation of the signals. Any delays must be carefully documented and reported. A daily diary should be kept in which all events and relevant information are logged. The information can be summarised in a number of status reports.
- 8 Any changes to the initial design should be properly authorised and logged (using variation orders). Changes may cover such items such as increased or decreased quantities, design alterations, equipment substitution, etc.

26.6 COMMISSIONING

- 1 Before a traffic signal is finally commissioned, it is imperative that the installation be properly checked and inspected, and traffic signal operations reviewed.
- 2 During this check, all signal plans should be tested and light signals inspected for proper operation. Once the proper operation of traffic signal equipment has been ascertained, traffic operations should be tested for a short period of time for possible serious traffic conflicts. A traffic officer should be present during the testing period.
- 3 A commissioning checklist is provided in Appendix C to assist with the commissioning of a signal. The checklist should be used as a supplement to, and not as a replacement for, the contract specifications and specific instructions of product manufacturers and suppliers. The checklist should be signed by the responsible registered professional engineer or technologist of the road authority.
- 4 It is important that the traffic signal should be monitored after it has been brought into operation. Traffic patterns may change as a result of the signal installation, while drivers may not respond to signals as anticipated.
- 5 Changed traffic patterns will require updating of traffic signal timings once traffic patterns have stabilised. At least one month should be allowed for traffic to stabilise. Traffic may then have to be recounted and new traffic signal timings and phasing determined. The provision of turning phases may even require modifications to the traffic signal face layout.

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CHAPTER 27: REMOVAL OF TRAFFIC SIGNALS

27.1 INTRODUCTION

- 1 Traffic operations at traffic signals should be periodically reviewed to establish whether the signal still meets the objectives of providing safe, convenient and affordable traffic control with a minimum of environmental side effects. This includes ensuring that the level of control at any junction is appropriate to the circumstances prevailing at that junction. For example, vehicles standing in queues at a junction without any cross flow are needlessly consuming energy, polluting the atmosphere with exhaust emissions and wasting time.
- 2 Warrants for the removal of a traffic signal are given in Chapter 2 of this manual (Volume 3). The traffic signal should be replaced by another more appropriate form of control such as a traffic circle when the removal of the signal is warranted.
- 3 In this chapter, attention is given to procedures that should be followed in removing traffic signals. It is important to note that, where design and signage would typically be geared to the needs of a driver unfamiliar with an area, removal of traffic signals would typically require attention being given to the needs of the familiar driver. The unfamiliar driver will respond to whatever circumstance confronts him or her at a junction, whereas the familiar driver is more likely to respond to whatever used to be the situation and not necessarily the changed situation.

27.2 IDENTIFICATION OF SIGNALS REQUIRING REMOVAL

- 1 The identification of signals requiring removal is more complex than the identification of locations where new signals are required. The reason for this is that signals will still operate fairly efficiently, even if they are no longer warranted.
- 2 It is possible to undertake regular comprehensive studies of all the junctions and crossings in the network to establish whether signals are still warranted. The cost of such studies, however, is high and such detailed studies are not required.
- 3 The queue length warrant used for justifying the removal of traffic signals is a relatively simple method of identifying possible locations for signalisation. If queues are generally short at a traffic signal, it may indicate that the signals are no longer warranted. It is, however, important to note that long queues at signals are not necessarily an indication that the signals are warranted – the long queues may be caused by poor traffic signal settings.
- 4 It is unlikely that signals on arterial roads carrying high volumes of traffic would have to be removed. It may be necessary to upgrade traffic signal settings to allow for increases in flows and changes in turning patterns.

- 5 The likely candidates for removal would be those on local roads carrying low volumes of traffic. In many cases, such signals were not warranted in the first place, or were only marginally warranted.
- 6 It is important to note that the removal of a traffic signal does not constitute an admittance that poor planning practices were applied, but rather that circumstances have changed. Urban areas are dynamic and control measures cannot remain static in time. Changes to the road network, in particular, can contribute significantly to such changes.

27.3 REMOVAL PROCEDURE

- 1 The removal of traffic signals should be undertaken with care. Drivers tend to be inattentive, and the sudden removal of traffic signals can result in traffic accidents. It is therefore essential that such drivers be made sufficiently aware of impending change.
- 2 The following procedure should be followed when removing traffic signals:
 - (a) Provide information to the public over a period of about 2 weeks. Install information road traffic signs containing information on the intended removal of the signals.
 - (b) Place signals in flashing mode for 1 or 2 days.
 - (c) Implement new form of control and mask traffic signals for a period of at least 7 days. A warrant study can be undertaken during this time to reconfirm whether signals are actually no longer required at the junction.
 - (d) Remove traffic signals together with any road and information signs.
- 3 Use should be made of all available avenues for informing the public of the impending removal of a traffic signal. These include press releases and radio announcements. Information signs should also be installed on each approach leg to a traffic signal. The date of removal should be given, possibly together with a countdown in days to the date of the intended removal.
- 4 It is essential that proper record be kept of the change process. This includes dated and properly annotated photographs of the junction throughout the process, commencing with the date at which the information signs were installed. Such records will be required in cases of accidents to indicate that due diligence and care have been taken.
- 5 The removal procedure provides for a warrant study as an additional measure of reconfirmation that existing signals are indeed no longer warranted. When it is found that the signals are indeed still warranted, alternative means of improving or upgrading the junction should, however, be explored before the signals are reinstalled.

