SUMMER 1999

UNIVERSITY OF CALIFORNIA
Institute of Transportation Studies
Technology Transfer Program

Tech Transfer

Technology Transfer for Local Transportation Agencies

IN THIS ISSUE:

Caution, Speed Bumps Ahead – Traffic Calming's Promises and Perils

Performance Measures

As California moves from theory to practice, challenges lie ahead for local and regional agencies.

By Michael Carroll

Using performance measures to monitor how well the state's transportation system is serving its customers is a high priority, Caltrans Director Jose Medina told an audience of transportation professionals representing all levels of government, academia, and the private sector. They were assembled in Sacramento last April for "Implementing Performance Measures for Transportation Systems Users and Investors in California," a conference presented by the UCLA Public Policy Extension Program and the University of California Transportation Center and sponsored by Caltrans. (This conference was a sequel to the "Performance Measures" conference held in October 1997 and summarized in the spring 1998 issue of *Tech Transfer*.) Conference sessions were devoted to exploring the state of the art and the technical and political challenges involved in putting these measures into place. But as the conference progressed, attendees made it clear that many challenges lie ahead.

The performance measures movement arises from profound changes in governance in the United States and seeks to accommodate demands for responsiveness and accountability. Performance measures define how well the system is doing in terms of broad social and economic goals or "outcomes" rather than in terms of "outputs" such as highway volumes or speeds or passengers per mile.

Nine broad categories for performance measures were laid out in the 1998 State Transportation Plan: mobility/ accessibility; reliability; cost-effectiveness; sustainability; environmental quality; safety/security; equity; customer satisfaction; and economic well-being. (See also the companion article in this issue by Gosling and Howe on multimodal measures in aviation.)

Although the measures themselves have in large part been defined, transportation agency staff and decision-makers who are trying to use them are finding that the application of performance measures can change the rules of the game and reveal unexpected inconsistencies in values and goals. Caltrans and its consultants have concentrated for nearly two years on developing a set of performance measures, and the task at hand is to work out the details of implementation. Performance measures can indicate to constituents, as consumers, whether they are getting their money's worth. Caltrans has committed itself to striving for an overall customer focus in applying performance measures and encourages consistency in the use of these measures for all transportation systems throughout the state, not just those directly under its jurisdiction.

(Continued on page 3)

Tech Transfer
Technology Transfer for Local Transportation Agencies

Technology Transfer Program (TTP) is a unit of the Institute of Transportation Studies at the University of California, Berkeley. Its mission is to support the development and implementation of advanced transportation systems by facilitating exchanges of information between research and practice and by providing a program of professional training and technical assistance in the areas of traffic operation; infrastructure maintenance; transportation planning and management; airport operations, planning and management; and traffic safety. The TechTransfer offices are located at the University of California, Berkeley, Richmond Field Station, 1355 S. 46th St., Richmond, CA 94804-4603. (510) 231-9590. The Web site is located at <www.its.berkeley.edu/techtransfer>.

Linda Howe Ph.D., AICP, *Director, Technology Transfer Program*
Natalie Fay, MA, *Associate Director*

Harmer E. Davis Library Institute of Transportation Studies

Reference, lending and search services are free to local transportation agencies in California with support from LTAP. Address questions and requests to:

Catherine Cortelyou, Associate Director
412 McLaughlin Hall, University of California, Berkeley, CA 94720-1720
Tel: (510) 642-3604; Fax: (510) 642-9180
e-mail: itslib@uclink4.berkeley.edu

Tech Transfer is published quarterly and mailed to 14,000 readers in California and the United States with funds from the Local Technical Assistance Program (LTAP). California's LTAP center is part of a nationwide network of centers established by the Federal Highway Administration (FHWA) in cooperation with state transportation agencies. The FHWA LTAP is under the State and Local Programs Branch of the Office of Technology Applications. California's LTAP is funded with support from the California Department of Transportation and is administered by the University of California, Institute of Transportation Studies, Technology Transfer Program. If you reprint one of our articles, please send us a copy.

Donna Reid, *Newsletter Editor*
Phyllis Orrick, *Contributing Editor*
Betsy Wing, *Contributing Editor*

LTAP Field Engineers

Field engineers provide peer-to-peer technical assistance to local transportation agencies. Four field engineers serve specific geographic areas in California. Larry Santucci can be consulted on asphalt paving questions by public agencies statewide. Call a field engineer when you need advice or help with a technical problem.

Central California
Les Jorgensen
2697 W. Dovewood
Fresno, CA 93711
(209) 435-2437
itsltap@aol.com

Far Northern California
Don Raffaelli
3433 Trinity St.
Eureka, CA 95501
(707) 443-5485
DRaffelli@aol.com

Southern California
Dave Royer
23933 Via Aranda
Santa Clarita, CA 91355
(661) 255-6556 (phone)
(661) 255-6156 (fax)
droyerpe@earthlink.net

Asphalt (Statewide)
Larry Santucci
1355 S. 46th St., RFS 452
Richmond, CA 94804-4603
(510) 231-9428 (phone)
(510) 231-9589 (fax)
ohotsky@uclink.berkeley.edu

Tech Transfer Editorial Board

Letter from the Editor

In addition to the technological changes we face as we head into a new millennium, enormous human issues equally daunt us. In this issue we explore some of those which concern the transportation community.

Performance measures can provide a reality check in evaluating our efforts both with the communities we serve and the agencies who provide the funding. A special report from a recent conference on this subject appears on our cover page. In addition, adapting those measures to an aviation context can be a challenge, as Linda Howe and Geoff Gosling demonstrate in their article on page 4.

While we strive to do our best for the agencies who employ and fund us, we also need to be mindful of the customer we serve, the end user. Traffic calming is one of those engineering and planning efforts that can spark heated debate in local communities. A look at this subject by Phyllis Orrick, along with some Web resources, might help fuel or extinguish efforts in this area, but most importantly we need to involve all of our constituents in the process.

For those of you struggling with one of the greatest tasks, keeping our infrastructure from crumbling, Fresno's success with cold in-place recycling should be of interest. We also are promoting our "Asphalt Road Show" which can visit your local agency to cover the basics for technicians and supervisors of pavement maintenance.

And if you have bridges under your jurisdiction, you'll want to know how to evaluate what goes on under those bridges. Professor Hsieh Wen Shen is a leading authority in hydrology and shares some tips on scour. You can learn more about this in a new course being taught next January by leading national experts.

While we concern ourselves with our constituents and our infrastructure, speculations about driver behavior continue in light of safety concerns. Sheila Sarkar, Director of our sister Traffic Safety program at San Diego State, reports on a program they have developed in Southern California to alter driver behavior and quell "road rage."

Transportation is of course more than the sum of the physical structures, administration, maintenance, and system users. As our recent workshop on Y2K made clear, the system is interconnected and interdependent. Problems occurring in one place will affect other parts of the system. At Tech Transfer, we want to help you find new tools and resources to confront this challenge, whether through our short courses or educational materials. We welcome your input so we can better equip you to be successful in these efforts.

Donna Reid

Performance Measures

(Continued from the cover)

A series of speakers from inside and outside California were asked to describe some of the do's and don't's of implementation. In Wisconsin, the measures have facilitated the move of executive-level decision-makers away from questions about *how* to do things, allowing them to focus on *why* to do them. It was recognized there as elsewhere that successful strategies should be freely borrowed and applied by agencies similar to those in which they were innovated.

Minnesota demonstrated that the challenge of implementing a complex set of measures could be overcome if senior members of the organization are involved in designing the measures and if all functional divisions of the organization proceed in lock-step. Their experience has proven wrong the assumption that once key players were involved in designing the measures, and staff was involved in collecting the data, application and use of the measures would be self-evident.

