This report provides a guideline to estimate the staffing and resource needs required to effectively operate and maintain traffic signal systems. The results of a survey performed under this project, as well as a review of the literature and other surveys indicated that agencies achieving a high level of signal system performance do so under a wide variety of conditions such as agency size, geography, system complexity and traffic conditions that do not adhere to the typical level of documented resource requirements. Accordingly, a set of performance-based criteria were developed to define requirements. The performance-based criteria are focused on establishing realistic and concise operations objectives and performance measures.

This synthesis will be of interest to administrators, operating personnel, and others interested in the management and operation of telecommunications systems in transportation agencies. Information is provided on the fundamentals of telecommunications, types of systems available, current uses in state DOTs, and implementation procedures and alternatives. Most departments of transportation have telephone and radio systems in use for communications with their own personnel and with the public. This report of the Transportation Research Board describes those systems as well as other telecommunications options that are in use by transportation agencies or are available for their use.
TRB’s Transportation Research Record: Journal of the Transportation Research Board, No. 1867 examines several algorithms that estimate speed from traffic surveillance cameras in a variety of traffic, weather, and lighting conditions; identify bottleneck locations, the active times, and the delays that are caused; and are applied to the archived loop detector data in the I-4 data warehouse.

In this project, Florida Atlantic University researchers developed a methodology and software tools that allow objective, quantitative analysis of the performance of signal systems.

Guidelines for implementing the standards and applications contained in the Manual on Uniform Traffic Control Devices.


The Routledge Handbook of Transportation offers a current and comprehensive survey of transportation planning and engineering research. It provides a step-by-step introduction to research related to traffic engineering and control, transportation planning, and performance measurement and evaluation of transportation alternatives. The Handbook of Transportation demonstrates models and methods for predicting travel and freight demand, planning future transportation networks, and developing traffic control systems. Readers will learn how to use various engineering concepts and approaches to make future transportation safer, more efficient, and more sustainable. Edited by Duaan Teodorovi and featuring 29 chapters from more than 50 leading global experts, with more than 200 illustrations, the Routledge Handbook of Transportation is designed as an invaluable resource for professionals and students in transportation planning and engineering.

TRB’s Transportation Research Record: Journal of the Transportation Research Board, No. 2128 includes 23 papers that explore green time at congested traffic signals, traffic signal maintenance and operations needs, railroad-preempted intersections, three dimensional mapping of inductive loop detector sensitivity, cycle length performance measures, bus priority strategies on arterials controlled by SCOOT, tolerances for magnetometer orientation and field calibration procedure, and optimization of the...
Before they begin their university studies, most students have experience with traffic signals, as drivers, pedestrians and bicycle riders. One of the tasks of the introductory course in transportation engineering is to portray the traffic signal control system in a way that connects with these experiences. The challenge is to reveal the system in a simple enough way to allow the student “in the door,” but to include enough complexity so that this process of learning about signalized intersections is both challenging and rewarding. We have approached the process of developing this module with the following guidelines:

* Focusing on the automobile user and pretimed signal operation allows the student to learn about fundamental principles of a signalized intersection, while laying the foundation for future courses that address other users (pedestrians, bicycle riders, public transit operators) and more advanced traffic control schemes such as actuated control, coordinated signal systems, and adaptive control.

* Queuing models are presented as a way of learning about the fundamentals of traffic flow at a signalized intersection. A graphical approach is taken so that students can see how flow profile diagrams, cumulative vehicle diagrams, and queue accumulation polygons are powerful representations of the operation and performance of a signalized intersection.

* Only those equations that students can apply with some degree of understanding are presented. For example, the uniform delay equation is developed and used as a means of representing intersection performance. However, the second and third terms of the Highway Capacity Manual delay equation are not included, as students will have no basis for understanding the foundation of these terms.

* Learning objectives are clearly stated at the beginning of each section so that the student knows what is to come. At the end of each section, the learning objectives are reiterated along with a set of concepts that students should understand once they complete the work in the section.

* Over 70 figures are included in the module. We believe that graphically illustrating basic concepts is an important way for students to learn, particularly for queuing model concepts and the development of the change and clearance timing intervals.