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CHAPTER 28: TRAFFIC SIGNAL MAINTENANCE

28.1 INTRODUCTION

- 1 Adequate maintenance of traffic signals is essential for proper operation. Neglect can lead to danger to road users and additional costs to the public and the road authority responsible for the traffic signals.
- 2 This chapter provides an overview only of aspects related to the *management* of traffic signal maintenance. Technical procedures and methods of maintaining traffic signals are not discussed – such information can be obtained from the manufacturers of signal equipment. Some information in this regard can also be obtained from the references given in the bibliography.
- 3 The chapter is further restricted to the management of traffic signal components only, and does not cover other work such as the road pavement, road markings, road signs, etc. Remedying defects that occur during the contractual defects liability period and which are covered under the implementation contract, is also not covered in this chapter.

28.2 CONSEQUENCES OF MAINTENANCE DEFICIENCIES

- 1 The cost-effectiveness of good signal maintenance is beyond question. The traffic safety implications of malfunctioning traffic signals alone can justify the cost of keeping signals in proper working order.
- 2 The possibility of liability judgements against a road authority is also an important consideration in signal maintenance. Proper maintenance of traffic signals is of vital importance if liability is to be minimised.
- 3 It is particularly important that appropriate maintenance procedures should be in place AND strictly adhered to by personnel. These maintenance procedures must demonstrate a thoroughness, and must reflect a duty to care and to report defects. The maintenance procedure can be used as evidence regarding the standard of care taken by the road authority concerned.
- 4 It is also particularly important that proper maintenance records be kept so that in the event of litigation there will be no doubt, as to the nature and extent of the maintenance actions taken, and when such actions were taken. Many litigation actions would tend to shift the blame for an accident onto some aspect of the traffic signal.

28.3 REDUCING MAINTENANCE REQUIREMENTS

- 1 The maintenance of traffic signals can require a significant expenditure on manpower and material. An effort should therefore be made during the design and installation stages to implement systems that would contribute to minimising maintenance costs.
- 2 The following are a number of the factors that can contribute to high maintenance costs:
 - (a) Inappropriate selection of technology and highly sophisticated systems without due consideration of available skills and maintenance funds.

(b) Inadequate inspection during installation is often an important reason for maintenance problems. Some deficiencies are of such a nature that they cannot be detected, even with proper inspection. It is therefore important that responsible and experienced persons should undertake signal installations.

(c) The use of poor quality or non-standard equipment will require more skills and greater inventories of spare parts. Different types of equipment may require different maintenance procedures, which increase the management effort.

(d) Not providing adequately for maintenance in the design of traffic signal components.

- 3 An important factor in the design of signals is the provision for resistance against damage due to power surges, such as those resulting from lightning. Power surges can result in the destruction of all electronic components at a traffic signal, which will then have to be replaced at high cost.

28.4 TYPES OF MAINTENANCE

- 1 Maintenance falls into two broad categories: **routine** and **repair** maintenance. The term "maintenance" is generally taken to mean both these operations.
- 2 Routine maintenance consists of a periodic inspection and servicing of traffic signals.
- 3 Repair maintenance is undertaken in direct response to reported failures at traffic signals.

28.5 ROUTINE MAINTENANCE

28.5.1 General

- 1 Routine maintenance should primarily be aimed at those components where pro-active intervention is required. It is not cost-effective to service all signal components regularly while they are still in operating condition. It is more important that attention should be given during routine maintenance to the identification of signal components that are faulty.
- 2 Routine maintenance actions would normally include those recommended by the manufacturer of the traffic signal equipment. Different manufacturers may have diverse maintenance requirements for their equipment. Information on these requirements must be obtained from the manufacturer.
- 3 Other routine maintenance actions are summarised in Table 28.1. The actions listed in the table are discussed in following subsections.
- 4 The intervals at which routine maintenance actions are undertaken depend on a variety of factors, such as the availability of a remote monitoring system. One possible method is to implement a regular inspection system and to undertake routine maintenance only when required.

28.5.2 Routine controller cabinet maintenance

- 1 The maintenance of the controller cabinet involves checking of the cabinet door for proper operation and ensuring that the cabinet is not damaged or dirty. Weatherproof seals must be in a good condition to prevent moisture entering the cabinet. The cabinet must be kept clean, and particular attention must be given to possible insect infestations.
- 2 Infestations by insects, especially ants, and other pests can be a serious problem at traffic signal installations. Special insecticides should be used that do not damage the electrical and electronic components. Infestations are also indicative that the cabinet or enclosure is not adequately sealed against elements.