Transit's Conflicting Goals

Case studies of performance measurement among transit operations revealed the potential for conflict between the goal of providing an equitable geographic distribution of service and the goal of basing funding on system performance. This pointed up the need to consider not only the performance of the system, but the performance of the performance-based finance program itself. Many agree performance measures' use will result in improved fiscal accountability as well as better investment decisions in the long run.

While SB 45 requires consideration of objective performance criteria, and performance measurement has been incorporated into the funding programs of the Transportation Equity Act (TEA 21), states and local agencies worry that their federal transportation aid might in the future be tied to some quantified measures of system performance, thus increasing the already stiff competition for limited federal resources. Evaluating the performance of investments in different states raises fears that the measures could be used to make unfair comparisons between states. In California the objective has been to establish outcomes-based measures for all transportation systems, both state and local, but moving from the theory of performance measurement to practice is not easy.

Importance of "Buying In"

Performance measures can be expected to work best when they reflect clear goals for transportation systems and for the organizations that manage and coordinate those systems. Where such goals cannot be agreed on, the ultimate impact of performance measures is not certain, but their application may actually help to identify the most reasonable goals. Both end users and staff must embrace the concept of performance measures. A sense of realism predominated at the conference with respect to this issue, given barriers to getting this "buy-in." Fortunately, examples have been offered where buy-in has been achieved. Internal buy-in has at least two significant dimensions. Resistance to change (a normal characteristic of organizations) presents a formidable barrier to implementation. However, a focus on outcomes rather than outputs helps to ameliorate fears of top-down management, increased workload and change in general. Externally, the challenge is how to supply decision-makers with appropriate tools for shaping policy while offering the public a means to ensure accountability. Furthermore, California can take heart from the recent experience in Minnesota, where the use of performance measures has survived the change in direction associated with the inauguration of a new governor.

All participants took the lesson that "one size does not fit all" very seriously. While consistency does require that individual jurisdictions avoid developing special measures to suit their own needs, Caltrans acknowledges the need to prevent measures from leading to unfair comparisons and retains its commitment to strive for consistency rather than conformity. The matter of how to define users also becomes important. Certainly system users are considered, and politicians must be considered, but costs to non-users of the system must be considered as well. All constituencies have an interest in government efficiency, regardless of whether they use a particular public service. The question then becomes who IS the "customer" transportation agencies are trying to satisfy? The traveler? The politically motivated decision-maker? The taxpayer? The businessperson? Mother Nature? Or all of the above? Each "customer" has very different expectations and needs, and it may take different kinds of performance to satisfy each one.

Capitalize on Existing Data

There is also the need to build up data capabilities from existing sources. If the state sees a need to require that certain data be collected uniformly, there is agreement that this should be tied to sufficient resources, particularly for rural areas. Finding the right balance between the need to keep things simple and comprehensible and still provide enough specificity for equitable comparison of strategies and investments is a lot easier said than done.

Local and regional jurisdictions are obliged to advance their own performance measurement efforts consistent with the State Transportation plan, SB 45 and forthcoming RTIP guidelines. Because of the difficulties and challenges, Alan Hendrix, Director of Planning at Caltrans, said it will focus in the near term on implementing just three of the nine measures: mobility and access; reliability; and safety and security. The Southern California Association of Governments (SCAG) and the Metropolitan Transportation Commission (MTC) in the Bay Area, California's two largest metropolitan planning organizations, are currently functioning as testbeds for how performance measures work in the real world. According to Hendrix, Caltrans will serve as a clearinghouse for technical assistance and resources to help agencies get data collection and performance measures plans in place. When funding levels rise in 2002, applications for TIP funding, local project planning and internal quality management will need to incorporate perfor-

(Continued on page 8)

Applying Multi-modal Performance Measures to Aviation

Best practices in this context may differ from those in surface modes.

By Geoffrey D. Gosling and Linda Howe

As a result of the passage of Senate Bill 45 and the California Transportation Commission's (CTC) efforts to take a more multi-modal approach to transportation decisions on investment, California's regional transportation planning agencies are now required to address coordination between airport facilities and services and other elements of regional transportation systems in their regional transportation plans. In addition, planning agencies must also submit a list of all planned airport improvement projects, whether funded by the state or not, in parallel with their regular Regional Transportation Improvement Programs (RTIP). In practice, this means public agency transportation planners are entering the relatively new territory of considering how changes in aviation facilities and services as well as the ground access to airports (both by highway and transit) will affect the overall performance of the transportation system.

Performance measures have been around for a long time. However, current practice in public agencies still tends to focus performance analysis on a single mode. Many traditional measures such as highway level of service are not only poor indicators of the overall performance of a multi-modal system, but also are not well linked with broad planning goals such as economic well-being or sustainability. Similarly, typical performance measures in aviation have been developed to serve the needs of airport operators and aviation users (airlines, pilots and aircraft owners). They do not necessarily serve the needs of those who make decisions about public investment in the transportation system or of the travelers or shippers for whom the air trip is only one segment of a door-to-door journey.

A proposed framework for developing specific multi-modal performance measures was included in the 1998 California Transportation Plan Update (CTP). Not all of the "candidate measures" proposed by Caltrans, however, are readily applicable in the context of aviation, and specific performance measures will need to be tailored to reflect the characteristics of the aviation system. For example, separate performance measures will need to be defined for commercial and general aviation, since these have quite distinct operating characteristics. What follows are major concepts to consider when analyzing aviation performance in the context of the broader transportation system. A discussion of the issues that arise in measuring the performance of the aviation system, as well as the list of specific proposed measures, can be found in a recent report, "Aviation System Performance Measures," by the National Center of Excellence for Aviation Operations Research (NEXTOR), Institute of Transportation Studies, University of California at Berkeley, dated January 1999. (The report may be downloaded from the NEXTOR Web site at www.its.berkeley.edu/nextor or ordered from ITS Publications by calling (510) 642-3558.)

System outcomes and multi-modal performance measures

SYSTEM PERFORMANCE OUTCOMES	CANDIDATE PERFORMANCE MEASURES
System effectiveness and efficiency	
Mobility and Accessibility	Travel time Delay (lost time) Access to desired locations Access to the transportation system
Reliability	Standard deviation of average trip time
Cost-effectiveness	Cost-effectiveness ratios
Customer satisfaction	Customer satisfaction index
Economic well-being	Share of transportation final demand in gross regional or state product
System responsibility	
Sustainability	Household transportation costs
Environmental quality	Conformity/compliance Livability
Safety and security	Accident rates Crime rates
Equity	Income group share of mobility benefits

SOURCE: 1998 CALIFORNIA TRANSPORTATION PLAN, TRANSPORTATION SYSTEM PERFORMANCE MEASURES, FINAL REPORT.

In applying this framework to the aviation system, the following issues need to be considered:

Travel Time

While door-to-door travel times can be calculated, the undertaking is formidable given the range of trip lengths, travel patterns, and modal choices. Actual flight time is not useful either, since this depends on aircraft technology as well as trip length. Commercial air travel times are, however, significantly affected by whether or not direct flights are available and the frequency of service. These measures may be more meaningful than actual door-to-door travel time. In contrast, general aviation flights are typically direct and of course scheduled to the needs of the users, so similar measures are not appropriate.

