TRB

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Mark your Calendar - Next TRB Annual Meeting - January 7-11, 2001

2000 TRB ANNUAL MEETING

The TRB 79th Annual Meeting that was held this past January was had a record number of attendees approximately 8,200.

The CD-ROM of the preprints from the Annual Meeting papers continues to be an overwhelming success. Over 900 papers accepted for presentation were submitted in time for us to include them on the CD-ROM and the CD-ROM was distributed free-of-charge to everyone that registered.

As a special initiative related to the new millennium, over 150 of TRB's standing committee prepared a report describing the state-of-the-art and practice in their technical area, as well as a look to the future issues and needs. These reports were placed on a CD-ROM that was also distributed at the Annual Meeting. In addition, these reports have been posted on the TRB website (http://www4.nationalacademies.org/trb/onlinepubs.nsf/web/reports_papers). We believe that in combination, these reports represent an excellent snapshot of the current status of transportation in the United States and identify critical issues for the future.

2001 ANNUAL MEETING - A LOOK AHEAD

There will be a number of interesting aspects to the TRB 2000 Annual Meeting, including:

- Sunday Workshops that will be available include the Incident Management Workshop, Traffic Signal Adaptive Control Systems Workshop and Human Factors Workshop.
- To provide a more timely Preliminary Program, TRB's Website will serve as the primary distribution mechanism for the detailed Preliminary Program. We mail out an expanded "Announcement" but for technical program details the website will serve as the only distribution mechanism TRB s homepage will provide downloadable files of the entire program for printing and electronic registration.
- The paper submission and peer review process followed in the past for the 1600 or so papers that are submitted for the Annual Meeting has largely been a manual, paper-oriented approach involving excessive time. For this year's Annual Meeting, we are implementing an on-line submittal and review process. Authors can upload their paper at the website and reviewers will be able to conduct on-line peer review of the submitted papers.
- In order to provide larger meeting space for TRB committees, we are implementing a 5% reduction in the total number of sessions at the Annual Meeting. In addition, we are restructuring the committee meeting times to better coincide with the session times. We will more aggressively encourage committees to look at poster sessions as an alternative method of presentation. Poster sessions are where a number of authors are gathered at individual tables in one room and no formal presentation is made participants move from table to table engaging in a more in-depth one-on-one dialogue with the author. These poster sessions have proven popular with both the authors and audience.
- We will continue to strictly enforce the August 1 deadline for paper submittals. Any paper not in our hands by August 1 will not be accepted for review for the 2000 Annual Meeting.
- We have implemented another change in the area of publishing TRB papers, the TRRecord series, which contains the papers presented at the Annual Meeting, has been re-titled as TRRecords -- Journal of the Transportation Research Board. This change was made to reflect the intensive peer-review process that is conducted to determine a paper's suitability for publication, which is comparable to reviews conducted for other journals. In the past, some universities, not familiar with TRB publications, have not given publication credit to its faculty because the Records were not recognized as being comparable to journals.

HIGHWAY CAPACITY MANUAL

2000 Highway Capacity Manual - Work Progressing on Schedule

With the release of a major update to the HCM, attention now turns toward research results leading to the HCM 2000. Discussion on the various research efforts can be found later in this report under the NCHRP 3-55 project listings.

Highlights of the HCM2000 include:

- Expected to be available by end of October, 2000
- Over 1,000 pages (150 pages in 1950)
- 1st release in metric units
- US customary units to also be released
- Hard Copy + Multimedia CD ROM with path to user-installed capacity analysis software
- Contains five separate parts
- Separates concepts from procedures
- Goes beyond individual points (signals), segments (freeways) to facility, corridor and area-wide analyses
- More facility types, congestion levels covered
- Recognizes and documents the role of simulation models
- Determines quality of service, BUT does not recommend which is more appropriate

Technical Changes in HCM2000 using the Chapter numbers in previous HCM's

Chapter 3- Basic Freeway Sections

- renamed Basic Freeway Segments
- new, reduced equivalency truck factors (ET) for trucks and buses on rolling and mountainous terrain and for specific upgrades.
- Slight changes in LOS thresholds and free flow speeds due to metric conversion

Chapter 4- Weaving Areas

- renamed Freeway Weaving
- recalibrated speed equations in metric units
- uses revised heavy vehicle factor
- capacity/breakdown conditions redefined as:
  basic segment capacity with same # of lanes
  or, weaving volumes exceed 2,800 pcph (Type A), 4,000 pcph (Type B) or 3,500 pcph (Type C)
  or, any combination of operational factors yielding a density of 27 pc/km/lane in the weaving area.

Chapter 5- Ramp and Ramp Junctions

- virtually unchanged from 1997 except for:
- using revised heavy vehicle factor
- streamlining the process of determining when a ramp junction is isolated and when affected by nearby ramps
- clarifying breakdown conditions
- predicting speeds across all lanes, not just lanes 1 and 2 for facility analysis

Chapter 6- Freeway Systems

- renamed Freeway Facilities
- NEW chapter and procedures provide quality of service for directional freeway facilities
- permits analysis of multiple contiguous segments over multiple time intervals
- integrates the methods in chapters 3,4 and 5 for undersaturated analysis
- extends the methods in chapters 3,4 and 5 to oversaturated conditions
- demand and/ or capacity can vary in each time interval for any segment
- effect of traffic incidents, geometric improvement and ramp metering can be tested
- queues on freeway mainline and ramps are predicted at the end of each time interval
- limited HOV analysis
- only performance measures given; no facility-wide LOS

Chapter 7- Multilane Rural and Suburban Highways

- renamed Multilane Highways
- uses revised heavy vehicle factors
- new driver population factor for consistency with other uninterrupted chapters
- minor changes in LOS thresholds.

Chapter 8- Two-Lane Highways

- NEW methodology developed based on speed and percent time spent following (PTSF)
- two classes of 2-lane highways, each having its own LOS criteria
- base capacity up from 2,800-3,200 pcph, in both directions

- new directional analysis gives speed and PTSF
- MOE-specific heavy vehicle factors
- passing lanes can be analyzed

Chapter 9- Signalized Intersections

- most changes enacted in 1997 HCM
- new methodology saturation flow adjustment factors for pedestrians, bicycles and protected-permissive left-turns from shared lanes
- added maximum back of queue length estimation: average and several percentile values.