28.5.3 Routine signal head maintenance

- 1 The maintenance of signal heads includes activities such as lamp replacement, cleaning of lenses and reflectors, alignment of the signal heads and inspection for damage.
- 2 It is important that lenses should be fitted and sealed properly to prevent the ingress of moisture and dust. Ingress of moisture or excessive condensation within the signal head housing may cause oxidation of metal parts and problems with electrical connections and transformers for quartz-halogen lamps.

28.5.4 Routine signal post maintenance

- 1 Signal post maintenance covers aspects such as checking for accident and other damage as well as the repainting of the posts.
- 2 Posts can usually not be repaired when damaged in an accident, and are then replaced with new posts.

28.5.5 Routine push button maintenance

- 1 Push button maintenance is required to ensure that push buttons are operating properly and that they are not damaged.
- 2 The maintenance action may have to be extended to also include special devices provided for disabled pedestrians.

28.5.6 Routine detector loop maintenance

- 1 The vehicle detector loop is one of the more vulnerable components of a traffic signal system. They can be a frequent source of trouble if they not correctly installed. The normal movement of a flexible road pavement, together with the ingress of material into the loop slots, can cause abrasion with eventual breakdown of the insulation on the loop wires.
- 2 The reliability of detector loops can be significantly improved by following proper installation procedures. These procedures are described in Chapter 20 of this manual (Volume 3).

TABLE 28.1: ROUTINE MAINTENANCE

Maintenance task

Controller cabinet (including pedestal)

Door, hinges and locks
Weatherproof seal (gasket)
Damage, rust, dirt, insect infestation, etc.

Signal heads (lenses, reflectors, visors, background screen, etc.)
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Clean signal heads (particularly lenses)
Signal head alignment
Damage to signal heads and lamps
Damage includes broken lenses, faded colours

Signal posts (including anchor bolts)

Repainting of posts
Damage and rust
Post support and anchors

Other road signs

Damage and rust
Anchoring of signs

Push buttons

Push button operation
Damage and rust

Loop detectors

Visual inspection of loops
Verify detector operation

Pull-boxes and manholes

Damage to covers and installations
Excessive water, dirt, insect infestation

Cables and other electrical

Cable joints (those that are visible)
Circuit breakers
Earthing

Controllers

Electromechanical assemblies
Relays, Flashers, Switches, Connectors
Lamp and fault monitor
Conflict monitor
Communication devices
Lightning protection unit (if testable)
Backup batteries (if provided)
Other as per manufacturer requirements

28.5.7 Routine maintenance of draw boxes and manholes

- 1 The maintenance of draw boxes and manholes involves checking them for damage and cleanliness. Checks should also be made for infestations by insects and other pests.
- 2 Theft of metal manhole covers may be a problem in certain areas. Consideration should then be given to using covers made of concrete or similar material.

28.5.8 Routine maintenance of electrical cables and other electrical components

- 1 Maintenance is required for all electronic components, including cables, cable connections, circuit breakers and earthing.
- 2 Cables can be vulnerable to damage during traffic accidents, and be a source of great danger when exposed. Maintenance efforts can be minimised if adequate provision is made for fail-safe designs or the easy replacement of cables.

28.5.9 Routine controller maintenance

- 1 The maintenance of a signal controller is a complex task and must be undertaken by skilled personnel. Routine maintenance may include tasks such as running diagnostic tests, replacing defective or damaged modules as well as printed circuit boards.
- 2 The advice and instructions of the manufacturer on maintenance and repair procedures, including testing and diagnostic procedures, should be closely followed. Where special tools or testing equipment are necessary, these should be made available to the maintenance and repair personnel and should be kept in good working condition.
- 3 Faults in electromechanical controllers can often readily be detected by visual inspection. Reasons for breakdowns include blown fuses, in-operative motors, contact points burnt or welded together, and camshaft lugs broken. Repair of electromechanical units is often relatively simple, provided spares are readily available.
- 4 Electronic controllers may be repaired by replacing defective circuit boards or modules. A controller will usually comprise several separate and independently replaceable boards or modules mounted on a motherboard or back plate.
- 5 Where a backup battery is provided in the controller, it is important that such battery be checked occasionally and replaced according to manufacturer's recommendations.
- 6 Where possible, lightning protection units should also be checked regularly and be replaced when defective.

28.5.10 Routine maintenance of road signs and road markings

- 1 The routine maintenance of road signs and markings provided at traffic signals is necessary when they are faded, damaged or not properly anchored to posts.
- 2 The maintenance of road signs and markings would usually not be undertaken by the signal maintenance team, and a separate team would normally be assigned for such work. It is, however, important that this team be informed of defects when they occur.