Delay

Delay is the difference between actual and optimal travel time. It occurs getting to and from the airport and during take off and landing due to air traffic congestion or weather. Delay is not usually an issue at general aviation airports, but demand-to-capacity ratios should be monitored to warn of future problems. Measuring flight delay can get tricky. For example, when a plane is held in Denver because of bad weather in San Francisco, at which airport is the delay counted? Does a cancelled flight have zero or infinite delay? Although delay

may be the most familiar measure of aviation performance to travelers, in practice, care is needed in its use.

Access to Desired Destinations

"Convenience" is a key concept but hard to define. The hub and spoke commercial air network allows for nearly all destinations to be reached with two or fewer transfers. Therefore relevant measures focus on the number of carriers providing service for a particular trip and the differences in air service between that at the airport closest to the user and that at the nearest airport with direct service to the destination or, if a destination cannot be reached by a direct flight, to some intermediate hub with connecting service. For general aviation, access is determined by differences in facilities (control towers, lighting, and so forth) and availability of aircraft parking or hangar space.

Access to the Airport System

All airports are accessible by the highway system, but just how easily accessible they are depends on the level of congestion on and off the airport, as well as the airport's location and nearby land development. For commercial airports, the availability, relative cost, and service levels of shared-ride public or private transport to and from the airport is important. However, there is a confusing amalgam of incomplete data and inconsistent definitions, making many suggested measures of limited use from a policy perspective.

Reliability

Knowing how often flights arrive late and by how much is more relevant to an air traveler than knowing the variability in actual flight times, since airlines make allowances in their schedules for some amount of delay. While passengers are generally less concerned with late departures than with late arrivals, departure delays are of concern to aircraft operators, since this affects how much slack remains in the flight plan to accommodate delays at the destination. The variation in highway airport access travel times may be helpful for travelers estimating how much allowance to make for "unexpected" delay on the way to the airport.

Cost-Effectiveness

Cost-benefit ratios are typically used to evaluate project alternatives, but they are hard to apply to system performance because of difficulties in estimating system-wide benefits. A better strategy is to use average airline fares and freight rates at a regional level as surrogates for the cost-effectiveness of the aviation system, since these capture the traveler's and shipper's actual costs and tend to reflect the various cost elements faced by airlines. For similar reasons, aircraft parking or hangar fees, fuel prices, and taxes capture the cost-effectiveness of general aviation operations. Expressing costs in terms of flight operations by based or itinerant aircraft can reflect choices available to aircraft owners, as well as those that are actually made. Data to measure air cargo service quality, however, is currently hard to obtain.

When households, tourists, or businesses spend less on transport, there is more money for other things, with their corresponding multiplier effects.

Customer Satisfaction

The only reliable way to know how individuals balance the different factors is to ask them. Trying to infer their satisfaction by measuring the physical system is at best speculative and at worst leads to false conclusions. Opinion surveys are carried out in airports but there are potential problems with the reliability of responses due to the practical difficulties of interviewing passengers who are hurrying to catch a flight. Performing surveys on board the aircraft can overcome these problems, but requires the cooperation of the airlines.

Economic Well-Being

The use of input-output analysis to estimate the share of transportation final demand in gross regional or state product, as proposed by Caltrans in the CTP Update, is a poor way to measure how the aviation system (or any other mode) affects a region's overall economic well-being. This type of analysis fails to address how improved productivity of the transportation sector benefits the larger economy. When households, tourists, or businesses spend less on transport, there is more money left to spend on other things with their corresponding multiplier effects. However, measuring productivity requires a way to cope with the mix of outputs (passenger travel, cargo, aircraft operations). One approach is to define each part of the mix in terms of "equivalent passengers" for commercial airports and aircraft operations for general aviation facilities.

Sustainability

This measure addresses the problem of providing for the needs of the present without reducing the resources of future generations. Household expenditure on air travel is an imperfect measure in the context of aviation, given the high volume of business-paid travel. Its relevance for general aviation is worse, since few households own private airplanes. More relevant measures address dependence on oil-based fuels, deferred maintenance of the infrastructure, trends in air transportation costs faced by businesses (and the impact of this on future economic well-being), and changing household spending priorities as real incomes rise or relative prices of services change.

Environmental Quality

While established measures that track performance of the transportation system against existing state and national environmental standards are readily available, there is also a need for indicators of progress towards achieving performance beyond established standards.

Safety and Security

Accidents and crime in the air transport system are relatively infrequent, so rates need to be tracked as multi-year averages to

(Continued on page 8)

Caution, Speed Bumps Ahead

The demand for traffic calming is rising, but making streets safer and more comfortable for people is still largely unmapped terrain.

By Phyllis Orrick

Traffic calming has had a bumpy history since it was introduced from Europe into a handful of United States cities some 30 years ago, and the controversy continues. For instance, in the city of Berkeley, which was among those to pioneer traffic calming, leaders in the disabled community say that they can't travel over a speed hump in a vehicle without excessive pain; therefore, speed humps might violate the Americans with Disabilities Act.

Speed humps are effective in pairs, as shown on this Berkeley street, left, and combined with other features, such as striping and curb extensions, at right. Berkeley has imposed a moratorium on their implementation, however, while it studies objections raised by disabled activists and emergency service providers.

Assistant fire chief Mike Migliore, along with civilian supporters of emergency service providers, has objected to speed humps and traffic diversions on the grounds that they slow emergency response time and endanger residents. The controversy has choked off the growth of Berkeley's extensive traffic-calming initiatives, to the point where the city imposed a near-total moratorium in 1995.

But while Berkeley's efforts have been frozen, many other cities are looking at ways to implement traffic calming measures when growing numbers of vehicles take to local streets to avoid clogged arterials. Even more jurisdictions are likely to consider traffic calming now that federal funding is available for it. The 1998 Transportation Equity Act for the 21st Century (TEA-21) specifically names "traffic calming" as a program eligible for funding. It's the first time this category has been identified by Congress in this type of bill.

Accompanying this trend, traffic calming has been the subject of numerous studies in recent years. One of the most recent and comprehensive is *Effective Traffic Calming Applications and Implementation*, published earlier this year by the Minnesota Local Road Research Board of Minnesota's DOT. This report defines "traffic calming" as the deployment of physical devices that alter the roadway with the objective of changing drivers' behavior. While traffic control devices such as stop signs or signals certainly control driver behavior, traffic calming works by creating an environment where drivers will be convinced to slow down or go elsewhere. Diverters literally steer drivers to alternate routes while other more subtle environmental effects create a sense of shared space, causing drivers to move more slowly and cautiously on the "calmed" route.

The Minnesota study criticizes agencies for past traffic-calming efforts because they failed to provide the data necessary to properly evaluate them. It recommends collecting pre- and post-implementation data about driver behavior to better analyze the effectiveness of traffic-calming measures and to help other agencies that might adopt them. Parameters that should be considered include average daily traffic counts, vehicle speeds, accident rates, residents' reactions, roadway classification, funding sources and effects on service providers. Data limitations notwithstanding, this study undertakes an evaluation of the advantages, drawbacks and effectiveness of 21 traffic-calming practices. The most promising and commonly considered follow:

Speed Humps

The speed hump is the most commonly used traffic-calming device in the United States according to last year's *A Survey of Traffic Calming Practices in the United States*, by Asha Weinstein and Elizabeth Deakin. The officials whom Weinstein and Deakin interviewed for their survey, representing 45 localities, said they chose speed humps because they are affordable ($1,000 - $3,500 apiece), and they are dramatically effective at slowing traffic.

Speed humps work best in pairs no more than 250 feet apart on streets two lanes wide or less. They are mounds, usually made of asphalt, that run from curb to curb and have a flat top that is three to four inches high and 6 to 8 feet across. No more than two pairs should be installed every half-mile. Their drawbacks are that they slow fire trucks and other large vehicles like garbage trucks and

buses and are difficult to cross safely for bicyclists and some disabled people riding in cars or vans. Speed humps should not be installed on busy streets because they are too disruptive of traffic flow or on transit routes because of their effect on buses. Many cities have banned them from emergency response routes. Other shortcomings include possible increases in traffic noise from braking and acceleration.