Chapter 10- Unsignalized Intersections

- most changes enacted in 1997 HCM

Chapter 11- Arterial Streets

- renamed Urban Streets
- all changes enacted in 1997 HCM

Chapter 12-Transit Capacity

- renamed Transit
- NEW methodology presented
- focus on service availability and quality
- emphasizes bus operation on surface streets

Chapter 13- Pedestrians

- updates and expands on pedestrian characteristics data
- Intersection LOS based primarily on ped. delay
- new analyses for shared ped-bike paths

Chapter 14- Bicycles

- NEW methodology now in place
- provides exclusive and shared bike path LOS
- bike path analysis based on passing / meetings
- LOS based on speed and delay on urban streets

New Interchange Ramp Terminals Chapter

- not covered prior to HCM2000
- no comprehensive methodology, but...
- discusses concepts of:
- queuing and platooning at interchanges
- signal timing at diamond interchanges
- saturation flow rate with a downstream queue
- the added delay concept

New Chapter on Simulation and Other Models

- new addition to the HCM
- applications of simulation
- numerical examples
- extensive reference list

TRB AND THE INTERNET

Some of you may have noticed that this past year s TRB Annual Meeting Preliminary Program was posted on TRB's home page on the Internet. The posting included a full listing of all sessions and committee meetings, and a registration form that could be either printed and Faxed to TRB or completed on-line and E-mailed back to TRB.

TRB's Home Page can be found at:

http://www.nas.edu/trb

Like everybody else, our homepage is continuing to evolve. Beyond the Annual Meeting information, the WWW site contains our publication catalog, conference programs and registration forms, links to other transportation related databases, NCHRP & TCRP project status and problem statements, and information on each of our Divisions. A secure Netscape Commerce Server allows credit card transactions for purchase of TRB publications and conference registration online.

TRB PUBLICATION INDEX ON THE WEB

The TRB Publication Index on the Web has been enhanced. The index now has citations to over 2100 papers, articles, and reports published by TRB from the early 1970s to date. The web based index now has links from the retrieved citations directly to TRB's Electronic Bookstore, an online form to order out of print publications, or the full text Web documents.

TRIS AVAILABLE ON THE INTERNET

The Transportation Research Information Services (TRIS) Database is the world's largest and most comprehensive bibliographic resource on transportation information. TRIS is produced and maintained by TRB.

TRIS contains almost a half million records of published and ongoing research on all modes and disciplines in the field of transportation. Last year over 30,000 new records were added to TRIS.

For almost 35 years, TRIS has been an important component of TRB's transportation information dissemination. It is used throughout the world by researchers, engineers, planners, economists, environmentalists, designers, consultants, lawyers, teachers, students and others interested in the many areas of transportation.

TRIS is now available as TRIS Online through the National Transportation Library's Website. Access TRIS Online at:

http://ntl.bts.gov/tris

Internet

The Internet is serving an ever-expanding role for TRB in information dissemination. The Internet is now TRB's primary mechanism for issuing Cooperative Research Program solicitations, disseminating preliminary program details for the Annual Meeting, and providing up-to-date information on publications. The TRB home page contains information on over 2,000 summaries of unpublished research performed by FHWA, FTA, NCHRP, TCRP, and the 52 member organizations of AASHTO in a web-searchable database; the TRB Maintenance Committees have published their research problem statements on TRB's web site; TRB publications may be purchased on-line from the TRB Electronic Bookstore; there are links to Transportation Events, including Conferences, Seminars, and Workshops conducted by TRB, TRB Sponsors, and others; and many TRB standing committees maintain homepages that are hyper-linked from TRB's homepage.

We are currently working with the NAS/NRC Information Technologies Services department to identify further actions that TRB should consider in our efforts to use the internet to expand our technology transfer capabilities and better serve the needs of our committees and sponsors.

California PATH Bibliographic Database now on TRB's Web Site

The California Partners for Advanced Transit and Highways (PATH) Database, the world's largest bibliographic database pertaining to Intelligent Transportation Systems (ITS) is now available on TRB's web site. The Path Database contains references to all aspects of ITS, ranging from historical materials dating back to the 1940s to topics of current interest and research. The Database reflects a wide coverage of ITS information including monographs, journal articles, conference papers, technical reports, theses, and selected media coverage. It currently contains close to 13,000 records with abstracts. (Since the Database is bibliographic, it therefore does not contain full-text references. Where documents are available in electronic forms, URLs are provided.)

To access the PATH Database directly the URL is:

http://www.nas.edu/trb/about/path1.html

STUDY FOR A FUTURE STRATEGIC HIGHWAY RESEARCH PROGRAM (F-SHRP)

In 1987 Congress authorized a Strategic Highway Research Program (SHRP), which was a highly focused, $150 million, 5-year effort designed to improve the performance of highway materials and highway maintenance practices. The SHRP program has received considerable support because it set clear goals and focused applied research, funded from the Highway Trust Fund, on solving major problems facing highway agencies and the motoring public. Now that the focus of the first SHRP effort is on implementation of results, Congress has requested that the Transportation Research Board initiate a new process of setting priorities and designing a program for another focused R&D effort. This F-SHRP program as it is being called, will not just be limited to materials and maintenance as was the case with the old SHRP. Potential focus areas include the following:

- Making a Quantum Leap in Highway Safety
- Accelerating the Renewal of America's Highways
- Serving Population and Economic Growth by Providing New Capacity in an Environmentally Sensitive Way
- Enhancing Maintenance and Operations in the Information Age
- Cross-cutting Topics

The study was initiated in January 1999 and is scheduled to be completed by October 2001.

RESEARCH & TECHNOLOGY PARTNERSHIP (R&T FORUM)

This partnership forum, cosponsored by TRB, AASHTO, and FHWA, seeks to develop a new framework for coordinating highway research and technology (R&T) activities among research sponsors, practitioners, researchers, and other stakeholders in highway transportation. The framework does not replace existing mechanisms for managing research, providing opportunities for collaboration between researchers and practitioners, or disseminating research findings. Instead, its main intent is to better investments among highway R&T programs and to do so in a manner that involves the diverse array of stakeholders in highway transportation. More specifically, the framework has four goals as follows:

1. To make R&T investments more effective and efficient through broadbased stakeholder involvement and greater interaction among different research programs and program sponsors.
2. To foster a better awareness and appreciation of existing research programs - a sense of ownership that extends beyond the research sponsors.
3. To stimulate the formation of productive R&T partnerships, which could include jointly funded projects, closely coordinated projects funded by different sponsors, research consortia, and joint public and private initiatives.
4. To help demonstrate needs/opportunities for research and the potential payoff from research investments, and to thereby help expand the constituencies for highway R&T.

TRB has established five Working Groups in the following areas:
1. Safety
2. Infrastructure Renewal
3. Operations and Mobility
4. Planning and Environment
5. Policy Analysis and System Monitoring

Each working group will:
- Identify the major issues in their area of interest
- Review existing R&T programs, including FHWA, AASHTO/NCHRP, state DOTs, and others being conducted in their area of interest;
- Assess the coverage in relation to the current issues, and identify gaps and areas of overlap
- Determine priority research areas 5.Develop marketing information on the benefits to result from research expenditures; and
- Facilitate partnerships and coordination to carry out needed research

It is anticipated that the working groups will primarily deal with research theme areas rather than individual projects, e.g., roadside safety rather than barrier design.