28.6 REPAIR MAINTENANCE

28.6.1 Introduction

- 1 Repair maintenance is aimed at repairing reported malfunctions in traffic signals. Such malfunctions occur due to reasons such as:
 - (a) Signal components reaching functional obsolescence.
 - (b) Poor construction techniques or substandard quality products.
 - (c) Traffic accidents, vandalism and natural causes, such as lightning, heavy winds, ingress of moisture, insects, etc.
 - (d) Environmental (dirt and dust).
- 2 Many malfunctions are caused by traffic accidents, but poor routine maintenance could also be contributing to a high incidence of signal faults.

28.6.2 Fault detection

- 1 Faults in signal operations can be detected in a number of ways. These include the following:
 - (a) Police reports of damage as a result of accidents.
 - (b) Complaints received from the public, the police or other departments of the road authority.
 - (c) Computer based detection of malfunctions.
 - (d) Routine inspections by a maintenance team.
- 2 Due to the high incidence of damage resulting from traffic accidents, standard procedures should be put in place according to which police can report such damage.
- 3 The public also plays an important role in reporting malfunctions. It is particularly important that an easy reporting procedure should be implemented which is widely publicised. A central fault reporting telephone number used for all types of municipal problems is a very effective method of allowing the public to report any faults.
- 4 The availability of a central computer (remote monitoring system) can simplify the detection of malfunctioning equipment significantly. A variety of diagnostic tests can be undertaken of the various electronic components in a signal system, and possible errors logged for further attention by a maintenance team.
- 5 The maintenance teams themselves can be utilised to undertake routine inspections when they are not attending to emergencies. These teams can undertake the routine repairs themselves, or work orders may be issued for more specialised repair work.

28.6.3 Response to malfunctions

- 1 Responding to a malfunction requires a formal system whereby a maintenance team can be instructed to undertake the required repair work.
- 2 Certain malfunctions require a more urgent response than others. Malfunctions that pose a public danger should receive priority.
- 3 Emergency malfunctions are those that create an immediate danger to the public or traffic, and should be attended to immediately. A 24-hour standby service should be available to handle such malfunctions. The following are examples of malfunctions that should be considered as emergencies:
 - (a) Any malfunction causing all red signal aspects failing on one or more approaches at a signalised junction.
 - (b) Displaced signal aspects resulting in the display of green signals to conflicting traffic streams.
 - (c) Signal posts and other components creating a hazard on the roadway.
 - (d) Exposed electrical cables that could result in life-threatening situations or in short-circuits.
 - (e) Opened or damaged controller cabinets resulting in exposed electronic or electrical components.
- 4 Other malfunctions that do not create immediate dangerous situations do not have to be treated as emergencies, and can be attended to at a more opportune time. Priority should, however, be given to those malfunctions that have the most disruptive effect on traffic flow, or which result in the highest levels of congestion.
- 5 The following response times, between the time that the maintenance team was informed of a malfunction and the time of arrival of the team at the site, are generally recommended:
 - (a) Emergency malfunctions that may have safety implications – The response time should not exceed two hours for 24 hours of the day, seven days of the week. Maintenance work undertaken in response to these malfunctions can be restricted to emergency repairs only.
 - (b) Major malfunctions that could seriously effect traffic flow, but not road safety – These types of malfunctions do not need immediate response, particularly if such malfunctions occur at night or over weekends. During weekdays, a response should be required on the same day if the malfunction is reported before 12:00. When reported after 12:00, or over the weekend or a public holiday, a response should be required before 12:00 on the next available workday.
 - (c) Minor malfunctions that would not seriously affect both traffic flow and road safety – A response time of longer than one day can be given, depending on the type of the malfunction.
- 6 Responding to malfunctions does not mean that a fault must be repaired immediately and at any cost. Maintenance work can be restricted to emergency repairs to make the signal safe, and the permanent repair work can be done at a more opportune time when manpower and materials are available for the work.
- 7 **A signal can be made safe by placing it in flashing mode, but where this is not possible the signals may be switched off. In cases where repair will take some time, consideration may be given to masking the signals out, and using temporary stop signs for the control of the junction or crossing.**

28.7 MAINTENANCE RECORDS

- 1 Detailed recording of fault reports and maintenance activities is an essential part of traffic signal maintenance. Such records are not only required for litigation purposes, but also form an important part of the management process. A file should be opened for each signal installation and record kept of each action taken at the installation.
- 2 An effective recording system is also essential where maintenance is contracted out and there are maximum time limits prescribed for action by the contractor, with commensurate penalties for failing to meet them.
- 3 Additional information on maintenance records is provided in Chapter 30 of this manual (Volume 3).