Speed Tables

Speed tables, unlike humps, don't stretch from curb to curb, making it easier for fire trucks and bicyclists to pass without going up and over them. Their top is wider, typically 12 feet or more, enabling both the front and back wheels of a standard vehicle to be on the table at the same time. They can be traversed comfortably at 15-25 mph, a little faster than speed humps, and they too can cause increases in traffic noise from braking and acceleration.

Traffic Circles

Traffic circles force drivers to slow down by exerting lateral motion on vehicles as they go around the circle. The circle must be at least 12 feet across to be effective. Usually, they are formed around a raised, landscaped island. Circles are most effective at reducing left-turn and sideways collisions. Singly, they only have a short-term effect on traffic speed, since drivers tend to reaccelerate quickly after passing through. However, if a series of them is constructed, they can noticeably slow traffic. They can be costly, $7,000 and up, depending on landscaping and curb design. Their disadvantages include: causing conflicts between bicycles and motorized vehicles by forcing them to share narrower traffic lanes; reducing access by emergency vehicles if vehicles are illegally parked on or approaching the circle; and a loss of parking since they require roughly 30 feet of clear curb on both sides of each entry.

Roundabouts

There are no United States DOT guidelines for roundabouts, but they are generally no smaller than 50 and no larger than 115 feet in diameter. They work best at increasing flow and capacity at an intersection by imposing a yield-at-entry rule, which means vehicles in the circle have the right-of-way over those entering, which are controlled by a YIELD sign, before being slowed and deflected to the right by the central island. Roundabouts can calm traffic indirectly by changing the character of a roadway as it goes from a busier, commercial district to a residential one. Their landscaping can also help to calm traffic. However, they can be extremely expensive to build, starting at $10,000. Their spatial demands can require removal of parking spaces and create difficulties for pedestrians.

Chicanes and Chokers

Chicanes also change a roadway's character. They are essentially islands or curb extensions built into the street in alternating pairs, like the teeth of a zipper, which force drivers to slow their cars. They provide opportunities for landscaping and refuges for pedestrians, both of which calm traffic by reminding drivers to share the roadway. They work best on low-volume streets and must be designed with care to prevent bicycles from being forced into too close proximity to motorized vehicles. Chokers are scaled-down chicanes and work singly.

(Continued on page 8)

Photographs on pp 6-7 courtesy of City of Berkeley; cover photo by Gerald Stone, PATH

Route modifications such as diagonal diverters, top and bottom, and partial diverters, middle, should only be installed after extensive study of possible spillover effects.

Performance Measures con't.

(Continued from page 3)

mance measures in some way.

Technology is rapidly developing in the meantime and will significantly enhance data collection through GSP-GIS integration, while storage and processing technologies will improve our ability to manage and analyze data in both large and small jurisdictions. We should also see better integration between performance measures, real time information, and transportation alternatives to enhance user choice. User input will also influence technology buy-in, creating a transportation system which better meets the needs of the changing consumer.

Michael Carroll is a graduate student in City and Regional Planning at UC Berkeley.

Aviation con't.

(Continued from page 5)

avoid wide year-to-year fluctuations. While data regarding the existence or condition of physical facilities that may improve safety or security should be collected, the use of such data to measure safety performance confuses means and ends.

Equity

The concept of mobility benefits and travel-time savings by income group is problematic in the context of aviation. Although higher-income groups do travel more by air, the so-called yield management system, which creates deeply discounted fares for those who can or will plan ahead, has broadened access to air travel for lower-income groups. More relevant measures concern long-term geographical distribution of airport development as well as who benefits versus who bears the adverse impacts of noise, congestion, and other externalities that fall on communities near airports.

Geoffrey D. Gosling is Assistant Research Engineer in Aviation with ITS, UC Berkeley; Linda Howe is the Director of the Technology Transfer Program, ITS, UC Berkeley.

Traffic Calming con't.

(Continued from page 7)

Route Modifications

These are cul-de-sacs, diagonal diverters, semi-diverters and medians. They require extensive pre-implementation study of their possible effects to avoid spillover on nearby streets. They are also generally very costly and their use must be reconciled with the objections of emergency and other service providers who will lose direct access to the closed off blocks.

Mechanized Enforcement

Mechanized traffic rule enforcement is gaining popularity. The best-known in use today is the Motion Imaging Recording System (MIRS), deployed in 13 states (including California). Its most common use is to catch red-light runners. A camera snaps pictures of an offending vehicle's license plate as it passes through the intersection, and the registered owner subsequently receives a summons or warning in the mail. The system's effectiveness has yet to be documented; its biggest drawback is political unpopularity among those who consider it an invasion of privacy.

On-Street Angled Parking and Protected Parking Bays

These narrow the roadway, causing drivers to slow down. Bays can be built around parallel end-to-end spots, or parking can be switched to angled, on-street spaces. However, such arrangements can increase danger for pedestrians, especially children, as they walk between parked cars, and, if there is only enough room to put the new configuration on one side of the street, parking capacity is cut, which could lead to illegal parking and added danger.

When Traffic Calming Devices Don't Make Sense

Another recent entry in the traffic-calming literature is the *Traffic Calming Primer,* published earlier this year by Pat Noyes & Associates. Pat Noyes, the lead author, says that in some cases the best traffic-calming devices are no traffic-calming devices. That happened in the city of Pleasanton, California, which hired Noyes to consult on a citywide traffic-calming plan. In one neighborhood, residents could not convince those a few blocks away (who had to pass through the trouble spot to get to their homes) to support traffic-calming devices. Instead, they created an educational campaign for their own problem blocks, using eye-catching posters on their curbside garbage cans asking motorists to slow down and share the street, as well as a temporary program of stepped-up enforcement. Residents with the traffic problem were happy with the resulting neighborhood solidarity and calmer traffic, and those less immediately affected did not have their driving patterns and streets disrupted.

The final word then is one of caution. Consider carefully the parties who will be affected by implementing traffic-calming measures, and be as inclusive as possible. Ultimately, the best effort might be limited to education and outreach.

Recommended Reading:

Effective Traffic Calming Applications and Implementation by Amy J. Saffel (Braun Intertec Corporation), Minnesota Local Road Research Board, Minnesota DOT, available from: National Technical Information Services, Springfield, VA 22161.

A Survey of Traffic Calming Practices in the United States by Asha Weinstein and Elizabeth Deakin, WP 703, Institute of Urban and Regional Development, March 1998, UC Berkeley.

Traffic Calming Primer by Pat Noyes & Associates, 1566 County Road 83, Boulder CO 80302.

Traffic Calming Surf City

http://pti.nw.dc.us/task_forces/transportation/docs/trafcalm

Public Technology Inc. has an excellent overview of traffic calming with information from the point of view of emergency service providers, police, cyclists and various cities who have had experiences with implementation. California experiences and contacts include the cities of Berkeley, San Buenaventura, San Luis Obispo, and Sunnyvale.

www.islandnet.com/~litman/calming.pdf

Todd Litman at Victoria's Transport Institute in Victoria, British Columbia, has just published an on-line research paper in pdf format on traffic calming, which provides details, data and ideas for those communities requiring hard facts.

www.ite.org/traffic/index.htm

ITE offers a publication on Traditional Neighborhood Development Street Design Guidelines, available through its Web site.

www.lgc.org/clc/pubinfo.