UPCOMING CONFERENCES

- 4th International Conference on Highway Capacity, June 27-July 1, 2000, Maui, HI
- 4th National Conference on Access Management, August 13-16, 2000, Portland, Oregon
- 10th International High Occupancy Vehicle Conference, August 28-30, 2000, Dallas, TX
- Remote Sensing for Transportation Conference ,December 4-5, 2000, Washington, D.C

RECENT TRB PUBLICATIONS

- Operational Impacts of Median Width on Larger Vehicles, NCHRP Synthesis 281
- Roadway Incident Diversion Practices, NCHRP Synthesis 279
- Traffic Signal Operations Near Highway-Rail Grade Crossings, NCHRP Synthesis 271
- Traffic Signing, Visibility, and Rail-Highway Grade Crossing, Record 1692
- Advanced Traffic Management Systems, Record 1683
- Transportation System Management, Transportation Demand Management, and High-Occupancy Vehicle Systems, Record 1682
- Highway Capacity, Quality of Service, and Traffic Flow and Characteristics, Record 1678
- Valuation of Travel-Time Savings and Predictability in Congested Conditions for Highway User-Cost Estimation, NCHRP 431
- Improved Safety Information to Support Highway Design, NCHRP 430
- Impacts of Access Management Techniques, NCHRP 420
- Older Driver Resource Directory, Circular 497
- Research on Intelligent Transportation Systems, Human Factors, and Advanced Traveler Information System Design and Effects, Record 1694
- Highway and Traffic Safety, Enforcement, Older Person Mobility, and Women s Issues Research, Record 1693
- Simulation, Instrumented Vehicles, and Human Performance in Highway Design and Research, Record 1689
- Truck Safety Research, Record 1686
- Pedestrian and Bicycle Research: 1999, Record 1674
- Statistical Methods in Transportation and Safety Data Analysis for Highway Geometry, Design, and Operations, Record 1665
- Combating Impaired Driving in an Era of Diminished Resources and Shifting Priorities, Circular 487
- Roadside Safety and Other General Design Issues, Record 1690

- Highway Geometric Design and Operational Effects, Record 1658
- Improved Safety Information for Highway Design, NCHRP Digest 239

CURRENT NCHRP SYNTHESIS PROJECTS

- Systems Engineering Process for Developing Traffic Signal Systems
- Sleep Deprivation Countermeasures for Motorist Safety
- Recent Geometric Design Research for Improved Safety and Operations
- Statistical Methods in Highway Safety Analysis
- Traffic Control System Configuration Management

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM (NCHRP)

New Projects (Scopes are tentative, panels are being formed to oversee these projects)

3-61 Communicating Changes in Horizontal Alignment

The objectives of this research are to evaluate the criteria, performance, and operational and safety effects of the combination of advance warning signs, advisory speed plates, and delineation treatments on horizontal curves as an integrated approach to communicating horizontal alignment changes. Appropriate revisions to the MUTCD and other related highway operational guidelines are expected.

3-62 Guidelines for Accessible Pedestrian Signals

The objective of this research is to develop research-based guidelines for the nature of accessible pedestrian signals that will provide optimal directional information when necessary, will provide unambiguous indication of which crosswalk at an intersection has the WALK signal, and will be no louder than necessary to enable pedestrians who are blind or visually impaired to safely, quickly, and efficiently cross at signalized intersections.

4-29 Selection of Sign Materials to Optimize Performance

For many years, engineering grade retroreflective sheeting was the only type of sheeting available for traffic signs. In recent years, there has been a proliferation of sheeting types and manufacturers. There have also been important changes in automobile headlight technologies and window tinting, which have a major impact on nighttime sign performance. However, even though there has been a dramatic increase in the choices of sign materials, there have been little or no changes in the design of traffic signs. Sign sizes and legend design have remained essentially constant for more than 25 years. There is a significant need for a sign design user guide that addresses the issues of sign size, sign placement, material selection, legend design, and total costs, in order to provide the optimal performance within the existing constraints.

5-16 National Calibration Standards for Measuring Retroreflectivity

This research is intended to develop a dedicated reference instrument to provide national calibration standards for retroreflectivity, thereby improving the accuracy of measurements made by other instruments. This reference instrument will use modern instrumentation techniques to perform routine calibrations in compliance with all relevant documentary standards. The instrument will have sufficient flexibility to measure spectral and luminous quantities of both signs and markings over the full range of angles, and will have the best possible accuracy.

15-22 Safety Consequences of Flexibility in Highway Design

The AASHTO publication *A Policy on Geometric Design of Highways and Streets*, a.k.a. the "Green Book," provides detailed guidance and control values for the design of new alignments or of those undergoing major reconstruction. Most of the design controls represent limits (i.e., maximums or minimums); however, in some instances a range of design values or even a single value is recommended. For most controls, the Green Book indicates that a combination of theory, measurement, or practice has shown the recommended control to provide a safe, comfortable, and aesthetically pleasing roadway.

The objective of this research is to expand the guidelines provided in the Green Book such that additional information is available about the benefits derived from critical alignment control values and the implications of a deviation from these values. Emphasis should be given to the major controlling criteria for rural highways: lane and shoulder width, vertical alignment, horizontal alignment, and superelevation. Implications considered should include safety, operations, comfort, cost, and roadway appearance. Research should be coordinated with ongoing efforts by FHWA to develop the Interactive Highway Safety Design Model (IHSDM), the Road Safety Audit Process, NCHRP Synthesis Topic 31-01, and a possible highway safety manual.

17-22 Identification of Vehicular Impact Conditions Associated with Serious Ran-Off-Road Accidents

The primary goal for roadside designers is to limit the number of serious injuries and fatalities associated with ran-off-road accidents. Roadside geometrics and safety features are believed to have a strong influence on the frequency of serious injury and fatal accidents. In order to design optimum roadside geometrics as well as determine which roadside safety features are appropriate for use along high speed highways, it is imperative to identify impact characteristics associated with serious injury and fatal accidents. This information has direct bearing on the safety evaluation criteria used to assess the performance of roadside safety features. Vehicle types used in the full-scale crash test evaluation are currently selected to represent a reasonable worst case situation. Further, impact speeds, angles, and orientations used in the testing procedures are selected to represent the 95th or 98th percentile worst case situation. Consequently, it is important to have definitive information regarding whether there is any real relationship between the selected test impact conditions and accidents involving serious injuries and fatalities. The same information will be very helpful for focusing designers attention on the roadside features that are involved in the greatest number of serious injury and fatal accidents. This data will help designers spend safety dollars on improvements that will have the greatest likelihood of reducing serious injuries and fatalities.

