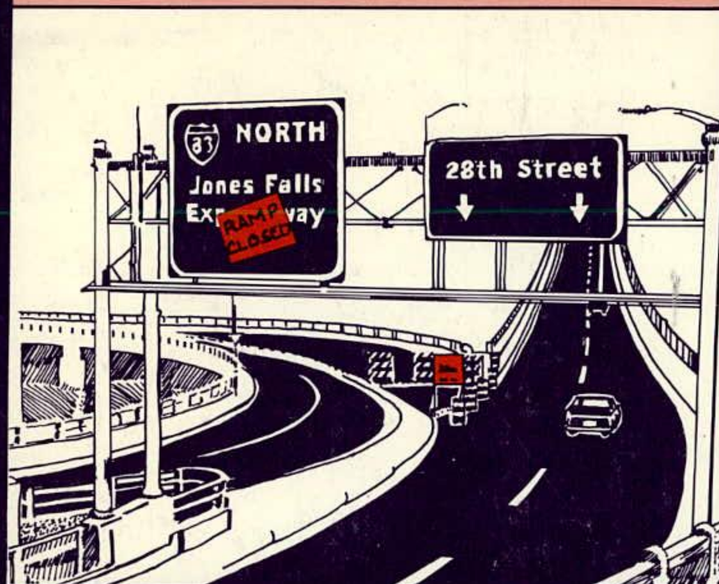
SPECIAL REPORT 212



Transportation Management for Major Highway Reconstruction

Proceedings of the National Conference on
Corridor Traffic Management for
Major Highway Reconstruction
Chicago, Illinois
September 28–October 1, 1986

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

1987 TRANSPORTATION RESEARCH BOARD EXECUTIVE COMMITTEE

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Louis E. Keefer, Conference Recorder

The organizational units, officers, and members are as of December 31, 1985.

Preface

Many of the nation's major urban highways have worn out, and more are wearing out every day. Some roadways have taken such constant pounding and are now deteriorated so badly that they cannot be simply repaired by resurfacing, but must be entirely removed and rebuilt from the ground up.

Such reconstruction projects are complex, time-consuming, and apt to create major traffic disruptions unless careful measures are taken to prevent them. The critical question is what happens to all the existing traffic on the highway while reconstruction is underway? The normal flow of traffic cannot simply be suspended until everything is back to normal.

Frequent travelers know that rebuilding projects are becoming increasingly common throughout the United States. It is becoming difficult in any large urban area to pick up a newspaper without reading about such projects. Frequently, the news pertains to some serious accident or some hours-long delay caused by chronic congestion.

But it need not be this way. Many departments have found ways to mitigate the adverse impacts of major highway reconstruction. It is possible to plan and manage projects so that they are finished quickly and with minimal complaints.

The National Conference on Corridor Traffic Management for Major Highway Reconstruction, under the direction of the TRB Steering Committee, brought together a large number of experts with an impressive range of experience in executing successful projects. They shared those experiences in workshops, developed an extensive checklist of factors to be considered in planning and managing major reconstruction projects, and now offer them here through the medium of this Transportation Research Board Special Report for the use of others contemplating similar projects. The summaries of the roundtable discussions and workshop checklist sessions were prepared and presented by two members of the steering committee, David A. Kuemmel and John N. LaPlante. Conference recommendations were also developed and presented. The final version as it appears in these proceedings was prepared by Louis E. Keefer, Conference Recorder.

MICHAEL D. MEYER
Chairman, Steering Committee for the Conference on Corridor Traffic Management for Major Highway Reconstruction

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Introduction

Conference Overview

MICHAEL D. MEYER
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

Many of the nation's major metropolitan areas have begun, or will soon begin, the reconstruction of heavily traveled urban freeways. Transportation agencies have long been responsible for highway maintenance and rehabilitation, but seldom have such activities occurred in so many places and with such a potentially large disruptive nature as is found with some of today's projects. Reconstructing major highways while still maintaining the ability of highway users to travel within acceptable levels of delay and providing reasonable access to sites within the highway corridor is a complex and politically sensitive undertaking. Maintenance of traffic for such projects is now more than just a matter of on-site traffic control. Opportunities to minimize traffic disruption can now be found in contract administration, construction management, and a wide variety of transportation system management (TSM) actions applied throughout the affected corridor.

To better assess the state of practice of corridor traffic management during major highway reconstruction, the Transportation Research Board held a conference in Chicago on September 28–October 1, 1986, under the sponsorship of the Federal Highway Administration (FHWA). The objectives of this conference were

- To provide an educational forum for exchanging technical information on planning, implementing, and managing highway reconstruction to minimize traffic disruption;
- To ensure that project planners consider contract administration items that can minimize traffic impacts without affecting construction quality;
- To promote TSM actions as means of managing travel demand and easing congestion; and
- To identify recommendations or related research to address issues discussed at the conference.

Representatives from FHWA, over 30 state transportation agencies, several cities, public transit agencies, regional planning agencies, contractors, and private consultants attended the conference. The conference was organized around several major activities.

First, a major benefit of the conference was the exchange of information on what has worked elsewhere. Therefore, representatives from Syracuse, Philadelphia, Atlanta, Seattle, Los Angeles, and Chicago made presentations on the corridor traffic mitigation strategies used on their respective projects. These case studies are presented in Part 4 of these proceedings.

Second, five major issues served as the major topics of discussion throughout the conference. Four of these issues—policy and plan development, mitigating measures, active plan management, and public information and public relations—were introduced to the conference by noted speakers who spent 30 minutes discussing the importance of these areas to effective traffic mitigation and the key characteristics of successful experience. The fifth issue area—construction and contract management—was discussed by a panel. The discussion papers for each of these areas, as well as an overview of FHWA's perspectives, are given in Part 3. After each of the major discussion points had been presented by the speaker, conference attendees were divided into roundtable discussion groups and spent an hour or so discussing the salient points of the issue.

The third major conference activity was a workshop session in which the conference attendees, again in small groups, listed conference recommendations and developed a checklist of important traffic mitigation tasks that could be undertaken by those facing such a challenge. The results of the workshops relied heavily on the issues covered in the roundtable discussions during the conference.

A summary of the roundtables, the checklist, and conference recommendations are found in Part 2.

By the end of the three days, conference attendees had analyzed key aspects of successful corridor traffic management efforts and had produced a useful project checklist. Most important, conference attendees shared a belief that transportation agencies can no longer afford to treat major highway reconstruction in the traditional engineering manner. Successful reconstruction projects rely heavily on public outreach and a heightened sensitivity to traffic management.

Conference Welcome

THOMAS B. DEEN
TRANSPORTATION RESEARCH BOARD

The outcome of this conference is important for at least two reasons. One relates to the need for reconstruction projects, and the second relates to the way the projects are handled.

It's entertaining to speculate about what changes in urban transportation capacity are on the horizon and what may evolve from emerging technology. Automated guideways, in-vehicle guidance hardware, new traffic surveillance and control systems, even new modal systems—all will no doubt have favorable effects on the urban transportation scene in a few years. The Transportation Research Board has even started a research project to measure such impacts. But their benefits are some years away from realization, and urban congestion is growing apace in many communities. What happens in the interim? The fact is, most gains in highway capacity will have to be achieved by rebuilding within present rights of way. Others will cover this subject in detail in the next two days.

Second, given that reconstruction projects will be part of the scene in many urban areas, how they are handled becomes extremely important. Most of these projects are expensive, more expensive perhaps than the original construction that they are replacing. Effective design and construction management are therefore significant in keeping costs at optimum levels. Apart from direct project costs, the effects on communities are likely to be great. High traffic volumes are the rule in these cases, so cities must reckon with congestion and delay. And reconstruction probably affects adjacent neighborhoods and their traffic as much as it affects the traffic that would normally use the facility. So traffic management provisions are costly, may affect construction staging, and can have broad community impacts. It behooves the transportation professionals involved—whether consultant, contractor, local official, or state engineer—to look for and weigh the many trade-offs among project construction costs and the safe and efficient movement of people. Procedures for such examinations might well be one of several products of this conference. Which brings me back to the conference objectives.

We at TRB do not overlook the fact that besides serving as an excellent medium for information exchange among all of you, this meeting has an obligation to deliver results to the sponsor. The program for the next two days points towards Wednesday morning and its concluding sessions entitled "Summaries", "Results", and "Recommendations." The results of this conference will be a report that contains whatever recommendations the group arrives at, as well as the presentations given.

In addition, as you may already have noticed, video cameras are here. We will be producing a videotape also to present the conference recommendations. This tape should be available to a wide range of audiences in 1987.

To insure a balanced view of the issues addressed at the conference, we have worked hard to include the variety of viewpoints and the types of agencies that have an interest in the problems generated by rebuilding urban freeways. Not surprisingly, state transportation agencies are best represented. In fact, attendees come from over half the states. State agency staff members here include not only those concerned with administration and project management, but also traffic engineering and community and/or public relations. People who hold similar positions in several cities are here as well. Also from state and local public agencies, we have a few enforcement and transit officials, who also have a vital role in the issues to be addressed.

The private sector is represented mostly by contractors and engineering consultants. And it's good to note that the commuter is not forgotten, though Carolyn DiMambro, Executive Director, Caravan for Commuters in Boston, and Patricia Price, District Manager, Commuter Transportation Services, Ventura, Calif., may have to speak for all of them.

There is every reason to think that this conference will be a success. You will be hearing not only from administrative leaders of organizations concerned with urban highway reconstruction. You will also hear case studies brought by others with specific successful experience in such projects. And you will also hear from one contractor, Robert Buckley, whose achievements in early project completion have earned substantial dollar rewards—perhaps the best measure of success.

Once you have heard these presentations, you will have the opportunity—in small groups—to learn about and discuss the experiences of other agencies. These discussions will then be compiled and presented to the whole conference for further consideration on Wednesday morning. The opportunity to focus on recommendations derived from discussing a wide variety of experience suggests to me that those recommendations should be both valid and valuable. If that is so, TRB will have done its job. So let me say thank you now for being here and for the contributions you will make in the next two-and-a-half days. May you have a pleasant and productive conference.

Major Highway Reconstruction in the United States: What's Ahead

LESTER P. LAMM
HIGHWAY USERS FEDERATION FOR SAFETY AND MOBILITY

There are some facts we all know: Mobility is essential to America's social and economic life. Transportation investments should improve mobility for persons and goods, and consequently yield safety, convenience, dependability, and affordability, combined with efficiency, speed, and comfort. Transportation systems should allow the individual the greatest possible freedom of choice.

If these are the desired attributes of transportation systems, some mammoth tasks lie ahead, because by the year 2000, these systems will be faced with an additional 34 million residents, at least another 14 million cars, and a still-growing fleet of larger and heavier trucks.

This adds up to an enormous increase in travel. Today, Americans log nearly 1.8 trillion vehicle-miles of travel per year. Federal Highway Administration's May 1985 report, *Status of the Nation's Highways 1985,* predicted that between now and the year 2000, traffic will grow from 2.50 percent to 2.75 percent annually. It actually grew by 4.40 percent between June 1985 and June 1986. Even at the more conservative rate, travel will increase 40 percent by the year 2000. A more realistic estimate is 60 percent, with some metropolitan areas and entire states incurring a doubling of today's traffic by the turn of the century.

Even before this travel increase, a tremendous backlog of highway needs has built up. FHWA reports that just maintaining the 1983 level of service on major highways would cost $18 billion annually up to the year 2000. Eliminating all deficiencies on major highways, except where right-of-way acquisition is particularly expensive, would cost about $26.7 billion annually, and eliminating deficiencies in these more difficult cases would cost another $7.3 billion per year.

In addition, almost one in four (23.6 percent) of the nation's bridges is structurally deficient, and one in five (18.8 percent) is functionally obsolete. An estimated $30.4 billion is needed to replace and rehabilitate bridges on federal-aid systems, and another $20.4 billion to do the same for off-system bridges.

Obviously, these are very large numbers, and even larger ones may be found in other reports on infrastructure needs.

The major implication for this conference is that the national highway program is clearly entering a new era, one that will focus more and more on the need to reconstruct many of our aging and traffic-saturated urban highways.

Although this conference is not about work zone safety, many of the past concerns about work zone safety are the very factors to consider when thinking about major reconstruction projects. The main difference is that the broader concepts of corridor traffic management that will be discussed at this conference generally go well beyond those of work zone safety. I will briefly review some common concepts.

Work zone safety is an old concern. But reconstructing a busy urban highway while trying to maintain today's traffic is much more difficult than building a new highway. Greater emphasis than ever should be put on preconstruction plans and procedures for work zone safety practices. And once these plans have been made, project sponsors should stress additional monitoring to assure that the desired practices are properly carried out at each work zone site.

There is no single answer to the problems of work zone safety, but many practices will help.

Sensitizing contractor and state highway agency personnel to the special needs of work zone safety planning and control is clearly very important. Effective traffic barriers, impact attentuation devices, and lane delineation are also vital. Appropriate signing and warning devices, driver information services, and nighttime lighting are all key.

Users are continually confounded by signs either inappropriately placed for warning purposes or left too long after construction is completed. Sometimes the sheer number of signs, on what has become an unprecedented number of reconstruction sites operating under traffic conditions, adds to the highway users' perceptions that work crews are out merely to inhibit traffic flow!

This misperception has to be corrected. Drivers must realize that they cannot simply disregard work zone safety warnings. They must drive more carefully and patiently, not only for their own safety, but out of respect for the safety of construction crews and other drivers. To help them do so, highway departments must improve the way they advise drivers about construction activities and how they are expected to drive in work zones.

The Highway Users Federation is developing some audiovisual programs on these aspects of driver behavior, which will be made available to the more than 7,000 automotive dealers who belong to their affiliated Dealers Safety and Mobility Council and will be loaned to social and civic groups and to schools at the community level.

Most highway departments must also start emphasizing the benefits derived from highway construction and reconstruction. A lot of people think there's an answer other than building and rebuilding highways. I don't think so. Nothing is going to modify America's dependence on the highway system. It is simply not realistic to believe that any majority of people will switch their dependency to transit. Nor is it likely that everyone will work at home computers and never use their cars.

Of course, the private sector can help alleviate urban traffic problems—particularly those that go along with major reconstruction projects—in a variety of ways. Companies can, for example, stagger work hours, promote carpooling and vanpooling, use shuttle buses or charter bus services to move large numbers of employees between work sites and/or remote parking lots, and similar practices.

Although the private sector has already made important contributions to many urban transportation improvements, its role can and will expand over the coming years. Those of you who are responsible for planning major reconstruction projects ought to be knocking on the private sector's door every day.

One of the best things that can happen is that developers face facts and start limiting the traffic-generating potential of their new super-scale developments to the capacity of the highway and transit systems trying to accommodate all the added travel. Developers have always provided for utilities, sewage, and other services for their new properties. People are as important as sewage.

Such limitations are coming. I just hope we last long enough to see it; we've all talked about it enough!

The public sector is obviously already much involved in traffic management. A few actions of particular importance are:

- *Ramp metering*—With metering, 2,000 vehicles an hour can move in every freeway lane; without it, as many as 10,000 freeway users may be delayed at a time, rather than perhaps several dozen drivers who might have to wait briefly at a few ramps.
- *High-occupancy-vehicle (HOV) lanes*—Many more miles of HOV lanes are needed in congested, high-density urban areas. The time has come to discourage single-occupant commuting by every means possible; the lure of free-flow HOV lanes is probably still greater than any deterrent we can use.
- *Incident control management*—Better ways are needed to deal with freeway incidents, whether caused by a jack-knifed trailer with a spilled load or one person with a flat tire who can clog a whole freeway for an hour at a time. One- or two-hour delays, and sometimes much longer, are becoming common.
- *Traffic surveillance*—Transportation planners need to make more widespread use of known freeway surveillance techniques, to get the best out of the systems; freeway capacity is too precious and costly to waste by simple inattention to system performance. Many highway departments must realize that building and maintaining freeways isn't enough; they must also actively manage their operation.
- *Parking regulations*—Cities need to do a much better job of developing and enforcing citywide parking policies, programs, and regulations. The old saw is still true: Streets are much too expensive to be used as parking lots.

Now, clearly, although all of these so-called "low-cost solutions" will help ease urban traffic congestion, they are not the answer to the 40 to 60 percent increase in traffic expected by the year 2000.

Increased capital will be necessary at all levels of government to meet current and future highway needs. Everyone, meaning both the public and the private sectors, must get involved in the money solution, because better highways are among the most effective investments any metropolitan area can make.

Here at this conference on corridor traffic management for major highway reconstruction, attention is properly turned toward many of the planning and engineering questions involved in that effort. I recognize that they are formidable. So are questions about highway finance.

But somehow, I'm confident that we'll all find the answers to these questions and keep moving forward together toward our common goal of better transportation.

Luncheon Address

HAL KASSOFF
MARYLAND DEPARTMENT OF TRANSPORTATION

"When will you ever finish construction on these roads?" I'm frequently asked.

"Never!" I reply.

"But you can't be serious," I'm told. "There has to come a time when you guys will finish up, pull out those orange construction signs, and let us drive around on a completed highway network. When can we look forward to that?"

"Never!" I reply again. "The job will never be finished."

"But why? Just tell me why," pleads the questioner, with a mixture of disbelief, scorn, and frustration.

"It's pretty simple when you think about it," I explain.

"First of all, highways are unlike many of the things we build. How many things can you think of that we construct with concrete and steel—like buildings, pipelines, dams, and power lines—that receive the kind of punishment that a road is subjected to? Over the course of its life, a highway is subjected to literally millions of hits, and each hit strikes with the force of thousands of pounds. That in itself is enough to wear anything out. Add to it the use of corrosive salts for snow and ice control, and the cyclical effects of freezing and thawing. Then you will understand why roads and bridges wear out."

"And think about it," I continue, "We have millions of miles of roads and hundreds of thousands of bridges in this country. Our pavements last only about 15 years on the average. So in any particular year, seven miles out of 100 will be repaved. Our structures do better, with bridge decks lasting 30 to 40 years and the superstructures and substructures an average of 60 to 80 years. So in any year, figure about four or five out of every 100 bridges will be under reconstruction. When you add projects for widening, drainage improvements, and safety, you can understand that, over the long run, we can expect major reconstruction activities on about one mile in every 10 to 15 in any particular year."

"Next time you take a long trip," I mention, "count the *number* of construction zones, and the *miles* of construction zones for each 100 miles you travel. You'll probably be surprised."

"But it never used to be that bad," my questioner insists. "What happened?"

"You're right," I reply. "Here's why. A large percentage of the principal arterial roadways we travel on—especially Interstates and other freeways—were built after the mid-1950s. So during the past 30 years, we've had a relatively new network of major roads. But 30 years of pounding, caused by heavier loads and a greater number of loads than we expected, and 30 years of deterioration caused by materials not well protected from the effects of chlorides, have run the clock out. Let's face it, we have an aging system. And from now on it will *always* be an aging system, so figure that the orange construction signs are here to stay."

"Then what you're telling me is that extensive reconstruction of our road network, and the headaches that come with it, is not a one shot deal—it's a permanent fact of life?"

"Now you've got it," I reply. "The projects and routes will vary from year to year, but don't figure on taking too many long trips without encountering an array of arrowboards, cones, portable barriers, *and,* worst of all, delays and inconvenience."

"So then," comes the retort, "what are you doing to cope with this permanent fact of life? What are you doing as my highway transportation agent to keep things moving?"

"Funny you should ask," I say. "Come with me to Chicago."

And so here we are at a conference whose purpose it is to confront the worst headache of modern highway construction—namely, rebuilding our roads while they continue to carry heavy traffic.

With the benefit of 20/20 hindsight, I believe that most of us who participated in the heyday of new highway construction, which began in earnest with the 1956 Interstate Highway Act, would admit that it was not just the public who was caught relatively unprepared. Transportation professionals were caught off guard as well.

Certainly, those in the field knew that someday these roads would have to be rebuilt, although that day seems to have arrived earlier than expected in most cases. They knew too that the highway industry had the engineering and construction know-how to get the job done. And with improved technology and materials, they would surely do the job even better the second time.

But I must ask in all candor whether we were ready, philosophically and conceptually, to tackle this new type of work. What do I mean by that? What do philosophy and concept have to do with rebuilding a road under traffic? Well, let's reflect for a moment on how things were the first time through. First of all, most new roads were built on new locations, and managing traffic was simply *not* a horrendous problem. For those projects that *were* built under traffic, consider that (a) volumes were substantially lighter 25 to 30 years ago; (b) the prior condition typically found traffic on narrow, signalized arterials, so things could only get better; (c) public transportation was a more viable alternative; and (d) people used to put up with more grief and did so with less complaining and protest than today.

So now, in 1986, traffic volumes have grown, drivers are used to the convenience of freeways, a demanding and impatient public has grown to rely on the highway system, and public transportation capacities are generally lower than they were a generation ago.

So where does *philosophy* enter the scene? Philosophy enters when we consider our fundamental choice. This is the choice of whether providing an acceptable quality of highway service during the perennial process of highway reconstruction remains a desirable but adjunct factor to consider among the myriad factors we must take into account in our work—factors such as funding, engineering, environment, construction management and, of course, maintenance of traffic, *or*—and this is the choice—whether the provision of adequate traffic service becomes a *compelling, overriding objective*—an objective of *paramount concern.*

At a conference such as this, dominated by transportation planners and traffic engineers, it is tempting to conclude that this choice has been made, and that we have made the transition to a new era in which traffic service goals are indeed dominant when planning, designing, and carrying out major reconstruction projects. Were this true, this conference might be superfluous. It is not.

The fact is that the industry, as a whole, has not yet made the transition. We who are here today are still pioneers. The traditional engineering and construction disciplines still consider the function of traffic service under construction as a necessary evil, an incidental nuisance, a nonproductive diversion of energy and resources. And so the success stories of well-planned, comprehensive corridor traffic management for major highway reconstruction still stand out as exceptions and are not yet the norm.

The pressures and incentives to overcome in achieving these successes are considerable. The pressure of cost is one example. Even though budgets are limited, funds are needed to construct temporary roadways, improve adjacent routes, provide special transit services, and offer bonuses for early completion. The pressure of construction convenience is another consideration. The best way to provide traffic service during construction may not coincide with the best way to build the project. Then there's the pressure of quality: How much quality do we sacrifice when using nighttime construction and materials that can be placed faster but are not as strong or durable?

Are we simply giving in to a different kind of pressure—political pressure—when we bear the higher costs, when we sacrifice construction efficiency, and when we possibly compromise construction quality to accommodate traffic? This is where the philosophical question comes to bear. Where *does* our primary obligation lie? Is it a higher public good to shut down the freeway or close off the bridge while we rebuild them, because by doing so we can save money, reduce construction time, and improve the quality of the final product? Or do we serve a higher public purpose by compromising these factors to keep the road or bridge open, or go to extraordinary lengths to provide alternatives?

If considered from the point of view of consumers of public services, the priorities are clear. What would be the response of consumers of electric power, telephone service, or sewer and water, if severe curtailments occurred five to ten percent of the time while the system was under reconstruction? No one would stand for it. Similarly, the priorities of transportation officials must be to keep open the arteries of personal mobility and commerce. That is where the obligation lies. And so the provision of high-quality traffic management as part of our major highway projects must be central to our thinking—from policy to practice.

Project sponsors must integrate the function into project development work, bringing together planners, traffic engineers, designers, construction managers, public affairs specialists, and all affected agencies and institutions. They must overcome inertia and myopic thinking, and re-orient and retrain. They must find innovative ways to achieve objectives without incurring unacceptable costs, inefficiencies, or losses in quality. They must be concerned first and foremost about people—the customers. They have grown to depend on the product—highways—for their basic well being. We cannot let them down, or trade their interests off in the name of engineering efficiency.

If the public is to support reconstruction programs as voters, they must be treated as *customers* whose loyalty and confidence must be won. We must not only care, we must *show* that we care in what we do, little things and big things, to minimize inconvenience and frustration. And when a certain measure of inconvenience and frustration is unavoidable, project sponsors must communicate with customers about the whats, whys, whens, and hows. They must believe we know what we're doing, and that customer service, and not bureaucratic expedience, is our foremost value.