The Center for Livable Communities, a national initiative tied to both the EPA and local government, helps local governments and community leaders to be proactive in land use and transportation planning. Its goal is to create more livable communities. One of its resources is the Community Image Survey.

www.roundabouts.com

The Web site for Ourston & Doctors, a private firm specializing in roundabout consulting, is a good resource for this particular device. The firm designed the first roundabout installed on a U.S. highway (in Santa Barbara, CA). It also has educational materials, including design guidelines based on British documents (and used for high-capacity roundabouts in the U.S.) and adapted for American usage with permission of Her Majesty's Controller.

www.ci.berkeley.ca.us/PW/traffic/trafcalm.html

The City of Berkeley has a tumultuous history of traffic calming. See its Web site for more.

www.transci.portland.or.us/Traffic Management/traffic calming

The City of Portland, Oregon, has been a national leader in the implementation of traffic calming measures and the public process required to achieve success.

www.ci.seattle.wa.us/npo/tblis.htm

The City of Seattle, Washington, also boasts a successful traffic calming program.

www.tac-atc.ca/programs/calming/calming.htm

The Transportation Association of Canada (TAC) and the Canadian Institute of Transportation Engineers (CITE) have a Web-based look at their manual (in progress) on traffic calming – Special Project 208.

www.roads.detr.gov.uk

The United Kingdom provides its transportation planners with a copy of the "Road Traffic Reduction Act," passed in 1997 and placed on the Web site in early 1998. In this document you can learn more about how planners and engineers conceive of traffic calming on the other side of the pond.

www.digitalthreads.com/rada

This Web site, Road Access for Disabled Americans, was set up by and for disabled Americans and their advocates. They maintain that speed humps are barriers to access and go against ADA requirements. A thorough presentation of anti-traffic calming sentiment from this important perspective, with other links.

www.io.com/~bumper/ada.htm

This site for Americans Against Traffic Calming provides a number of convincing arguments against these measures and includes stories from California, particularly from the many gated communities in Southern California noting problems with emergency response in these areas.

New Freebies Available at the Library!

The ITS Library has received excess copies of the following, which it is making available free of charge:

FHWA Reports: "Meeting the Customer's Needs for Mobility," and "Safety During Construction and Maintenance Operations" and a video, "Protecting our Pavements: PREVENTIVE Maintenance."

Also now on loan (one copy only) is RU Y2K OK? Ask for Video #409.

Please contact the ITS Library @ (510) 642-3604.

ITS Training Calendar

To register for one of the courses below call UC Berkeley Extension Registration at (510) 642-4111. For a catalogue or more details, call (510) 231-9590 or visit our Web site at www.its.berkeley.edu/techtransfer. Course EDP numbers, dates, locations and fees are listed below. Fees are two-tiered, with a subsidized rate for public agencies provided with funds from the Cooperative Training Assistance Program (CTAP).

TRANSPORTATION PLANNING AND POLICY

PL-01 Fundamentals of Transportation Planning Practice

Oakland	Jan. 24-28	$250/$525	EDP# 483172

PL-06 Walkable and Bikeable Communities

Oakland	Nov. 1-2	$125/$295	EDP# 481325

NHI-02 Advanced Urban Travel Demand Forecasting

TBA, call for further information

ENVIRONMENTAL ISSUES IN TRANSPORTATION

EV-06 Bridge Scour & Bank Erosion for Hwy Engineers

Richmond	Jan. 24-28	$325/$650	EDP# 483164

TRAFFIC ENGINEERING AND SIGNALIZATION

TE-01 Fundamentals of Traffic Engineering

Oakland	Oct. 4-8	$250/$525	EDP# 481135

TE-02 Basic Traffic Signal Design

Sacramento	Nov. 16-18	$175/$395	EDP# 481150

TE-07 Overview of Off-the-Shelf Traffic Simulation Models

Richmond	Oct. 19	$65/$150	EDP# 481341

TE-13 SYNCHRO: A Tool for Traffic Signal Timing Analysis

Milpitas	Feb. 8	$65/$150	EDP# 483180

TE-17 Understanding and Using CORSIM for Corridor Analysis

Sacramento	Nov. 1-3	$270/$450	EDP# 481358

TE-18 Advanced Applications of CORSIM

Richmond	Nov. 4-5	$125/$295	EDP# 481366

PROJECT DEVELOPMENT AND MANAGEMENT

PD-01 Fundamentals of Inspection Practice

Eureka	Oct. 21-22	$125/$295	EDP#481275
Ventura	Nov. 18-19	$125/$295	EDP# 481283

PD-02 Construction Inspection for Traffic Signals & Lighting

Richmond	Nov. 30 - Dec. 2	$175/$395	EDP# 481192

PD-07 Project Management and Claims Avoidance

San Diego	Jan. 20-21	$125/$295	EDP# 483131

PD-12 Calif Laws Governing Capital Proj Development

Vacaville	Oct. 19	$65/$150	EDP#481267

PD-13 Prep of Specs for Capital Improvement Projects

Stockton	Oct.14-15	$125/$295	EDP#481259
Ventura	July 26-28	$175/$395	EDP#485128

INFRASTRUCTURE DESIGN AND MAINTENANCE

IDM-01 Topics in Geometric Design I

Modesto	Oct. 28-29	$125/$295	EDP# 481176

IDM-02 Topics in Geometric Design II

Modesto	Nov. 18-19	$125/$295	EDP# 481184

IDM-03 Asphalt Pavement Fundamentals

San Diego	Oct. 12-14	$300/$450	EDP#481200
Modesto	Feb. 1-3	$300/$450	EDP# 483115

IDM-04 Asphalt Pavement Maintenance

Oakland	Oct. 1	$65/$150	EDP#481317
Visalia	Dec. 8	$65/$150	EDP#481333
Vacaville	Feb. 8	$65/$150	EDP# 483156

IDM-05 Asphalt Pavement Maintenance: The Road Show

Call to book at your location & time $500

IDN-06 Recent Developments in Asphalt Paving

Fresno	Oct. 6	$65/$150	EDP#481218
San Diego	Dec. 15	$65/$150	EDP# 481234

IDM-07 Asphalt Mix Design and Analysis

Richmond	Dec. 6-10	$525/$750	EDP# 481242

IDM-08 Concrete Pavement Fundamentals

Richmond	Nov. 16-17	$200/$300	EDP# 481226

IDM-09 Rockfall Hazard Mitigation

San Diego	Sept. 28	$125/$295	EDP# 481309

TRAFFIC SAFETY

TS-03 Design & Eval of Roadside Safety Structures

Redding	Sept. 20	$65/$150	EDP#481119
San Diego	Oct. 25	$65/$150	EDP# 481143

TS-04 Road Safety Mgmt Systems & Traffic Problem Analysis

Quincy	Sept. 30-Oct. 1	$125/$295	EDP# 481127

AVIATION

AV-01 International Airport Noise Symposium

San Diego	Feb. 14-16	$550	EDP#493114

Fresno's Hot on Cold Recycling

The City of Fresno Public Works Department has taken the Central Valley's lead in the innovative field of cold in-place recycling of asphalt pavements. Fresno's cold recycling program was initiated in 1994 with a pilot project involving four miles. To date, the city has recycled 40 miles of major streets, at an average cost of about $150,000 per mile. It has proven economical, efficient and friendly to the environment.

Early in 1998, the city received ISTEA Surface Transportation Program (STP) funds, which required a local match of 11.47%. These "lifeline" funds were administered by the Council of Fresno County Governments and overseen by Caltrans. In May of 1998, bids were accepted on another project to recycle 10 additional miles with ISTEA funds. The total for both projects exceeded $5,000,000. The city hired a private pavement-recycling consultant to train staff and lead the design/inspection process.