The objective of this research is to identify the vehicle types and impact conditions associated with serious injury and fatal accidents involving roadside features and safety devices. This research project would provide a foundation for selecting impact speeds and angles to be used in full-scale crash test evaluation of roadside safety features. By identifying the impact speeds and angles associated with serious injury and fatal accidents, it will be possible to estimate the impact of changing crash test guidelines. The research will also help identify roadside features and situations that commonly cause serious injuries and fatalities in ran-off-road accidents. This information will help roadside designers focus safety funding on locations where it would be most likely to reduce serious injury and fatal accidents. Impact speed and angle distributions developed during this study will also be very valuable for use in encroachment-probability-based benefit/cost models, such as the Roadside Safety Analysis Program (RSAP).

G-15 Benefits of Freeway Monitoring Operations for Incident Response (Contingent on Funds)

Closed Circuit TV systems (CCTV) can provide police, fire, emergency medical, and towing and recovery responders with a powerful tool for coordinating the activities of emergency field forces responding to the scene of a major accident. In addition, the traffic surveillance and roadway condition information obtained by a traffic operations center (TOC) can be of great value to responders attempting to reach an incident scene. The key to obtaining rapid and efficient response from all agencies to incidents is the inter-agency exchange of information regarding the incident so that proper response can be assessed. Not only can public safety agencies benefit from obtaining CCTV pictures for verification of an incident as they begin their response, they can also benefit from information regarding traffic conditions on their response route and special information such as blocked railroad crossings or construction which might affect their response.

The overall objective is to develop materials that will provide information on the benefits of traffic monitoring and surveillance information for responders and which might be a catalyst for better participation from the emergency response community in the development of freeway management systems. This will be achieved by identifying the issues of interest to public safety, and identifying locations where surveillance and monitoring information is shared with responding agencies and where dispatch information from public safety agencies is shared with traffic management.

SP-13 Safety Evaluation of Raised Pavement Markers (Contingent on Funds)

The proposed study would assess the safety impacts of RPMs and identify critical design parameters. The study should encompass a representative sample of the United States and document the accident rates both before and after the installation of RPMs at selected sites. A number of past research studies have indicated that RPMs are useful as supplemental delineation treatments in improving driver preview distances. However, there has been little work done in quantifying the safety implications of RPMs. It is possible that RPMs may be misused or overused, which may explain the increase in accidents found by some agencies. This study should focus on determining the causative factors involved in the possible risks of using RPMs and recommend design practices to remedy the problem.

Ongoing Projects

3-50(2) Additional Investigations on Driver Information Overload

Drivers are typically confronted with a multitude of traffic control devices displaying regulatory, warning, and guidance information. Unfortunately, there exists little guidance as to what constitutes too much information, how this problem can be detected, and what can be done to improve the sign system at a particular site. NCHRP Project 3-50, "Driver Information Overload," made substantial progress in understanding the problem and developing a general model that captures the primary aspects of the problem. Two research experiments conducted under Project 3-50 provided

some empirical basis for certain aspects of the model. However, at the conclusion of the project, the model remained primarily conceptual rather than empirical. Quantitative data to refine and validate the model were lacking. The objectives of this research are to continue efforts to develop and validate a driver information overload model for freeways and to translate the model into a practical tool for traffic and safety professionals to use in analyzing driver information loadings.

The contract began on October 13, 1999 and is scheduled to be complete in January 2002.

3-54(2), Evaluation of Traffic Signal Displays for Protected/Permissive Left Turn Control

NCHRP Project 3-54 found that seven basic forms of P/P left turn control exist and that research on their relative safety and operational effectiveness has been limited. Specifically, research is needed to address the yellow trap and driver confusion problems. The safety implications of increased signal efficiency and the difficulty in establishing uniformity between states must be considered. The objectives of this project are to evaluate the effectiveness of different signal displays and phasing for P/P left turn control through laboratory and field studies and recommend uniform signal display(s).

The contractor has identified the flashing yellow arrow as a promising alternative to the green ball. These alternatives are being assessed through driver simulation and field evaluations. The project will be completed in March 2001 and a presentation to the NCUTCD Signals Committee is being arranged for the January 2001 meeting.

3-55(6) Production of the Year 2000 Highway Capacity Manual

The update of the 1985 Highway Capacity Manual (HCM) was completed in 1994 and has been distributed by the Transportation Research Board. Concurrent with this distribution of the 1994 HCM, the NCHRP initiated a major project, NCHRP 3-55, with the intent of giving the user community a completely new and updated HCM by the Year 2000. As the first phase of this effort, the NCHRP 3-55 project determined how the current HCM is used, what the user community identifies as the most critical needs or gaps in knowledge, and what the format and delivery system enhancements would be required or desirable for the HCM2000. The objective of this research is to develop and deliver a complete document, both hard copy and electronic components, that can be distributed as the Highway Capacity Manual in the Year 2000 (HCM2000).

The contract began in October 1996 and is expected to be complete in November 2000. The metric text has been edited by TRB staff and the U.S. customary text will be delivered to TRB soon. Both are expected to be available for purchase by October 15, 2000 and 500 complimentary copies will be distributed to the state DOTs with each state receiving at least three copies. The manual includes the results of NCHRP Projects 3-55(2)A, Planning Applications for the Year 2000 Highway Capacity Manual; 3-55(3), Capacity and Quality of Service of Two-Lane Highways; and 3-55(5), Capacity and Quality of Service of Weaving Areas. The multimedia CD-ROM are being developed and should be available by the end of the year.

3-56 Systemwide Impact of Safety and Traffic Operation Design and Decisions for Resurfacing, Restoration, or Rehabilitation (RRR) Projects

The objective of this project is to develop a procedure for allocating the limited funds available for RRR projects so as to maximize the effectiveness of those funds in improving safety and traffic operations on a network or system of two lane roads. (Note: This project will focus on the traffic operations element of RRR projects while NCHRP Project 17-09(2) will be directed towards the safety aspect.)

The interim report was approved and data collection and analysis efforts are proceeding. Data is needed from NCHRP Project 17-19(2) which is causing this project to fall behind.

3-57, Recommended Traffic-Control Devices for Railroad-Highway Grade Crossings

Based on perceived shortcomings in the standard MUTCD grade-crossing traffic-control devices, transportation agencies across the United States have implemented a wide variety of modifications to the standard devices (e.g., "Ohio Buckeye," retroreflective patterns on crossbuck posts, "Yield to Trains" and "Look for Trains" signs, and rumble strips on approaches). Such modifications have contributed to the inconsistency of grade-crossing treatments across the United States. The objective of this project is to recommend traffic-control devices that improve the behavior of motorists when approaching and crossing a railroad track or tracks. The final report will be submitted to the NCUTCD and FHWA for consideration in a future revision of the MUTCD.

The contract began on June 1, 1999 and is scheduled to be complete in December 2000 though the contractor is about three months behind schedule. Focus group evaluation of various TCDs is almost complete and laboratory studies of driver comprehension have begun.