Customers must see that corridor traffic management for major highway reconstruction is a priority of our agencies and our profession, from top to bottom. They must hear from us, have access to us, and perceive the visible results of our efforts. As an ex-New York City strap-hanger, I can assure you from personal experience that the transportation consumer's willingness to put up with inconvenience is directly correlated with the information he or she is given about the nature of the problem. No one likes to be kept in the dark.

And finally, customers must be made aware that this is not a problem that will go away soon. This is not a fad. This is not a passing phenomenon. Rebuilding our highways is an undertaking that will never be complete. Provision of a reasonable quality of service during reconstruction is therefore a necessity. It will not be enough for administrators and traffic planners to work alone. There is a philosophy of public service inherent in this issue that must become a pervasive value of our transportation agencies. It is a philosophy that must be infused into the everyday design and construction decisions made by engineers, technicians, and contractors. And it is a philosophy that will not have fully succeeded in taking root in our profession until it is apparent that meetings such as this are, indeed, superfluous. Only then will we have succeeded.

PART 2

Roundtable Summaries, Checklist, and Recommendations

Roundtable Summaries

The following sections provide detailed summaries of the roundtable discussions. The reader will notice that the four sets of roundtables did not always adhere to the suggested four subject areas, but often drifted back and forth among all subject areas. This was expected, and discussion leaders made few attempts to prevent unavoidable and probably beneficial overlap.

POLICY AND PLAN DEVELOPMENT

Discussion Questions

The development of a comprehensive corridor traffic management plan is an important first step in dealing with the potentially disruptive nature of highway reconstruction. Not only is this plan important from a technical perspective, but it could also play a significant role in gaining public acceptance of what might otherwise be controversial projects. The intent of this first set of roundtable sessions was to examine these issues in some detail. To guide discussion, the conference steering committee suggested that participants address the following questions:

Political Effects

- Why can reconstruction projects become the concerns of politicians and agency heads?
- What are some of the intergovernmental issues relating to reconstruction efforts?
- Who should be involved in developing a comprehensive plan?

Coordination

- How can the planning of reconstruction projects be coordinated with other construction projects on the transportation network?
- What mechanisms (e.g., management teams, task forces) can be used to ensure institutional coordination for a reconstruction effort?

Funding

- Who should fund traffic mitigation measures?
- How does one determine the cost-effectiveness of alternative measures?

Scheduling and Design

- How does one balance initial design/traffic management decisions against future construction and maintenance needs?
- How can project construction be scheduled to minimize disruption?

Innovation

- Based on the participants' experience, what do they see as possible areas of innovation in reconstruction planning?

Summary of Discussion

Major reconstruction projects can become politically important because they affect many people in a region. Although the users of the reconstructed highway will be affected first, the reactions of communities through which projects pass and of regional commercial and industrial constituencies can generate even higher-level attention to the project. Thus, effectively dealing with traffic flow during reconstruction can become a test of political and administrative leadership.

Most roundtable participants agreed that the potentially damaging political effects of reconstructing major highways can be avoided by *early coordination* with concerned neighborhood groups, civic associations, local elected officials, and representatives of all affected local, state, and federal agencies, as well as the news media. When planners involve these groups at the outset, they have the opportunity to establish the need for the project and discuss the process being used to identify timing and construction details and possible impacts. Early coordination with all groups could also help the project sponsor determine the most appropriate mitigation measures.

The project sponsor's public relations staff should be involved from the beginning in the development of any corridor management plan. This staff should consist of experienced professionals who know how to work with the news media and bring journalists into the phases of plan development and execution at the right times and in the right ways. They must also be able to translate the technical jargon of project planners and engineers into easily understood nontechnical language.

Generally, local elected officials should be given the first opportunity to become familiar with major reconstruction projects and the sponsor's proposed plans for managing them. When possible, they should be briefed by appropriately high-level agency staff before neighborhood and various civic groups get involved. In this way they can play a leadership role in gaining needed public acceptance for the project. As long as they are kept fully informed, local elected officials need not serve on task forces or committees.

Project planners should consider the concerns of many constituencies: neighborhood and civic groups; homeowners associations; utility companies; business associations; chambers of commerce; police and fire departments; municipal engineering or public works departments (and traffic engineering departments, if separate); regional and local public transit agencies; privately owned transit companies; automobile clubs; major trucking companies and associations; regional and municipal planning agencies; public school officials; officials responsible for the safe shipment of hazardous materials; media traffic reporters; construction management professionals and contractors groups; and others. Many of these groups could be formally represented on a project planning committee or task force. Planners should be especially careful to provide opportunities for the involvement of groups that might *oppose* the contemplated project. Working with them is far better than working against them.

One roundtable recommended that planners give particular consideration to businesses that will be affected by the project. When business groups are convinced that a project will give them an important long-term benefit, they can be very helpful in overcoming any problems associated with construction. They may actively support the project by helping to resolve certain intergovernmental differences, carrying key information between their employees and the project sponsor, and even by helping to secure favorable news media coverage.

Roundtable participants agreed that some formal institutional mechanism, such as a committee or task force, should be established to guide project planning. The project sponsor should take the lead in chairing this group and developing the corridor management plan. Such leadership does not mean unilateral decision making. The development of virtually every successful case study discussed at the conference was the result of some task force or committee that involved most or all of the concerned parties. These committees, as a whole, worked to evaluate corridor problems, develop and discuss the solutions, and develop final management plans. If all parties involved agree on a comprehensive plan as early as possible, they may then always act and speak positively about the project, rather than having to react defensively to recurring questions and objections.

Planners should begin the process by looking at the metropolitan highway network both inside and outside of the designated project corridor. Focusing on the alternate routes inside the corridor, they should compare highway capacity to the travel demand to see where the loss of capacity caused by the project would cause the biggest problems. Planners should examine both peak and off-peak traffic demands.

The management plan thus attempts through highway and mass transit improvements to provide highway capacity equivalent to that expected to be lost temporarily as a result of the proposed project. Also, the plan should ease any problems caused by the diversion of traffic through various transportation system management (TSM) and related traffic operations measures. Planners should consider whether it might be possible to use some mitigation measures to produce desirable and lasting changes in corridor modal splits.

Roundtable participants identified various construction techniques that reduce the time required to complete a project. These include (1) working at night or on weekends; (2) staging work to minimize shifts in traffic patterns; (3) providing incentives for the contractor to complete the project early and penalties for late completion; (4) using new construction techniques and materials (such as faster-setting concrete); and (5) using prefabricated construction components (such as pre-cast concrete median barriers, certain pavement curbing, and some types of noise barriers). One roundtable suggested it would be worthwhile for the project sponsor to employ an independent construction contractor (one unlikely to bid on the project) to review the project during the preliminary planning phase, and perhaps again as it neared completion, to advise on state-of-the-art construction and accelerated scheduling techniques.

Participants were especially enthusiastic about "piggy-back" scheduling: the coordinated scheduling of all anticipated road construction by all agencies, so that one project does not hamper or damage another. Such interagency coordination is crucial to keeping motorists assured that construction agencies are doing all they can to minimize delays and other driving irritations.

Piggy-backing is important not only when reconstructing a highway within a single jurisdiction, but also when working on highways that cross jurisdictional lines. For example, whenever one of the trans-Hudson tunnels or bridges in New York City is closed for repairs, needed repairs on approach roadways in New Jersey are scheduled at the same time.

Good interagency communication and cooperation are essential to coordinating construction scheduling. They are particularly important to completing multiyear, multijurisdictional highway projects in which several agencies may work together to complete the reconstruction—one agency needing to take certain steps before another agency can act.

Interagency communication and cooperation can also help assure that main parallel highways in the same travel corridor (perhaps one owned by the state, another by the city) are not simultaneously scheduled for major reconstruction or repairs. When possible, one project should be deferred until the other is completed. For especially large reconstruction projects, in fact, participants suggested that a moratorium on all other major construction projects might be desirable.

Planners face a complex choice when they must decide between completing a project as quickly as possible, perhaps with sharper but more concentrated effects on motorists, or taking several years, and so reducing but extending the effects. In some cases, weather may dictate the choice. For example, the construction season in many northern states is unavoidably curtailed by winter snow and ice. In other cases, the choice may hinge on a cost-effectiveness analysis. It may well be possible to condense construction into one intensive season, but the cost may be prohibitive compared to the benefits to motorists.

In many cases, this trade-off is not feasible. Project schedulers must be aware of unique local conditions, as well as various construction practicalities and political realities of any given situation.

In some projects, political factors heavily influenced the development of a corridor management plan largely because the governor or department of transportation had a policy that projects were to be completed as quickly and efficiently as possible, virtually without regard to cost. As more and more major reconstruction projects are undertaken, however, it seems likely that public officials will place much greater emphasis on more rigorous examination of the cost-effectiveness of the various options available to manage traffic.

Although success may be measured in terms of traffic volumes, speeds, or accidents, one roundtable surmised that, ultimately, it might best be measured by the lack of complaints received—that the best return on investment might simply be good public relations within the community.

The roundtables did not agree on what constituted adequate mitigation. To date, project sponsors have spent widely varying amounts on mitigation measures. One project in Boston reportedly included $10 million in mitigation measures over and above construction project costs of $63 million.

In Philadelphia, the state Department of Transportation worked from a task force list of potential off-expressway mitigation measures for a $175-million reconstruction project and budgeted $12 million to cover six generic categories. Through a need/cost justification analysis, approximately $3.2 million was spent on road and signal improvements and expanded station parking lots and $2.6 million on public transportation, primarily added bus and train service.[1]

[1] This example from Philadelphia was supplied after the conference, during preparation of the proceedings.

As yet, planners have not developed reliable rules of thumb by which to estimate the cost of an adequate package of mitigation measures. However, they can use the answers to several questions to arrive at a figure. How much are elected officials and their appointed transportation agency heads willing to pay? Will various state and local transportation commissions and other programming and budgeting bodies be willing to contribute comparable amounts? The roundtable participants agreed that budgeting bodies should understand that mitigation measures are not optional, but are, in fact, *integral to* most major highway reconstruction projects.

Roundtable participants also agreed that support from highway agency heads is essential to the success of these projects. Moreover, this support must permeate every division of the responsible highway agency, from planning through traffic engineering and operations, design, construction, maintenance, and any others. Cooperation and coordination must be *internal* as well as external. Responsible transportation officials should constantly encourage both staff and construction contractors to view the public as a customer whose perceptions and attitudes toward projects must be considered.

MITIGATION MEASURES

Discussion Questions

Experiences from around the country indicate that a wide variety of mitigating measures have been used successfully in different situations. However, what works in one city might not work in another.

The conference steering committee's suggested questions on this topic included the following:

- What types of measures seemed most effective (and how does one measure effectiveness)?
- How has (or would) the public accept and believe in the effectiveness of mitigating measures?
- How should mitigating measures be funded?
- What process can be used to predict the effects of highway reconstruction on traffic diversion? How does one assess the resulting level of service? What level of delay is considered tolerable for highway traffic?
- How does one gauge the safety and environmental effects of the mitigating measures and the management plan?
- What does one do about truck diversion?
- What is the contractor's role and accountability in making the traffic management plan work?
- What construction and management innovations have been developed, and what new ideas might still be expected?

Summary of Discussion

Roundtable participants agreed that effective mitigating measures must address the needs of transportation users or customers. These customers must be identified, their needs determined, and solutions geared to meet those needs. In one instance, project task force members made a conscious effort to travel to work through the project corridor to sensitize themselves to the needs of all regular commuters—those customers for whom they were planning mitigation measures.

One roundtable believed that acceptable delay would probably vary from city to city, and possibly even between different corridors in the same city. According to studies of actual situations, the popular perception of acceptable and unacceptable delay actually changes when customers are asked to measure their delay scientifically—the perceived delay almost always exceeds the measured delay. Thus, mitigation measures should emphasize reductions in *perceived* delay.

Various project sponsors have used a broad range of mitigation measures, including: (1) providing additional bus or commuter rail service within the travel corridor; (2) sponsoring and supporting expanded carpooling/vanpooling opportunities; (3) building appropriately located park-and-ride lots; (4) encouraging preferential parking rates for high-occupancy vehicles; (5) providing free or reduced-rate transit passes; (6) publishing information on the availability of alternative public transportation routes, the schedules, and fare structures; (7) encouraging flextime and staggered work hours to reduce the sharpness of peak traffic periods; (8) keeping drivers informed of traffic conditions ahead, through both fixed and changeable message signs; and (9) improving traffic flow on alternate routes.

Roundtable participants believed that project descriptions, maps, and widely available informational brochures; news media announcements about alternative driving routes and alternate travel modes; and various other means of providing up-to-date information to regular commuters were mitigation measures in themselves, or at least necessary adjuncts to more familiar measures.

Mitigation measures fall into one of four groups: (1) on-site measures, (2) off-site measures, (3) alternative-mode TSM measures (whether on- or off-site), and (4) all others.

Some specific *on-site* measures mentioned in the various roundtable discussions included:

- reviewing and using design strategies such as frontage roads, narrowed through lanes, and paved shoulders;
- reviewing contracts to ensure that they include such desirable practices as night-time and weekend work, proper lighting for night work, the advance delivery of steel and other materials, noise abatement levels and where the noise measurements would be taken, concurrent rather than sequential work, optimum work staging, working through inclement weather, and maintaining communications with project engineer and public relations staff at all times;
- considering various operational features such as converting some existing lanes to exclusive high-occupancy-vehicle (HOV) operation, creating reversible lanes, closing certain ramps, providing cameras to photograph speeders and mailing them citations rather than having police chase them through the work zone, providing courtesy service patrols to help drivers with disabled vehicles, installing real-time driver information systems including both fixed-site and transportable changeable message signs, and others.

Some specific *off-site* measures mentioned by various roundtable participants included:

- reducing tolls on alternative routes in order to divert traffic to them;
- improving the signal timing and restricting parking on alternate routes;
- designating new HOV lanes;
- restricting left turns;
- restricting trucks and limiting delivery hours; and
- adopting various other means of improving alternate routes.

Information booths, installed at rest areas on major highways that lead into the larger metropolitan areas, might also provide suggestions about alternative routes to out-of-town motorists and truckers.

Some of the *alternative-mode TSM measures* included:

- constructing park-and-ride lots with express bus service to them;
- establishing various special inducements for regular commuters to share rides;
- purchasing vans and leasing them to qualified van pools;
- increasing the capacity of existing transit service;
- altering old routes and adding new ones;
- providing subsidized or even free transit passes.

Some of the *other mitigation measures* included:

- making and displaying scale models of the project;
- using experienced contractors in order that their awareness and compliance with mitigation measures be assured;
- minimizing the number of construction stages so as to avoid excessive opening and closing of through lanes;
- publishing and following a detailed construction schedule;
- erecting signs that tell motorists the projected date of completion.

The effectiveness of any particular mitigation measure will vary widely. Rideshare programs, for example, have seemed highly successful in some instances, but not others. Similarly, transit improvements that worked well in some situations might not be as effective elsewhere—just as HOV lanes obtained good results in some cities but not others.

One of the difficulties that planners face in preparing a corridor management plan is that they cannot always accurately predict the relative effects of alternative mitigation measures. Trip distribution, modal split, and traffic assignment models often provide numbers that are too gross to forecast precisely the effects of any particular mitigation measure. In some instances, especially where Metropolitan Planning Organization (MPO) area-wide travel data are somewhat outdated, sponsors may take a special origin-destination survey of project corridor traffic as the first step toward planning needed mitigation measures. Without current data on travel and the highway/transit network inventory, judging the effectiveness of alternative mitigation strategies can become subjective.

One roundtable emphasized the need to define which measures—such as total driver/passenger delay, truck delays, business losses, route uncertainty, accident potential, or political problems—would be improved under a given plan. A plan aimed primarily at minimizing possible accidents, for example, might differ from one with a goal of preventing business losses.

Roundtable participants agreed that the most desirable mitigation measure was to make every attempt to maintain the original number of traffic lanes during construction. Participants believed that this alternative should be considered even if existing lanes might have to be narrowed, and shoulders and median areas eliminated.

Keeping the maximum amount of traffic on the highway under reconstruction, rather than diverting it elsewhere, has certain obvious advantages. One is that commuters who can continue to use familiar routes to work are less likely to be unhappy about some delay. Another is that it helps to avoid any suggestion that the project will create traffic congestion on *both* the subject highway *and* its parallel routes. Yet another advantage is that keeping trucks on the highway under construction may prevent drivers from seeking shortcuts to alternate routes through sensitive residential areas.

However, if diversion to alternate routes cannot be avoided, then roundtable participants viewed TSM improvements to those alternate routes as the next-best solution. Although the residents and businesses along the alternate routes may object to the additional traffic, they nevertheless will often appreciate that, after the highway has been reconstructed and is again carrying its normal traffic, they will then enjoy their own improved highway, without the extra through traffic.

In general, roundtable participants believed that mitigation measures must be considered collectively as a package solution. While any one measure, if put into effect, might do relatively little to reduce the unwanted impact of highway major reconstruction, combining them might produce highly desirable combined effects. All participants, including all potential project construction contractors, should have access to project improvement plans, as well as to all the proposed and adopted mitigation measures, during all phases of planning. Interested contractors may wish to assist with plan development and may suggest improvements.

Because no corridor traffic management plan can ever be perfect, it is usually desirable to establish a well-publicized project hot line that unhappy commuters may call to ask questions, suggest operational changes, and possibly vent anger at project public relations staff, rather than at elected officials in more sensitive positions.

For the same reason—no plan is ever perfect—one roundtable suggested that contingency funds must always be available to use in correcting certain problems as they develop, especially on designated alternative routes. Contingency funds should include federal participation where such measures do in fact improve performance of traffic mitigation plans.

The most effective mitigation measures are the product of a careful, sensitive public-involvement program, where the rules are applied fairly and sensibly. In Chicago, for example, curb parking was eliminated throughout one project corridor in order to provide additional capacity. This was very successful, except that some businesses could only receive their deliveries from that street. The fair solution was to establish a mid-day period during which deliveries could be made without causing a significant effect on traffic.

Roundtable participants considered the *availability* (but not the *eligibility*) of federal funding for mitigation measures a problem. The amount of highway reconstruction needed throughout the nation's urban areas is expected to far exceed even the combined resources of federal and state transportation agencies—especially considering the funding competition from other highway construction and maintenance programs.

Federal funding has been used, at least in several projects, for a variety of mitigation measures. Funds have been used for public relations programs, traffic control, traffic incident detection and management during construction, purchasing buses, and upgrading parallel routes by such TSM improvements as modernizing signal systems, creating one-way pairs or "offset lanes" (four in one direction and two in the other, instead of three each way), and other traffic engineering techniques.

Roundtable participants disagreed somewhat, however, about how consistently the division offices of the Federal Highway Administration (FHWA) have interpreted the funding eligibility of various mitigation measures. Some measures reportedly have been allowed in some states, but disallowed in others. The groups believed strongly that *all* mitigation measures should be eligible for federal funding assistance. It should be consistently understood that mitigation measures are an integral part of project costs.

Traffic control and management on alternate routes probably deserves more funding than is now available. The main route under construction usually has adequate funding for the necessary police support, but this support may be absent on parallel local routes. This can create problems that attract unfavorable public attention and thus diminish a project's overall effectiveness.

A good project/construction engineer is critical to assuring that contractors cooperate and adhere to the corridor management plan. A good project/construction engineer must be able to obtain the contractor's support for the overall corridor management plan. Among other responsibilities, contractors should recognize that workers must be visibly working wherever lanes have been closed; lanes unused for no apparent reason are certain to arouse adverse public reaction.

Contractors should generally already be qualified to undertake major reconstruction projects, especially those involving urban freeways. Problems have arisen when new contractors have tried on-the-job learning on difficult reconstruction projects.

Roundtable participants gave considerable emphasis to hastening the usual pace of construction. Shortening the total time over which the highway user experiences traffic delays during a reconstruction project may be as important as lessening daily delay. Thus, applying new materials and techniques to shorten the total construction period becomes extremely important. Among the ways to do this are:

- using incentive/disincentive (I/D) clauses related to project completion dates;
- working 24-hour schedules (doing only quiet work at night);
- using prefabricated construction components such as precast concrete bridge deck panels;
- using special and/or high production equipment such as specialized demolition machinery to rapidly remove worn out pavements or bridge decks;
- stockpiling certain standard materials before construction begins;
- using Critical Path Method and other management tools to assure maximizing manpower and equipment utilization.

Routine post-construction reviews to consider the good and the bad points of completed reconstruction projects can help planners and contractors to avoid repeating mistakes. Another way to profit from completed projects is to keep the project task forces intact, not simply disbanding them at the end of projects, but keeping members involved in subsequent projects, whenever applicable.

ACTIVE PLAN MANAGEMENT

Discussion Questions

Once the corridor traffic management plan has been put in place, its effectiveness depends on monitoring the performance of the plan components and adjusting them if necessary. This requires the active participation of enforcement agencies, the contractor, and many other agencies. The steering committee's suggested topics for the several roundtable discussions included the following central questions:

- What are the possible strategies for surveillance, enforcement, and response to incidents?
- How does one establish an effective communications/coordination mechanism (e.g., corridor management teams)?
- What can (and should) the contractor be expected to contribute to active plan management?

- How does one establish an effective community feedback mechanism on plan effectiveness?
- What training/education efforts are needed to enhance the capabilities of the contractors and transportation agency employees in this area?
- What kinds of innovations can be suggested?

Summary of Discussion

Active plan management might be defined as maintaining a steady surveillance of project operations, evaluating all the elements of the corridor management plan, and changing them as conditions warrant. Active plan management is the opposite of sitting back and expecting the predetermined plan, once activated, to operate without further managerial intervention.

Among the sources of information and the surveillance techniques currently used to evaluate traffic conditions during construction are daily reports from highway agency and contractor personnel, police and news media ground/air observations, in-pavement and portable traffic counters, radar speedmeters, closed circuit TV, time-lapse photography, and truckers or local delivery companies that use CB radio or alphanumeric pagers.

Other techniques that some jurisdictions reportedly are considering are solicited reports from public transit and school bus drivers, airport limousine and taxi drivers, and United Parcel Service truck drivers, or any large radio-equipped fleet with a central dispatcher. Such public-private sector cooperation was identified by one roundtable group as the key to success in identifying congestion and other problems, and thus being able to alleviate them.

When traffic surveillance techniques show that some element of the corridor management plan should be modified, the change should be made quickly. In some instances, this need for fast action has raised the question of who within a multi-agency managerial task force should have the authority to make quick changes. Generally, it is accepted that the highway agency must retain that final authority, but this acceptance should be well established before any emergency action becomes necessary.

In most instances the project management team or task force should remain active throughout the entire project. Too many personnel changes must be avoided, although the project implementation team may, of course, have somewhat different membership than the early planning team. In particular, project planners should seek the continued availability of project engineers and principal public relations spokespersons, because they become the authorities from whom the public and the news media will most confidently seek detailed announcements about the project.

In Chicago, the Department of Public Works was instrumental in creating a city-wide, all-agency standing committee to monitor all highway reconstruction projects. With all interested parties represented and good continuity of membership, the committee has functioned very effectively.

Roundtable participants agreed that highway agency project engineers, especially those who also act as spokespersons for the agency, must be among the most technically qualified that the agency has to offer. Along with their technical competence, they must bring to the task a high degree of sensitivity to driver needs—that is, a real concern for highway consumers. Nothing could be worse than having a project engineer with a "public-be-damned" attitude. Maintaining good communication with the public, it was suggested, can sometimes make even an average plan look fairly good.

Active plan management generally requires the project managers to establish a good community feedback system, so they can constantly assess the public's views of the project and its progress. The desired feedback can usually be obtained by establishing 24-hour community hotlines or conducting telephone polls and news media surveys.