The cold in-place recycling process involves pulverizing the top 3 inches of the existing pavement and mixing it with an emulsified recycling agent to an approved uniform mix in a recycling machine. The machine places it in a windrow, which is then fed into an asphalt paver that spreads the mix back over the pavement. Both steel - and rubber-tired rollers are used to compact the recycled material. After a curing period of seven days, the recycled mix is overlaid with a 2-inch lift of asphalt concrete. Other tasks include cold planing, adjusting manholes and other facilities, and installing traffic loops, traffic striping, and pavement markers.

Cold in-place recycling of asphalt pavements is not a new concept. However, it's becoming increasingly popular. Cold in-place recycling has the following benefits:

Less Expensive

Total construction cost is about 1/3 to 1/4 of the typical "remove and replace" methods used in the past. Fresno DPW staff found cold recycling of major streets to be the most cost-effective construction method available that could provide a 15-20 year pavement life**.** The recycling cost is about $.57 per square foot, compared to about $2.00 per square foot for a typical major street reconstruction method and $.45 a square foot for an overlay. Additionally, there are reductions in design and inspection costs.

Less Inconvenient for the Public

There is less traffic congestion from various construction vehicles and roadway excavation. The only material being imported to the job during the recycling portion of the project is recycling oil. Since the oil represents only two percent by weight of the total roadway section being recycled, there is virtually no added traffic to the city streets for moving construction materials. Dust, noise and street closures are less objectionable due to an abbreviated construction period. Work days for a recycling project are a fraction of a street reconstruction schedule.

A mix paver placing cold recycled mix.

Environmentally Friendly

Reduced energy consumption is a major feature of this process. Traffic and hence pollution is minimized. With no roadway excavation; old sections are rehabilitated in-place and used again. There are no trucks used to haul off the deteriorated street section. There is a significant saving of native aggregates and no new asphalt binder is being used. In addition salvaged milled chips are used to fill depressions in alleys and for other street maintenance repairs.

Significant Improvement in Road Quality

Before recycling, many street sections show significant lateral and longitudinal cracking, but no subgrade failures. Adjacent structures (curbs, gutters) typically are left in good condition or are replaced to improve drainage. The ride of the new roadway resembles that of total reconstruction rather than the sometimes-rough surface associated with a new overlay.

Rapid Completion Time

The construction period for a mile of cold recycling is six working days rather than 4-6 months for typical street reconstruction. After recycling is completed, traffic is permitted back on the recycled street surface within four hours.

Reduced Liabilities

Since the existing street section remains, there is less chance of damage to shallow utilities than with reconstruction. Short construction periods allow staff to schedule projects in good weather – avoiding the impacts of rain delays. Claims and lawsuits from contractors and the public are minimized due to the short construction period.

In instances where a street requires widening, subbase reconstruction, or other major enhancement work, Fresno will continue to use the more traditional methods. A cold recycling program is not the answer to all street problems; however, it should be given first consideration when the street conditions meet prerequisite design criteria such as a good subgrade, sufficient material to recycle, and acceptable drainage.

Bridge Scour and Bank Protection on Highway River Crossings

By Hsieh Wen Shen

According to a Federal Highway Administration study, more than 85% of bridge failures in the U.S. were caused by pier and abutment scours during floods. Highway bridges are supported by piers, which derive their strength from forces generated through friction between the pier structure and the soil. Scour action will erode the soil, decreasing the force between the soil and the pier, causing the pier to move downward, and the bridge to collapse. Strong floods can also erode channel banks and cause bank protections to collapse. Both highway and flood control engineers need to extensively investigate stream stability problems due to scouring.

Scour Near Bridge Structures

There are four basic components of scour near bridge piers and abutments:

•change of river regime and/or lateral river migration;

•long-term degradation and aggradation of river bed;

•contraction of flow area due to the presence of the bridge structure; and

•local scours due to flow separation by the bridge pier and abutment.

A natural river is usually dynamic and can migrate in both downstream and lateral directions. A river cross-section can change with time, the deeper part of the river moving toward the bridge pier or abutment, thus decreasing the force of friction generated between the soil and the structure. This is the first possible component of scour. Knowledge of stream morphology is needed to identify and predict possible channel migration.

If a bridge is constructed at a downstream section of the river from a dam, sediment particles are usually trapped at the reservoir and only relatively clear water is released from the reservoir. Clear water removes sediment without replacing it, more quickly eroding the riverbed and causing long-term degradation at the bridge section. This is the second possible component of scour. A mathematical model is needed to evaluate the lowering of the riverbed by erosion.

Bridges are usually constructed at a narrow section of the river to reduce the cost of construction. The presence of the bridge structure, together with its approach sections will reduce the flow area at the bridge section of the river. The decrease of the flow area will increase flow velocity to cause so-called contraction scour. This is the third possible component of scour and its magnitude can be estimated based on the increase of flow velocity at the bridge section.

The last possible scour component which has been investigated extensively is local scour. Local scour is caused by the obstruction of flow due to the presence of a pier and/or abutment. It is generated by a separation of the flow near the junction between the front of the hydraulic structure, such as a pier or an abutment, and the river bottom. Hydraulic Engineering Circular No. 18, published by the Federal Highway Administration, provides a summary of research, now superceded by more recent studies from New Zealand.

Bank Protection

Bank protection is usually needed near a bridge to stabilize the river migration or counter scour action caused by the increase of flow velocity resulting from reduction of flow areas by the bridge structure. Two general types of bank protection are employed: the first type is to protect the banks from erosion and the second type is to divert high velocity flow away from the river banks. According to a report by the Federal Highway Administration, the countermeasures to reduce bank stability problems are as follows:

•flexible revetment of bed armor which includes: dumped rock riprap, rock-and wire mattress, gabion, planted vegetation, precast-concrete block, willow mattress;

•rigid revetment of bed armor which includes: concrete pavements, sacked concrete, concrete-grouted riprap;

•concrete filled fabric mat, bulkhead;

•flow control structures which include spurs, retard, dike, check dam-jack field;

•modification of bridge section which includes: realignment of approach channel, construction of overflow section on roadway, realignment of bridge piers;

•measures incorporated into the design of bridge section which include: increase the length of the bridge section, reduce the number of piers.

In Mississippi, their six highway districts were surveyed. Out of 39 bridge sites with problems, 15 were due to the shifting of stream channels; 10 due to scour at abutments; 5 to stream erosion; 5 to general scour; 3 to channel degradation, 3 to pier scour, 1 to scour at approach channel and 1 to slumping of the approach to the embankment.

Here in California, our own El Niño floods as well as natural processes make it essential for our bridges to be evaluated and maintained utilizing the most up-to-date information and tools available.

Hsieh Wen Shen is Emeritus Professor of Civil and Environmental Engineering, University of California, Berkeley.

In January 2000, Tech Transfer will introduce a new workshop covering current information about scour near hydraulic structures and problems related to bank protections. The popular HEC-6 model will also be discussed in detail. This workshop will be conducted by Professor Hsieh Wen Shen assisted by William A. Thomas, the developer of the HEC-6 model for the US Army Corps of Engineers, and by Sterling Jones, scour expert at the FHWA.

Bridge Scour

A bibliography compiled by Catherine Cortelyou of the Harmer E. Davis Transportation Library, Institute of Transportation Studies

For these materials, write to Interlibrary Lending, ITS Library, 412 McLaughlin Hall, University of California, Berkeley, CA 94720-1720; telephone us at (510) 642-3604; send a fax to (510) 642-9180 or e-mail us at itslib@uclink4.Berkeley.edu.