3-58, Assessing Traffic Control Signal Installations Using Capacity Analysis and Simulation

The objective of this research is to develop a user's guide for using capacity analysis and simulation in engineering studies to determine the appropriateness of traffic control signal installations. The intent of this project is to focus on the engineering study process and not on identifying deficiencies in the MUTCD warrants.

The contract began on August 4, 1999 and is expected to be complete in November 2000. The project is on schedule.

3-59, Assessment of Variable Speed Limit Implementation Issues

Variable speed limits are intended to allow reasonable and realistic speeds based on time of day, traffic conditions, weather conditions, construction or maintenance activities, and other factors. With the exception of school zones, use of variable speed limits in the United States has been limited, although many transportation agencies have expressed interest in them. Use has probably not been more widespread due to concerns over their legal basis, the level and type of enforcement required, and the lack of information on proven benefits. The objectives of this project are to (1) assess the impacts of and the implementation issues associated with deployment of variable speed limits for a limited number of driving situations and (2) develop operational test plans for the most promising applications.

The contract for this project is pending.

4-28, Feasibility Study for an All-White Pavement Marking System

The use of yellow and white pavement markings has been the subject of debate for transportation agencies since the 1920s. In 1971, the Manual on Uniform Traffic Control Devices first specified that yellow markings would be used to separate traffic traveling in opposite directions. However, it is uncertain whether most U.S. drivers understand or appreciate the significance of the current system. Yellow markings are less bright (on average) than white markings and are more expensive to manufacture. A one-color system would reduce the cost of inventory, equipment and application. The objective of this study is to identify and quantify the benefits, costs, drawbacks, and implementation issues of switching from the present two-color system to an all-white pavement marking system.

The contract began on May 25, 2000 and is scheduled to be complete in November 2001.

5-14, Advance Warning Arrow Panel Visibility

The objectives of this research were: (a) to determine the effects of parameters that affect the visibility and conspicuity of arrow boards, (b) to determine suitable performance standards for arrow boards for operating conditions typically encountered in highway work zones, and to develop simple, reliable means for checking arrow board performance, including bulb brightness, under field conditions.

The revised final report has been approved but preparation of an NCHRP publication has been suspended until a procurement specification for arrow panels is available. Draft procurement specifications have been developed under a separate contract. The project panel has reviewed the specification and the contractor is making the appropriate revisions.

5-15, Visibility Performance Requirements for Vehicular Traffic Signals

The light intensity and distribution requirements in the Institute of Transportation Engineers' Standard for Vehicle Traffic Control Signal Heads were established approximately 50 years ago based on the capabilities of traffic signals at that time. The objectives of this research project are to develop visibility performance requirements for vehicular traffic signals that are independent of light source and to develop practical, reliable, and economical test methods to verify compliance with the performance requirements. The performance requirements shall be based on the visibility needs of the driving population and shall consider the special needs of older drivers and those with color-deficient vision.

The contract began in March 1996 and the contractor has encountered numerous difficulties and delays. Laboratory studies and controlled field studies have resulted in some preliminary recommendations on intensity. An observational field study of those recommendations is underway. Completion of the project is expected in late 2000.

8-35 Incorporating ITS into the Transportation Planning Process

The objective of this project is to develop a guidance document for incorporating and integrating ITS improvements into the multimodal planning and programming processes. This guidebook will be used by state, metropolitan, and local decision makers and staffs as well as by federal agencies and private industry partners; it should supplement U.S. DOT guidance documents, training initiatives, and other research on ITS. The research should focus on lessons learned from actual experiences in different regions with different scopes and levels of complexity. At a minimum, it should include statewide, urban, and rural applications as well as a range of differing sized metropolitan areas. It should also identify the various approaches to implementing ITS through the existing planning, project development, maintenance, and operations processes. Attention should be given to the integration of appropriate ITS strategies tailored to the needs of the specific area. In addition, it should also focus on analytical methods, data requirements, and planning and

programming process actions that can assist decision makers in evaluating and prioritizing ITS applications to their transportation systems. Finally, the project should produce recommendations for disseminating the findings and conclusions of this research as well as recommendations for maintaining and updating the information in the guidebook.

The contract began in May 1998. Additional NCHRP funds were approved to update the material that has been developed to reflect the final TEA-21 policies and requirements for consistency with the National Architecture. These funds will also be used to help in technology transfer. A contract completion date has not yet been set.

10-38(2) Fatigue-Resistant Design of Cantilevered Signal, Sign, and Light Supports

The objective of this study is to expand the knowledge base, developed in NCHRP Project 10-38, for considering wind-induced fatigue in cantilevered signal, sign, and light supports. This study will provide information on loads resulting from variable-message signs, methods for mitigating galloping effects, methods for tightening anchor bolts, methods of identifying structures and sign configurations susceptible to galloping, and characterization of importance factors. In addition, example designs shall be prepared to provide a comprehensive assessment of the effects of the design provisions developed in NCHRP Project 10-38. Finally, guidance on the design, installation, inspection, and maintenance of cantilevered supports shall be developed.

The contract began in June 1998 and is expected to be complete in October 2000.

15-18 Design Speed and Operating Speed

There is a need to reevaluate how AASHTO defines speed-related terms (i.e., design speed, operating speed, average running speed) and uses speed as a control in its technical policy and guidelines on geometric design. The objectives of this research are to evaluate the relationships among speed, geometric design elements, and highway operational practices and recommend appropriate revisions to the AASHTO technical policies and related highway operational guidelines.

The contract began in December 1998 and will be complete in November 2001. Recommended definitions for the various types of speed are being finalized and will be sent to the FHWA for consideration in the next MUTCD and the AASHTO Task Force on Geometric Design for consideration in the next Green Book.

17-09(2) Impacts of Resurfacing Projects with and without Additional Safety Improvements

Design standards are considered essential to highway safety and the application of the highest design standard is thought to maximize safety. Safety needs to be considered in making decisions on resurfacing projects since a smoother pavement often results in higher speeds on a facility. Further, attempts to stretch limited funds often reduces the type and scope of additional safety improvements. Limited research has been done to determine the safety impact of resurfacing projects with and without additional safety improvements. It is desirable to determine the safety impacts to provide information to decision makers on the importance of safety improvements associated with resurfacing projects.

The objectives of this research are (1) to identify the major categories of safety improvements implemented with resurfacing of two lane roads; (2) to document the accident impact, relative to the conditions before the project, of resurfacing and of resurfacing in conjunction with the major categories of safety improvements; and (3) to present data comparing pre and post improvement accident experience for the various improvement categories. The scope of this research will be two-lane, free-access roads for only two ADT conditions. Two-lane roads are defined to include those roads in rural and suburban areas with posted speeds 45 MPH or above.

Data collection is complete and the project is expected to be complete in August 2000.

