PRESENT TESTING

At present, this methodology is in the process of being field tested by a cooperative effort between the Florida Department of Transportation and local agencies in the Tampa-St. Petersburg area. The site of the demonstration is the Howard Frankland Bridge between Tampa and St. Petersburg on I-275. The demonstration has progressed through all of the steps of the methodology and is currently in progress. In the near future, additional data will be collected so that the estimated delay savings can be compared with the actual delay being saved.

REFERENCES

1. G. L. Urbanek and R. W. Rogers. Alternative Surveillance Concepts and Methods of Freeway Incident Management: Vol. 1—Executive Summary. Federal Highway Administration, Rept. FHWA-RD-77-50, 1978.
2. J. R. Owen, J. M. Bruggeman, and G. L. Urbanek. Alternative Surveillance Concepts and Methods for Freeway Incident Management: Vol. 2—Planning and Trade-Off Analyses for Low-Cost Alternatives. Federal Highway Administration, Rept. FHWA-RD-77-59, 1978; NTIS, Springfield, VA, PB 279 497/AS.
3. G. L. Urbanek and J. M. Bruggeman. Alternative Surveillance Concepts and Methods of Freeway Incident Management: Vol. 3—Computational Example for Selecting Low-Cost Alternatives. Federal Highway Administration, Rept. FHWA-RD-77-60, 1978; NTIS, Springfield, VA, PB 282 497/AS.
4. G. L. Urbanek and J.R. Owen. Alternative Surveillance Concepts and Methods of Freeway-Incident Management: Vol. 4—Guidelines for Specific Low-Cost Alternatives. Federal Highway Administration, Rept. FHWA-RD-77-61, 1978; NTIS, Springfield, VA, PB 279 498/AS.
5. G. L. Urbanek and J. R. Owen. Alternative Surveillance Concepts and Methods of Freeway Incident Management: Vol.5—Training Guide for On-Site Incident Management. JHK and Associates, Alexandria, VA; Federal Highway Administration, Rept. FHWA-RD-77-62, 1977; NTIS, Springfield, VA, PB 279 499/AS.
6. J. M. Bruggeman and G. L. Urbanek. Alternative Surveillance Concepts and Methods of Freeway Incident Management: Vol.6—Delay Time and Queue Tables for Trade-Off Analyses. Federal Highway Administration, Rept. FHWA-RD-77-63, 1978; NTIS, Springfield, VA, PB 284 781/AS.
7. F. DeRose, Jr. An Analysis of Random Freeway Traffic Accidents and Vehicle Disabilities: Freeway Operations. HRB, Highway Research Record 59, 1964, pp. 53-65.
8. S. E. Bergsman and C. L. Shufflebarger, Jr. Shoulder Usage on an Urban Freeway. John C. Lodge Freeway Traffic Surveillance and Control Research Project, Detroit. Study 417, 1962.
9. H. Lunefeld and others. Postcrash Communications. U.S. Department of Transportation, National Highway Safety Board, Rept. DOT-HS-800-289, July 1970.
10. Now That the Pipeline's Almost Built, Who's Going to Take the Oil? National Journal, Washington, DC, Vol. 8, No. 50, Dec. 11, 1976, p. 1764.
11. M. E. Goolsby. Influence of Incidents on Freeway Quality of Service. HRB 349, 1971, pp. 41-46.
12. W. R. McCasland. Experience in Handling Freeway-Corridor Incidents in Houston. TRB, Special Rept. 153, 1975, pp. 145-155.
13. A. Gianturco. Incident Response Team Brings Order out of Chaos. Public Works, Vol. 108, No. 2, 1977, pp. 51-53.

Publication of this paper sponsored by Committee on Freeway Operations.

Abridgment

Traffic-Condition Grade: Evaluation of Concept

Robert J. Benke, Traffic Engineering Section, Minnesota Department of Transportation

The quality of service as perceived by drivers in a traffic stream is a function of how they perceive the various traffic-flow characteristics. Because the mental and physical attributes of drivers vary, different drivers will perceive the same condition as being of a higher or a lower relative quality on some idealistic, undefinable scale. Drivers differ in their degree of acceptance of slower travel times, heavy traffic volumes, and unpredictable events. They also differ in their attitudes toward the driving task itself.