Rapid-Estimation for Assessing Scour at Highway Bridges Based on Limited Site Data

By Stephen R. Holnbeck and Charles Parrett. Helena, Montana: U.S. Geological Survey, 1997.6p. (USGS Fact Sheet FS-244-96).Also available at http://water.usgs.gov/pubs/FS/FS-244-96/ and from National Technical Information Serivce. 1-800-553-6847 or www.ntis.gov, order number PB97-160055INZ.

Data from detailed scour analyses performed in 10 states was used to develop relations between scour depth and hydraulic variables that can be measured or estimated rapidly in the field. This method was developed to facilitate scour assessments at a large number of bridges for the national survey of scour-susceptible bridges. This fact sheet summarizes the 86-page USGS Water Resources Investigations Report 96-4310 by the same authors.

Experimental Study of Scour Protection Alternatives at Bridge Piers

By D.A. Bertholdi, et al. McLean, Va.: Federal Highway Administration, 1996. 84p. (FHWA/RD-95/187) Also available from National Technical Information Service.(see above), order number PB96-168794.

Riprap is the most common and best-documented means of scour protection at bridge piers, but it may not be available, placement may be difficult, or high-velocity streams may require unreasonable riprap sizes. Alternatives to riprap as scour countermeasures are evaluated in this study. Tests were performed on grout mats, grout bags, extended footings, tetrapods, cable-tied blocks, high-density particles, tile mats and anchors, and all were evaluated for their overall performance and cost-benefit.

Summary of 1998 Scanning Review of European Practice for Bridge Scour and Stream Instability Countermeasures

McLean, Va.: Federal Highway Administration, 1999. 10p. Also available at: http://www.fhwa.dot.gov/BRIDGE/scan-txt.htm.

A study tour of Switzerland, Germany, the Netherlands and the UK was sponsored to assess technology for bridge scour and stream instability countermeasures, as well as the European laboratory and field research programs. This summary notes that estimation of turbulence intensity in relation to the structure is considered a key factor for estimating scour potential and discusses the widespread use of riprap, testing of geotextile filters, use of river training and stabilization, riverbed degradation and selected alternative countermeasures. Panelists considered Europe a leader in the use of bioengineering techniques for river instability problems.

Evaluating Scour at Bridges

Third edition. Washington, D.C.: Federal Highway Administration, 1995. 204 p. (Hydraulic Engineering Circular no.18) Also available from National Technical Information Service (see above), order number PB96- 163498.

This essential manual presents the state of knowledge and practice for the design, evaluation and inspection of bridges for scour. This edition uses metric units of measurement and incorporates new materials developed since the 1993 edition. The manual begins with basic concepts and definitions and an introduction to aggradation, degradation and backwater. A brief section discusses designing bridges to resist scour. The estimation of scour at bridges is presented thoroughly along with scour example problems and a discussion of scour analysis for tidal areas. The following chapters cover evaluating the vulnerability of existing bridges to scour, inspecting bridges for scour and installing scour countermeasures.

"Scour Around Exposed Pile Foundations"

By Mohammad Salim and J. Sterling Jones. McLean, Va.: Federal Highway Administration, 9p. (Originally published in the Proceedings of the ASCE North American Water and Environment Congress 96).Also additional material at: http://www.tfhrc.gov/structur/hydro/scour.htm.

FHWA's Chief of the Bridge Division has issued this paper with a memorandum describing the methodology acceptable to estimate scour due to pile groups and pile caps located at the water surface. Since the 1996 revision of Hydraulic Engineering Circular 18, additional research at the FHWA Hydraulic Laboratory measured local scour around exposed pile groups for a variety of conditions including different spacings, skew angles, patterns, and exposures of a pile cap in the flow field. Findings were used to test the validity of scour estimation methods, and to develop an alternative approach of estimating scour due to exposed pile foundations combining methods developed previously by the FHWA and the People's Republic of China. The current procedure given in HEC-18 should continue to be followed for all pile caps and footings located below the water surface.

Instrumentation for Measuring Scour at Bridge Piers and Abutments

Washington, D.C.: Transportation Research Board, 1997. 110 p. (NCHRP Report 396), and companion manuals: *Sonar Scour Monitor: Installation, Operation and Fabrication Manual*. Washington, D.C.: Transportation Research Board, 1997. 38p. (NCHRP Report 397A) and *Magnetic Sliding Collar Scour Monitor: Installation, Operation, and Fabrication Manual*. Washington, D.C.: Transportation Research Board, 1997. 40p. (NCHRP Report 397B).

Because scour holes generally fill in as stream flows diminish, post-flood inspections are not adequate to determine fully the extent of scour damage. This report documents laboratory and field test findings for magnetic sliding collar and sonar-based devices and presents detailed discussion of the significance of these findings. Its companion manuals provide guidance for selecting the device most suitable for a bridge and its location. Detailed instructions, including fabrication drawings and parts lists, are included to permit the fabrication of the monitors in most machine shops. Instructions for operation and maintenance are also given.

"Time Scale for Local Scour at Bridge Piers"

By Bruce W. Melville and Yee-Meng Chiew. *Journal of Hydraulic Engineering* (ASCE), Vol. 125, No. 1, January 1999, pp. 59-65.

New data are presented and used to quantify the influence of flow duration on the depth of local scour at cylindrical bridge piers in uniform sand beds. An equilibrium time scale is defined, and a method is given for determination of the time for development of the equilibrium scour depth for a given pier, sediment, and approach flow velocity. The concomitant estimation of the scour depth at any stage during development of the equilibrium scour hole is also described. Results show that after only 10% of the time to equilibrium the scour depth is between about 50% and 80% of the equilibrium scour depth, depending on the approach flow velocity.

Informational Seminars on Aggressive Driving Instituted in Southern California

By Sheila Sarkar and Alanna Martineau

Aggressive driving can encompass both a wanton disregard for the rules of the road (speeding, tailgating, running red lights, etc.) and the endangerment of other road users (cutting off drivers, not yielding to pedestrians at the crosswalk, not yielding to drivers when legally needed). Types of aggressions can range from simply discourteous acts to those that endanger the lives of others and provoke retaliation, sometimes even violent retaliation from other drivers. Numerous media reports and safety programs have documented specific aggressive driving incidents that have culminated in violence and fatalities while researchers have tried to understand the reasons for aggressive driving. There appear to be many factors contributing to aggression on the road including physiological arousal; territoriality; anonymity; flashy automobile imagery; and discourtesy.

Dr. Arnold Nerenberg conducts a seminar at a workplace.