17-10(2) Structural Supports for Highway Signs, Luminaries, and Traffic Signals

The objective of this research is to enhance the recommended specification for structural supports for highway signs, luminaries, and traffic signals developed under NCHRP 17-10 and provide a strategic plan for future development of the specification. In particular, information is needed on the following: (a) the consequences of changes in the wind speed map, (b) fatigue in noncantilevered structures, (c) foundation selection criteria, (d) drag coefficients for multisided tapered poles, (e) connection plate flatness criteria, (f) strength of rectangular poles bent about the diagonal, and (g) performance specifications for fiber-reinforced composite structural elements. In addition, more extensive design examples than were possible in the earlier work must be prepared.

The contract began in March 1999 and will be complete in June 2001.

17-14 Improved Guidelines for Median Safety

The objective of this research is to develop improved guidelines for the use of median barriers and for the selection of median widths and slopes on new and existing high-speed divided highways. The guidelines should be suitable for inclusion in *AASHTO's Roadside Design Guide* and *Policy on Geometric Design of Highways and Streets*.

The contract began in March 1997 and is expected to be complete in December 2000. The contract was amended to provide additional data verification and data collection on actual median slopes.

17-15 Accident Mitigation on Congested Rural and Exurban Two- and Three-Lane Highways

The objective of this research is to develop a guide that aids the transportation practitioner in identifying, programming, and designing projects to improve safety on congested rural and exurban two- and three-lane highways. The guide should help identify primary accident types and critical causal factors for accidents and evaluate countermeasures for reducing the number or severity of accidents. In addition to recurrent congestion, the research should address roads with episodic congestion (e.g., recreational and seasonal demands and special events).

The report is being edited and should be published in August as NCHRP Report 440.

17-16, Accident Warrant for Traffic Signals

The objectives of this project are to develop an improved accident warrant for traffic signals to be submitted to the National Committee on Uniform Traffic Control Devices for their consideration and to provide a model(s) to estimate the safety impacts of installing or removing traffic signals.

The contract began in March 1997 and is expected to be complete in January 2001. Numerous data collection difficulties have caused delays but they have been resolved and no further delays are expected.

17-17 Development of Guidelines to Improve Safety During Night Time Construction or System Preservation Work

There is a need to develop specific guidelines to improve safety during nighttime construction and maintenance work. Research has been undertaken to improve workzone safety which has addressed sign reflectivity, channelization, use of steady burning lights, arrow panel visibility, night work illumination requirements, and setting workzone speed limits. Recent research has not specifically addressed safety at night during these activities. With congestion increasing on the nation's highway system, particularly in the urban areas, pressure to perform construction and maintenance work at night is rising. Standards for Work Zone Traffic Control (WZTC) for night time operations are needed.

The objectives of the research are to: (a) determine whether the existing WZTC standards for construction and maintenance adequately provided guidelines for nighttime activities, and (b) develop appropriate recommendations for improved night time WZTC standards.

The draft procedures have been delivered. A contract modification is being processed to enhance the guidelines with additional photographs and drawings and to conduct six case studies to validate the applicability and demonstrate the flexibility of the guidelines. The final guidelines and procedures are expected in September 2001.

17-18 AASHTO Highway Safety Strategic Plan Implementation Support

This project will provide technical support for efforts to identify best practices, develop new programs, coordinate efforts, disseminate information, and other work to facilitate the implementation of the 22 aspects of the strategic plan. The project will start with a detailed review of the background to the plan compiled from the many volunteers who formulated it. The needs for action and research will be highlighted and mechanisms established to get information on effective approaches to improve safety disseminated to transportation professionals in the most expeditious manner.

Information has been gathered on each of the strategies and a web site (http://safetyplan.tamu.edu) has been developed.

17-18(3) Guidance for Implementation of the AASHTO Strategic Highway Safety Plan

The AASHTO Strategic Highway Safety Plan includes strategies in 22 key emphasis areas that affect highway safety. The goal is to reduce the annual number of highway deaths by at least 5,000 by 2004. To meet this goal, agencies must continue the effective measures that they are using and implement new strategies. The objective of this research is to develop and validate guidance documents to assist state and local agencies with reducing fatalities in targeted areas. This project will focus on the following areas: aggressive driving, head-on and run-off-the-road crashes on two-lane roads, drivers with suspended and revoked licenses, hazardous trees, and unsignalized intersections.

The contract began in March 2000 and is expected to be complete in March 2002 though interim documents will be published as they become available.

17-18(4) Highway Safety Manual

There is a significant opportunity for improving the explicit role of highway safety in making decisions on roadway design and operations. Improved, low-cost technologies have encouraged many state Departments of Transportation and other agencies to develop systems to deliver better safety information. In addition, there has been a parallel advancement in the science of safety impact prediction. Better understanding of the statistical nature of crashes, coupled with new analytical tools, makes it possible to produce more valid estimates of the affect of geometric and operational changes on the frequency and severity of crashes.

In December 1999, a workshop was held, under sponsorship of eight TRB committees funded by FHWA to determine the need for, nature of, and feasibility of producing a *Highway Safety Manual* (HSM). The group concluded that there is definitely a need for such a manual and that work should begin as soon as possible. The results of the workshop will be documented in a TRB Research Circular. The HSM should have similar attributes to the *Highway Capacity Manual.* The purpose of a HSM will be to provide the best factual information and tools, in a useful and widely accepted form, to facilitate roadway design and operational decisions based upon explicit consideration of their safety consequences.

The objectives of this project are to (1) complete a scoping study that details the effort required to produce the first edition of the *Highway Safety Manual* and (2) develop a prototype chapter that incorporates the analytical procedure that is being developed by the FHWA for safety estimation on rural two-lane highways.

Proposals are currently being requested.

20-07 (Task 81), The Relationship Between Headlamp Design and Retroreflective Sign Visibility

The objective of this project is to recommend headlamp-intensity requirements above the horizontal plane of the headlamp. The recommendations should be principally based on the visibility and legibility of signs, but must also consider pedestrian and vehicular safety, infrastructure costs, costs to headlamp and vehicle manufacturers, and the associated glare.

The contract began in April 1997 and is expected to be complete in Fall 2000.

20-07 (Task 116), User's Guide for Evaluating Sign Retroreflectivity

The AASHTO Task Force on Retroreflectivity developed alternative language for specifying the minimum retroreflectivity of signs in the MUTCD. The objective of this project was to review the alternatives and provide recommendations to the Task Force. It also recommended changes to the FHWA's draft "Nighttime Visual Inspection Guide for Traffic Sign Retroreflectivity." The task force will present their recommendations for the MUTCD at various AASHTO Highway Subcommittee meetings in Summer 2000. The final recommendation will be made to the AASHTO Standing Committee on Highways in Fall 2000.

22-09 Improved Procedures for Cost-Effectiveness Analysis of Roadside Safety Features

The objective of this research is to develop improved microcomputer-based cost effectiveness techniques for use in assessing alternative safety treatments at a site and also for generating warrants or guidelines for the application of safety features.