28.8 MAINTENANCE PERSONNEL

- 1 Required maintenance personnel levels and skills are discussed in Chapter 25 of this manual (Volume 3). A maintenance team should consist of qualified electricians, line workers and worker assistants.
- 2 Electricians are responsible for the maintenance of the electrical and electronic components of traffic signals. Line workers are responsible for tasks such as lamp replacement, cleaning of lenses, painting of posts and alignment of signals.
- 3 At least one emergency response team should always be on standby, 24 hours of the day, even if the team has limited capabilities. This team should be able to undertake emergency repairs.
- 4 **IMPORTANT NOTE:** All electrical work may only be carried out by a qualified electrician and under no circumstances should anyone else open a cabinet or enclosure containing electrical apparatus, live cables or exposed electrical terminals where there is a danger of electric shock.

28.9 MAINTENANCE RESOURCES

- 1 Adequate resources and spare parts should be available to allow maintenance personnel to undertake and complete maintenance work.
- 2 It is important that an administration facility be provided from where the maintenance activities can be managed and where malfunctions can be reported.
- 3 Teams should be provided with service vehicles equipped with all the required tools, spares and consumables required for the maintenance of traffic signals. Radios or cellular telephones should be provided for on-street communication. At least one truck must also be available that will allow personnel access to overhead signals.
- 4 Larger road authorities may also provide a workshop facility where signal components can be repaired. Smaller authorities would probably employ contractors for such maintenance duties.

28.10 CONTRACT MAINTENANCE

- 1 Traffic signal maintenance can readily be undertaken on a contractual basis. Smaller road authorities can probably not justify employing a full-time staff complement for maintaining signals. For larger road authorities, however, there could also be advantages in employing a contractor to undertake the signal maintenance.
- 2 Two types of contract maintenance can be considered. Firstly, the contract is between two separate road authorities with adjoining jurisdictions. Under this arrangement, the one road authority can maintain traffic signals on behalf of the other road authority. Payment for the service is usually a flat annual amount.
- 3 The second type of maintenance contract is with a private contractor. The contract should normally include only those tasks that are well defined, such as group replacement of signal lamps, painting of posts, etc. Where new installations are constructed by private contractors, a period of contract maintenance may be a part of the installation contract.
- 4 Provision should be made in the contract for two types of maintenance. The one type relates to routine inspections and maintenance, including the repair of defects other than those caused by damage. The other type will cover the repair of damage resulting from collision, explosion, earthquake, flood, riot and other incidents.
- 5 An essential element in any maintenance contract is the establishment of an effective system for recording the details of defects and damage as they are reported, and of subsequent repair work when it is completed. The records should clearly indicate the category of work, for payment purposes. Dates and times of these events should always be carefully recorded.
- 6 To ensure timely performance by the contractor, it is important to specify maximum time limits for the response to a reported malfunction, and for effecting repairs (see Section 28.6.3). If the contractor fails to meet a stipulated deadline for a single call-out, a penalty should be specified, usually in the form of a rebate to the road authority, per hour or other period by which he exceeds the time limit. The response times can be negotiated with contractors with the aim of reducing costs, as long as road safety is not compromised.

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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.
- 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 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.

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 as 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.

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CHAPTER 30: TRAFFIC SIGNAL RECORDS

30.1 INTRODUCTION

- 1 An essential component of any management system is its inventory of assets and the keeping of various types of records. Such information should be kept in a well-organised record system.
- 2 A variety of traffic signal records may be kept, depending on the purpose for which the records are required. The following are the minimum that should be kept by a road authority:
 - (a) Installation records.
 - (b) Fault log and advice records.
 - (c) Maintenance records.
 - (d) Controller logs.More details of the above records are given in the following sections.
- 3 The traffic signal record keeping system can be either operated manually or it can be computerised (or both). Computerised record systems have the advantage that they can also be used for purposes such as the automatic scheduling of routine work and maintenance and the provision of statistics on a variety of aspects (such as the number of signals, maintenance response and repair times, etc). It is important that computerised systems be kept up to date and regularly backed up.

30.2 INSTALLATION RECORDS

- 1 According to the National Road Traffic Regulations, a record SHALL be kept for each traffic signal containing at least the following installation information:
 - (a) Scaled drawing of the layout of the junction or crossing, indicating lane markings and road layout.
 - (b) Number, type and location of traffic signal faces
 - (c) Number, type and location of pedestrian and pedal cyclist facilities, including pedestrian push buttons.
 - (d) Phasing, time plans and offset settings.
 - (e) Date of implementation.
 - (f) Name and registration number of the engineer or technologist (engineering) who approved the signal, and date of signature.
- 2 The above record should be that of the signal installation as it currently exists. Where a traffic signal installation has been modified or changed, a completely new record should be issued, and the older record archived for future reference.

- 3 Care should be taken to ensure that the installation record is a true reflection of the actual current traffic signal installation. It is relatively simple to check physical components of the installation, but it is more difficult to check traffic signal timings. It is therefore recommended that a record be kept of some unique code generated by computer software when timing plans are downloaded to a controller. Such a code could be a version number generated, or a checksum calculated by the computer.