Despite the variability of driver attitudes and characteristics, several assumptions can be made relative to how quality of flow is perceived by most drivers. The first of these is that, for each situation experienced, there will be a median perceived value of quality; half of the drivers will rate the instance lower and half of the drivers will rate it higher on the scale. A correlated requirement is that the surrogate scale must be understood and accepted by the highest proportion of drivers possible. In this situation, actual measures of the differences among drivers need not be known. Rather, we can assume that most drivers will be reasonably close to the median estimate of the quality of flow.

A second assumption (simplistic but essential) that can be made regarding perceived quality is that most drivers recognize smooth, fast flow as evidence of a

Figure 1. Traffic-condition grade sign.

good quality of service. Conversely, they perceive congestion conditions to be symptomatic of a poorer quality of service. From this assumption follows the ability to anchor the surrogate quality scale to actual measurements of various traffic-flow parameters. The problem then becomes one of calibrating the surrogate scale so that relative placement on it is correlated with what most drivers perceive the real-world quality of service to be. This calibration process is complicated by the fact that standard technical terms are not understood by many drivers. Terms and phrases such as capacity, lane-occupancy percentages, density, and volume-to-capacity ratio are usually meaningless to them. Likewise, average delay to be encountered or ratings of heavy congestion are too broad to be of more than general applicability.

The scholastic grading system of ABCDF is proposed as a quality scale that is simple and easily understood by most people and might be adaptable to this need. It remains then to determine the traffic flow that can be rated A (or excellent) and that which should be considered F (complete failure). Because most computerized traffic-control systems use the lane-occupancy percentages and volumes in their control algorithms, it is logical to base the various grade levels on these measures, just as scholastic grades are based on test scores and the quality of work done. If the grade limits are defined and validated by actual experience, then the traffic-condition grade can be determined quantitatively and serve as a surrogate measure of the qualitative level of acceptability of the traffic flow.

SIGN SYSTEM DESCRIPTION

Figure 1 illustrates the signs by which the traffic grade is presented to drivers approaching the two study-area ramps. In-place structures were used, and the TRAFFIC CONDITION legend was added to the route guide sign. A single 36-cm (14-in), seven-by-five-bulb matrix module is used to display the grade. The sign is controlled by a direct wire connection to the traffic management center. The estimated cost of the three signs was $9500 each, including modifications in the center operations room and the direct-wire communication links. The signs are operated only during the evening peak period (3 to 6 p.m.). The display grade is determined and updated on the basis of average lane-occupancy rates at detector stations on the 9.7-km (6-mile) link of I-35W between the Minneapolis central business district and Hennepin County Highway 62.

The average lane occupancy is compared with threshold values, and a grade is selected for display. The initial grade-change points were selected after comparing system-operator, field-observer, and computer ratings of several weeks' experience to provide a less conservative grading. The current thresholds are shown below.

Grade	Lane-Occupancy Range (%)	Volume (vehicles/min)
A	0-12.0	
B	12.1-16.0	
C	16.1-22.0	
D	22.1-40.0	15
F	22.1-40.0 or > 40	15

The traffic grade being displayed is also used by the system operator when reporting traffic conditions to local radio stations, which provides earlier coverage for some motorists.

PREOPERATION PUBLICITY

Before the system was turned on, there was an extensive publicity campaign in the local media to teach drivers the grade meanings. All publicity was generated as news coverage; there were no paid advertisements. The initial coverage included taped interviews and video tape coverage on three of the four local commercial television channels and photographs and descriptions of the signs in areawide, downtown employee, and suburban newspapers.

EVALUATION SURVEY

A mail-back postcard survey was distributed to outbound evening drivers to measure their understanding of the traffic grades and their reactions to the concept. Survey forms were distributed at two entrance ramps on Tuesday, June 21, 1977. A total of 5890 forms were distributed among an estimated 6100 automobiles between 3 and 6p.m., a 97 percent coverage rate. The forms were designed so that a driver was asked to define the meaning of only one letter, thus eliminating any learning bias. They were arranged sequentially in groups of five so that identical numbers of forms with each letter were distributed. The mix of letters over time and location was therefore constant; however, the letter received by a given driver was determined on a random-chance basis. A total of 2271 surveys were returned in time to be included in the subsequent analysis, a 38.6 percent return and 37.4 percent coverage of all entering drivers.