A revised version of the Roadside Safety Analysis Program software was tested by an independent contractor and found to be fully functional and capable of providing reasonable results. Limited distribution of the software and documentation took place in Fall 1997. The contractor delivered a revised version of the software and documentation in December 1998. The panel and others are reviewing the software and documentation and considering options for using available continuation funds to enhance the software, demonstrate its usefulness, or develop training materials.

22-11 Evaluation of Roadside Safety Features to Accommodate Vans, Mini-Vans, Pickup Trucks, and 4-wheel Drive Vehicles

The objectives of this research are to evaluate the safety performance of roadside features for each subclass of light trucks, to assess the gaps in safety performance information, and to recommend priorities for research, testing, and development to address the needs identified.

The contractor has compiled data on the characteristics of the light truck class of vehicles, investigated accident data, and conducted simulation analyses of dynamic performance. The initial crash testing has been completed and the analyses of accident histories, crash tests, and simulation studies have been used to assess how well the light truck class of vehicles is accommodated by roadside hardware. The panel has approved several additional crash tests to answer critical questions. These additional tests were conducted in March, 1999. The contractor has submitted the first of three appendixes to the preliminary draft final report and is scheduled to submit the entire preliminary draft final report by May, 2000. A no-cost time extension amendment is anticipated to extend the completion date of the project to July 31, 2000.

22-12 Guidelines for the Selection, Installation, and Maintenance of Highway Safety Features

According to the recently published NCHRP Report 350, "Recommended Procedures for the Safety Evaluation of Highway Safety Features" a safety feature may be developed to meet one of up to six "test levels" (TL). For example, a longitudinal barrier such as a guardrail, can be developed for one of six TLs, a crash cushion for one of three test TLs, and a Truck Mounted Attenuator for one of two TLs. The feature may be designed for temporary or permanent applications. Features developed for the lower TLs may be applicable for low speed, low volume conditions and will have minimal containment capabilities for heavier vehicles.

The objective of this research is to develop improved guidance for the selection, installation, and maintenance of highway-safety features based on the performance concept. Specifically, the research will address (a) selecting the appropriate highway-safety feature given the characteristics of a site, (b) installing highway-safety features, (c) maintaining highway-safety features to ensure effectiveness over time, and (d) upgrading existing highway-safety features and justifying design deviations or field modifications. The research should be applicable to all types of urban, suburban, and rural highways. This research effort will concentrate on nonproprietary features, but also compile information provided by manufacturers of proprietary hardware.

Preliminary selection guidelines were presented to the AASHTO Task Force for Roadside Safety in September, 1998. They requested additional information and examples prior to making decisions on the acceptability of the criteria. These were provided in late December, 1998. Draft installation and maintenance guidelines as well as preliminary findings have been submitted for panel review and were presented to the Task Force for Roadside Safety during their September, 1999, meeting for their review and comment. The Task Force's comments were forwarded to the panel and to the contractor in December, 1999. An interim panel meeting to discuss the Task Force's comments is anticipated, as is a no-cost time extension.

22-13 In-Service Performance of Roadside Barriers

More motorists are killed annually from barrier and barrier terminal impacts than any other man-made roadside obstacle, except utility poles. Studies also show that barrier terminal impacts are much more severe than other barrier crashes. State agencies install many miles of barrier and the associated end treatments annually and maintain extensive inventories of such systems. New barrier systems continue to be developed, but these systems need only pass a few controlled crash tests to be certified for general use. Field reviews (in-service evaluations) are recommended in NCHRP Report 350, but agencies find it difficult to devote the resources needed to conduct these studies. Research is needed to conduct extensive field studies of longitudinal barriers and end treatments, and to determine their performance when impacted.

The objectives of this research are to (a) establish a practical procedure(s) for gathering data on the in-service performance of traffic barriers; (b) develop a viable process for compiling, maintaining, and using in-service performance data to improve roadside safety; (c) demonstrate use of the procedure(s) and process for the evaluation of a designated subset of barriers; and (d) offer recommendations for implementation of the procedure(s) and process. The procedure(s) should be comprehensive enough to apply to all common barriers and typical field applications, and a broad definition of performance is assumed.

The revised final report is expected in June 2000.

22-13(2) Expansion and Analysis of In-Service Barrier Performance Data and Planning for Establishment of a Database

The objectives of this research are to (1) extend the in-service performance evaluation database developed in Project 22-13, (2) develop insights on hardware effectiveness from analysis of the data gathered, and (3) establish means to access, maintain, supplement, and disseminate data on in-service performance. It is intended that data collected in this continuation effort will be compatible with data already collected and that various analyses will be updated when significant increases in the available data occur. It is expected that a national repository will be established that will allow convenient access to the data.

The project began on April 1, 1999 and is scheduled to be complete on March 31, 2001.

22-14 Assessment of Updating Needs for the Procedures for the Performance Evaluation of Roadside Safety Features

NCHRP Report 350, "Recommended Procedures for the Safety Performance Evaluation of Highway Features" is the latest in a series of documents aimed at providing guidance on testing and evaluating roadside hardware and other features. NCHRP Report 350 incorporated significant additions over NCHRP Report 230 including criteria for multiple performance levels, procedures for testing features not previously addressed, and translation to metric units. It addressed needs associated with the changing character of the highway network and the vehicles using it. Recent tests under NCHRP Report 350 have, however, indicated that some existing hardware and current vehicle designs have difficulty passing the recommended test conditions and hence raised questions about the appropriateness of the test criteria for these vehicles.

The objectives of this research are to review the guidance provided in NCHRP Report 350, assess the needs for updates to the document, and develop a strategy for updating performance requirements and evaluation criteria based on the projected vehicle fleets, current research, and emerging highway safety technology.

Eight white papers have been received. Findings and proposed recommendations for five of the white papers were presented at the August, 1999 meeting of TRB's Roadside Safety Committee (A2A04) for committee discussion and input. Committee recommendations have been summarized and sent to the oversight panel for review and comment. The project is expected to be complete in September 2000.

22-15 Assessment of Means to Improve the Compatibility of Vehicles and Roadside Safety Hardware

Recent roadside safety research has noted that the increased variation in the size, weight, distribution, and shape (geometrics) of vehicles in the U.S. fleet is raising the concern that existing barriers, related hardware, and other features cannot fulfill their safety functions. Currently, developers of roadside safety hardware react to changes in the nation's vehicle fleet design, instead of being proactive to changes in vehicle design (i.e., increased use of three-quarter ton vehicles, increased use of composite materials and light weight plastics in vehicle manufacture, small light weight electric city vehicles, and a wide range in centers of gravity). Roadside safety hardware is designed to meet the testing requirements for a range of vehicles defined by NCHRP Report 350. Recent testing has revealed that some vehicle characteristics can lead to undesirable results. A study is needed to identify vehicle characteristics that can negatively effect the impact performance with roadside safety hardware.