As one way to get feedback, one roundtable suggested that every major project should establish an information center at some accessible location near the project. As part of an open-door policy, the center's phone number would be widely publicized and continuously answered by specially trained, responsive personnel assigned from the highway agency's public relations staff, or otherwise provided under contract. These employees would log all calls and walk-in contacts, and promptly refer any questions they could not answer to the project engineer or his designate.

Most major highway reconstruction projects will probably also need to establish some radio- and telephone-equipped, central communications center at which the principal project participants can exchange information through their own direct hookups, as well as at regularly scheduled coordination meetings. It might even be possible and desirable to combine such a project command post with the recommended citizens information center.

The need for up-to-date driver information is particularly important. One roundtable emphasized that motorists and truckers must be kept constantly informed about comparable driving times on most alternative routes they might use. Transportable changeable message signs (CMS) are one way to provide such information; fixed-site, remote-controlled CMS are another.

Alternate route information can also be passed along through either commercial radio broadcasts or roadside Highway Advisory Radio (HAR). In Chicago, for example, ordinary AM and FM radio stations now regularly announce estimated driving times between well-known landmarks with information supplied through a computer link-up to the expressway surveillance system of the Illinois Department of Transportation; Boston has its so-called "harbor tunnel radio"; Richmond, Virginia, has used HAR as part of at least one major reconstruction project.

In some roundtable groups, participants considered safety questions such as the enforcement of work zone speed limits and the problem of so-called "3D" drivers (drowsy, drunk, or drugged). The groups considered well-enforced limits particularly important, not only to protect passing traffic from collisions with stationary obstacles and moving construction vehicles, but also to protect construction workers and their equipment from the traffic. One complication of possible speeding problems is that construction zone traffic volumes—and thus speeds—may vary sharply in the early weeks of work, as drivers switch back and forth between alternate routes.

If speed enforcement is to succeed, great care must be taken to make both the necessary speed limits and their means of enforcement (e.g., police patrol cars) highly visible—to make them stand out from the normal maze of other distractions to driver attention. There must, of course, also be room for the enforcement of speeding and other traffic violations; that is, shoulder or median areas must be wide enough to accommodate stopped violators and police chase cars. Where that room absolutely cannot be provided, some radar/camera/videotape technique can be used to identify lawbreakers, and police can mail citations to them.

Because of the unavoidable hazards of many urban highway reconstruction projects, incident management is particularly important, even more so when normal response techniques cannot be used. Among the innovative suggestions for dealing with incidents were: using firemen, police or paramedics as project flagmen; giving paramedics motor scooters to get through traffic quickly; keeping professional traffic engineers continuously present on the job; contracting for extra police in the project area, paid for as a contract expense; and giving resident project engineers special training in managing incidents.

Even with various innovative techniques, however, it is always necessary to plan ahead to determine who will handle major traffic incidents and how they will be handled. Most roundtable participants agreed that an interdisciplinary team that meets regularly should undertake this planning. Each member would have the authority to make decisions on behalf of his group or agency as needed. In some instances, such teams were established in the names of mayors or governors to guarantee much-needed interagency cooperation.

Project contractors themselves must be part of this team, and should be brought into the planning process as early as possible. Each contractor must become totally convinced that his cooperation is crucial to maintaining safe and efficient traffic movement, both within and beyond the project limits, throughout its entire life. Experience suggests that once they understand that they, as well as the responsible highway agency, might be either praised or blamed for the project management, they are usually eager to help plan for its complete success.

One reason to make project contractors part of both project task forces and incident management teams is to make it clear to them why the responsible highway agency may depart from familiar design standards, materials specifications, and maintenance of traffic during construction practices—all of which are often necessary in major highway reconstruction jobs. Early participation by contractors might, of course, help determine whether such departures are needed and if so, how they should be carried out.

Another reason to make contractors part of these teams is so that they will realize the full importance of sharing advance information with the incident management team about "planned" traffic incidents that result from moving large units of construction equipment, temporary lane closures, or construction material deliveries. Contractors need advance notice not only to warn highway users of potential delays in a timely fashion, but also to keep business and industrial interests fully apprised, and inform elected officials and the general public. Surprise delays due to various changes in construction schedules generate bad press.

Roundtable participants discussed incentive/disincentive (I/D) contract provisions at some length, but agreed only that sometimes they have been surprisingly successful, while at other times they have been dismally disappointing.

That I/D clauses require *both* contracting parties to take enormous care with the precise content and language of every contract was seen as both an advantage and a disadvantage. It is an advantage because nothing is left to chance. Both highway agency and contractor know exactly what to expect of the other. However, it is a disadvantage because this very precision may cause both parties to pay undue attention to the ticking of the clock and to small quibbles that waste time rather than conserve it.

There are problems, too, about when I/D clauses take effect. Notice-to-proceed (NTP) dates become critical. They must allow time for the contractor to mobilize men and equipment, arrange any required subcontracts, order and stockpile materials, and make many other preparations. NTPs must also take weather into account, so that the contractor is not penalized for work delays that are beyond his control.

Indeed, the I/D time span may differ from the total contract time span. For example, the I/D clause could specify that the fabrication and delivery of all structural steel would precede any lane closures, and only the latter event would inaugurate the

I/D period. Similarly, it could be specified that the I/D period would end with the completion of all of the major work but before the structures were painted and the roadway reopened.

Although some contractors have earned bonuses of over $1 million on a single job, most reportedly do not favor I/D contracts. Very often, profit margins are much less than they seem. To speed up work, the contractor must pay high premiums in wages in order to attract an experienced staff willing to work double and triple shifts, and in rentals and leases needed to assemble special equipment and work vehicles.

Nevertheless, participants strongly agreed that the progress of big reconstruction projects should always be accelerated by every possible means. It has become totally unacceptable for any project to drag on, year after year, seemingly without end. Participants believed that most large projects *can* proceed faster without the use of incentive or disincentive contracts.

Any number of projects were reported to have experienced long delays because the responsible highway agencies fell short of the funding needed to meet project cost over-runs. To avoid this in the future, planners should not schedule major projects until full funding, with margin for contingencies, is reasonably assured.

Perhaps the single strongest consensus among plan management roundtables was that reconstruction projects must have more than routine, business-as-usual attention. They must have active management. This means the day-to-day interest, support, and real involvement of many key highway agency personnel; the cooperation and genuine concern for the safety of highway users and convenience of every working contractor; and, last but not least, the patience and understanding of the highway users themselves.

PUBLIC INFORMATION AND PUBLIC RELATIONS

Discussion Questions

One of the major conclusions drawn from reconstruction projects all over the country is that a good public outreach program is essential to success. Such programs, however, require a great deal of thought to identify the target audience and assess alternative strategies to reach it. The steering committee suggested several topics for the roundtable discussions, including the following:

- What are the purposes of a public relations/information program?
- How does one develop such a program and what are possible measures of its effectiveness?
- What are the possible contents of a good program?
- What are some of the timing and implementation considerations in such a program?
- What are the respective roles of the public and private sectors?
- What are some of the innovative techniques that have been developed to date for application in reconstruction projects?

Summary of Discussion

Most roundtable participants agreed that effective and timely public information (PI) and public relations (PR) programs can seldom be overdone. Because most metropolitan area residents or their families and friends will eventually drive somewhere within the corridor served by the highway being reconstructed, the PI/PR programs should ideally reach everyone. Some redundancy of distributed information is not only acceptable, but should probably be planned.

Whenever a reconstruction project is expected to be controversial and arouse some antagonism, either about what will be done, or about the mitigation measures to be used, project planners will usually find it prudent to contact local elected officials individually and personally. State legislators and congressional representatives should get personal briefings as well.

In designing an effective PI/PR program, it helps to think like those who will be most affected and ask the simple and familiar questions: who, what, where, when, why, and how? The answers may give program designers a better perspective about what information drivers really need, and how they might best be provided with the key information.

It also helps to remember that good communications always run two ways. Given an opportunity, most drivers will readily express their concerns. To hear them, the PI/PR staff—and other project participants—need only listen attentively.

Perhaps the three most basic questions for many drivers, especially out-of-town tourists and truckers who may pass through a construction zone only occasionally, are, How many miles will this go on? How much time will I lose? Will this job be finished the next time I visit?

At this basic level of concern, very simple information, flashed by a well-placed CMS, such as "This project is four miles long; today you'll pass through it in 10 minutes," has proven effective.

More sophisticated means are available for making information available to regular commuters:

- door-to-door handouts;
- direct mass mailings, or indirect mailings using materials designed for enclosure with utility bills, sports/cultural event season ticket holders, book club mailings, and so on;
- handouts at parking garages, intersections and ramps, parking lots, and on buses and on trains;
- interviews with news media;
- informational materials distributed through employers, labor and political organizations, chambers of commerce, various professional and business associations;
- announcements at public events;
- paid advertising;
- speakers bureaus.

One roundtable group believed that highway agencies should be less reluctant to buy newspaper, radio, and TV advertising. Instead of trusting the news media to accurately report the facts about a forthcoming project, agency staff might prepare maps, figures, and descriptive text that could be published in the newspapers. On longer-term projects, agency staff would regularly provide status reports and up-to-date maps and schematic illustrations of the project roadways and traffic schemes.

A campaign slogan is useful—some key word or catchy phrase that the public will come to associate instantly with the project and what it is trying to accomplish (a modern version of "Get the farmer out of the mud"). A good slogan is particularly useful in a long, multiphase project, because it can provide the needed and continuing identification link between phases.

Several roundtables stressed the need to be honest and factual in all communication with the public. Good public relations is not like advertising; it is not an attempt to sell the public anything. Rather, good public relations means explaining why a project is necessary, what temporary problems it may cause, what steps will be taken to ease those problems, and what good results will come from the completed project.

Good public relations also means listening to citizens and acting upon their comments, not just telling them what will be done.

Some participants cautioned against using scare tactics; that is, announcing that if travellers do not do such-and-so (rideshare, switch to public transit, etc.), then traffic chaos will result. Scare tactics can only be used once; like crying wolf, further alarms will not be believed. If the consequences are exaggerated, some people may expect and later perceive that the project's effects are worse than they really are.

In addition to giving drivers this advance information, planners should make sure drivers receive useful route information as they approach and pass through the construction zone. Various advance warning signs, transportable and fixed-site CMS, highway and commercial radio messages, and other techniques have been used for this purpose.

PI/PR programs might well begin with an awareness campaign at the top; that is, they may begin in the governor's office and work down through the ranks of other highly influential people to let locally influential people know what is coming. The feedback from this group will normally help the staff to shape a PI/PR message that is both useful to the driving public and acceptable to those in power.

Some participants agreed that the ultimate purpose of PI/PR programs is to help establish and maintain overall support for the highway agency's total transportation program, not only support for a particular reconstruction project. Some reconstruction projects may actually improve public relations, because highway agencies are shown in their best light.

The specific PI/PR program goals include improving public awareness of impending major reconstruction projects, modifying motorists' travel habits by telling them about alternate routes and travel modes, reducing traffic volumes through the construction zone, and assuring both driver and worker safety within that zone. All this should be accomplished as simply as possible, while maintaining safe and efficient traffic flow through the corridor.

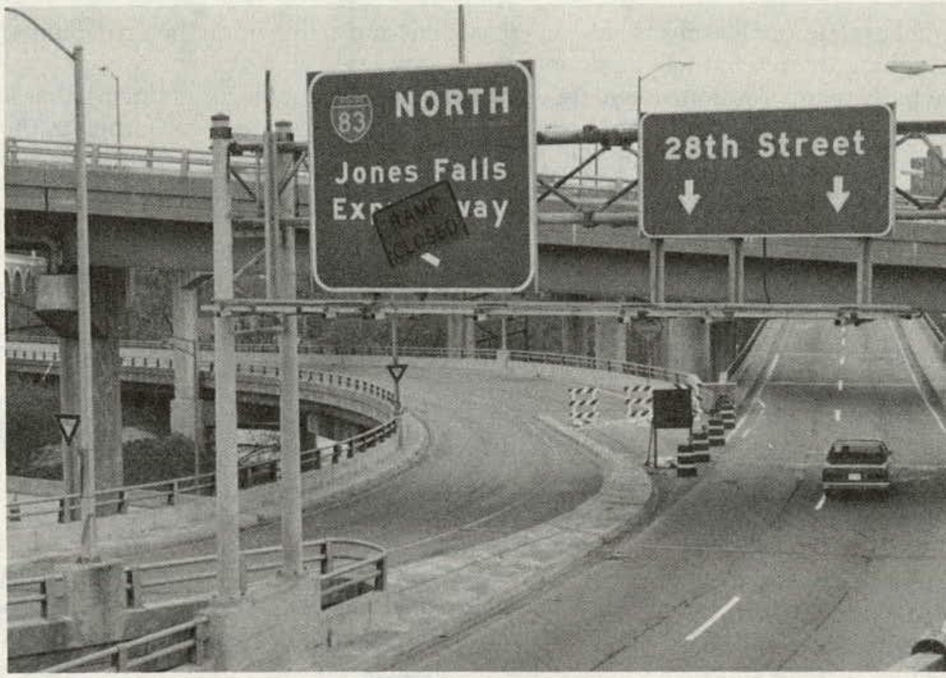
The effectiveness of any public information program must relate to its announced goals. More exact goals will generally require equally exact measures of effectiveness; more general goals need only general measures of effectiveness. Both types of measures can be useful.

Measures of how effectively exact goals have been reached may be based on various kinds of before-and-after traffic surveys, and could include changes observed in the amount and speed of traffic through the corridor, the number of carpools and vanpools, and the number of bus and train passengers. Through such measures, project sponsors can help develop summary appraisals of the cost-effectiveness of the steps taken to alleviate project effects.

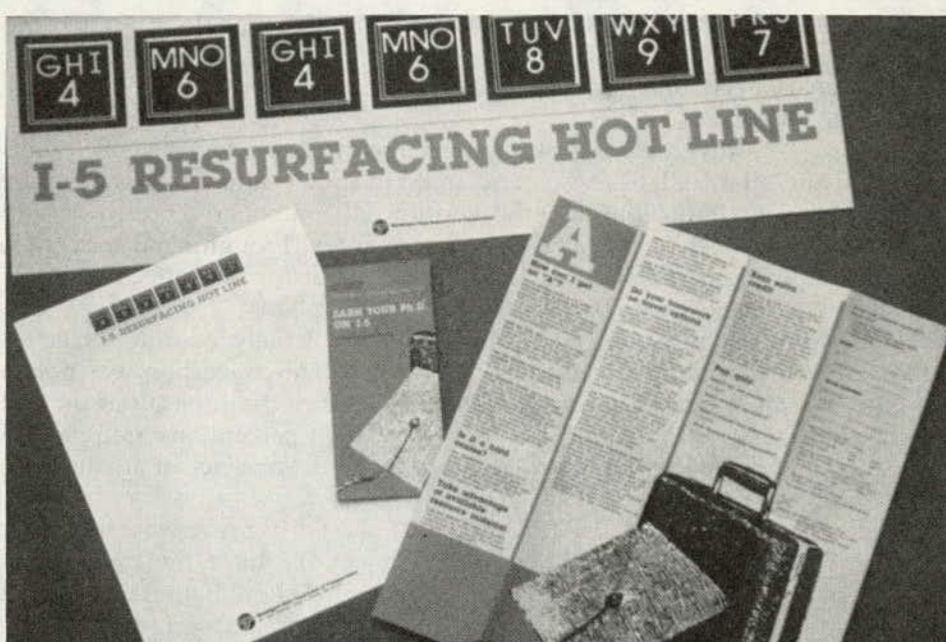
General effectiveness measures, in contrast, depend largely on the subjective perceptions of the majority of drivers, who must think that congestion was not so bad, the pace of traffic was not much different than before the project began, and that driving safety was not impaired. In most cases, such perceptions are reflected not so much by any praise that might be received as by the absence of any adverse publicity.

Participants agreed strongly that PI/PR programs should begin at least 6 months before construction, and continue through the project. To have the background needed to make this early start, public relations personnel should attend all project planning task force meetings from the project's inception.

The highway agency director and his top planning/operations staffs should usually review and approve the content of proposed public relations program. They must set policy—not the PI/PR staff—and they must authorize the expenditure of funds



Reconstruction of the Jones Falls Expressway in Baltimore calls for effective signing of interchange ramp closures. (Photograph by Wayne Berman, FHWA)



Public information on Seattle's I-5 resurfacing takes the form of brochures, letterheads, and posters. (Photograph from Washington State Department of Transportation)

Brochures and newsletters give the facts to the public during I-5 resurfacing in Seattle, Washington.
(Photograph from Washington State Department of Transportation)

In Seattle, signs advise motorists of closed ramps and alternate routes during I-90 reconstruction.
(Photograph from Washington State Department of Transportation)

for program components. And they are ultimately responsible for the success of such programs.

An example of the budgeting used by the Washington State Department of Transportation for public information is that for the resurfacing project on the northbound and southbound lanes of Interstate 5 through downtown Seattle. The DOT resurfaced the northbound lanes in 1984 at a bid price of $2,260,984 and budgeted $30,000 for the public information program. That contract fell well behind schedule, and closer to $45,000 was eventually spent on public information. In 1985 when the southbound lanes were resurfaced at a bid price of $3,899,961, the public information budget was $63,000. The project went very smoothly and only $27,000 was spent on public information.[1]

Everyone must recognize that good public relations can never make up for poor planning. The highway agency's project planning and operations staff must first have answered some key questions. These include why the project is needed, how much it might cost, where and when traffic might be interrupted, and the kind of mitigation measures to be used. These questions must all be answered to the public's general satisfaction before the PI/PR staff begins disseminating information.

The most valuable attribute for public relations staff involved in reconstruction projects is sensitivity to the public's concerns. Indeed, at times, public relations staff may actually need to represent the public, apparently against the interests of the highway agency, especially when it may be necessary to seek concessions on the management of corridor traffic from schedule-conscious project managers. In fact, such apparent adversarial advocacy usually works in favor of agency interests.

Many highway agencies probably do not yet have the strong public relations staff needed to handle several major reconstruction projects simultaneously. Some agencies have faced this problem by first building up their staffs with temporary consultants, and then hiring the best of them permanently—a practice that offers an entry/screening method of staff development.

Because most public relations staffs will always be small relative to the total highway agency staff, agencies should exert more effort in training all of their key personnel to be better agency representatives and to constantly practice the fundamentals of good public relations.

When preparing for major reconstruction programs, most highway agencies would find it useful to prepare and show training films or slide shows explaining the goals and objectives of good corridor management practices to appropriate staff members. These films and slide shows should include a message conveying the agency director's unequivocal personal support for such practices.

Finally, one roundtable emphasized that any good PI/PR program be ongoing, whether or not it was established and expanded as part of a big reconstruction project. The public relations staff involved should continue to meet with editorial boards, news media, planning task forces, and others to maintain valuable contacts and working relationships for future projects.

[1] This example from Washington State was supplied after the conference, during preparation of the proceedings.

Project Management Checklist

After all roundtable discussions were completed, each group met again separately to share ideas in six workshops with the same two major purposes: (1) to make a checklist of tasks that could be used by those responsible for reconstruction planning in developing an effective corridor management program, and (2) to identify specific conference recommendations.

The chairpersons of these workshops then met to develop a composite checklist and the overall conference recommendations. At the final conference plenary session, all conference participants were invited to comment on the checklist and recommendations either during the session or by mail.

Conference attendees conceived of the overall task of corridor traffic management for major highway reconstruction projects as consisting of four major tasks: (1) developing the transportation management plan, (2) preparing to carry it out, (3) following the plan, and (4) completing certain post-construction activities.

Recognizing the complexity of such projects, the attendees believed that a concise yet comprehensive checklist, or catalog of all the various tasks that might conceivably be required at any stage of their planning and execution, would be useful to anyone with such responsibilities. Obviously, not all tasks are appropriate to all reconstruction projects. Such a checklist will, however, help planners and engineers avoid overlooking potentially critical steps in the overall process.

The checklist follows in catalog format and reflects some post-conference comments.

I. *DEVELOP TRANSPORTATION MANAGEMENT PLAN*
   - A. Identify and quantify the problem
     - 1. Define project parameters
       - a. Funding
       - b. Time table
     - 2. Need for TSM
   - B. Identify the corridor
     - 1. Define corridor boundaries
     - 2. Identify affected facilities
       - a. Route itself
       - b. Parallel facilities
       - c. Secondary impact areas

   3. Identify affected communities
- C. Inventory the corridor system
   1. Origin-destination data
   2. Average daily traffic
   3. Travel time data
   4. Existing transit facilities
      a. Bus routes
      b. Commuter rail
   5. Traffic mix
      a. Vehicle types
      b. Truck restrictions
         (1) Height
         (2) Weight
         (3) Width
         (4) Material restrictions
      c. Geometric turn restrictions
   6. Traffic signals
   7. Turn restrictions
   8. Bridges
   9. Incident management capability
   10. Capacities
      a. Facility to be reconstructed
      b. Parallel facilities
         (1) Road
         (2) Transit
- D. Identify key opinion makers
   1. Political leaders
   2. Governmental groups
   3. Community leaders
   4. Business groups
   5. Major employers
   6. Service and professional associations
   7. Media
- E. Develop support for transportation management concept
   1. Develop strategy for involving opinion makers
      a. Make political contacts first
      b. Decide who makes other contacts and how
   2. Set up initial meetings
- F. Establish transportation management team and other committees
   1. Identify different types of committees
      a. Political oversight council
         (1) Policy decision makers
         (2) Meets as needed to be kept informed (quarterly?)
      b. Community advisory committees
         (1) Community representatives
         (2) Meets as needed to keep them informed and obtain feedback from them
      c. Transportation management team
         (1) Day-to-day decision makers
         (2) Meets weekly to provide continuous project monitoring
         (3) Limited size (20?) to keep ability to act

2. Identify transportation management team leaders and lines of authority
3. Actors to possibly be involved
   a. Government agencies
      (1) Local construction agency
         (a) Project engineer
         (b) Resident engineer
         (c) Right-of-way engineer
      (2) Transportation agencies
         (a) State DOT
         (b) City/county traffic bureau
         (c) Transit agencies
         (d) Ride sharing
      (3) Oversight agencies
         (a) Federal Highway Administration
         (b) Metropolitan planning organization
         (c) Department of transportation
         (d) Planning agencies
            (i) Regional
            (ii) Local
      (4) Enforcement and emergency service agencies
   b. Business and community organizations
      (1) Chambers of Commerce
      (2) Community leaders
      (3) Homeowner/condo associations
      (4) Major employers
      (5) Utilities
   c. Other special interest groups
      (1) Private transportation companies
         (a) Bus
         (b) Taxis
         (c) Limousines
      (2) Trucking associations
      (3) Tow truck operators
      (4) Special districts (i.e., port authority, tollways)
      (5) American Automobile Association
      (6) Contractors (Associated General Contractors)
      (7) Major traffic generators
   d. Hired consultants
      (1) Traffic
      (2) Public information

G. Identify goals and constraints
1. Facilitating traffic or construction
   a. Number of lanes open (or close facility)
   b. Long trips vs. short trips
   c. Cars vs. trucks
   d. Incentives or disincentives
   e. Alternative construction schedules
2. Maximize peoplemoving capacities (encourage other modes)
3. Establish budget constraints
4. Establish schedule constraints

H. Identify possible mitigation measures
   1. Temporary widening or use shoulders
   2. Temporary roadways and/or ramps
   3. Ramp closures
   4. Ramp metering, surveillance or control
   5. Signing
      a. Advance warning or information
      b. Detour
   6. TSM on paralleling routes
      a. Signal timing
      b. Parking restrictions
      c. Roadway repaving, widening, or channelization
      d. Offset lanes
      e. One-way streets
      f. Turn restrictions
      g. Truck restrictions
   7. Ridesharing and van pools
   8. Other modes
      a. Transit improvements
         (1) Schedule adjustments
         (2) Additional equipment
      b. Transit incentives
         (1) Subsidized service
         (2) Create park-and-ride lots
         (3) Free ticket distribution
      c. Commuter information hot line
      d. Employer work schedule adjustments
   9. Incident management plan
   10. Public information plan
      a. Media
      b. Community
      c. Political
I. Quantify contributions and estimated costs of mitigation measures
J. Identify funding sources and amounts (cost effectiveness)
K. Select traffic mitigation plan and schedule
L. "Sell" the traffic management plan to support and funding agencies
M. Include traffic management plan provisions in contract documents
   1. Special provisions
      a. Incentives/disincentives
      b. Include mitigation measures
      c. Include enforcement officers
      d. Noise abatement provisions
      e. Allowances for contingencies
      f. Peak-hour work restrictions
   2. Separate contract for mitigation measures
   3. Training of resident engineer and contractor's project manager
   4. Coordinate with conflicting and/or adjacent construction projects
   5. Include time for special meetings
      a. Pre-design
      b. Pre-bid
      c. Pre-construction
      d. Weekly

II. *PREPARE TO CARRY OUT PLAN*
   A. Prepare public awareness campaign
      1. Designate public information team
         a. Public information office
         b. Consultant
      2. Create identity logo for project
      3. Identify audience
      4. Develop public information and input program
      5. Establish procedures for responding to worst-case scenarios
   B. Establish implementation team (if different from traffic management planning team)
   C. Perform necessary "off-project" work identified above
   D. Insure adequate staffing for transportation management plan implementation
   E. Perform necessary dry runs and refine plan as needed
   F. Publicize and market traffic management plan
      1. Publish brochures, maps, ads, etc.
      2. Distribute material
         a. Media
         b. Mailings
            (1) Direct
            (2) Utilities
            (3) Newsletters
         c. Door-to-door
            (1) Community organizations
            (2) Political organizations
         d. Major employers
         e. Parking garages
         f. Toll booths
         g. Signing on facility
      3. Hold press briefings and conferences
      4. Establish hot line for public information
      5. Identify continuing media spokesperson for project

III. *CARRY OUT AND OPERATE PLAN*
   A. Start construction
   B. Begin ongoing transportation monitoring program
      1. Traffic volumes
      2. Transit passenger volumes
      3. Speed-and-delay runs
      4. Accident data
      5. Incident impact
   C. Continue weekly transportation management team meetings
      1. Monitor effectiveness of plan
      2. Revise plan as needed
      3. Evaluate user feedback
      4. Evaluate safety record
   D. Maintain incident management efforts
   E. Maintain media briefings

IV. *POST-CONSTRUCTION ACTIVITIES*
   A. Continue transportation management team for ongoing customer service

B. Hold separate post-construction meeting to discuss transportation management plan
C. Evaluate contractor performance for pre-qualification ratings for future jobs
D. Evaluate and revise transportation management plan checklist for future corridor construction projects

Recommendations

The conference recommendations are presented here under six headings: general findings, corridor traffic management planning, funding, education and training, information dissemination, and action items or research.