The returned questionaires were examined to determine whether they were representative of the traffic that had entered the freeway during the survey period. The tests showed that the return rates varied significantly by 30-min time increments ($\chi^2 = 313$); the peak rate occurred between 4:30 and 5:30 p.m. This finding shows that the sample contains, proportionally, too many peak-hour users. However, these drivers are those most frequently faced with congested flow and their response is of greatest concern. In this instance, oversampling during the peak hour does not create a problem. An analysis by letter grade, of the number of surveys returned, showed a uniform distribution, indicating a generally random response and no statistically significant variation.

SURVEY RESPONSES

A tabulation of the responses to the question about grade meaning showed that 1173 of 2257 people (52 percent) correctly identified the correct definition. The correct-response rate was variable, probably because of the word-choice options presented. In the case of the grades A, B, and C, a second response can be considered correct, depending on the person's perceived value scale. For example, some persons might consider a B to be a good grade relative to a D or F but others might consider it to be a fair grade relative to an A. These almost-correct answers illustrate the difficulty of agreeing on commonly defined descriptions of traffic conditions. In retrospect, further pretesting of the questionnaire was warranted.

The inclusion of almost-correct answers as correct responses results in a comparable percentage correct for grades A, B, and D but not grades C and F. The lower percentage correct is correlated with a higher degree of uncertainty and a higher selection rate for the alliterative word option (F = fair) for grade F. The grade C difference resulted from a 14.8 percent response to the poor option. A second tabulation (given below) of the responses of persons who use the freeway at least 1 time/week between 3 and 6 p.m. showed a slightly more accurate response.

Grade	N	Correct (%)	Almost Correct (%)	Total Correct (%)
A	383	45.7	33.2	78.9
B	379	39.3	31.4	70.7
C	392	55.0	7.9	62.9
D	377	77.5		77.5
F	400	60.3		60.3
Total	1931	54.2	14.2	68.4

The non-peak-hour users were less sure and less accurate in their responses.

Subsequent analysis of the accuracy of peak-hour users showed that the media coverage had played a significant role in educating them. More than 80 percent of those who indicated that they had heard or read about the grade signs were able to correctly define the meanings (see below).

Coverage	N	Total Correct (%)
Newspaper only	151	83.4
Radio only	288	73.3
Television only	222	84.2
Subtotal	661	79.3
Two of three media	279	80.3
All media modes	216	84.3
Total media	1156	80.4
None	793	50.8

Only half (51 percent) of those who had not read or heard about the signs gave correct responses. However, this level of response based only on exposure to the sign suggests that there is a latent ability to decipher the code or to guess the correct meaning. The high level of response accuracy, given the rather limited press coverage, suggests that, with additional education, understanding of the grade concept could be improved to include almost all peak-hour and most casual users of the system.

When asked about their typical use of the traffic grade signs, 51 percent of the peak-hour drivers who correctly defined the letter grade replied that the signs alerted them to problems ahead and 30 percent used the grades to make route choices (see below).

Sign Use	Commuters (%) (N = 1692)	Others (%) (N = 1077)
Route choice	29.8	14.1
Alerts to hazard	50.6	26.8
Of no use	17.8	22.7
Do not understand sign	1.8	36.4

Most of the drivers who did not use the signs responded that they could not because they did not understand them or found them of no use. Many of the commuters who said that the signs were not useful to them indicated by written comments that they were more or less forced to use the freeway for some reason so that the signs were irrelevant to them.

In retrospect, the high rate of response to the two use options (route choice and alert to hazard) may have been a result of the structure of the question and the options presented. Attempts to validate the route-choice rate have not been attempted thus far because of the infrequency of the use of the grade F. The grade D is not expected to divert a measurable number of drivers because most drivers will still prefer the freeway over alternative routes. The study structure was not designed to provide a validation check of the response to the alert-to-hazard use. It is reasonable to assume that, although the rates of use for route choice and alert are not high, there are still a significant number of drivers who understand and use the traffic-grade information. The problem that remains is to determine more accurately the true level of use and the level of use needed to make the sign system (or any driver information system) an effective concept.

The reactions of the commuter drivers who gave correct responses to the traffic-grade concept were very positive (see below).

Reaction	Commuters (%) (N = 1333)	Others (%) (N = 938)
Like it (as is)	48.6	24.3
Like it (needs work)	27.9	26.5
Not sure	8.9	14.8
Do not like it	6.5	6.8
Stop work on it	3.4	6.3
No answer	4.8	21.2

Only 9.9 percent did not like the concept and 76.5 percent did. The other drivers (non-peak-hour users or those who gave incorrect definitions) were less impressed but were still positive in their reaction.