The objectives of this research are to 1) identify current and future vehicle characteristics that are potentially incompatible with existing roadside safety hardware, 2) assess opportunities for and barriers to improve compatibility, and 3) prepare materials to increase the awareness of vehicle and hardware manufacturers and decision makers of the problem.

The project began in February 1999 and will be complete in March 2001.

22-16 Development of an Improved Roadside Barrier System

Roadside barrier systems have been developed over the years to safely redirect vehicles that leave the roadway. Such barrier systems are intended to be sacrificial, which requires substantial replacement after major vehicle impact. Maintenance crews must spend considerable time maintaining these systems, which results in high costs and safety risks to motorists and highway workers. Concrete safety-shaped barriers of varying designs have also been used as roadside barriers. Concrete barriers, while higher in initial cost, tend to require less maintenance, but are less forgiving in severe impacts.

The ultimate goal of research in this area is to develop an improved roadside barrier system that will meet the latest crashworthiness criteria. The system will be expected to provide increased safety, competitive initial and life-cycle costs, reduced maintenance, and greater flexibility in field applications over a typical strong-post, W-beam guardrail (i.e., G4-1 system). The objectives of this project are to (1) investigate the feasibility of various candidate design concepts for an improved roadside barrier system, (2) develop and evaluate the most promising design concept(s), and (3) formulate plans for full development and testing of the most promising design concept(s).

The contract began on July 16, 1999 and is expected to be complete in April 2001.

22-18 Crashworthy Work-Zone Traffic Control Devices

All work-zone traffic control devices used on the National Highway System must meet the evaluation criteria in *NCHRP Report 350* in the near future. Certain low-mass items, referred to as Category 2 devices, must meet *NCHRP Report 350* criteria if they are purchased new after October 1, 2000. Category 2 devices include the MUTCD Type I, II, and III barricades, vertical panels, and temporary sign supports. Currently, most of the devices in use are shop-fabricated of readily available materials but have not been properly crash tested. There are a limited number of vendors furnishing approved crashworthy devices. Many of the approved devices are proprietary and cost considerably more than comparable shop-fabricated devices.

The objective of this research is to develop plans and specifications for nonproprietary crashworthy work-zone traffic control devices constructed of readily available materials. These devices shall meet the evaluation criteria in *NCHRP Report 350* as supplemented by FHWA Memorandum, Identifying Acceptable Highway Safety Features," dated July 25, 1997. Category 2 devices (as defined by the above-referenced FHWA memo) meeting the requirements of the MUTCD (e.g., Type I, II, and III barricades, vertical panels, and temporary sign supports) shall be evaluated with and without signs, lights, and flags. Temporary sign supports shall include both 300-mm (1-ft) mounting height and 2.1-m (7-ft) mounting height on portable stands.

This contract is pending.

TRANSIT COOPERATIVE RESEARCH PROGRAM (TCRP)

A-5A(1),(2) Active Train Coming/Second Train Coming Sign Demonstration

Many light rail transit (LRT) and commuter railroads agencies have been experiencing difficulty in effectively communicating with motorists, pedestrians, and bicyclists that a light rail vehicle (LRV) or train is approaching the at-grade crossing. For this purpose, LRT agencies have installed LRV-actuated, internally illuminated, warning signs with legends such as TRAIN, TROLLEY COMING, TRAIN APPROACHING, etc. These active signs warn motorists, pedestrians, and bicyclists of the increased risk associated with violating the primary regulatory crossing control device (e.g., a standard traffic/pedestrian signal), which prohibits crossing when the LRV is approaching. Although these active warning signs have proven somewhat effective, they provide only a legend and thus take some

time to comprehend and react, plus they may not be fully understood by those people who do not typically communicate in English. This issue is further complicated when two LRVs or commuter trains approach a crossing from opposite directions and would arrive there almost simultaneously.

The objectives of this project are (1) to develop one or more prototype second train coming warning signs applicable to railroad grade crossings with high train frequency and train operations generally at speeds in excess of 35 mph, and (2) to evaluate the impact of the prototype sign in operation. Prototype devices are being evaluated in Los Angeles County and Baltimore and the evaluation should be complete by December 2000.

A-7A Operational Analysis of Bus Lanes on Arterials

This project had three objectives: (1) to expand the field testing of the bus lane capacity and flow level-of-service relationships developed in TCRP A-7 (and described in TCRP Report 26); (2) to refine as necessary the analysis methods; and (3) to communicate with transit industry end users the results and format of the TCRP A-7 information and refine as necessary.

A research results digest is being prepared that summarizes the results of the research.

A-13 Light Rail Service: Pedestrian and Vehicular Safety

When LRT systems operate at speeds above 35 mph in exclusive or semi-exclusive rights of way, there is still interaction with motorists, pedestrians, and bicyclists at grade crossings and in the vicinity of stations. Safety improvements identified in TCRP Project A-5, *Integration of Light Rail into City Streets*, do not always apply to higher speed operations at grade crossings on semiexclusive rights of way. Higher speed LRT grade crossings are often treated as standard railroad crossings, but LRT systems and LRVs have operating characteristics different from both freight and passenger rail. Typically, LRVs operate more frequently and in shorter trains.

This project will extend and complete the research started in TCRP Project A-5. The objectives of this research are to identify, validate, and recommend safety enhancements that will reduce incidents at higher speed (greater than 35 mph) grade crossings involving LRVs, motor vehicles, pedestrians, and bicycles and to develop recommended modifications to the MUTCD Light Rail Transit chapter.

The contract began in April 1996 and is scheduled for completion in November 2000.

A-15A Update of the Transit Capacity and Quality of Service Manual, First Edition

The TCQSM was published in May 1999 as TCRP Web document 6. An immediate update is underway to fill gaps and expand and enhance the scope. The procedures will be beta-tested at transit agencies with assistance from the researcher. The TRB has also established a Task Force on Transit Capacity and Quality of Service, A1E53. This Task Force will oversee the long-term development of the manual in a manner similar to that of the Highway Capacity and Quality of Service Committee.

The contract began October 29, 1999 and is scheduled for completion in October 2000.

A-16A Improved Traffic Signal Priority for Transit

Traffic congestion and traffic signals cause significant delay and increase operating costs for on-street transit service. Signal priority has been a promising method to improve transit operations and service quality, but it has not seen widespread deployment in North America. The resistance to implementation has often been based on a concern that overall traffic performance may be unduly compromised when signal timing intended to optimize traffic flow is overridden to provide a travel advantage to transit vehicles. The objective of this project is to develop and test improved transit priority algorithms for traffic signal controllers and systems taking into account various levels of hardware sophistication, operating characteristics, and transportation management strategies. The major products of this project will be a description of the algorithms, an evaluation of their associated benefits and effects, and a detailed implementation plan.

The second phase of the work began on June 7, 1999 and is expected to be complete in January 2002.

TRB REPORT
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