GENERAL FINDINGS

- The era of major reconstruction projects is just beginning. Because of the age of much of the urban highway system, and the mounting volume of traffic that major routes must carry, many cities in this country are going to be facing very serious reconstruction problems. The problem is not going to go away; it will be around for many years and must be dealt with.
- Considering the importance and magnitude of reconstruction needs, and the political nature of displacing and disrupting normal traffic while meeting those needs, it is desirable that affected highway users and residents be treated as customers whose needs are understood and satisfied through the very best possible corridor traffic management. Highway planners and engineers, as well as the entire highway industry, must cultivate a more sensitive attitude toward their consumer-customers.
- There are no standard answers. Because each city has particular circumstances and characteristics, the traffic mitigation measures and accelerated construction techniques that work in one city may not necessarily work in another. This means that every city must establish its own planning process, one that involves all of the many individuals, organizations, agencies, and associations discussed throughout the conference, working together as a coordinated team.
- Many cities have long used the corridor traffic management approach for all kinds of transportation improvements, not only highway reconstruction projects. The common concept involves constantly monitoring whole systems from an operations/management point of view, and then actively managing both individual system facilities as well as the demand for them. Many of the techniques discussed in the conference have applications beyond reconstruction projects, and should be used wherever appropriate.

CORRIDOR TRAFFIC MANAGEMENT PLANNING

- Project design and resident engineers both must be involved continuously throughout a project to ensure it is carried out as effectively as possible. Although either may be given the prime responsibility for the project, it may also be assigned to some third-party coordinator (such as a state planning bureau) or to a project management team. Whatever the arrangement, the key principles are continuity and accountability within the planning process.
- It should also be recognized that the planning process almost always involves a great diversity of affected parties. This means that there must be a high degree of coordination, requiring both institutional mechanisms and an organized public relations program to get everyone involved and aware of what is happening.
- Once an effective, fundable, practicable plan has been developed, it should be followed as carefully as possible, not simply discarded at the first sign of trouble. Good plans will have built-in flexibility. Both planners and those carrying out the plan must also develop and maintain flexible personal attitudes about individual plan provisions.
- Plans have various impacts on various groups. Often there will be several sets of issues: those mainly concerning regular corridor commuters, those mainly concerning corridor residents, and those concerning a variety of others. Such diverse issues may all require different levels of planning responsiveness, as achieved through special analytical procedures and specific public information programs.
- The cost-effectiveness of individual components of a corridor traffic management plan are extremely difficult to disaggregate, because too many synergistic effects are involved. Although such analyses should remain part of the planning process, highway user perceptions of cost-effectiveness, ultimately linked to political approval or disapproval, may prove far more important from the standpoint of successfully advancing projects.
- Public information and public relations programs are an extremely important part of the planning and reconstruction processes. Although a good plan must always be the goal, the public's perception of the plan may be even more important; indeed, good plans may be nine-tenths perception.
- Many different on-site and off-site mitigation measures are available. Which measure or combination of measures is selected depends on the particular characteristics of the individual urban area and subject travel corridor. Plans should identify agencies responsible for carrying out each adopted measure.
- Plans should be completed far enough ahead of construction to allow time to put all mitigation measures in place before traffic is disrupted. The time required should not be underestimated; as much as 12–18 months is usually required.

FUNDING

- In the short term, the Federal Highway Administration (FHWA) should clarify the extent to which current regulations and policy permit funding of reconstruction project mitigation measures as well as off-facility, parallel, or alternative route improvements as part of the project. All clearly project-related measures, including "operations" measures (perhaps even operating existing incident management systems) should be fully eligible for federal funding assistance.
- In the long term, federal and state highway funding must be increased to support needed reconstruction projects, as well as other highway needs. Present funding

levels are far below amounts needed to build new roads in fast-growing urban areas, and at the same time repair those roads that, in virtually every urban area, require major restoration.

EDUCATION AND TRAINING

- Training on all the issues connected with reconstructing major urban highways is badly needed. Appropriate courses should be developed and presented by the National Highway Institute. They should be offered free if possible, but with fees if necessary.
- Sensitivity training is particularly needed, not only for project engineers, but for all agency personnel involved in reconstruction projects. These employees need to be more aware of the issues, think about them more, and better understand the need to respond to the public's interest in getting jobs done quickly and safely.
- Consideration should be given to making the results of the conference more widely available through a series of regional workshops. Regardless of sponsorship, such workshops should aim at encouraging participants to apply all useful conference findings in an organized and systematic way.

INFORMATION DISSEMINATION

- In addition to possible presentation in regional training workshops, conference findings should be presented at the American Association of State Highway and Transportation Officials, Institute of Traffic Engineers, and other agency and professional society meetings, as well as to contractors and highway construction associations such as the American Road and Transportation Builders Association and the Associated General Contractors.
- It was also suggested that a national information network be established, wherein known corridor traffic management experts would be identified as available resource persons to answer all questions from planners in urban areas needing assistance with new programs. Such experts might then collectively be sponsored by FHWA as a speakers bureau or users group, much as Urban Mass Transportation Administration now pays for selected resource persons as visiting "consultants" on several UMTA programs.
- Since there is absolutely no doubt that enforcement agencies are critical to the success of reconstruction projects, they too should be made completely aware of the information coming out of the conference, and should be urged to discuss the subject at their own annual meetings and special conferences.

ACTION ITEMS OR RESEARCH

- All federal, state, and local design and construction specifications for highways, bridges, and tunnels should be reviewed and updated as necessary to permit the application of sound practices proved safe and effective in accelerating the reconstruction of major urban highways. Traffic operations manuals and specifications should be similarly reviewed and updated.
- The many successful corridor traffic management plans prepared to date and the excellent results obtained with them should be synthesized for reference by all

state and metropolitan transportation and planning agencies likely to face rebuilding of major highway facilities.

- The relationship between accelerated construction practices and quality in construction should be explored in some depth. This means looking at factors such as facility life, facility cost, and facility safety/economy as experienced by highway users, compared to the time saved by an acceleration practice.
- The surveillance, communications, and control techniques and strategies used with reconstruction projects should be examined for possible application to other kinds of projects; many seem equally appropriate in other contexts.
- Market and consumer research should be directed at the attitudes, perceptions, and desires of commuters before, during, and after highway reconstruction projects, and the effects of management plan strategies on them. In-depth interviews might, for example, reveal that certain successful techniques might have been made even more successful through only relatively minor modifications.
- Questions about the tort liabilities of highway and enforcement agencies, contractors, and other project participants merit examination in some depth, particularly those associated with such drastic incident management techniques as summarily removing by helicopters or bulldozers any disabled vehicles or spilled loads.
- Information on how reconstruction projects have been funded to date, and how they might be funded, including expanded private sector support, should be synthesized and then related to the subject of future federal support.
- Although the conference program was not intended to address work zone safety questions, participants recognized that corridor traffic management involves many of those questions. Any research that may be undertaken as a consequence of conference recommendations should take them into account.

PART 3

Discussion Papers

Policy and Plan Development Related to Corridor Traffic Management for Major Highway Reconstruction

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Major metropolitan highway reconstruction presents many challenges. The technical challenges, the scheduling challenges, the political challenges—all are enormous. The projects are typically expensive, so the financial challenges are equally large. Probably the greatest challenges, however, are those of systems analysis and customer service.

Nowhere is systems analysis more appropriate than when developing the policy and plan for a major metropolitan highway reconstruction project. Transportation planners learned a long time ago that, in urban areas, getting from point A to point B is a lot more complex than it appears. Typically, metropolitan areas have complicated, interconnected transportation systems. Also typically, major urban areas have complex, poorly connected decision-making systems. Reconstruction of major metropolitan highways has an enormous impact on the transportation system and the socioeconomic system of the area, as well as on the political system.

Highway engineers are only beginning to appreciate the concept of customer service. For years, if not decades, they saw themselves as highway builders. The simple solution was—build a new one, bigger and better! Now they are beginning to understand that, for many highways and in many metropolitan areas, the citizens don't want a new, bigger, better highway. Instead, they want better service from their old highways, their old and new political leaders, and particularly their highway and transportation agencies.

What do you do with an old, tired, and worn-out highway in a major metropolitan area? Many of these highways were built in the early days of the Interstate Program, often even before the program began. The design standards and construction methods in those days differed greatly from the modern, high-tech standards of today. Typically, these old highways carry huge volumes of traffic. In Pennsylvania, this means about 80,000 to 100,000 vehicles per day on four-lane highways. In short, states cannot afford to fix these highways, nor can they afford to leave them unrepaired.

Political leaders shudder when they think of reconstructing a major metropolitan highway. The political liability of possible failure and the many chances of failure get attention quickly. Reconstruction gives local politicians an opportunity to protect the interests of their city, borough, or village and maybe get a few extra benefits in the process. For state legislators, reconstruction is an opportunity to protect and serve their constituents who live and do business in the corridor. For the governor, however, highway reconstruction is a huge, extremely visible project that will undergo public scrutiny in every possible medium.

For all politicians, whether state or local, the key is to turn a potential political liability into an opportunity to better serve constituents. To put it another way, it is a chance to turn a potential nightmare into a politician's dream. What is a politician's dream? A politician's dream would be to run unopposed. But we'll settle for getting reelected.

A key to getting reelected is to not only do good, but more important, to be perceived as doing good. The secret is to avoid disasters. Do a good job and create a public perception that you are doing a good job. Because of the great political liability associated with major metropolitan highway reconstruction, a good place to start when developing policy and plans is with the goal of turning a potential political nightmare into a politician's dream.

Project management is perhaps the most critical element in successfully reconstructing a major metropolitan highway. The most important organizational activities require the attention of top management. In the case of major metropolitan highways, it is critical to involve both the top elected officials and the top appointed officials. At the state level this means the governor and the secretary or commissioner of transportation; at the local level, mayors and county commissioners. The public perception that top elected and appointed officials are giving the project personal attention is paramount to successful policy and plan development.

When developing policy and plans, the management and decision-making team should include members with a broad range of expertise. Elected political officials are a key part of the team, as are top administrative officials of the various governments and public agencies. Finally, technical experts should be on the team—including transportation systems analysts, project design engineers, construction engineers, project scheduling and management experts, and public relations specialists. The management team for a major metropolitan highway reconstruction project might well follow the matrix model composed of individuals representing both the breadth and depth of political, administrative, and professional interests involved.

Even when the management team's expertise is both broad and deep, a clear line of responsibility must be retained for accountability. The chief administrative officer of the public agency that owns and operates the highway assumes primary accountability. A short chain of command between the day-to-day project manager and the chief administrative officer should be established and retained throughout the project. The single greatest project challenge is probably gaining broad participation in decision making, while retaining strict accountability for developing policy and plans and carrying out the project.

In Pittsburgh, during the reconstruction of the Parkway East, the district engineer retained day-to-day responsibility for policy and plan development. The media and the public both perceived the district engineer as a competent manager, as well as an effective engineer. In the Pittsburgh case, the district engineer personally coordinated both political and professional involvement in the project. Because of his prestige, he was able to gain broad political support and favorable media coverage. His professional expertise also allowed him to manage both the development and technical aspects of the project. Despite the complexity of the project, there was never any question about who was in charge and who had the authority to make decisions.

In Philadelphia, a bright young engineer was project manager. He was given broad latitude in policy and plan development and making day-to-day decisions. He organized a 27-member task force of state and local officials to advise on policy and plan development. During the project he was in touch daily with the district engineer and in contact with the secretary of transportation at least weekly. In Philadelphia, too, no one questioned who was in charge. The young engineer's willingness to take responsibility and be held accountable is in no small way responsible for the success of this project thus far.

Successful policy and plan development requires both a great deal of imagination and the most careful attention to detail. Each major metropolitan corridor is unique, as is each area, and each group of people who live and work in the corridor. In many ways, each project must be started from scratch. Imaginative, innovative, and creative approaches to managing traffic and implementing actual reconstruction certainly pay off.

SPECIFIC ISSUES

Policy and plan development for corridor traffic management during major highway reconstruction raises certain specific issues. The issues came from the conference chairman, Michael Meyer. The responses came from the project manager on the Philadelphia project, Jeffrey Greene.

Issue 1: Importance of Having an Overall Plan for Dealing with Reconstruction Projects

It is vital to have an overall plan/strategy for a major reconstruction project that affects three fourths of a million users daily but we went further with the I-76 project—the administration made a strong, unwavering commitment to complete the project by the end of its time in office. Within that framework, the plan was to minimize disruption to the traveling public and do the job right—temporary fixes were not acceptable. Also, back in 1981, the department's finances had begun to rebound but were not, for many reasons, sufficient to finance such an effort. At the project level, while efforts to secure the funding were underway, planners devised a series of cash flow plans to provide for any eventuality.

It was only when the funding picture cleared that work on the traffic plan began in earnest. In short, *before preparation of construction plans began,* the department approved a comprehensive plan for the project that included

- A financial plan,
- An overall traffic management plan,
- A construction schedule, and
- A public information program.

With these four elements, the department could proceed in a unified, purposeful manner. In fact, except for Section 400, the plan held, the construction schedule was met, the budget remained intact, traffic flowed as expected, and the public perceived a job well done.

Had the department not done this level of planning, the schedule probably would not have been met; the development of traffic plan and public information plan would have been perceived as last minute add-ons and the department's efforts would not have been as credible.

The plan was central to the success of the I-76 project, and other agencies should undertake and complete this level of planning before construction plans are drawn—not after the construction plans are complete.

Issue 2: Political Implications of Doing a Good (or Bad) Job

In Massachusetts, many said the governor's reelection depended on successful completion of the Southeast Expressway reconstruction. In Pennsylvania, no one's reelection depended upon successful project completion, but the administration wanted to be remembered as the one courageous enough to tackle what some called an impossible project and determined enough to do it right. The public and public officials had to *perceive* that the department was devising and then carrying out a plan to minimize disruption.

Through a 27-member task force that guided project planning, local governments, elected officials, public agencies, and public interest groups were all involved in the development of the plan. Although some were involved more actively than others, all had the opportunity, through 14 formal task force meetings and over 50 public and private meetings requested by task force members and legislators, to influence all aspects of the traffic management plan as it was developed.

Further, the department made every effort to truly permit the task force to make project planning decisions. For example, the task force

- Reviewed the results of the origin-destination survey after approving the questions to be asked;
- Reviewed the diverted peak hour traffic volumes and the potential impacts; then

—Suggested, then approved, the off-system improvements based on an analysis of benefit;

—Determined the construction section limits after reviewing construction implications, such as what could be accomplished in *one construction season;*

—Determined that the task force wanted to actively manage the traffic demand on the expressway by closing ramps; and

—After each task force meeting, participated in a news conference (or other media contact) to announce the decisions made.

In short, every effort was made to make the final plan the task force's plan, even though the department kept ultimate responsibility for its success or failure.

Issue 3: Need to Look at the Entire System to Identify Potential Problems

All agencies that were responsible for operating transportation facilities were on the task force, formally or otherwise. A map was made showing potential construction conflicts, and each agency, including the department, worked to either accelerate, postpone, or modify the construction. This was not a problem, but had it not been done, many key diversion routes would have had traffic restrictions on them.

The regional transit operator in the Philadelphia area, through a subsidy from project funds, added additional services. Under the subsidy agreement, additional patronage diverted by the project reduced the subsidy paid to the transit operator, who was allowed to keep fare box revenue. The service added due to the project operated at lower subsidy levels than estimated from the results of the origin-destination survey. In fact, one line required no subsidy at all and operated at a profit.

Issue 4: Determination of Project Design Criteria to Meet Future Construction and Maintenance Needs

No one wanted to have to go through this effort again on I-76, and a plan was made to minimize future maintenance and eliminate the need for later major reconstruction. Key elements of the plan included

- A thick asphalt overlay on a fully repaired concrete base,
- Saw cutting and sealing the overlay to eliminate reflective cracking,
- Concrete "jersey" barriers rather than guiderail,
- A concrete median barrier high enough to be a glare screen, and
- Epoxy reinforcing steel in all bridge decks and concrete exposed to corrosive salt.

The construction materials used should make future reconstruction unnecessary. Routine pavement maintenance includes milling the old asphalt surface course and then overlaying with new or recycled material. This would be expected at 10-year intervals.

There is no maintenance-free highway, but by managing project design and construction materials, planned maintenance can be minimized, as can the associated traffic disruption. In this case, the milling and overlay operation for next resurfacing can be done at night without affecting daytime traffic.

Issue 5: Level of Service Acceptable for Highway Users During Reconstruction Projects

The task force discussed no specific level of service as a goal either on the expressway or on the diversion routes.

What members discussed instead was expected travel delays on the expressway over preconstruction travel times and the location of bottlenecks on the diversion routes created or made worse by diverted traffic. The key issues were travel time increases and the greater difficulty side-street traffic would face when entering diversion routes. Level of service really has no meaning to the public. Consequently, in the project planning, bottlenecks received attention for TSM type improvements and arteries for coordinated signal system installation.

Issue 6: Importance of a Corridor Management Team or Some Institutional Framework to Guide the Project

The I-76 corridor management team was the Traffic Monitoring Program. The traffic planning consultant stayed to work with department traffic engineers to solve problems as they arose. Program officials undertook an extensive program of traffic counts, field observations, and travel time studies. Signal timing plans were optimized, and the performance of temporary traffic signals was evaluated. Decisions to resolve traffic problems were made virtually on the spot.

The first two construction seasons, the biggest, came off without serious traffic disruptions. In fact, they went so smoothly that the media covered a nonevent the first year, and the second year reported that the traffic diversions and delays occurred as predicted. In many cases, as problems arose and were reported by the media, engineers were on the scene solving them. The Traffic Monitoring Program was designed to be one step ahead of the media, so that when the media reported a bottleneck, they also reported that it was being corrected.

On the expressway, the plan was to make the unavoidable delays predictable—the same each day and of reasonable length—less than 20 minutes at any given location.

Issue 7: Need for Funding Mitigating Measures or Improvements on Alternate Routes

Had funding for improvements to alternate routes, the transit system, or other programs such as ride sharing not been available, the project would probably not have been as successful. In fact, the government would have looked unresponsive to a real and documented need.

The I-76 project proved the need for off-expressway strategies. Bottlenecks were eliminated, improving traffic flow over existing conditions even with increased traffic. Overall flow on major parallel arteries was improved with the new coordinated signal systems. These were visible and, in most cases, permanent improvements. The government appeared to be in front of the issue in the eyes of the public and not reacting to public pressure after the fact.

Issue 8: Trade-off Between Scheduling Project Construction to Minimize Disruption or Speeding Up the Construction Process

This is, in a way, a false issue. Every project is different—its setting in the transportation picture, the type of traffic it carries, and the work to be done. A better issue is the maintenance of the movement of people, goods, and services to the greatest extent possible and fitting this movement into a construction plan that is as rapid as possible. The interests are not competing ones that can or should be the object of a trade-off analysis. If serious disruptions are unavoidable, then incentive/disincentive contracts are indicated. The construction industry can respond to a challenge to speed work. They also can respond with surprising ingenuity to work around traffic. However, the plan must be well thought out from the point of view of design. The biggest challenge is changing the institutional aspects of normal highway construction to meet the special needs of a potentially disruptive project. Once a project is no longer business as usual, the industry will respond successfully.

Once traffic restrictions are in place and construction is underway, the public expects to see daily progress. If all they see is one crew doing one operation, the public's confidence will erode. Every portion of the work zone should have work going on. To the extent possible, the construction schedule should demand this. Only then is the price the public is paying in travel delay tolerable.

GENERAL COMMENTS

To summarize, these are the general subtopics for policy and plan development generated by the conference steering committee. These topics were selected to stimulate discussion.

There is no question of the importance of an overall plan or strategy for dealing with the project. Each city, each transportation system, each corridor is unique. Opportunities are limitless for creative solutions and innovative approaches. Plan development is most likely to succeed when there is broad participation in the plan development process. In the case of corridor traffic management during major highway reconstruction, it is impossible to plan too much.

The political implications for major highway reconstruction are enormous. On the negative side are the potential liabilities of possible disasters. On the positive side are the opportunities to serve citizens in a very special way. Major highway reconstruction is most certainly going to generate a lot of publicity. Be prepared to give the credit to politicians when things go right and to take the responsibility when things go wrong. Although the potential political pitfalls are great, so are the political benefits of being part of something as important as a major highway reconstruction, and particularly one that goes reasonably well.

Having a corridor management team is a definite advantage. People affected by the project want to be involved in decisions that touch their lives. The corridor management team is an excellent mechanism for informing various interest groups of what to expect. The corridor management team is a way to get others involved in the project and share responsibility for what happens. In the long run, managing the corridor management team may well be even more difficult than managing the project itself. But the advantages are certainly worth every effort.

The need to look at the transportation system as a whole is critical in major highway reconstruction. First of all, transportation systems always seem to have more capacity than they appear to have. We need to find this capacity and use it. Every conceivable alternative route and mode should be considered. Coordination of possible construction work on alternative routes is another critical element in managing traffic during construction. Clearly, a good understanding of systems analysis and its application to both urban transportation and traffic operations is valuable in major highway reconstruction.