CONCLUSIONS

Concept Validity

The survey findings demonstrate that a significant majority of drivers can correctly interpret the meanings of the traffic-condition grades A, B, C, D, and F. This ability could be improved by more effective media publicity. The survey also demonstrates that many drivers use the information communicated by the grade in their subsequent route-choice process and freeway travel. We can therefore conclude that the criteria of understanding and use are met and that the traffic-grade concept is valid.

Driver Reaction

The survey also demonstrates that drivers generally like the traffic-grade concept but that some shortcomings should be corrected. Specific areas of concern include the following:

1. The use of a conservative grade-selection algorithm creates some credibility problems among drivers.
2. The freeway zone represented by the sign is a composite of two areas that have different operating characteristics, which means that some drivers use the freeway without encountering the situation that determines the displayed grade and creates the impression that the signs are unreliable.
3. The locations of the three signs are close to the entry points to the freeway but still allow for diversion to surface streeets. Driver requests for locating the signs further away are reasonable. However, the abundance of in-place signs, communication problems, and the number of additional signs that would be needed to provide earlier warning on all routes mitigate against major system expansion. The use of a flashing mode for grades D and F has not been evaluated but does provide partial relief.
4. The responses of most drivers were positive and encouraging. The greatest shortcoming identified was the failure to reach all drivers with an explanation of the grade system. Additional efforts to reach both peak-hour and off-peak-hour users are required.

Publication of this paper sponsored by Committee on Freeway Operations.

Predicting Effectiveness of Transportation System Management Measures

Mark H. Scheibe, Puget Sound Council of Governments, Seattle
Neil J. Pedersen, JHK and Associates, Washington, D.C.

Transportation planning is moving into an era in which the object is to manage the existing system rather than to expand the present facilities. Most transportation planning tools, however, were designed for the latter task. Consequently, many planners are foregoing quantitative analyses when developing plans for management of the transportation system while awaiting the development of new forecasting and analysis tools. This paper reports on a recent study in the Washington, D.C., area that was oriented toward evaluating various measures for possible inclusion in a revised transportation control plan to achieve air-quality standards and used existing models to analyze a wide variety of transportation policy and low-cost improvement measures. The study did not demonstrate that no further model development is needed, but it did show that the quantitative information needed for the development of transportation system management plans can be obtained from existing models.

The planning of transportation services is becoming increasingly complex. On the one hand, many of the transportation improvements that were planned 10 to 20 years ago, such as major freeways and rapid transit facilities, are no longer feasible because of decreasing transportation revenues and increasing citizen opposition. At the same time, air-quality and energy concerns are focusing on the present transportation system as a significant cause of pollution and waste. As a result, many current transportation implementation actions involve low-cost modifications to the existing system and policy changes to encourage the use of high-occupancy modes and discourage the use of modes that are less energy efficient and cause more pollution per passenger.

Most transportation planning tools were not designed to be used in determining methods of managing the transportation system to achieve better efficiency, a major planning task today, but rather to be used in identifying the most effective use of high-cost capital investments in new facilities. As a consequence, transportation planners frequently feel compelled to forego quantitative analysis when developing plans for management of the transportation system while awaiting the development of a new breed of transportation forecasting and analysis tools. This decrease in quantitative analysis is evident in many of the transportation control plans that have been prepared in various metropolitan areas as a result of the U.S. Environmental Protection Agency (EPA) regulations and in many of the transportation system management plans prepared in response to the regulations issued by the Urban Mass Transportation Administration and the Federal Highway Administration. Many of these plans consist of tabulations of actions that are either already programmed or have appealed to the planners and do not have an accompanying assessment of either the overall effect of the entire package of measures or a comparison of the relative effectiveness of the individual measures. In some regions, this has given rise to confrontations between transportation and air-quality agencies in which one side claims that a certain set of measures will allow air-quality standards to be met and the other claims that a harsher set of measures is needed.

Obviously, all differences of opinion between transportation and air-quality professionals will not dissolve as a result of the use of predictive models. However, increased quantitative analysis of both transportation and air-quality phenomena will improve the information available to decision makers. Contrary to the feelings of some in the transportation planning field, the existing models are not totally inadequate for the task of evaluating the effectiveness of transportation policy decisions and low-cost transportation improvements. Disaggregately calibrated behavioral models are designed to replicate travelers' choices when faced with decisions involving time and cost. Most transportation system management measures, even those that have rarely been implemented, ultimately primarily impact the time and cost variables involved in transportation decisions.