* Over 50 computational problems and two field exercises are provided to give students the chance to test their understanding of the material. The sequence in which concepts are presented in this module, and the way in which more complex ideas build on the more fundamental ones, was based on our study of student learning in the introductory course. The development of each concept leads to an element in the culminating activity: the design and evaluation of a signal timing plan in section 9.
The student must learn about the sequencing and control of movements, presented in section 3 of this module. But to determine split times, step 6 of the design process, four concepts must be learned including flow (section 2), sequencing and control of movements (section 3), sufficiency of capacity (section 6), and cycle length and splits (section 8). Depending on the pace desired by the instructor, this material can be covered in 9 to 12 class periods.

Typical vehicle detection systems used in traffic signal operations are comprised of inductive loop detectors. Because of costs, installation challenges, and operation and maintenance issues, many alternative “non-intrusive” systems have been developed and are now commercially available. Field-testing was conducted to evaluate eight alternative vehicle detection systems (four video, one radar, one infrared, and two hybrid) at the stop bar zone of a signalized intersection under six conditions: (a) daytime, (b) nighttime, (c) favorable conditions, (d) windy conditions, (e) rain, and (f) snow. With several exceptions, performance generally degraded in nighttime when compared with day light conditions, and in adverse versus favorable weather conditions. In general, radar and hybrid systems performed with the greatest accuracy.

TRB’s second Strategic Highway Research Program (SHRP 2) Report S2-L06-RR-1: Institutional Architectures to Improve Systems Operations and Management examines a large number of topics concerning organizational and institutional approaches that might help transportation agencies enhance highway operations and travel time reliability.

This handbook, which was developed in recognition of the need for the compilation and dissemination of information on advanced traffic control systems, presents the basic principles for the planning, design, and implementation of such systems for urban streets and freeways. The presentation concept and organization of this handbook is developed from the viewpoint of systems engineering. Traffic control studies are described, and traffic control and surveillance concepts are reviewed. Hardware components are outlined, and computer concepts, and communication concepts are stated. Local and central controllers are described, as well as display, television and driver information systems. Available systems technology and candidate system definition, evaluation and implementation are also covered.

The management of traffic control systems is discussed.

Most current traffic signal systems are operated using a very archaic traffic-detection simple binary logic (vehicle presence/non presence information). The logic was originally developed to provide input for old electro-mechanical controllers that were developed in the early 1920s. It is currently in urgent need to improve the performance of traffic control devices. With the development of automatic controls, sensors, and devices, it is now possible to design advanced intersection control systems that can fully utilize advanced technologies of detection and communication as well as the high quality data acquired by such technologies. One example of such systems is Vehicle Infrastructure Integration (VII). VII links vehicles, drivers, and surrounding infrastructure (which includes roadways, traffic controls, etc.) to improve the efficiency of traffic systems and promote transportation safety. It promises to “bridge the gap” between the infrastructure and individual drivers. The purpose of this research is to 1. Investigate the potential to utilize VII data to characterize system operation and estimate system-wide measure of performance, and 2. Develop advanced signal timing procedures that can capitalize on VII data and enhance the operations of traffic signal system operations. Three advanced traffic signal control systems are developed and tested in this research. The advantages of such systems were tested in terms of time savings, the environment, and system improvements.
This project was conducted to investigate new concepts, new tools and emerging technologies directed at enhancing traffic operations and safety on signalized urban arterials that operate under saturated conditions. McFarland Boulevard, a six-lane urban arterial running north-south through Tuscaloosa, AL served as the research focus and test bed for the project. There are nine urban intersections along the study route, with a variety of configurations, turning movements and traffic volumes. In a unique approach, this project was conducted as three related and parallel efforts by the three participating UTCA universities. UAH investigated the feasibility of using video data for determining control delay on the approach to signalized intersections, and used the results to investigate the accuracy of delay predictions by popular simulation models. UAB investigated use of VISTA as a simulation model for saturated arterial traffic flow analysis. UA investigated methods to optimize traffic flow at saturated intersections through enhanced simulation models.