Non-highway or rather, off-highway, mitigation measures should be considered. Experience has shown that commuter rail and rail transit alternatives are more effective when they already are part of the corridor system. Also on-highway transit and paratransit are probably the most effective alternatives as far as transit goes. Most travelers who are diverted from the primary facility somehow find an alternative route using their regular mode of travel. Even though most people still use their cars, every possible alternative should be identified and promoted.

In many ways, level-of-service is the most critical issue. Also, in many ways, it's a non issue. Most people interested in the project don't really understand the level-of-service concept. People do know how long they have to wait to get through certain bottlenecks. The key measure of performance for the public and elected officials is minimal delay at bottlenecks. It seems that they place more importance on the level of effort to minimize delays. The public expects delays. They will accepts delays given sufficient information on where they are likely to be, when they will happen, and how long they will last.

Project design criteria now reflect great sensitivity to the next reconstruction cycle. For example, shoulders are redesigned to serve as extra lanes during reconstruction, even though under normal circumstances they would be reserved for reasons of safety and emergency storage. Pavements, in particular, are designed to minimize future reconstruction requirements, as well as to minimize disruption when reconstruction is required. In general, project planners are tending to use materials and designs that will require a minimum of maintenance and last indefinitely if not infinitely. Apparently, many public, political, and psychological costs are associated with major highway reconstruction that were not accounted for in the original cost-benefit analysis when these projects were first designed and constructed. These should be considered in reconstruction.

The public must feel as if project sponsors are doing absolutely everything possible to shorten the inconvenience. Of course, the ultimate solution is to close the facility to traffic during reconstruction. Most lack the courage to do this, even though it has been suggested. Construction scheduling is even more important in the snow belt states where the season is short and winter driving is hazardous in itself. In general, it is best to keep the facility partially open to traffic during reconstruction and, as far as possible, completely open to traffic during the winter. Within these constraints, do everything possible to compress the schedule.

Public information is by far the most critical ingredient in a successful major reconstruction project. The public information aspects of major reconstruction projects are too critical to assign to an engineer, no matter how skilled. A trained public relations and communications expert should be assigned to the project. This expert will advise on how to educate the public about possible problems, inform them when things are going to happen, advise them on alternatives, and explain things that don't go quite right. In the final analysis, of all the experts, the public relations and communications expert will have been the most valuable.

Dealing with the Traffic Impacts of Urban Freeway Reconstruction: Mitigation Measures

PAUL N. BAY
HARRIS COUNTY METROPOLITAN TRANSIT AUTHORITY

In discussing plans for managing traffic in highway construction zones, we need to be very clear about our goals: Exactly what effects are we trying to mitigate? To begin the discussions, six areas of impact quickly come to mind:

1. Actual delay to motorists, especially peak period commuters, involving significant increases in daily travel time.
2. Day-to-day uncertainty in travel time—"Will it take me 30 minutes or an hour to get to work today because of construction?"
3. Losses to businesses adjacent to highway work zones whose normal access has been disrupted.
4. Major delays and disruptions to truckers and to those businesses throughout an urban area that rely on regular, timely truck deliveries.
5. Accidents and safety problems for motorists and highway construction workers.
6. Political problems that arise when the public's perception of construction impacts may hamper completion of needed highway programs.

CATEGORIES OF MITIGATION MEASURES

A broad range of possible mitigation measures can be proposed to deal with these six areas, and many will be discussed at this conference. Rather than attempting an exhaustive list, we can categorize them into four somewhat arbitrary groupings that relate primarily to who has responsibility:

1. *Mitigation Through Design Techniques.* These measures should be taken at the very beginning of design work on the facility, not as afterthoughts once construction is underway. Examples include:
   —Use of pre-cast concrete or steel girders instead of the usual cast-in-place concrete structures over main traffic lanes. These can avoid the need to narrow or shut down lanes, and may reduce construction time.
   —Bridge rehabilitation or widening instead of demolition and replacement.
   —Specification of faster placement materials, such as asphalt or fast-curing concrete substitutes at critical locations.

—Construction of new frontage roads or other parallel facilities to act as detours during main lane reconstruction.
—Incentive/disincentive clause in contracts.

2. *Mitigation Through Construction Techniques.* These are actions taken during construction, which usually involve a shared responsibility and close coordination between the contractor and the owner. Examples are:
   —Night-time or weekend activity to replace peak-hour construction activities.
   —Total highway shutdown for certain activities, such as major demolition, in order to finish the work and reopen the highway quickly.
   —Greatly improved construction signing, lighting, and striping, together with contractor work-crew training in these areas.
   —Incident management plans for accidents that include the contractor's responsibilities.
3. *Mitigation Through Traffic System Management Techniques.* These are the kinds of traffic engineering practices that are usually considered, but not consistently used. They also are most successful when they involve a team approach—owner, contractor, other agencies, business community, and the traveling public:
   —Temporary or permanent intersection and traffic signal improvements on parallel routes to increase capacity and improve travel time.
   —Public transit improvements such as special park-and-ride lots, use of peak period high-occupancy-vehicle (HOV) lanes, and preferential treatment for buses at on-ramps or other congestion points.
   —Promotion of ride sharing through assistance in vanpool and carpool formation, HOV lanes, special central business district parking locations and rates, and similar incentives.
4. *Mitigation Through Improved Public Communication.* This category involves consistent, thoughtful, and effective provision of advance information to the parties affected by construction activities. It can include such techniques as:
   —Cooperative efforts with radio and TV traffic-watch reporters and daily newspapers. The media can not only inform motorists in advance of construction changes, but can advise them of proper courses of action during unforeseen incidents.
   —Effective roadside signing to advise motorists of upcoming lane and ramp closures.
   —Advance work with affected businesses to let them know exactly what to expect and to alleviate problems where possible.
   —Advance planning with school districts to revise school bus routes or provide safer crosswalk locations.
   —Provision of information to elected officials and other public leaders so that they are not taken by surprise when construction begins.

EFFECTIVENESS OF MITIGATION MEASURES

This conference should also be looking hard at how to measure the effectiveness—and the cost-effectiveness—of the various mitigation measures. Participants need to review experiences elsewhere to assist in predicting effectiveness. As we try new ideas, we should plan in advance exactly what we expect to accomplish and on how to measure and judge whether the measures actually achieve our goals. This is much harder than it might seem and will not happen without real thought and effort. Here are some of the issues:

1. How do we measure congestion levels before, during, and after reconstruction?
   —Perceived levels of service? Length of peak periods?
   —Corridor throughput of persons per unit of time?
   —Corridor throughput of vehicles per unit of time?
   —Average travel time per vehicle passing through the construction zone? Through the corridor?
2. How do we measure safety?
   —Accident records on facility being rebuilt?
   —Accident records in the corridor?
   —Insurance costs and tort claims to owner and contractor?
3. How do we measure effects on businesses?
   —Unsupported statements of business owners?
   —Actual sales volume records or customer counts?
   —Number of business days when normal access routes are disrupted?
   —Trucker travel times or delivery costs?
4. How do we measure public acceptance and response?
   —Number of complaints to highway agency offices?
   —Number of complaints to elected officials?
   —Attitude of media news stories and editorials?
   —Public opinion polls and surveys?

FINANCING MITIGATION

The last subject surrounding mitigation measures that this conference must address is how to pay for them. There is no doubt that the effects of urban highway reconstruction are real, and that they may be costly to highway users and businesses. Effective mitigation measures may reduce these costs substantially, but these measures may, in turn, cost something. How do we ensure that their costs will be met?

Historically, highway agencies have tried to achieve the lowest cost to themselves for the design and construction of a needed facility. However, if the *total* cost, including construction costs to users and businesses are taken into account, different design and construction techniques should apply. Clearly, planners must change their outlook. We must work together to achieve these changes as more and more of the major highways in our urban centers undergo necessary rebuilding.

Active Plan Management

DAVID H. ROPER
CALIFORNIA DEPARTMENT OF TRANSPORTATION

Too many times a good plan to manage traffic during a construction project fails to do the job—primarily because the plan was turned over to the motorist to carry out. The user of the system wasn't informed of how the plan was intended to work or how to use it; there was no real coordination between the operation of various elements of the overall plan; there was no active monitoring of how the plan was working; and there were no means to quickly modify the plan to meet changing traffic patterns. In short, no one was making the plan happen—seeing that the various pieces were in place when needed, that each element was doing the job intended, and that the plan was being adjusted as needed.

The motorist is a key player in the successful operation of any traffic management plan. In most cases, the motorist will be called upon to make voluntary changes in existing travel patterns—whether it is to modify modes, times, or routes of travel—to accommodate the planned construction. The motorist needs to be convinced that changing will be in his best interest. To do this, he needs to be informed of the alternatives available and the kind of service each will provide to him. This means that a marketing/public information effort must be a part of any traffic management plan. And it needs to begin before the freeway is ripped up—so the motorist has time to shift those travel patterns.

If the traffic management plan is to succeed, those involved in the construction project—agency and contractor personnel alike—must understand that the movement of traffic is an important part of the project. It is essential that the contract plans and specifications call for those things that are essential to the traffic management plan—order of work, times during which lane closures are prohibited, provision of officers and flagmen to expedite traffic flows, signing, and operation of roadways. Contract documents should clearly establish that the contractor will be required to do certain things to facilitate the movement of traffic, and should include penalty clauses for failure to do so. Project personnel then need to enforce those provisions. Operation of the plan should be monitored daily, and adjustments should be made to improve traffic flows.

Putting the plan into effect will call for the cooperation and coordinated effort of a number of players—enforcement agencies, traffic and transportation organizations, contractor personnel, and others, such as transit service providers and major employers. Procedures, working relationships, and roles of each in making the plan work need to be established before the plan is carried out; lines of communication with each need to be in place.

Project managers need to give special attention to communication with the public throughout the life of the plan. As the construction project progresses, varying patterns will be called for; in fact, day-to-day changes are likely to be common. Information needs to be up to date, and it must be communicated to the public in a timely manner. Communication systems to get information to drivers in their vehicles need to be in place—changeable message signs, highway advisory radio, and information links with commercial radio stations have all been used successfully. Bear in mind that the more a driver knows about what is going on and what steps he can take to avoid problems, the better the chance that the driver will modify travel patterns and that the plan will be a success.

The development of a good traffic management plan is important—but its success or failure will depend on the operation of the plan. Planners can't afford to sit back and hope it will work—they need to manage the plan to make sure it does the job.

Remarks on Public Information and Public Relations

DUANE BERENTSON
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

Five-and-a-half years ago, when I became Secretary of Transportation in Washington State, I looked around and came to the conclusion that the greatest challenge facing our Department of Transportation was in our capacity to increase construction programs.

We were then—and still are—one of the high growth rate states in the nation. Particularly in the Puget Sound Basin, rapid growth continues today and congestion on our highway system—and in certain parts of our ferry system—is still building as traffic increases and exceeds the capacity of our facilities.

I've been around long enough to realize that the subject of this conference—reconstruction of major urban freeways—may well be an even greater challenge to us as time goes by.

Washington State has a newer system than many states, but it is clear that we will soon face reconstruction situations that many states have already tackled.

I am here today to talk with you about public information and public relations. I'm pleased to do that for several reasons. Since I currently serve as chairman of the AASHTO Standing Committee on Administration, public affairs falls under my purview.

Additionally, my lengthy career as a state legislator may bring to you a different perspective than some other CEO's might hold.

What I'd like to discuss here is:

- my perspective of the relationship between public information and the continuation of our programs;
- some of the techniques that have been used across the country to control construction under traffic; and
- some thoughts on future needs.

In Washington, the Department of Transportation is directed largely by the legislature. The secretary serves at the pleasure of a commission appointed by the governor and confirmed by the state senate. The Transportation Commission sets broad policies and is responsible by statute for several aspects of the agency's functions.

As secretary, I have some very broad and some very specific responsibilities under state laws.

Those laws, of course, are made by the legislature. Washington has very close legislative oversight through a bipartisan legislative transportation committee. Members of my staff and I appear before that legislative transportation committee at least once each month when the legislature is not in session and almost daily during the session.

People who serve in the legislature come from fairly small districts. They have very close contact on a day-to-day basis with their constituents—and their constituents are our constituents, too.

They are the people all transportation professionals ultimately serve. They, in my estimation, are the most important public with whom we must communicate—not the working reporter, not the editorial writer or the investigative reporter, not the special interest group, or even local government officials.

Over time, I have concluded that with enough money and enough engineers, the transportation agencies of the states in this nation can accomplish just about anything. Ultimately, they can fix virtually any problem.

But public confidence is the key to acquiring the resources needed to resolve the problems that the public itself identifies—a belief that we can respond to their needs.

The days are over of closing down miles of freeway for resurfacing and leaving citizens to fend for themselves. Today, we know we must develop traffic control measures and plans that bureaucrats call "mitigating measures."

But all the sophisticated traffic control plans and procedures in the world will not alleviate the confusion, inconvenience, and congestion created by the mega projects that confront states today. If constituents are not informed and educated through public information and public relations activities, we waste money, create needless confusion—and are perceived to be deliberately disrupting the lives of those we are trying to serve.

That is unacceptable to the public. It is unacceptable to legislatures. It should be unacceptable to us, if only for a very selfish reason: self-preservation.

If we are to preserve and continue the great transportation agencies of this nation, which have built and still maintain the finest transportation network of any nation in the world, we must keep the confidence of those we serve.

We won't maintain that confidence if we do not communicate. We will not maintain that confidence if we do not educate. And we will not maintain that confidence if we do not instill the urgency of those endeavors in our own agencies.

If you look around the country, you will quickly be able to identify some real examples of success. I'm sure we could cite some gigantic failures as well, but the successes should be our focus and our guide.

In Washington State, over the last two years, we have been able to successfully resurface a critical portion of Interstate 5 through downtown Seattle. There are very, very few alternatives for traffic running north and south through Seattle. Thus, to avert chaos, we had to develop and carry out a massive public information program.

Our engineering and public relations staffs worked closely with:

- local government
- transit agencies
- citizens groups
- industry
- the news media
- individual citizens, in many instances

We believed it was crucial that as many people as possible understood a series of issues:

- why we were doing the work
- what we would be doing
- when it would be carried out—not just which months or weeks, but the actual days and hours
- what would be the benefit of the project
- what were the alternative routes or modes of transportation
- where the public could go for help or more information
- what the effects were on other government services, such as police, fire, and ambulance
- what kinds of ancillary effects would occur, such as the noise that certain construction operations would inflict on residents and employees

We used virtually every available public relations tool:

- news conferences
- meetings with community groups
- brochures
- telephone hot lines staffed with information clerks
- DOT employee visits to residents of affected neighborhoods to hand out fliers
- mass mailings
- pay envelope stuffers for businesses
- advertising cards in and on buses promoting the telephone hot line
- radio public service announcements
- news releases
- aggressive scheduling of speeches before service clubs
- posters in businesses and on their employee bulletin boards
- briefings for our own employees not connected with the project so that they could give informed responses to questions posed by neighbors and friends
- appearances on radio and television talk and public service programs
- inclusion of project information in routine correspondence about subjects not connected to the project
- briefings to local government public meetings where additional press coverage could be secured

We tried to do everything we could. We repeated our messages over and over, sometimes even to the point that some—including our staff—considered overkill. But because you have told and heard the same story yourself over and over and over, ad nauseam, you will still not have reached everyone you need to reach and so must continue repeating the message. The I-5 resurfacing job was small compared to many efforts elsewhere. In Pennsylvania, for example, there have been huge projects in Pittsburgh. Massachusetts completed and documented in extraordinary fashion their Southeast Expressway Project.

Here in Chicago, the city has completed work on the Edens, and the Dan Ryan Expressway is scheduled for reconstruction in 1987 or 1988.

The keys to success in Washington and other states are very simple. Transportation planners must use a multidisciplinary approach to the problem. They must also plan early and stay committed to the plan. At the same time, they must employ the expertise of planning professionals; traffic engineering, design, and construction engineers; experts in print communication; experts at targeting audiences; and public relations coordinators.

If a department lacks expertise in any of the areas critical for success, the initial planning process must recognize that deficiency and make appropriate provisions for acquiring outside help or allowing time to develop it in the organization.

If employees don't have these capabilities now, this is the time to begin developing their skills. Because, as we all clearly recognize, these projects represent a large part of the future.

There is, of course, one other aspect of the public relations and public information campaign. That is the matter of safety.

I am referring to safety for its own sake—the preservation of life and limb of citizens, contractor workers, and employees—and also safety as an economic consideration.

In this litigious era, defense against both justified and spurious lawsuits demands that we can demonstrate that preventive measures were taken. A well-thought-out and well-implemented public information program can deter accidents and lawsuits; it can also be part of a good defense of suits that occur.

By virtue of the fact that this conference is taking place, I believe the future is very clear to us all. The age of reconstruction is here. The age of improving old facilities and constructing new ones under traffic is here. No longer can we simply go out and get something built without considering the effects.

The real basis and need for public relations and public information is the same as the purpose underlying all of our work: to improve the transportation systems of the states and the nation as a service to the taxpayers.

I sincerely believe that we have a moral obligation to accomplish that end.

To anyone who would disagree on that issue, let me repeat that it is in your own best interest to practice strong and positive public relations.

When I served in the Washington State Legislature, our Department of Transportation was responsive to the needs of citizens. The department's responsiveness diminished the number of frantic and fanatic phone calls, letters, or meetings that were critical of the transportation program. That allowed me, as a legislator, to exercise strong and unswerving support for the DOT and its objectives of serving the state.

To a large extent, I realize, I am preaching to the converted. I know that the majority of you know, understand, and believe that we are obliged to be forthright and straightforward in our dealings with our many publics, whether they are citizens, legislatures, or any of the other segments of our society.

The message I want to leave you with is that there are a few transportation professionals left who don't share and understand this philosophy. We have a responsibility to convince them, to convert them to this way of thinking, and doing business. I believe the consequences of not accomplishing these goals are clear to us all.

FHWA Perspectives: A Comprehensive Approach to Major Highway Reconstruction Projects

REX C. LEATHERS
FEDERAL HIGHWAY ADMINISTRATION

On the 30th anniversary of the Interstate Highway Program, with about 98 percent of the system complete, the highway community's emphasis undoubtedly has turned to the rebuilding of our nation's highways (both Interstate and non-Interstate) rather than to expanding through new construction. The highways are being rebuilt for many reasons: safety improvements, resurfacing, modernization and capacity improvements, and repair of deteriorated pavements and structures. This shift in emphasis can be illustrated by noting that between 1983 and 1985, the number of miles of highways and bridges resurfaced, restored, rehabilitated, or reconstructed (4R) was over 15 times the number of miles newly constructed. The emphasis clearly is on rebuilding.

The need for 4R-type improvements is likely to continue well beyond the year 2000. The 1985 report to Congress on *The Status of the Nation's Highways: Conditions and Performance* showed that in 1983, less than 3 percent of the urban Interstate pavements were deteriorated to the point of needing major reconstruction. The report went on to show that by the year 2000, we will need to reconstruct better than 40 percent of the Interstate highways and about 70 percent of the arterials.

This rebuilding effort coincides with the need to maintain and even expand the capacity of existing highways to meet an increasing demand for travel. This is why this conference is so vital: annual increases in travel demand are occurring on highways that also need to be rebuilt. A recent analysis of urban freeway congestion, using the Highway Performance Monitoring System, estimated that traffic will increase on our freeways by nearly 60 percent between now and the year 2000. Further, the analysis estimated that the largest 37 major metropolitan areas will experience a more than 200-percent increase in congested travel and over a 300-percent increase in delay, solely as a result of increases in travel demand.

This conference represents the beginning of a national focus on the skills and approaches needed to facilitate travel by the public during major reconstruction. This issue has attracted the attention of many interests and disciplines, as shown by the conference attendance list of construction engineers, designers, traffic operations engineers, enforcement officials, planners, transit and ridesharing professionals, and contractors. Being at this conference, with its variety of viewpoints, gives me a special opportunity to share with you my thoughts on six areas that we all must consider as we approach major rebuilding programs. By addressing these areas comprehensively, rather than piecemeal, we can maintain acceptable levels of service while we rebuild the highways. These six areas are corridor analysis, traffic management, work zone safety, public information, contract administration, and coordination.

First, we must look at the entire corridor to identify opportunities to minimize inconvenience to the traveling public. This approach has two aspects, both equally important. From the transportation side, a corridor analysis can reveal opportunities for shifting traffic from the highway being reconstructed onto alternative routes or other modes of transportation within the corridor. The objective must be to find cost-effective ways to facilitate travel by the public through the corridor. The point to remember here is that actions such as alternative route programs, traffic engineering improvements, park-and-ride lots, and ridesharing programs can be effective when developed through a corridor management approach.

The other aspect of corridor analysis is improving coordination and scheduling by contractors so work can be done effectively with a minimum of inconvenience to the public. This coordination of scheduling is especially critical on major rebuilding jobs that cover several miles and involve work at several locations, possibly by multiple contractors. It may be better to do the work over the entire length of the highway for one or two construction seasons, rather than to spread the work out over many smaller individual projects for a longer period. Economics is a concern, but sometimes it is cheaper and causes less inconvenience to start the project, concentrate on completing it as quickly as possible, and then open the area back up to traffic. This was the philosophy for major reconstruction projects along I-376 in Pittsburgh, the Southeast Expressway in Boston, and the Schuylkill Expressway in Philadelphia. Successful and accelerated completion requires good coordination and scheduling by the contractors.

Doing a corridor analysis can also lead to alternative management and project design choices. For example, such an analysis may show that a highway can be closed completely, rebuilt in one season (instead of two) at a lower cost, and result in only a slight increase in delay along alternative routes. The corridor analysis can highlight the trade-offs in design and management that can be made to balance inconvenience to the traveling public and the cost of the construction project. The corridor analysis must be done early in the project development phase if it is to result in cost-effective management and design decisions. Similarly, good traffic management, the second important area in a comprehensive approach, must be incorporated into project design at the earliest stage. How the project is designed affects what actions can be used to manage traffic during the reconstruction. The success of the reversible lane configuration during Boston's Southeast Expressway reconstruction is a good example of how traffic management can be incorporated effectively into project design. Compared with the original roadway, this configuration resulted in higher vehicle speeds and fewer accidents while handling nearly the same traffic volumes. Another example of incorporating traffic management into project design effectively occurred on the Shirley Highway (I-395) in the vicinity of Washington, D.C. When the Shirley Highway was rebuilt in the early 1970s, Virginia highway officials designed the project to allow for a temporary bus lane through the construction zone. This feature not only permitted the efficient movement of people during the reconstruction, but was a major factor in the development of the present high-occupancy-vehicle (HOV) lane on the Shirley Highway.

The relationship between good traffic management and design is an important element in the reconstruction of U.S. 12/I-394 in Minneapolis, to cite another example.

The interim HOV lane established to handle traffic during the reconstruction will become a permanent feature of the final design of I-394.

Good traffic management also includes cost-effective actions to move people and vehicles through the entire corridor, not just on the highway that is being rebuilt. In reviewing some of the reconstruction projects around the country, we find that traffic engineering improvements along alternative routes in the corridor can be the most cost-effective action for managing traffic. When alternative routes are improved with coordinated signal controllers, parking restrictions, and traffic control officers at critical intersections, they can handle up to 25 percent more vehicles. As for expense, the alternative route improvements in Pittsburgh cost about $320,000; in Boston, about $200,000; and on the Ventura Freeway reconstruction in Los Angeles, the cost is expected to be about $500,000.

Other actions should also be thoroughly analyzed for their effectiveness in moving people through the corridor during the reconstruction. Preferential-treatment for high-occupancy vehicles, corridor vanpool programs, park-and-ride lots, express bus services, and the like can reduce demand through the construction area. They may also create long-term changes in commuter travel habits. This change was noticed in Pittsburgh after completion of the I-376 project. About 1,000 commuters switched permanently to vanpools after the reconstruction. The cost of this vanpool program was about $60,000.