30.3 FAULT LOG AND ADVICE RECORDS

- 1 *Fault log and advice records* contain information on all reported faults as well as the action taken in response to such reports.
- 2 Records should be kept of all faults and malfunctions reported by any person, including the public and the police. Records should also be kept of all faults reported by a remote monitoring system, if such a system is available.
- 3 The information recorded may contain the following:
 - (a) Dates and times of fault report and advice.
 - (b) Name of person handling fault report.
 - (c) Source of information.
 - (d) Location of the fault.
 - (e) Apparent nature of the fault.
 - (f) Description of action taken, including name of person requested to attend to fault.
 - (g) If police were contacted, the name, rank and number of the police officer.

30.4 MAINTENANCE RECORDS

- 1 A record should be kept of all maintenance and repair work undertaken by the road authority or a contractor. A maintenance record should be created for each separate signal installation.
- 2 The following information should be recorded in the maintenance records:
 - (a) Junction or crossing description and number.
 - (b) Date and time of repair.
 - (c) Maintenance team identification.
 - (d) Nature of fault or malfunction.
 - (e) Repairs and maintenance undertaken.
 - (f) Details of further work required.

30.5 CONTROLLER LOGS

- 1 Controller logs are kept in controller cabinets as a running record of all routine inspections, repair work, modifications as well as changes to the signal timing and phasing.
- 2 Provision should be made for the entry of the following information in the controller logs:
 - (a) Junction or crossing description and number.
 - (b) Date and time.
 - (c) Name and initials of person undertaking maintenance.
 - (d) Brief description of the modification or work undertaken.
 - (e) An indication if the work is complete or whether further action is needed.
- 3 Where signal timing plans are not downloaded from a central control system, a separate log should be kept of the dates and times timing plans were changed on a controller. The log should contain a version number (or checksum) of the latest timing plan installed on the controller. This log is particularly important where different maintenance personnel have access to the controller, and there is a possibility that an older timing plan may inadvertently be reinstalled.

30.6 ARCHIVING OF RECORDS

- 1 The responsible road authority should keep the current installation record of each traffic signal for as long as the traffic signal is in operation.
- 2 All other records described above, including older installation records that have been superseded by a new installation record, should be archived for a period of at least **5 years**.
- 3 When a traffic signal is removed, all records pertaining to the traffic signal should also be archived for a period of at least **5 years** after removal.

30.7 REFERENCING SYSTEMS

- 1 Traffic signal records require a relatively simple referencing system. A simple junction or pedestrian crossing number would normally be adequate for this purpose.
- 2 One method for numbering junctions or pedestrian crossings (nodes) is to subdivide an area into smaller zones. These zones could simply be the individual pages of a map book, or it could be the suburbs of a large city. Each zone is given an alphanumeric number, normally consisting of two or three letters. Each street in a zone is also numbered, also using a two or three letter alphanumeric code.
- 3 The junction number is determined as a combination of the zone number and two street numbers. Pedestrian crossings are numbered as a combination of the zone number and one street number, followed by a sequence number (to allow for the possibility of more than one crossing on the street).

CHAPTER 31: CONTRACTS

31.1 INTRODUCTION

- 1 Road authorities may elect to outsource the design, installation and maintenance of traffic signals. The extent and nature of the projects can vary significantly, and may range from the installation of a single traffic signal to that of an advanced central control system.
- 2 Regardless of the scope of the projects, there are features common to all. The outstanding feature is that a contract between the road authority and a consultant or contractor is brought into being. A further feature is that the road authority is finally responsible for the provision and operation of a safe and efficient traffic signal system.

31.2 CONTENT OF CONTRACT DOCUMENTS

- 1 The intent behind the drafting of any contract is that there should be a clear, unambiguous and shared understanding between the contracting parties of items such as the following:
 - (a) The exact extent of the work to be undertaken in terms of the contract (with extent implying both a quantity and quality of specified activities).
 - (b) The responsibility of the contracting parties to each other.
 - (c) The time frame within which the work is to be completed.
 - (d) The total cost of the work.
- 2 It is often said that a contract document is not necessary until relations between the contracting parties become soured. To allow for this eventuality, contracts should always include clauses defining what constitutes disputes and the methods to be employed in their resolution.
- 3 Contracts also include clauses setting out the grounds and methods for termination of the contract. The preferred termination is simply that the work has been completed and paid for to the satisfaction of both parties. It is also possible that non-performance by either of the parties may force a premature termination as the only option.