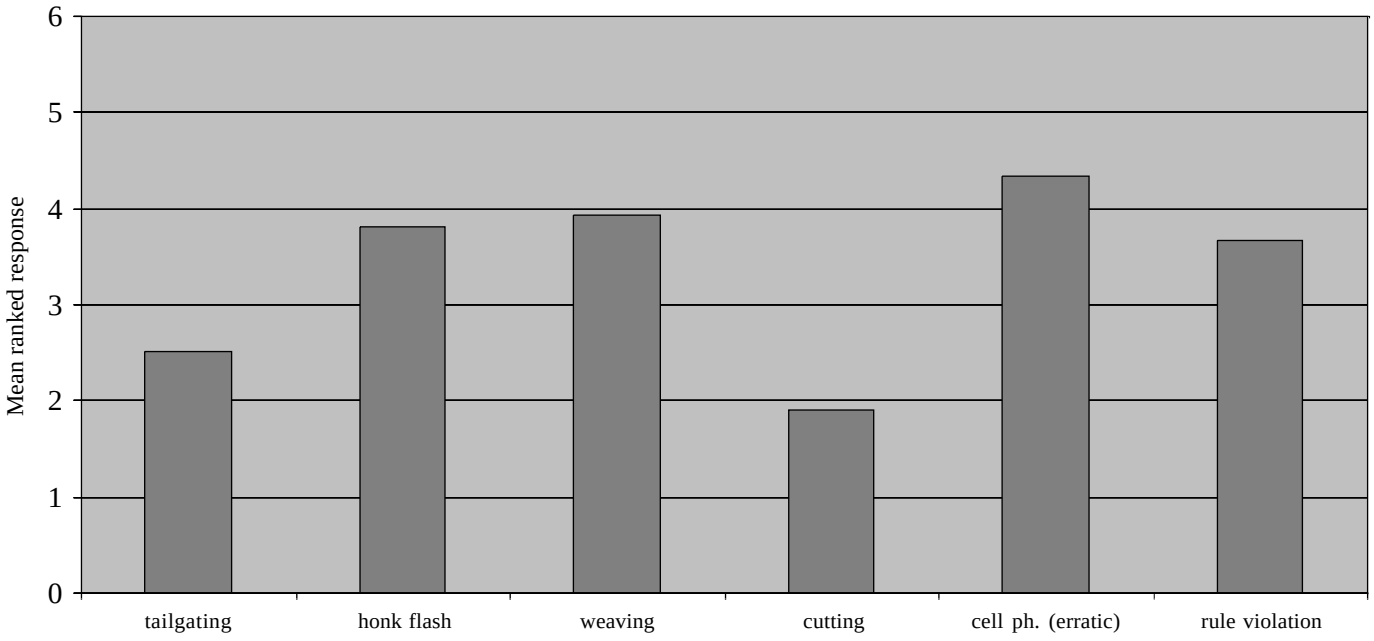
The Cool Operator Program

San Diego State University has begun a new program to try and combat aggressive driving behavior. The Cool Operator program, funded by the California Office of Traffic Safety (OTS), has created seminars in which participants discuss the serious ramifications of aggressive driving and are made aware of the possible outcomes resulting from retaliation against other aggressive drivers. The seminars are led by three distinguished traffic safety professionals: Dr. Arnold Nerenberg, a clinical psychologist who has been studying aggressive driving for the past seven years; Allen Sill, a former California Highway Patrol officer with over 30 years of experience in traffic safety; and Monica Zech, a traffic reporter for the past 15 years who is a member of MADD and dedicated to improving traffic safety. The Project Director, Dr. Sheila Sarkar, has been conducting traffic safety research for the past five years.

The seminars are two hours long and are conducted free of charge. They are being offered to interested employers, agencies and organizations through the Institute's newsletters and Web site as well as the Office of Traffic Safety newsletter and by word-of-mouth. The curriculum is customized to the needs of the particular audience. Topics covered include: an overview of traffic statistics; the hazards of aggressive driving; accounts of personal experiences with aggressive driving; and managing responses to others' transgressions using anger management techniques. As the program is evolving, more interactive techniques are being added. The hope is that by showing drivers the end result of their aggressive driving (or retaliation behaviors) they will be less inclined to act aggressively on the road. The program is expected to reach 2,400 drivers through 80 seminars annually.

Since December 1998, the Cool Operator program has reached over a thousand drivers including on-the-job drivers, high-risk young adults, employees, and novice drivers. Over 35 seminars have been hosted throughout the counties of San Diego, Orange and Los

Figure 1 (lowest number = highest response).



Angeles. Both public agencies and private corporations have taken advantage of these seminars.

While the program is still new, some interesting information has been discovered. The return rate of post-seminar questionnaires is about 30 percent. Most respondents were very aware of aggressive driving and about 60 percent had witnessed "one to five" incidents per day. Another 30 percent had witnessed 6 to 10 incidents per day. The definition for *aggressive driving* in the responses varied, but most mentioned discourtesy. However only 10 percent have ever reported aggressive driving to authorities.

Respondents also shared what type of aggressive driving angered them most. They said being cut-off annoyed them most, followed by tailgating. (Figure 1).

To help evaluate the effectiveness of the program, seminar attendees are urged to fill out questionnaires. In addition, those who book the seminar may arrange for a follow-up visit to be scheduled after six months to ascertain the long-term effectiveness of the seminar on attitudes toward aggressive driving. Attitudinal change would be elicited from attendees themselves through self-evaluation forms where they are asked to share their personal experiences and report positive behavioral changes.

The seminars have been requested by a wide variety of public agencies, private corporations and other organizations. The favorable responses and repeat requests from organizers have been extremely encouraging. In some instances employers who hire drivers have scheduled seminars for their traffic violators. We hope that one outcome of participating in these seminars is that participants will come away with the awareness necessary to help them control their anger towards others on the road. As the program is still new, we are considering modifying the structure of the seminar to collect self-reporting measurements both pre- and post-seminar. This way we can get more self-reported feedback on attitudinal changes that may have occurred from attending the seminar. STOP

Sheila Sarkar is the Director of the California Institute of Transportation Safety at San Diego State University. Alanna Martineau is a Research Assistant at the California Institute of Transportation Safety.

Agencies, employers and other organizations interested in increasing their employees' level of awareness about aggressive driving should call the Institute at: (619) 594-0164 or visit their website at www.engineering.sdsu.edu/civil/cits/coola.htm to schedule a seminar.

TECH TRANSFER
University of California
Institute of Transportation Studies
Technology Transfer Program
1355 S. 46th St.
Richmond, CA 94804-4603
(510) 231-9590
www.its.berkeley.edu.

Nonprofit Organization

U.S. Postage

PAID

University Extension

University of California

PLEASE ROUTE TO:

- ☐ PLANNING DIRECTOR
- ☐ PUBLIC WORKS DIRECTOR
- ☐ TRAFFIC ENGINEER
- ☐ TRANSIT MANAGER
- ☐ TRAINING MANAGER
- ☐ _____

ASPHALT COURSE HITS THE ROAD IN RURAL AREAS

When Roger Smith gets up to teach an asphalt class, he is doing more than just imparting the basic techniques of asphalt paving, he is also reaching out to our rural constituents. At a recent "Road Show" course on Asphalt Fundamentals in Ukiah, Smith ran local road maintenance staff through such basics as:

asphalt products & issues;

how many layers to lay;

what temperature the mix should be;

what kind of signs to look for in decaying pavement;

how pavement management systems can help;

various maintenance options;

and how to identify the best repair strategies.

This half-day primer on asphalt maintenance is currently touring the road in numerous parts of rural California. In addition to Ukiah, the course has gone to Oroville in Butte County, Redding in Shasta County, Quincy in Plumas County, Fortuna in Humboldt County and El Centro in Imperial County.

Smith has spent many years improving techniques in the bituminous field. He began as a Caltrans research engineer developing

design methods and specifications for pavements and later became the District Manager for the western states at the Asphalt Institute. Now Smith serves as Executive Director of the Northern California Asphalt Producers Association based in Nevada City.

As part of its LTAP responsibility to serve the needs of rural areas, Tech Transfer's field engineer Don Raffaelli helped pilot this half-day course in March of this year. The six courses put on in late spring were a huge success and local agency maintenance staff in these communities now feel they are better trained to tackle the problems of a decaying rural infrastructure.

For only $500, your rural county or town can book this comprehensive half-day course that is suitable for up to 50 students from one agency or a consortium of local agencies. Call Jo-Elaine Curry at (510) 231-5673 for more information or to book a course in your area.