Commuter rail improvements are another matter. They may have potential in corridors where commuter rail service existed before the reconstruction. This potential was shown by the projects in Boston and Philadelphia. But from the viewpoint of economics, it is important to analyze the cost-effectiveness of commuter rail improvements thoroughly. Some limited experiences suggest that new commuter rail lines may not be effective at diverting trips from the reconstructed highway. For example, the use of a new commuter rail line established for the reconstruction of I-376 in Pittsburgh cost about $1.6 million and moved only about 500 people daily. Meanwhile, approximately $1 million in traffic engineering actions along alternative routes resulted in an extra 4,700 vehicles using the routes each day. Clearly, the commuter rail line was not cost-effective. In fact, this commuter rail line was discontinued after the first construction season.

Good transportation management should also include provisions for incident management during the reconstruction. Tow trucks, road service, and variable message signs can do a great deal to lessen congestion, as was shown by projects in Pittsburgh, Boston, Chicago, and Philadelphia. Anticipating the need for these services helps promote good public relations for the state.

Traffic management to minimize delays to the public may also include the use of innovated designs, construction materials, and methods that will reduce construction time and exposure. For example, the use of pre-cast concrete bridge deck panels can speed up bridge repair and reduce delay to the traveling public. This was shown by successful bridge projects in California, Connecticut, Delaware, Illinois, Maryland, New York, and Pennsylvania.

A final point about traffic management involves economics. Some reconstruction projects have traffic management programs that account for 10 to 15 percent and even up to 20 percent of total project cost. These programs do drive up the cost and, therefore, require thorough analysis to determine which actions are cost-effective and what trade-offs can be made.

The third essential area to address is work zone safety. While traffic flow, construction schedules, and economics are critical to a reconstruction project, the safety of the workers and people passing through the project must be given significant consideration. From 1982 to 1985, work zone fatalities on the Interstate System alone increased from about 90 to 200, a reflection in part of the increased work that resulted from additional funding approved in early 1983 for Interstate 4R projects. About 15 percent of all work zone fatalities involve pedestrians, many of whom may be employees of the state or the contractor. Of course, reducing vehicle demand by instituting good traffic management programs will help address this work zone safety problem, and we will continue to emphasize safety in work zones. However, the states and contractors can have the most impact on safety by using effective traffic control plans for reconstruction projects.

Public information and relations is a fourth area of major importance to a comprehensive approach for reconstruction projects. It is one thing to develop transportation management actions, but making the actions effective requires a good public information program. The successful rebuilding projects have all had strong programs to inform the public and the media of the reconstruction project and of the alternative routes, modes, and services available. States such as Massachusetts, Minnesota, New Jersey, New York, Pennsylvania, and Washington, for example, have prepared commuter guides for informing the public. A good public information program is an essential part of a reconstruction project. We have noticed that it can lead to good public and political support for state projects.

In this type of project, contract administration demands more attention than usual. Construction oversight for a reconstruction project is different than it is for a traditional new construction project. When feasible, incentive/disincentive clauses can do a lot to accelerate construction progress or to keep a project on schedule. These provisions are most effective for 4R, bridge reconstruction, or other projects where traffic inconvenience and delays can become significant. Evaluation of these provisions showed they were not abused and were valuable construction tools. They should be used when experience or analysis shows they will be effective in reducing inconvenience, saving money, benefiting the public, and increasing safety. Incentive/disincentive clauses are key elements of the contract provisions for major projects under way in Houston, Philadelphia, and Seattle.

We have recommended the use of unit bid prices to pay for traffic control items on major or complex projects, but some agencies have been hesitant to use this approach in their contracts. The separate bid item approach gives contractors a financial incentive to install and maintain traffic control devices properly. It also gives a state better oversight of the traffic control devices. Using separate bid items may mean additional administrative effort and expense; however, states using this concept have found that it is more effective than the lump-sum bid item approach.

The contract should require that materials be provided on site. When we are talking about an accelerated project, material availability and management are critical. To minimize delays, contracts should require that contractors have the materials on site and available. The Pennsylvania Department of Transportation, for example, is doing a good job of this on the Schuylkill project. Another important element of good contract administration is fast decision making. Because reconstruction projects are often on accelerated schedules, decisions for the contractor, the state, and the public must be made as quickly as possible. States and contractors need to streamline and expedite decision making in whatever way they can. This effort may involve the delegation of authority to the lowest level possible. Project engineers should have as much authority as possible to make on-the-spot decisions about the project work plans. Such streamlined decision making will benefit the public by enabling the project to proceed with minimal delay.

The sixth and final area is the need to coordinate all aspects of the reconstruction plan—public relations, design, traffic management, and contract administration. Coordination should take place not only within the state, but with local leaders, business and civic groups, the media, the transit agency, and the ridesharing agency. An effective way to coordinate this effort is to establish a corridor management team that meets frequently from the earliest design phases through reconstruction. This team can be the focus of planning and decision making on all aspects of the project. Experience in Boston, Chicago, Minneapolis, and Pittsburgh has shown that the management team approach is an effective device for getting things done.

In summary, the theme of this discussion is ways of maintaining mobility and safety while undertaking major reconstruction projects. The six areas highlighted—corridor analysis, traffic management, safety, public information, contract administration, and coordination—all affect how well we can do this. We must understand the trade-offs that exist in trying to balance the need to facilitate travel by the public with economic, engineering, and design concerns. This conference is enabling us to take a significant step toward establishing a comprehensive view of major highway reconstruction projects.

Before closing, I want to call your attention to the FHWA case studies report, *Corridor Traffic Management for Major Highway Reconstruction,* that was prepared for this conference. This report includes summaries of a variety of reconstruction projects, a reprint from the *Federal Register* on the use of incentive/disincentive provisions, a summary of ways to expedite expressway and bridge rehabilitation, and a statement on applying traffic management actions. In addition, the report contains abstracts and summaries of current literature. It is available from FHWA, U.S. Department of Transportation.

An Analysis of the Use of Incentive/Disincentive Contracting Provisions for Early Project Completion[1]

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Across the United States, transportation agencies have embarked on a major effort to upgrade the nation's overburdened and aging urban freeways, sometimes simultaneously adding public transportation facilities such as high-occupancy-vehicle (HOV) lanes. In most cases, the construction work involved in both must be carried on while the existing facility continues to carry heavy traffic volumes.

No matter how carefully planned and executed, such construction work delays and frustrates the very public the projects are intended to serve. There is a clear national consensus that these projects should be built as fast as possible to cut the length of time the traveling public must endure the inconveniences of construction work. Moreover, the sooner such projects are done, the sooner the public will benefit from them.

One of the ways used to get construction contractors to work faster is to offer them a financial incentive to do so—and also assess them a financial penalty if they do not meet schedules. Contract language covering such matters is called an incentive/disincentive (I/D) provision or clause.

In Houston, Texas, the Metropolitan Transit Authority of Harris County (METRO), in cooperation with the Texas State Department of Highways and Public Transportation (SDHPT), used I/D provisions to expedite a joint project to construct a transitway in an existing freeway median while the freeway was being rehabilitated. This project, the first of its kind for both agencies, was successfully completed ahead of schedule, but not without some difficulty for both contractor and agency personnel.

At METRO's request, the Texas Transportation Institute (TTI) examined both the benefits and difficulties resulting from the effort to speed up the pace of this (and other) projects. The institute also reviewed current practice with I/D provisions elsewhere to help identify ways to speed up future construction projects while minimizing the adverse effects of the additional effort needed to do so.

The findings of the TTI study are presented here in condensed form. Experience with incentive/disincentive contracts is still limited. Few reports about completed

[1] This paper and the following outline by David S. Gendell formed the basis of the panel discussion on construction and contract issues.

I/D projects have been published. Accordingly, quantitative data are insufficient to support rigorous statistical analyses upon which to base firm conclusions. Fortunately, however, many of the people directly involved with I/D projects across the nation were willing to relate their recent experience in interviews.

PROJECT BACKGROUND

In the early 1980s, METRO and SDHPT agreed to replace a successful experimental 9.6-mile HOV contraflow lane on Interstate 45 (I-45) immediately north of downtown Houston with a permanent transitway called an authorized vehicle lane (AVL) in the median of the freeway. Both agencies wanted the contraflow operation to cease as soon as possible. To do so, a strategy was devised in which the overall work required (in excess of $50 million) was divided into a series of contracts, one of which would provide a narrow interim AVL at the earliest date possible. This $8.2 million contract, called Phase 1B, included both AVL and remedial freeway work, and it employed I/D provisions to encourage the contractor to expedite the AVL portion.

The Phase 1B contract required prospective contractors to bid both time and money, a process often called (A + B) bidding. Contractors had to specify the number of days it would take to open the interim AVL to traffic. The successful bidder was the one whose construction cost plus the number of days bid multiplied by $5,000 was the lowest. (The $5,000 figure was derived from an estimate of administrative and construction engineering and inspection costs as well as the cost of operating the contraflow lane.) However, this amount was for low-bid determination only; the contractor was paid solely for work done.

To stimulate an even faster opening of the interim AVL, the contract provided an incentive of $5,000 for each day the contractor could cut from the time he had bid, up to a maximum of 90 days (making the maximum incentive payment possible $450,000). The contract provided an identical disincentive for failure to make the time bid. In this case the contractor bid 360 days for opening the AVL. He actually did so in 269 days, thereby earning the full $450,000 incentive. The overall work in the $8.2 million Phase 1B contract was finished in 470 days instead of the 540 days allowed by the contract. The project began in December 1983, the interim AVL was opened on September 14, 1984, and the Phase 1B contract was completed on April 13, 1985.

In January 1985 METRO awarded the next contract in the series (Phase 2), a $43.4 million project to provide the permanent AVL (as well as freeway reconstruction). The techniques employed were similar. The successful contractor selected 750 calendar days' working time (as opposed to the minimum time bid of 720 days allowed in the invitation to bid). The incentive was $6,000 per day up to a maximum of 170 days ($1,020,000). The disincentive (and the value used for time cost in bid determination) was $12,000 per day. By May 1986 Phase 2 was slightly more than 60 percent complete and the contractor was on a schedule that roughly extrapolated optimistically to a 720–750 day completion time.

On both the Phase 1B and Phase 2 contracts, METRO was the contracting and financing agency (with UMTA funding assistance), and SDHPT performed project engineering and inspection. On a subsequent contract to extend the AVL about five miles farther north, the SDHPT handled all functions (with FHWA funding assistance). This project (called Phase 3) did not utilize incentive provisions.

GENERAL FINDINGS

From extensive interviews with individuals experienced in I/D projects and from a careful review of the completed Phase 1B contract and the ongoing Phase 2 contract, it has been possible to arrive at some general answers to questions that have been raised about contracts with I/D provisions.

How much sooner can an I/D project be constructed compared with a project contracted in the usual way?

Experience to date indicates that I/D projects can be completed in approximately half the time, often saving a year or more.

How much more does it cost to do so?

It is generally conceded that it costs the contractor from 10 percent to 20 percent more, most of which is passed on to the contracting agency. In addition, the agency may have to bear the cost of the early-completion incentive, which usually is about 5 percent of the contract amount.

How extensively have contracts with I/D provisions been used and with what success?

To date, at least 58 contracts with I/D provisions have been awarded in 30 states. So far, it appears that about 95 percent of the contracts that have been completed have finished on time or sooner. In Texas, in addition to the two METRO-SDHPT projects on I-45, the SDHPT has recently awarded three more contracts with I/D provisions: a $39.8 million contract on the Dallas North Central Expressway (US-75) with a $10,000/day incentive; a $46.8 million contract on West Beltway 8 in Houston, also with a $10,000/day incentive; and a $6.3 million contract in Houston on Spur 548 with a $3,000/day incentive. All three of these projects began in 1986. It is too early to determine whether the I/D provisions have speeded progress.

Shouldn't I/D provisions be used more often if they work so well?

I/D contracts are an effective, nationally accepted means of completing projects early. However, those with experience strongly recommend that I/D contracts not be used routinely; their use should be limited to those projects whose construction would severely disrupt traffic or transit service, significantly increase roadway user costs, create safety problems, or substantially affect adjacent business, or whose early completion would provide a major improvement in transportation.

Are there ways to get contractors to speed up their work rates without paying them an incentive?

Yes—but probably not to the degree that an I/D contract can attain. Nevertheless, some techniques have been used successfully:

- Louisiana standard specifications contain a provision for disqualifying a contractor from bidding or subcontracting other projects when he is substantially behind schedule on a contract.
- Texas has a special provision that has been used successfully on five out of six contracts. It provides that succeedingly larger amounts (30 to 50 percent) of the monthly payment due the contractor for work done be withheld should he fall behind a schedule approved by critical path method (CPM) analysis.
- California specifies in the plans when the contract working time or an extensive traffic control plan or both will require the contractor to work two shifts.
- High liquidated damages have been used by several states where the basis of the liquidated damage value has included costs other than those incurred

by the agency for construction engineering and inspection during the period of contract time overrun. This practice may not stand up in court or receive federal approval and its use is not recommended.

IMPACTS OF PROJECT ACCELERATION AND OTHER FINDINGS

Project Acceleration Impacts

- The cost of accelerating the Phase 1B contract was offset by the benefits derived:
  —Cost of acceleration: $450,000[1]
  —Benefits of acceleration[2]: $5.1 million to $26.8 million
- The 24-hr/day, 7-day/week work schedule used on the project resulted in extremely severe working conditions for an understaffed SDHPT inspection work force. More personnel and less overtime were needed.
- The contractor and his personnel also experienced adverse effects attributed to the intense effort to accelerate the work rate, as follows:

Project	Size of Work Force	Workers Hired	Turnover Rate (%)	Avg Wage Rate ($)	Work-Related Accidents	Relative Insurance Rate
Phase 1B	100	700	600	15.42	411	1.3
Conventional[3]	100	200	100	10.00	50	1.0

- Correspondence and paperwork increased an estimated two to three times normal levels because the contractor documented every occurrence that might allow a claim for time if he failed to earn the incentive he had planned for.
- Administratively, SDHPT had an organization in place; METRO had to establish one. Although the METRO administrative group performed well, it would have benefited from the addition of two people to handle the work load generated by the contractor's round-the-clock schedule.
- Keeping the contraflow lane and the interim AVL in operation through the construction work zone cost the contractor an estimated $75,000 to $100,000 per year.
- During construction, contraflow use fell an estimated 15 to 20 percent, which was attributable at least in part to poor contraflow operating conditions that resulted from the accelerated construction work. Use rebounded after the AVL opened; however, vanpools are now declining, probably from the employment drop in downtown Houston caused by declining oil prices.
- From 1983 to 1985, average annual 24-hr traffic volumes on I-45 at the midpoint of the Phase 1B project increased from 177,000 to 197,000 vehicles per day, indicating that the reasons for accelerating the transitway construction were even stronger than originally believed.
- Analysis of bidding for Phase 1B and Phase 2 contracts is inconclusive. The Phase 1B contractor's bid was 7.8 percent below the engineer's estimate; the Phase 2 contractor's bid was 9.2 percent above the engineer's estimate. But both contractors underbid their nearest competitor by $2.064 million (20.1 percent) and $5.689 million (11.7 percent), respectively.

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[1] Incentive only; construction cost bid was less than engineer's estimate.
[2] For only the reduction in user-delay costs resulting from construction, depending on assumptions made for time saved and user cost values.
[3] Estimated average.

- On neither Phase 1B nor Phase 2 did bidding of contract time (A + B bidding) influence the outcome.
- When the Phase 2 contract was 60 percent complete, it appeared unlikely that the contractor would be able to earn much of the incentive available.

Other Findings

- Federal and Texas officials support the use of I/D provisions when such provisions are warranted.
- I/D provisions should not be used on projects that have key elements sensitive to weather, or where significant adjustments to pay quantities might be anticipated.
- The efficacy of requiring bids for both cost and time (A + B bidding) is still in question and is considered experimental by federal officials. Those interviewed knew of only one case where (A + B) bidding was the factor that decided the successful bidder.
- If a project warrants acceleration, contract time should be measured in calendar days instead of working days.
- For I/D projects, completion times must be realistic. They should be established by methods such as CPM analysis performed by those experienced in both the analysis techniques and construction practices.
- On I/D projects, close coordination among the contractor, METRO-SDHPT, and federal agencies is critical. Decisionmaking and approval authority (for field changes, shop drawings, etc.) must be available whenever the contractor works. At night and on weekends, all involved offices should have designated contact persons.
- For I/D projects, small interagency task forces for both preconstruction and construction phases have been helpful in expediting projects. Before construction, the group advises project design staff, reviews the projects accelerated and I/D provisions, and helps set up future interagency procedures to ensure timely contract decisions, field change approval, shop drawing review, and so on. During construction, the task force meets frequently and regularly with the contractor to (a) expedite the procedures mentioned above, (b) reduce the amount of paperwork that naturally accompanies accelerated contracts with I/D provisions, and (c) find ways to avoid conflicts and delays rather than dealing with them after they occur.
- A contractor's past and current performance record should be taken into account by either prequalification or disqualification provisions.
- Nationally, daily I/D rates have varied from \$3,000/day to \$30,000/day for recent projects of roughly the same order of magnitude. In many cases with the lower values, user delay costs have been reduced by administrative decision (or not used at all) apparently to forestall possible criticism of, or challenges to, the assumptions used.
- User delay costs resulting from construction are acceptable to federal officials as one of the factors in computing the daily I/D values.
- On I/D projects, the contractor must deploy many crews simultaneously, requiring more subcontracting than usual. Federal regulations permit 70 percent of the work to be subcontracted; most other agencies do likewise for I/D contracts.

RECOMMENDATIONS

Deciding which projects should be contracted with I/D provisions should be done well before plans are complete to provide time to ensure that project design, specifications, schedules, and so on, are compatible with the contractual approach selected.

Most guidelines for selection of projects for I/D provisions suggest that the project have the following characteristics:

1. High delay costs to road users that can be attributed to delay resulting from construction activity.
2. High traffic volumes generally found in urban areas.
3. Involvement with major reconstruction of an existing freeway.
4. Benefits, in terms of cost savings and/or safety, that outweigh the cost of incentive payments and additional construction cost.

But nearly all of the METRO/SDHPT planned transitways have these characteristics—and the same guidelines state that I/D provisions should be limited to only the most critical projects. To differentiate between the many projects that need to have their construction schedule accelerated and the few that should use I/D provisions to do so, the following procedure is suggested.

Classify Projects

Three categories are used:

1. Conventional—does not have the characteristics noted above. The normal contracting method is used.
2. Accelerated—has above characteristics; merits accelerated construction pace over conventional contracting. (Most of the transitways fall in this category.)
3. Incentive (I/D)—a special case of the accelerated category. These projects would have one or more of the following additional characteristics:
   - Some useful part of the contract can be done well before the rest of the work and is of significant benefit to the public (e.g., early use of an AVL or freeway main lane).
   - Is a prerequisite to the use of some other project (e.g., to fill a gap or remove a serious bottleneck).
   - Is needed by a specific date to provide service to some other traffic generator (e.g., a new school).
   - Is located on a freeway with a traffic density above 15,000 vehicles per day per lane of average weekday traffic within the project limits.
   - Involves the prolonged closure of one or more freeway lanes.

Compute Contract Time

For accelerated projects, computation of contract time is a very important factor. For I/D projects, it is critical. Those who compute contract time must choose assumptions that are appropriate to the urgency of the project but that will not result in a schedule so tight that few, if any, contractors would bid on the project. The following approach to estimating contract time is suggested:

- For accelerated and I/D projects, measure contract time on a calendar-day basis, but preclude work on Sundays and national holidays except for emergencies.
- The number of days allowed the contractor to do the work should come from a careful CPM network analysis performed by individuals experienced in both the

CPM and construction. The level of contractor work effort to be used in making the CPM analysis for each category is suggested below:

Project Classification	*Working Period (hr/work week)*
Conventional	One shift: 40–60
Accelerated	Two shifts: 96
Incentive (I/D)	Two shifts: 120

Accelerated Projects Without I/D Provisions

For accelerated projects without I/D provisions, plans and specifications should clearly specify that the contractor is expected to exert extra effort and should also include ways to encourage him to do so. Such ways could include

- A note that more than one shift will be necessary to meet the schedule (usually with Traffic Control Plan notes).
- A provision that disqualifies the contractor from bidding on other projects if he falls substantially behind schedule.
- A provision to withhold part of the monthly payment due the contractor if he falls behind schedule.
- A carefully calculated value for liquidated damages, utilizing the most recent salary and other costs involved in construction engineering and inspection and based on the staff necessary to oversee for the number of hours per week that would have to be worked to meet the project deadline.

I/D Projects

1. The duration of the incentive period should be no longer than the difference in time between that computed for an accelerated project and that computed for an I/D project.
2. The maximum incentive payment to the contractor should be established. This amount should be approximately 5 percent of project cost.
3. The daily I/D rate should be computed by dividing the amount arrived at in the previous step by the number of days calculated in step 1. To determine whether the daily rate so computed is justifiable, daily costs associated with user delay from construction, construction engineering, and so on, should be computed by using such tools as SDHPT's computer model HEEM-II or *A Manual on User Benefit Analysis of Highway and Bus Transit Improvements* (AASHTO, 1977). In the event that such analyses do not justify the daily rate computed, it (and the maximum incentive) should be scaled down accordingly. However, any project where these values are less than 60 percent of the computed daily rate probably should not use I/D provisions. For I/D projects, the liquidated damage value should be stated separately.
4. As noted earlier, the effectiveness of requiring the contractor to specify contract time by bidding (A + B bidding) is still under debate. Its use is not recommended. If it is to be used, it is recommended that the full value of user delay costs associated with construction be employed to compute time cost; in no case should this be less than the daily I/D rate.
5. The preconstruction task force mentioned in preceding sections should review the I/D values before final adoption to make sure they accord with project and economic conditions.

6. Before the bidding, adequate agency staff should be ensured for a full contractor work week, which can be as long as 120 hours. If agency personnel levels are not sufficient, outside firms should be retained to assist in the effort.
7. Before construction, night and weekend contact persons should be specified in writing.
8. As a follow-up to the preconstruction task force, a small construction task force should be established to meet regularly with the contractor in the manner discussed in preceding sections.

Construction and Contract Issues[1]

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1. *Cost-effectiveness of accelerated contracting procedures to traffic management (includes the use of incentive/disincentive clauses)*
   - By minimizing the period of traffic disruption due to construction, specific road user costs can be reduced:
     —Accident costs
     —Delay costs
     —Operating costs
     —Traffic control costs
   - Accident costs are reduced by minimizing the time traffic is exposed to hazards present in the work zones.
   - Delay costs reflect the value of time lost while one is traveling through a work zone. Although establishing a dollar value for time is highly controversial, everyone agrees that long delays in work zones consume valuable time.
   - Reduction in construction time also minimizes operating costs associated with speed-change cycles and delays.
   - Since rentals of traffic control devices are generally on a daily basis, overall traffic control costs for a given project can be reduced with shorter project durations. Similarly, the state can reduce construction engineering costs, and the contractor can often reduce insurance, equipment, and overhead costs.
   - Accelerating projects is a cost-effective approach when the benefits of the approach (reduced road user costs) exceed the costs of implementation. However, the road user costs depend on many factors, such as the amount of traffic affected, the reduction in project duration, and the nature of the construction. In addition, many intangible benefits and costs are associated with the approach. Therefore, no clear-cut formula exists to determine when the approach should be used.

     In general, the approach is recommended for projects in which the following conditions occur:
     —Significant road user costs can be saved

[1] This outline and the preceding paper by Dennis L. Christiansen formed the basis of the panel discussion on construction and contract issues.