31.3 STRUCTURE OF CONTRACT DOCUMENTS

- 1 An important principle in drawing up contract documents is the need for standardisation. Insistence on unique contract documents for each project will require contractors to study each tender document in detail prior to calculating and submitting a bid. Bid submissions are usually made under tight time constraints and contractors will price accordingly, usually with a margin of safety to allow for contingencies they may have been overlooked. Insistence on unique documents will thus carry an implicit cost penalty. A further penalty involves the fact that the continuous development and updating of any document, whether by the road authority or some other body can be a costly exercise. Furthermore, unique documents can inadvertently contain loopholes that can result in problems.

- 2 Standardisation of documents will allow for improvement over time by introducing amendments making individual clauses more readily understandable, and simultaneously removing loopholes that have presented themselves. Many bodies, such as SAICE and FIDIC, have developed standard documents that are a solid basis for any contract. It is also possible to refer to other documents such as the SABS standard specifications, Acts of Parliament, Provincial Ordinances and local by-laws. It is not necessary to repeat the content of these documents in the contract documents, and references to them would be adequate.
- 3 The contract documents should include the following:
 - (a) General Conditions of Contract, which spell out the typical relationship between client and contractor.
 - (b) Standard specifications being descriptions of the work to be done and that do not vary from project to project.
 - (c) Project specifications describing the specific project.
 - (d) A list of quantities, which may either be a Bill of Quantities or a Schedule.
 - (e) Drawings, which may include standard drawings.
- 4 In order to tailor the standard documentation to a specific project, it may be necessary to include the following in the contract:
 - (a) Special Conditions, which take precedence over the General Conditions and further define the contractual obligations of the two parties; and
 - (b) Special Provisions, which modify the Standard Specifications.
- 5 Contract documentation typically requires that the contractor provides performance guarantees in the form of insurance policies. In the event of non-performance by the contractor, it may be possible to recover losses sustained as a result of this non-performance.
- 6 A Tender Bid becomes a Contract on signature by both parties of a Letter of Agreement. The contract documentation normally includes a pro-forma Letter of Agreement for the information of the tenderer.
- 7 Tenders can be fixed price or allow for escalation, the latter being more equitable in times of high inflation or where the project may span over more than one year. In this case, the basis on which escalation of the contract price is calculated is defined in the contract documentation.
- 8 For a variety of reasons, it seldom happens that a project is built exactly as detailed in the original drawings. As the work progresses, it will be necessary to issue instructions or revised drawings (referred to as Variation Orders) to the contractor. These typically are grounds for the contractor to revise a price quoted for an item or to quote a new price for the work. Once agreed to by both parties, Variation Orders are signed by both and thereafter become part of the Contract Documentation.

- 9 Very often, a Dayworks Schedule is also included to allow for abnormal circumstances not necessarily forming part of the contract but where it is convenient to have these additional activities undertaken by the contractor. The Dayworks Schedule is, however, not considered as part of the contract for adjudication purposes.
- 10 Because of the issue of Variation Orders, it is necessary at completion of the project for "As Built" drawings to be submitted to the client. In the event of any subsequent dispute, reference is made to the "As Built" and not to the original design drawings.
- 11 Many contracts also provide for a period of maintenance, usually with a duration of twelve months, to ensure that there are no latent defects in the work as delivered. Any defects revealed during this maintenance period are repaired by the contractor at his own expense.

31.4 TENDER PROCESS

- 1 The client issues a Call for Tenders by advertising it in gazettes as well as newspapers. This advertisement typically includes:
 - (a) The name of the client.
 - (b) The number and name of the project being tendered for.
 - (c) A brief description of its content.
 - (d) The closing date for submission of bids.
 - (e) The source from which tender documents can be obtained, including reference to any payment that must be made for these documents, specifying whether this is a refundable deposit or not.
- 2 The tender documents are, in fact, the contract documents and include a list of quantities against which the tenderer can quote rates for each item billed.
- 3 If the client considers a Tenderers' Site Visit desirable, details of the date and venue will be included in the Call for Tenders. The Site Visit may be compulsory, in which case the client will issue Certificates of Attendance to tenderers. These should then be bound into the submitted bids. Failure to return a certificate could be deemed adequate grounds for rejection of the associated bid.
- 4 At the Site Visit, the client will describe the full extent of the works and draw attention to any points of particular concern as well as clarifying any uncertainties that would-be tenderers may have.
- 5 Tender submissions can take many forms. One method that can be followed consists of first requesting the tenderer to submit information illustrating an ability to undertake the intended project. This can be followed by a request for a technical proposal, which in turn may be followed by a request for the final bid.
- 6 A second method is the two-envelope process in which a tenderer submits a technical proposal (as well as information on the ability of the tenderer to undertake the intended project) in one envelope and a bid in the other envelope. Tenderers are then first adjudicated on the submitted technical proposals, followed by a second round of adjudication based on submitted bids.