—Continuously high traffic volumes cannot be easily diverted
—Project construction time can be substantially reduced
—Work is well-defined (since unanticipated work creates contractual difficulties)
—Adequate funds are available to cover the contractor's added costs

2. *Negotiating or establishing amounts of incentives or disincentives (I/D)*
   - The amount of incentive and disincentive must be of significant benefit to the contractor to encourage interest, stimulate innovative ideas, and maintain profitability while meeting tight schedules.
   - The maximum amount of I/D payment should be based on the anticipated users' savings. References that may be used to estimate these costs include:
     —*A Manual on User Benefit Analysis of Highway and Bus Transit Improvements*, 1977, AASHTO, Washington, D.C.
     —*Traffic Control for Streets and Highway Construction and Maintenance Operations*, FHWA, 1978 (This publication is currently being updated and its replacement is entitled *Design and Operation of Work Zone Traffic Controls*.)
     —*Planning and Scheduling Work Zone Traffic Control*, Report FHWA IP-81-6, FHWA, October 1981.
   - Certain road user costs should not be used in the calculations, such as insurance, parking costs, tolls, and certain taxes.
   - Maximum I/D that has been used recently was $30,000 for a major urban freeway project.
   - Total amount of the payment normally should not exceed five percent of the total project costs.
   - A large incentive payment may be questioned by the public and news media. Therefore, we should be in a position to show that a savings has been made to the public.
3. *Application of new materials or techniques to speed construction*
   - High early-strength concrete, such as the material used for the "fast-track" concrete paving operations
   - Special and/or high production equipment, such as the use of specialized demolition machinery to rapidly remove deteriorated bridge decks
   - Redesigning the highway or bridge to expedite construction, such as the use of precast, prestressed concrete deck forms that become part of the deck
   - Critical Path Method and other management tools to assure maximizing manpower and resources
   - Precast concrete bridge deck panel used on the Woodrow Wilson Bridge project
   - Use of full-width steel grates to serve as temporary bridge deck sections during construction
   - Slipforming concrete barriers
4. *Benefits/Disadvantages of speeding up construction*
   - Benefits
     —Less time to complete project
     —Avoidance of traffic congestion, motorist delay, and driver inconvenience
     —Reduced road users' cost (accident, delay, operating, and traffic control costs)
     —Better public relations
     —Reduced inflation costs
     —Allows contractor to bid on more projects, thereby stimulating competitive bidding
   - Disadvantages
     —Higher contractual costs due to increasing the number of crews, personnel

recruitment problems, higher pay differentials, material acquisition, additional and/or special equipment, etc.
—May reduce construction quality due to lower work force morale, thereby requiring higher inspection demands and other related construction engineering costs
—Requires more preparatory work by the state
—Contractor claims or requests for price/time adjustments may be more likely when unanticipated work delays completion time.
—Environmental considerations (such as nighttime operations creating noise and lighting problems to nearby residents)

5. *Contractual responsibilities: What needs to be in the contract for better traffic management*
   - Engineering time spent during project development pays dividends during construction. A field change to correct mistakes in plans can cost time and money.
   - Plans and specifications must be complete and accurate to provide a clear understanding of what is to be constructed. Any error may result in a claim.
   - Plans and specifications should indicate any unusual condition or restriction affecting the contractor's operations.
   - Local officials, police, local traffic engineers, construction engineers, and other appropriate parties should be involved in the project development.
   - Predesign survey is essential since as-built plans or old construction plans are often unreliable.
   - Contract time needs to be carefully determined:
     —Recommend the use of the Critical Path Method (this approach also is useful in settling claims, determining time adjustments, and evaluating the progress of work)
     —Contract time should be on a calendar day basis or using a specified completion date (working day basis has been found to be less effective and puts pressure on the project engineer in determining the number of working days)
     —Project or major phase of the project should be completed in one construction season if feasible
   - Effect of field changes and how field changes will be evaluated for time adjustments must be clearly spelled out in the project documents. Contract time adjustments should be limited to only major work items affecting completion and should be so identified in the contract.
   - A specific definition of what constitutes the completion of the project to avoid potential legal hassles
   - A clear and comprehensive traffic control plan. This plan should include measures to provide for adequate worker safety. Traffic conditions can be potentially hazardous to workers under an accelerated project.
   - Unit bid items for traffic control devices result in more control over the devices by the state.
   - Use of an effective traffic control strategy to minimize construction time, e.g., total roadway closure, and two-way, two-lane operations on normally divided highways

6. *Enforcement of contract*
   - State is under pressure to maintain adequate quality control under accelerated conditions.
   - Project needs to be adequately staffed by qualified people who are adequately compensated and available whenever the contractor is working.

7. *Legal considerations*
   - Contractor claims may occur when a delay occurs and affects the specified completion date; therefore, the state should take steps necessary to avoid or minimize such delays:
     —Well-defined, accurate plans and specifications
     —Early preparation work such as railroad and utility adjustments completed in advance or clearly defined and coordinated
     —Use of the Critical Path Method to minimize contract time
     —Have experienced, qualified project personnel with approval authority when the contractor is working
   - Project personnel should provide adequate project documentation
   - Important to conform to MUTCD and other traffic control standards in the event of lawsuits

8. *Contractor/Agency relationship*
   - Coordination among the contractor, state, and the FHWA is essential. Delays in the approval of a field change or working drawings can cost time.
   - Approval authority must be known by all and be available throughout the project life in order to minimize delays in the approval of a field change.
   - Need to hold regular progress meetings
   - Clearly established lines of communication and ensuring that all appropriate parties have involvement in reviewing plans, shop drawings, etc.

9. *Innovations*
   - Award a project to a low bidder based on the dollar amount for all work and the amount of time the contractor will use on the project. The low bid would consist of the dollar amount plus the product of the "bid time" and the road user cost per day.
   - Establish a special task force responsible for managing, organizing, and coordinating efforts throughout the life of the project. This task force should be given sufficient authority to cut through red tape.
   - Conduct constructability reviews to assure that the plans and specifications are reasonable, e.g., minimize discrepancies between construction operations and traffic control requirements.
   - Provide contingency plans covering possible situations, such as long construction delays, delays caused by third parties (e.g., utility and railroad companies), and inclement weather.
   - Assure that strategic materials and equipment are available throughout the life of the project:
     —Let projects in fall or early spring to give contractors time to mobilize and order materials
     —The state should consider buying strategic materials before bid opening for projects with tight schedules.
     —Require stockpiling of materials that may be needed
     —Provide for backup equipment, particularly for critical operations
   - Establish a public relations staff to provide press releases, commuter guide publications, hot-line phone numbers, meetings with citizen groups, etc., and information to travelers on construction operations and their effect on traffic conditions.
   - Subcontractors can be assigned sole responsibility for maintaining the traffic control devices and reporting directly to the state.
   - Some contractors have distributed incentive payments to their employees.

We can do a good job on these difficult projects. It will take proper engineering, attention to detail, a close working relationship among everyone, and, most important, a commitment to quality.

Think of it as a challenge. It will not be easy, but we have to consider the public and their travel and safety needs, because ultimately, all of us in the highway field are working for them.

PART 4
Case Studies

Syracuse, Interstate 81

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The upstate New York city of Syracuse, with a population of approximately 150,000, is the business hub of surrounding Onondaga County (population 500,000). Interstate 81 is a major through Interstate that runs north–south through the city, just to the east of the central business district.

By the 1970s, I-81, planned 30 years before, had reached its capacity as a four-lane Interstate carrying annual average daily traffic of approximately 70,000. In the late 1970s, reconstruction work started on some 10 miles to add two more traffic lanes and replace and modernize three major urban interchanges. By 1984 construction under way in the corridor had cost well over $100 million. Traffic was maintained on two lanes in each direction most of the time and always on at least one lane in each direction. Nevertheless, significant delays occurred throughout the construction season. To complicate the situation further, some 2.8 miles of the narrow three-lane viaduct and adjacent structures carrying southbound traffic through the I-81 interchange with I-690, including on- and off-ramps for the downtown business area, were slated for major bridge deck rehabilitation and some substructure repair. The length and narrowness of the structures required complete closure to traffic for most of the work.

The project was designed to maintain and protect traffic measures that had been standard up until that time. These included detour signing, some flagmen, and signed detours on local streets. The shutdown was scheduled for mid-July 1984.

In May 1984 regional planners became aware of new federal policies that allowed the use of portions of Interstate project funding for special traffic system management efforts where the construction had severe effects upon the local urban community. With that knowledge, a crash program was immediately instituted to mitigate the closing impacts in cooperation with Federal Highway Administration, city and county government, the Metropolitan Planning Organization (MPO), police departments, the Central New York Regional Transit Authority, Syracuse and Oswego Motor Lines, and owners of private parking lots in the area.

The acronym used for the program was TOTE for Total Transportation Effort. Under this cooperative program, the following actions were complete by the mid-July closing:

1. Upgraded traffic signals on 30 city street intersections;

2. Arranged for city police and county sheriffs to direct the flow and traffic at critical locations;
3. Placed 500 special traffic, information, and detour signs;
4. Arranged for five park-and-ride lot locations;
5. Coordinated six express bus runs from each lot at 15-minute intervals during rush hours;
6. Established high-occupancy-vehicle (HOV) lanes for buses, carpools, and emergency vehicles;
7. Improved the MPO's carpooling program to handle the extra load;
8. Printed and distributed 70,000 brochures describing the program;
9. Arranged for 29 newspaper ads in six papers and radio spots on five stations; and
10. Had one major press conference, visited with the Syracuse papers' editorial boards, and made numerous special radio and TV appearances.

One item not described in the brochure was the HOV lane. After planners considered its use on the expressway itself, along with the possibility of closing one or more major interchanges to all but HOV vehicles, those plans were rejected because they disrupted through traffic and congested local streets as much as the closure itself. Instead, they established an HOV lane on an alternative route that allowed faster travel into downtown for buses and vehicles containing three or more persons.

In effect, I-81 was closed from mid-July to late November, and the transportation system management (TSM) cost, which stayed close to budget, was $357,990. The cost summaries are shown in Table 1. The goal set during program development was to reduce the amount of traffic on mainline I-81 during the morning peak by at least 10 percent and, in fact, that goal was exceeded, with a total traffic reduction of 17 percent.

Public communication through the media, paid advertisements, and the brochure produced the major impact on traffic reduction. The free media built up an end-of-the-world scenario for the first day of closure that had the beneficial effect of causing commuters to spread out the morning peak time so that traffic congestion that first week was lighter than it had been before closure. However, it slowly drifted back into the tighter peak period as summer ended, drivers became aware of less-than-anticipated delays, and the school year began. The first week's free bus service showed a corresponding decline and did not significantly pick up even after a second week of free service was added at the start of the school year.

TABLE 1 Cost Summaries

Strategy	Total Cost ($)	Unit Cost ($)
CBD signal improvements	14,121	0.08/car/day
Police deployment	73,000	0.42/car/day
N. Salina signal improvements	11,825	0.51/car/day[a]
HOV lane	100,800	1.38/car/day
Express bus park 'n ride	74,092[b]	
Centro	38,858	4.48/round trip
S & O	35,235	6.86/round trip
Carpool service	6,074	15.00/respondent[c]
Media	78,078	N/A
Total	$357,990	

[a] Interconnection of signals saved $5,546 because of increased speeds over existing condition during four-month period.
[b] Net cost.
[c] Does not account for persons forming their own carpools as a result of media advertising and those people responding after conclusion of TOTE program who were informed of carpooling via TOTE advertising.

Use of paid radio advertising was effective, especially with the two local stations that used traffic reporters flying over the area during the morning and evening rush hours. In addition to the commercials scheduled during those flight periods, the stations drew public attention to the closure and alternative transport. Police deployment, except at a few critical intersections, had marginal effects and as the season progressed, efforts were made to reduce the deployment accordingly.

Planners hoped that some of the TSM efforts would have positive long-range effects, including a continued spread of the rush hour peaks, more use of transit, and carpooling. The most substantial lasting benefit was the improvement in traffic signals on local heavily trafficked streets, which will continue to serve the public for the foreseeable future. Long-term transit use was disappointing, as it not only tapered down during the closure period, but had little residual effect. Similarly, the park-and-ride lots, most of which were left signed and in use, now serve only a very limited number of commuters.

Public awareness of the project and use of the alternatives presented were major successes, which led to very favorable acceptance of the project, why it was needed, and the necessity of reducing traffic service during construction.

Retrospectively, considering cost-effectiveness, the most effective strategies were:

1. Open and frank discussion with the media before closure, aided by paid commercial media advertisements;
2. Traffic signal improvements on local streets;
3. Additional transit service in conjunction with outlying park-and-ride lots;
4. Some of the police deployment;
5. Use of the HOV lane; and
6. Expanded carpooling service.

Philadelphia, Schuylkill Expressway

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Designed as one of a network of expressways ringing the metropolitan Philadelphia area, Interstate 76,—or the Schuylkill Expressway, as it is more commonly known— was fully opened to traffic in 1961, 10 years after construction began. In the ensuing 25 years, I-76 came to stand virtually alone, as community opposition halted construction of almost all of the remaining proposed highways.

For most of its 21-mile length from the Pennsylvania Turnpike in Montgomery County to the Walt Whitman Bridge in Philadelphia, I-76 is a four-lane, limited access highway, with some short stretches of six or eight lanes. The highway carries between 80,000 to 143,000 vehicles daily. Much of the highway passes through difficult terrain composed of steep rock cuts, high embankments, and wide, deep gullies. These restrictions, along with other constraints imposed by an adjacent railroad, parkland, and residential properties, are responsible for the variation in width and lack of progress by the Pennsylvania Department of Transportation to widen the highway to provide additional expressway capacity.

In about the mid 1970s, it became obvious that both the expressway pavement and the bridges in the 17.7-mile section between the Turnpike and University Avenue in Philadelphia were rapidly deteriorating, making any further interim remedial action ineffective. Of the 50 bridges within these limits, 38 required redecking, including the 1500-foot Pencoyd Viaduct, which crosses a Conrail freight line and the Schuylkill River.

Because of the highway's importance and urgent need for rehabilitation, Secretary of Transportation Larson committed the department to reconstructing the expressway as quickly as possible with the least amount of disruption to motorists.

KEEPING TRAFFIC MOVING

Planning complex traffic strategies for major rehabilitation projects is not a new role for PennDOT. Responsibility for 44,000 miles of roadway and more than 25,000 bridges has provided ample opportunity to use construction and traffic management techniques over the last 12 years.

The challenge of the Schuylkill Expressway project was to provide sufficient off-expressway capacity on the local road system to handle the traffic expected to divert when construction started, as well as to maintain an acceptable level of on-expressway movement while the work was underway.

The department realized that the projected work would disrupt not only the more than half a million daily users of the expressway, but also the communities adjacent to I-76 and the local transportation system. The local system faced a two-fold dilemma: it would need to find additional capacity on trains and buses to carry the expected increase in passengers, and it would have to revise its schedules to reflect delays of those buses that used both the expressway and the local street system.

A project liaison engineer was named to coordinate the various aspects of the improvement project, from planning and design to trouble shooting during construction. The department also contracted with the traffic engineering firm of Orth-Rodgers & Associates, Inc. of Philadelphia, to plan the off-expressway strategies required to handle the diverted traffic. To gain insight into the problems likely to be experienced by the affected communities and get support from businesses, agencies, and other organizations and groups with an interest in the project, the project manager also put together a task force to help plan the traffic management for the necessary off-expressway improvements. The task force was composed of 14 municipal governments (including the city of Philadelphia), the local transit authority (SEPTA), the Delaware Valley Regional Planning Commission, the Keystone/Triple A Club, the Pennsylvania State Police, four local chambers of commerce, a paratransit association, and two traffic reporting services.

To begin the planning process, Orth-Rodgers set up a five-task work program that called for:

1. establishing and analyzing the existing transportation situation;
2. developing expressway reconstruction strategies;
3. evaluating the impact of the recommended reconstruction strategies on the region's transportation network;
4. developing and designing the traffic management plan;
5. monitoring the effectiveness of the traffic management plan.

ORIGIN AND DESTINATION SURVEY

Under the first task of the work program, planners made a detailed inspection of the expressway ramps and the mainline structure, and conducted an origin-and-destination (O & D) survey of peak period expressway users. They also studied travel time on 15 corridors running parallel to the expressway; automatic traffic recorder and manual-turning movement counts; intersection saturation flow; vehicle classification counts; on-street parking; intersection/corridor capacities; delays and level of service; and conducted a physical inventory of 250 traffic signals.

The O & D survey consisted of a pre-addressed, postage-paid postcard questionnaire. Respondents were asked six questions to determine their entrance and exit use, where they were coming from and going to, and the vehicle occupancy and type. The final question asked what the respondent would do, given certain choices, if expressway driving became too inconvenient during construction.

Of the 37,000 cards distributed, 14,000—or 38 percent—were returned, a response rate indicative of the keen public interest in the rehabilitation project. Among the survey findings were that the average vehicle occupancy was 1.45 persons, three out of four vehicles contained only a driver, and 17.5 percent had only one passenger.

Although 80 percent of the respondents indicated they would change their travel habits, 60.3 percent said they would change routes but continue to drive, 10.8 percent said they would use public transportation, and 2.2 percent said they would join a carpool.

The survey also indicated that the expressway trips were relatively short, averaging 5.5 miles. Also of particular interest was that only 18 percent of all users had a trip destination in center city Philadelphia, indicating that there were no concentrated travel patterns and that the resultant desire lines involved the entire region. These findings were especially important to developing the second task, the reconstruction strategies.

THE STRATEGIES

The construction staging and duration of the work were dictated by the 50 structures and the complexities of two of them: the Pencoyd Viaduct and the Vine Street Interchange, both of which required longer phasing.

The task force, using the survey results and the construction phasing requirements, decided on a three-year construction schedule that would involve a total of five sections. Most of the work would be done in the second construction season. They also defined three traffic-related goals to be followed as the strategies for the on-expressway portion of the traffic management plan were developed. They were:

- Maintain at least one lane of traffic in each direction at all times in the construction areas.
- Encourage trucks, tourists, and other long-distance travelers to remain on the expressway during construction.
- Reopen all lanes of traffic from approximately November through February. This third goal was later modified when planners determined that the redecking of the Pencoyd Viaduct could be done in one season if started several months earlier than the planned March 1 start date.

The probable key to achieving the desired 50 percent reduction of expressway traffic during the morning and afternoon peak periods was the decision to limit local drivers' access to the highway by closing certain ramps. Ramps were closed based on the following criteria:

1. On-ramps leading into a construction zone where only one lane was open;
2. Ramps with a bridge that needed rehabilitation;
3. Ramps blocked by a construction operation; and
4. Ramps that, if open, encouraged more than the optimum number of drivers to use the expressway.

The final decision was to close a total of 46 ramps, most of them on-ramps, over the three-year construction project. With this important decision made, the traffic consulting firm approached the third task, the problem of reassigning the traffic that would be diverted from the expressway onto the local street system.

MITIGATION MEASURES

The department's ability to make improvements on detour routes is the most recent development in the area of traffic control for construction projects. These mitigation measures can be used to: correct existing restraints on capacity; widen to increase capacity for the anticipated traffic movements; modify phasing, timing, and coordination of traffic signals; or improve public transportation facilities and service. In the case of the Schuylkill Expressway, all of these measures were used.

Because of the presence of the expressway, improvements had been negligible to many alternate routes, either because of other priorities or an insufficient benefit-cost ratio. As a result, the adjacent road system was not prepared to take on the added burden of diverted expressway traffic.

The task force was instructed to develop a list of potential improvements for the diversion routes and the public transportation system. This process was carried out during some 30 meetings of the task force members, with an evaluation of the proposals provided by Orth-Rodgers under task three of its five-point program.

The traffic management plan developed was based on the list and budgeted at $12 million. It contained the following general categories of improvements:

1. Traffic signals (coordination, timing or phasing changes, new or modernized signals and temporary signals);
2. Roadway construction (minor widening, turning lanes, on-street parking replacement);
3. Emergency restoration (immediate repairs to key diversion routes);
4. Transit (parking lot expansion, additional buses to maintain headways in increased traffic, additional rail cars to increase ridership, extension of rail service beyond the exiting terminus);
5. Ridesharing (increase regional ridesharing efforts in Schuylkill Expressway corridor);
6. Traffic control (assign traffic control officers to key intersection and school bus stops).

To carry out the improvements, two contracts totaling $1.3 million for roadway and signal work were let in 1984 in anticipation of the 1985 expressway construction. A combined roadway and signal project for $2.6 million was let in 1985 for off-expressway improvements required for the 1986-1987 expressway construction.

Except for the installation of 29 temporary signals, all of the improvements made under these three contracts were permanent.

In evaluating proposals of this type, it is important to favor acceptance of even marginal improvements to have a system flexible enough to adjust to traffic demand. This rationale is based on anticipated diversions and certain assumptions that may or may not prove valid.

Also of considerable benefit was the department's extensive file of existing traffic volumes on its nonprimary routes. This file provided the basis for the evaluations during construction to see if complaints were, in fact, the result of expressway diversions or if problems predated construction.

In addition to the contractual work, department maintenance workers performed emergency restoration consisting of mechanized patching on four corridors. This was done by accelerating the maintenance schedule for those roads tagged as possible diversion routes.

Transit improvements included parking lot expansions at three locations, an extension during peak travel hours of the Paoli local train service to Downingtown, and supplemental service for expressway bus routes. The result of the added train service was 1,300 more passenger trips per day on the Paoli to Downingtown extension. The supplemental bus service enabled SEPTA to provide service as frequently as before construction, despite delays of up to 35 minutes caused by the required detour routings. This minimized the impact of construction on some 6,000 bus users each weekday.

The Delaware Valley Regional Planning Commission contacted close to 1,000 companies as part of its corporate outreach program to promote vanpools and ridesharing during reconstruction. This effort was supplemented by speeches at business meetings, direct mail, public service announcements, news releases, and interviews.

Of the 5,016 commuter requests for matches in 1985, 3,206 were attributed to the expressway reconstruction, and more than half of those calls were received in the first four months of the year. Similar results were achieved in 1986. The increased workload was handled by adding telephone lines to the CAR POOL toll-free hot line and hiring one part-time employee during the first quarter of each of the two years.

Funds to pay for manual police control were allocated in the expressway construction project budget. Agreements were entered into with the various municipalities on hourly police compensatory rates when this service was required. Certain key intersections and school crossings were selected for police protection before the start of construction. Because the department could immediately place a police officer at specific locations when needed, it could quickly respond to problems until it could take other action, such as installing temporary traffic signals or changing the timing of a traffic light.

Three contracts totaling $13 million also were awarded in 1984 and 1985 to prepare the expressway to handle two-way traffic during reconstruction.

The first was a $2.5-million contract to improve the shoulder and concrete safety barrier along a six-mile section of the expressway. The contract also provided for correcting slope erosion and improving drainage.

During the 1985 construction season, while the eastbound lanes were being rebuilt, the upgraded shoulder and the westbound left lane handled the two-way directional traffic, with a safety lane in between.

The second contract was for $7.4 million and covered work on a five-mile area; in addition to the shoulder upgrading, it included building a concrete box culvert to replace an existing steel bridge over a railroad.

The final contract was for $3.2 million for a three-mile section of expressway and included improved lighting in the Philadelphia section of the City Avenue interchange.

While this preliminary construction work was going on, traffic on the expressway was maintained, except for certain exceptions made in the off-peak hours.

TRAFFIC MONITORING

Before start of the expressway project, the Orth-Rodgers consultant team took counts both on I-76 and on the alternate route system that provided the basis for determining where the traffic had gone. During construction, the team did a series of manual and automatic traffic counts as part of its on-going monitoring analysis of the on- and off-expressway traffic patterns.

The counts were taken in the peak commuting periods, 6 a.m. to 9 a.m. and 3 p.m. to 6 p.m., at key locations on the expressway and along the diversion routes. The team used speed and delay runs on the expressway to identify problem areas.

The consultants' quick identification of the problems, and an equally rapid review and decision process in the department's traffic unit, were important to the success of the traffic management plan. In the first several months of construction, adjustments for left-turn phasing, retiming of signals, and the addition or removal of a temporary signal were frequently made to improve traffic flow.

Surprisingly, auxiliary police were not needed as often or as extensively as anticipated for the off-expressway diversion routes. This was attributed largely to the wide dispersal of the traffic and the effectiveness of the revamped system of signals.