- 7 The two-envelope method has fallen into disfavour because, particularly on large projects, pricing a tender is usually not a trivial task and pricing strategies can, in fact, be quite complex. It is considered inequitable to require a tenderer to devote significant amounts of time and money to deriving a bid when, in the opinion of the client, he or she is not competent to undertake the project. On relatively small and straightforward projects, it does however have the advantage of shortening the time span between advertisement and award of contract.

31.5 PROCUREMENT

- 1 A somewhat different form of contract involves the procurement of supplies outside the scope of normal design, construction and maintenance contracts. It would be patently ridiculous for an authority to have to call for tenders every time a light bulb had to be replaced. As a public body, the road authority must, however, be able to account for all funds disbursed.
- 2 In effect, procurement contracts amount to the creation of a panel of preferred suppliers for specified products with prices agreed to for a finite period, usually one year in duration.
- 3 Apart from the benefit of the creation of a system whereby public accountability is subject to audit, a properly structured procurement contract relieves the client of the necessity for maintaining a large stores department carrying a variety of capital and consumable items.

31.6 SERVICE LEVEL AGREEMENTS

- 1 Service Level Agreements are another specialised form of contract. They are brought into play when a road authority elects to outsource one or other of the activities that would normally be carried out in-house. A case in point would be the maintenance of all its traffic signalisation equipment.
- 2 All the normal conditions of the contract previously described apply equally to the Service Level Agreement. What is additionally specified, is the extent and quality of service required. For example, the maximum acceptable time elapsed between a request for service and arrival on site would be defined in the agreement.

31.7 BIBLIOGRAPHY

- 1 SAICE, 1982, General Conditions of Contract, South African Institution of Civil Engineering, Johannesburg.
- 2 FIDIC, 1987, Conditions of contract for electrical and mechanical works including erection on site, with Forms of Tender and Agreement, International Federation of Consulting Engineers, Lausanne.

CHAPTER 32: ANNUAL REPORTS

32.1 INTRODUCTION

- 1 The annual report is an important function of a traffic signal division. The purpose of the annual report is to provide information on the work of the division and to indicate that the work was undertaken responsibly and in the best interest of the community and the road user.
- 2 Performance management and the assessment of key performance indices are mechanisms to ensure that the goals and objectives of providing traffic signals are achieved. The annual report should provide information on the degree to which these goals and objectives have been reached.

32.2 CONTENTS OF THE ANNUAL REPORT

32.2.1 General

- 1 The annual report should provide information on aspects such as the following:
 - (a) Institutional.
 - (b) Special projects.
 - (c) Routine projects.
 - (d) Training and technology transfer.
 - (e) Programme and budget.
 - (f) Statistics.
- 2 Throughout the report there should be an emphasis on achievements and the degree to which key performance indices have been achieved.

32.2.2 Institutional

- 1 The annual report should contain information on the institutional and organisational structure as well as staff composition of the traffic signal division. Staff shortages and vacancies should also be indicated.
- 2 The facilities available in the traffic division should also be described, together with an indication of the traffic control system in use.
- 3 Information should also be given on the utilisation of consulting engineers and contractors, as well as the projects on which they were utilised.
- 4 Details should also be provided on co-operation with other authorities as well as duties undertaken on behalf of such authorities.

32.2.3 Special projects

- 1 The annual report should provide short summaries of special projects that have been undertaken by the traffic signal division.
- 2 Special projects would, for example, include upgrading to a new traffic signal system, installation of an operations control centre, installation of new traffic signals, etc. A special project is one that is not routinely undertaken each year.

32.2.4 Routine projects

- 1 Routine projects are those routinely undertaken each year. These include the upgrading of traffic signal settings, maintenance activities, etc.
- 2 A short description should be given in the report of all the routine activities of the signal division.

32.2.5 Training and technology transfer

- 1 The development of skills and knowledge in the traffic signal division is of such importance that it warrants a special section in the annual report. The signal division should be proud of any efforts made to provide training and to provide opportunities to personnel to improve their knowledge of traffic signalisation.
- 2 The report should highlight the importance of continued skill development and may refer to this manual to indicate the responsibility of road authorities to institute specific programmes at improving skills and knowledge.

32.2.6 Programme and budget

- 1 One of the essential elements of the report is the work programme and budget of the traffic signal division, for the current year as well as the future year.
- 2 Proper account must be given of all work and expenses undertaken by the traffic signal division. Any new proposed projects should be well motivated and their benefits to the community and the road user explained.

32.2.7 Statistics

- 1 Detailed statistics should be given in the report on all the activities of the traffic signal division. These statistics must cover the work of all personnel as well as consulting engineers and contractors.
- 2 Statistics should be given on aspects such as the following:
 - (a) Staff levels, subdivided according to function and qualifications.
 - (b) Traffic signal installations and other facilities.
 - (c) New traffic signal installations.
 - (d) Upgraded traffic signal installations.
 - (e) Traffic studies and accident statistics.
 - (f) Maintenance activities.
 - (g) Reported malfunctions, subdivided into classes of malfunctions.

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