The department kept construction interference with the traffic movement on the expressway at a tolerable level by making the contractors responsible for warning motorists in advance of any added restrictions. The traffic unit approved the type of restriction and the times it could be in effect. Peak hour restrictions were kept to an absolute minimum and approved only under unusual circumstances.

To help the department control the on-expressway traffic disruptions required by the contractor, all contracts included a clause entitled, "Advance Notice of Traffic Restrictions." The clause stated:

> Notify the engineer at least four calendar days in advance of the start of any operation which will affect the flow of traffic and provide the engineer with details of the work to be done. After notification, the District Office will advise the public of these traffic restrictions and possible delays.

Motorists were then given sufficient warning through the various mechanisms set up under the public information program and could choose an alternative to avoid the added delay. As a result, unusually long and enduring backups rarely materialized.

Lastly, breakdowns and accidents on the expressway in the construction zone were handled by towing services that were hired by the general contractors for each zone. The service was provided free, 24 hours a day, seven days a week, for the duration of each contract. It helped immeasurably in maintaining the flow of traffic through the construction.

INFORMING THE PUBLIC

The data derived from the O & D survey were valuable not only in planning how to maintain traffic during construction, but proved very useful in putting together the public information program, which was the responsibility of the press office. Among the most significant findings in the survey was that 80 percent of the expressway users indicated they would change their travel habits during the construction. One of the public information goals was to give this group information that would help at least half of them make this change.

In the early planning stages of the project, it became apparent that hardly anyone but PennDOT wanted the reconstruction to take place at the time. Both business and government viewed the proposal with considerable misgiving, convinced the reconstruction would totally disrupt the only major east-west traffic movement between city and suburb and so play havoc with the area's economy.

The suggested alternatives ranged from the impractical—such as waiting to complete several new expressways still on the drawing board—to the impossible, which included the suggestion to build an expressway on top of the existing one.

To address these concerns, the press office, in putting together the public information program, also listed among its goals the need to allay fears that the reconstruction would shut down the city of Philadelphia, make it impossible to get anywhere, and frighten tourists away.

Using the O & D findings press officers divided the audiences into two major groups when putting together information that would help motorists either cope with the construction or avoid it. The first group included visitors, tourists and truckers; the second consisted of commuters and occasional local drivers.

Because of the lack of a good parallel route or another expressway, it was not practical to try to divert tourists, truckers, and other long-distance users from I-76, so they were encouraged to stay on the expressway. Conversely, commuters and occasional local drivers had numerous options, and they were encouraged to choose an alternative to I-76 during the reconstruction.

To accomplish this, the 1985 and 1986 public information program provided for:

1. A *Visitors' Guide* (Figure 1) for each of the first two construction seasons. The guide was directed at truckers, tourists and other long-distance travelers, and was designed to encourage them to stay on I-76.

2. A *Commuters' Guide* (Figure 1) for each of the first two construction seasons. A more comprehensive brochure, this guide described in detail ramp closures and detours, alternate routes, and other ways to ease commuting.

In 1987, when over 90 percent of the work will be completed, the two guides will be combined.

3. A special mailing list composed of tourist bureaus, travel agencies, trucking associations, convention centers, hotels, automobile clubs, chambers of commerce, corporations, service organizations, cultural and sports institutions, medical centers,

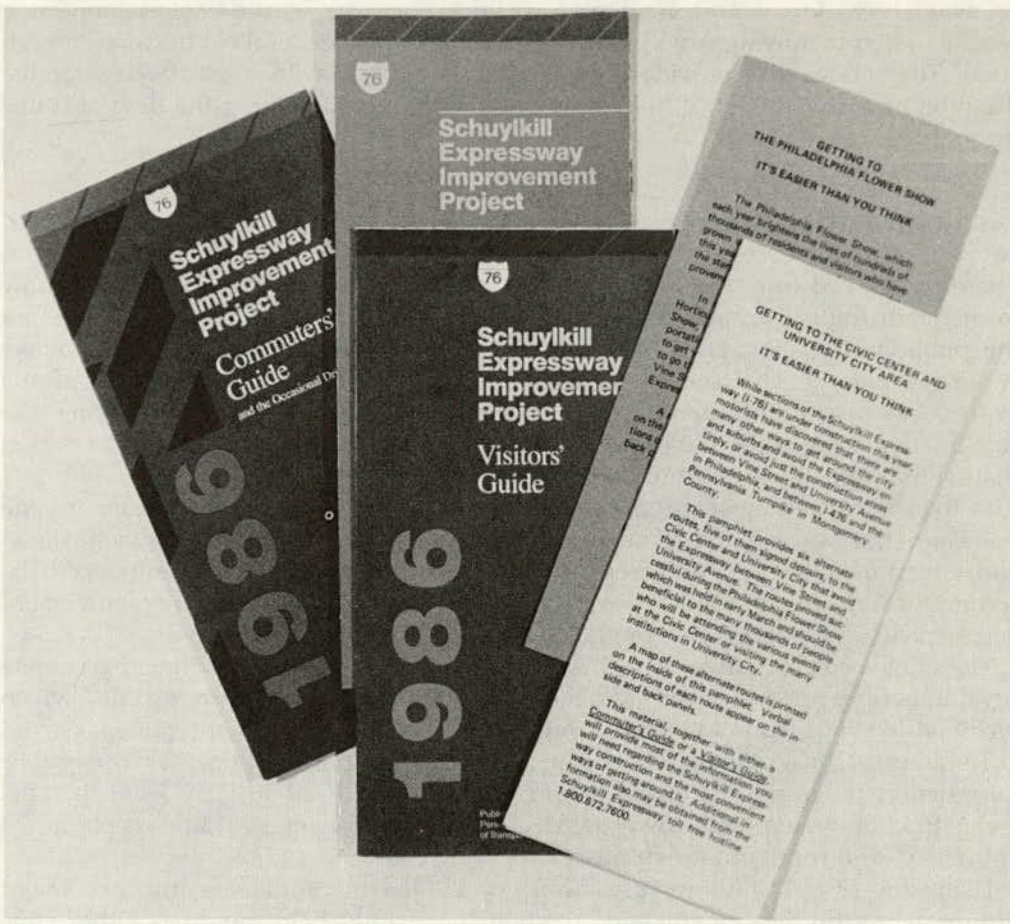

FIGURE 1 Brochures prepared by Public Information Program for Schuylkill Expressway Improvement Project.

and hospitals, colleges and universities, and government and elected officials. Those on the list received the brochures and other special mailings.

4. Stationery to give the project its own identification.

5. Three PSAs initially, and funds for two more if required. The first two PSAs were completed in time for the initial press conference on January 17, 1985.

6. A Toll Free Hotline set up at the department's district office in St. Davids (a suburb) for the press office to use to oversee the operation. Operators described alternate routings to callers, and also answered questions about the construction, took complaints for forwarding to the press office, and sent out information.

7. Other public relations tools, including press conferences, news releases, radio and television interviews, and special media events.

Planning the public information program took approximately a year, although publicity on the project had been continuous since 1982. The major thrust of the publicity was the distribution of the guides, which took place during the 12 weeks preceding the permanent traffic restrictions.

The long-range planning for the expressway rehabilitation, the mitigating traffic measures—including the monitoring during construction—and the largest public information program ever undertaken by the department for a construction project, combined to make the expressway project a success.

No massive traffic jams materialized; life went on in the city of Philadelphia; the tourists came as usual; and the region's drivers proved that, given choices and information, they could be quite resourceful and cope successfully with a major reconstruction project.

Atlanta, Freeway System Reconstruction

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The genesis of Atlanta was transportation. The beginning was only 153 years ago in 1833 when a railroad surveyor named Stephen Long drove a stake to locate the intersection of two railroad lines, one coming south from Chattanooga and the other west from Augusta. Mr. Long predicted that no great town would grow around this railroad terminus, only a blacksmith shop and a country store.

A historical marker now locates the railroad zero milepost intersection in underground Atlanta very near Five Points, the heart of downtown Atlanta, Georgia.

Stephen Long's predictions turned out to be as inaccurate as many subsequent growth predictions for the City of Atlanta.

The railroads dominated Atlanta's early development and severely restricted its street pattern. Also a rail cordon completely encircles the central business district, with very few major street crossings.

Construction of the original freeway system in Atlanta did not begin until after 1946, when H. W. Lochner & Company and DeLeuw Cather & Company completed a report on transportation needs. This report recommended an expressway system that became the core of Atlanta's existing freeway network. By 1955 the construction of this freeway system was well underway.

In 1956, with the passage of the National Interstate Act, the partially completed expressway system was incorporated into the Interstate Highway System. The roadways built before the Interstate Act were financed with bond funds sold by the city of Atlanta and Fulton County, with the Georgia State Highway Department sharing in the construction cost. After 1956 the system was largely financed with Interstate Highway funds.

The early freeways were constructed using state-of-the-art methods, but did not avoid bad design elements such as poor alignment, steep grades, and no acceleration or deceleration lanes, or inside lane drops.

The 130-mile freeway system in Atlanta was completed in 1967 with typical sections of 4 and 6 lanes. No additional work was done on the system until 1978. An attempt was made in the mid-1960s to eliminate a major flaw in the original system. That flaw was the combining of two freeways, Interstate 75 and Interstate 85, into a common roadway through downtown Atlanta. A new route called Interstate 485 was proposed through the east side of Atlanta. This route went through the Morningside residential community, and the proposal led to environmental suits based on the environmental protection laws enacted in the late 1960s. The City of Atlanta withdrew its support for the proposed roadway, and the route was eventually taken off the planning map in 1972.

The remaining gaps in the Interstate System throughout all Georgia were closed in 1978. With the approval of a new transportation plan for the city of Atlanta, emphasis was shifted to reconstructing the freeway system in Atlanta. Population growth had rendered the old system grossly inadequate. According to predictions, older sections of the freeway designed for 52,000 vehicles daily would have to carry more than 200,000 vehicles per day in the year 2000.

The new plan called for adding additional lanes to the existing system and constructing a 100-mile rail transit system. Georgia DOT Commissioner Thomas D. Moreland referred to the reconstruction as adding muscle to the old skeleton. The reconstruction was labeled "Freeing the Freeways." As the Department developed the program, officials identified three major areas of concern: cost, environmental effects, and construction under traffic.

The first major task was determining how to finance the project. This was solved in a number of ways, including evaluating the eligibility of the various freeway segments for Interstate participation. In 1963 Congress realized that a 1975 horizon for Interstate design left only a 12-year traffic growth projection and the law was corrected to provide for a full 20-year traffic projection period. Atlanta's system was caught in this squeeze, and therefore became eligible for Interstate funds to bring their traffic projections back up to full 20-year period. Some segments were justified because they had been constructed before the Interstate financing program with other than Interstate funds and many of the radial freeways were to contain high-occupancy-vehicle lanes, which also made them eligible for Interstate financing.

The second major concerns were environmental effects and public relations. The Department of Transportation held public meetings to review environmental concerns. The most common worry turned out to be anticipated noise. The construction of noise barriers between the expanded freeway and major residential areas solved this problem.

The final major task in the initial development was to design the freeway in such a manner as to maintain traffic during the construction. The Georgia DOT commissioner charged the designers with keeping the same number of lanes that existed before construction open during construction. This required considerable effort in the designing, as a principal criterion was traffic handling as well as cost effectiveness. As the projects were let to construction, contractors and construction engineers worked together with the designers and many modifications of stage construction plans were developed where money and time could be saved without compromising safety or existing traffic capacity. Many innovative ideas resulted by using this procedure.

Safety was another prime concern. On many of our reconstruction sections, we actually experienced a reduction in accidents.

The Georgia DOT now has all work either completed or under contract, except for one segment of Interstate 20. All of this has been accomplished since 1978. The total cost to date is $1.4 billion. When the project is finished in 1990, we will have completely reconstructed 130 miles of urban freeway in 12 years, from start to finish. Construction of the original system took nearly 20 years.

Let's now discuss some of the main segments of roadway.

I-285

This route completely encircles Atlanta. The reconstruction of I-285 began in 1978. Half the highway was only four lanes wide, and the plan called for eight. The four-lane was the easiest portion since 64 foot wide medians allowed the addition of two lanes in each direction in the median while maintaining traffic on the outside. The completed section included resurfacing the old lanes.

There were some sections where we only had a 40-foot median and in order to develop a full eight-lane section, it was necessary to construct one lane in the median, and move traffic over into this lane while the outside lane was reconstructed. Of course, this affected all the overhead bridges and required complete reconstruction of the overhead bridges in the narrow median sections.

I-75/I-85 COMMON ALIGNMENT

This section of I-75/I-85 runs from Williams Street to the Brookwood Station, and was originally constructed in the early 1950s as a six-lane section with bad curvature and no deceleration or acceleration lanes. This segment has now been widened to a twelve-lane section, the alignment changed both horizontally and vertically, and several ramps eliminated to reduce weaving problems. All bridges had to be rebuilt while maintaining traffic on the existing roadway and on the cross streets. This was done through extensive use of temporary shoring. Additional right of way was kept to a minimum by the application of retaining walls almost the entire length of the project.

I-85 FROM BROOKWOOD STATION/I-75 INTERCHANGE TO LENOX ROAD

This reconstruction converted the existing expressway to an arterial street connector. A new freeway was built immediately adjacent to the old freeway, thus getting the two facilities for the price of one. This also greatly aided maintenance of traffic during construction. A 4,800-foot viaduct was constructed at one point along the project to maintain the existing expressway interchange with the local street system and also to span a railroad and a creek.

I-85 FROM LENOX ROAD NORTH TO I-285

This section of freeway was widened from four to eight lanes. The original project had a two-way uncontinuous frontage road system on each side that complicated the interchange ramp intersections with the cross roads. The frontage road system was converted and redesigned to be one way to improve the flow of traffic in a highly commercial and industrial area. Several special U-turn arrangements were provided to avoid the difficulties of indirect travel and additional traffic in the interchange areas.

I-85/I-285 NORTH INTERCHANGE IN DEKALB COUNTY

The original interchange, a cloverleaf between two major freeways, I-85 and I-285, was further complicated by a local access on each leg. The redesign of the interchange involved reconstructing the freeway-to-freeway interchange as well as the four local access interchanges while accommodating nearly 290,000 vehicles per day during construction.

The bidding allowed alternate designs. DOT provided a design for steel boxes and segmental concrete boxes. The contractor-proposed design, which was awarded, provided for the conventional cast-in-place concrete boxes. This necessitated a good bit of false work and innovative protection for that false work during construction.

The four-level interchange is now almost complete at a cost of $65 million.

I-75/I-85 IN DOWNTOWN ATLANTA

The downtown central business district segment has been under construction for about one-and-one-half years. The reconstructing will increase an existing eight lanes to fourteen lanes. Building the portion immediately east of the central business district required relocation of 90 families from the Capitol Homes and Grady Homes Public Housing Projects. Extensive use of walls reduced high-cost right-of-way acquisition for this portion of freeway.

I-20/I-75/I-85 INTERCHANGE

The large I-20/I-75/I-85 interchange immediately south of the central business district and adjacent to the Atlanta Stadium is now under construction to add capacity, eliminate left-hand exits, provide acceleration/deceleration lanes, and improve local access for the stadium area. Squared-off bridges were used extensively at the skewed intersections. This technique kept minimum span distances and reduced grade adjustments.

We could not have accomplished this work without using innovative designs. One such innovation is the extensive use of precast retaining walls. Another example is a reinforced earth-type wall consisting of precast panels supported by frictional straps in a granular backfield. Another example is a bin wall or precast hollow box filled with aggregate. These walls can be erected with minimal equipment in all kinds of weather in less than one-fourth the time needed to build conventional reinforced concrete walls. The variety of wall facings improves the appearance of these walls.

Other special techniques involved the use of slurry retaining walls. These require the excavation of a trench in the ground as the form work for the wall. The trench is filled with a slurry to keep the sides from caving in; a cage of reinforcing is then forced into the slurry, and concrete pumped in from the bottom. The wall is either strutted against a parallel wall or tied back for structural integrity. This method enabled us to limit excavation, eliminate shoring, and maintain groundwater levels adjacent to multistory buildings.

Of course, all the planning, design, and construction was coordinated with our MARTA system or rapid rail transit system, which is under construction simultaneously. We have a MARTA rail station built over the freeway to be widened. An existing street was raised, the rail line and station placed at the existing street elevation, and the structure widened to provide for a twelve-lane future freeway where a six-lane facility now stands.

Park-and-ride lots are also a part of the coordinated transportation plan for Atlanta.

Seattle, Ship Canal Bridge

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WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

Like many places, the Seattle area is reconstructing many parts of its freeways. Aside from completing Interstate 90, much of the work involves resurfacing bridges that are 20 years old and showing their age.

To keep track of how each project is affecting traffic and be sure that the two main highways are not closed simultaneously, the Seattle office of the Washington State Department of Transportation (WSDOT) created the Urban Construction Coordination Office.

The staff of this office uses two approaches to coordination:

1. The urban construction coordinator has a background in traffic and handles the day-to-day project coordination. He also reviews traffic control plans for future projects.
2. The urban construction public information officer is responsible for informing the public about the projects, their effects, and what motorists can do to reduce their frustration and confusion.

These officials report to the Urban Construction Impacts Task Force. The task force handles policy issues and directs the work of the coordinator and the information officer. The primary goal is to complete a high-quality job while minimizing the effects on the public.

This new coordination office proved its worth during the summers of 1984 and 1985, when WSDOT resurfaced two bridges with latex-modified concrete on Interstate 5 just north of the Seattle central business district (CBD).

PROJECT DESCRIPTION

Interstate 5 is the Seattle area's major north-south roadway. The section of I-5 resurfaced carries a total of 210,000 vehicles per day in both directions.

The northbound lanes that were resurfaced are approximately one mile long. The southbound resurfacing covered about two miles.

Interstate 5 includes a separate, reversible roadway called the express lanes. It runs north from the CBD for eight miles. The express lanes were not resurfaced during these projects.

The need for the resurfacing was evident, given the condition of the roadway; the exposed reinforcing steel, extensive delamination, and chloride intrusion threatened the integrity of the bridge decks.

The express lanes became the primary alternate route during the resurfacing. The northbound lanes were resurfaced one year, and the southbound lanes the next.

The northbound lanes on the two structures were resurfaced in the summer of 1984. The afternoon commuters experienced most of the impact as they left the downtown area and drove through the construction area toward the north end or across Lake Washington via SR 520.

The southbound lanes on these structures were resurfaced during the summer of 1985. Morning commuters, residents of the north end or the east side working in Seattle, were affected most by the project.

TRANSPORTATION SYSTEM MANAGEMENT MEASURES

For the northbound project, planners estimated that about 7,700 vehicles would be required to divert daily from I-5. The effects of the southbound project were expected to be much worse: over 22,000 vehicles would have to divert from I-5.

During these projects, WSDOT was committed to close coordination with enforcement, transit, and local agencies to ease the effects of the construction projects. The objective was to reduce the number of vehicles in the construction area. The department did this by encouraging commuters to

- change their routes;
- change their modes of travel to buses or carpools; and
- travel outside the peak hours.

The department encouraged the use of alternate routes in three ways:

- by retiming signals on parallel routes;
- by restricting access to the freeway before and through the construction area; and
- by extending the hours of operation for the express lanes as an alternate route.

Crossover ramps between the main lanes and the express lanes were built. These ramps increased access to the express lanes and allowed traffic to bypass the construction site and return to the main highway.

Commuters were encouraged to use transit and carpools by establishing high-occupancy-vehicle (HOV) only ramps in critical areas. Riding the bus was encouraged by funding additional bus routes. Some buses were rerouted to avoid the worst of the anticipated congestion.

The department worked with businesses and employee groups to encourage them to permit and use flexible working hours. Up-to-the-minute reports on traffic conditions were given to the media and passed on to the public.

The urban construction coordinator and information officer worked closely with the project office. They kept the traffic control plan as responsive as possible to changing conditions. The Urban Construction Coordination Office also cooperated with other agencies. The coordinator was the focal point for technical interagency coordination. The information officer coordinated information efforts with other agencies.

CONSTRUCTION/CONTRACTING ISSUES

The department learned a valuable lesson about the phasing of the construction work during the 1984 northbound resurfacing.

Aiming to avoid affecting peak travel times as much as possible, planners scheduled preparation work for off-peak times, reopening lanes to traffic during heavy commute times. Then they closed two lanes at a time to lay down the concrete and let it cure. It was a good idea in theory.

But in fact, the contractor needed a lot of time to deal with daily traffic control setting. The entire project took much longer than expected. Moreover, the public became confused by continual changes in traffic patterns.

For the southbound resurfacing in 1985, the department changed strategies. The barrier went down the first day. The contractor did all preparation and paving work on two lanes and then switched to the other two lanes. As a result, the operation was much smoother and more efficient. Motorists had fairly stable driving conditions. Even though the southbound project was almost twice as long as the northbound project, it was completed much faster.

Incentive clauses were important to both contracts. For the northbound project, the contract provided for a $10,000 daily bonus for each day ahead of schedule the resurfacing work was completed. Conversely, the contractor had to pay a $10,000 penalty for each day work continued after the scheduled completion date. For the southbound project, the bonus/penalty was $20,000 daily.

PUBLIC INFORMATION

Project planners developed an extensive information campaign to give the public enough advance information to be prepared for the project. This campaign described the anticipated effects and how motorists could deal with them.

A second objective of the campaign was to maintain a positive image of WSDOT in the community. Both motorists using I-5 and residents in the project area were targeted to receive special information.

Brochures were prepared to explain the project in detail. Notices were sent to residents, planners of special events, and community groups to address their special circumstances. Presentations were given to business and community groups to respond to their specific concerns.

A 24-hour hotline was put into operation. The hotline was also a helpful internal device, because all WSDOT offices could turn over inquiries to the hotline, and so relieve project and administrative personnel of information duties.

All information pieces were developed in cooperation with Metro Transit, Commuter Pool, and the city of Seattle to present a unified public image.

Media contacts were scheduled to coincide with major project shifts. Project sponsors placed particular emphasis on daily contact with traffic reporters to get accurate information to motorists.

Motorists also received pertinent information by means of variable message signs and the highway advisory radio system.

RESULTS

These efforts brought exceptional results. During 1984, weekday traffic volumes on northbound I-5 decreased 38 percent through the project area. During the 1985 project, weekday traffic volumes were reduced 40 percent.

These results are the product of close coordination of traffic and information efforts. Letting people know in advance gives them time to prepare. A survey of Seattle-area residents indicated that 89 percent knew about the project and believed the work was necessary.

Efforts to encourage people to try buses and carpools succeeded. The requests for ride matching increased 56 percent in August 1985 compared to August 1983. In the summer of 1985, bus ridership figures showed an increase of 10 percent over those for a usual summer.

LESSONS LEARNED

The project yielded several valuable lessons for Seattle planners. Based on the Seattle experience, incentive clauses should only be used on critical phases of the contract. The incentives make the contractor more responsive to the schedule. However, they make contract administration more difficult by placing increased importance on the number of working days—claims are virtually unavoidable.

Incentive clauses should only be used on projects with major effects and should be based on the cost of those effects to the public.

Phasing of the construction is critical. It's best to make the entire project as efficient as possible and get the job done on time.

The most critical lesson the department learned was that good public information can prevent many problems. The public was well informed about the project before it began. They understood the need for the work and the anticipated effects. Motorists could plan alternate routes accordingly.

Finally, the Urban Construction Coordination Office was a focal point for project coordination for the public, other agencies, and employees within the department.

This project was one of many going on simultaneously throughout the Seattle area. Closures and other effects had to be coordinated among all these projects. Traffic control plans were modified in response to changing traffic patterns. The public information was kept up to date and to the point.

So after a summer of irritating, congestion-free commuting, it was good to get back to the normal stop-and-go conditions everyone was used to.

Chicago, Lake Shore Drive

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Traffic management concepts and tools have been a part of traffic engineering in the Chicago area for many years. However, it is only recently that these everyday operational techniques have been recognized as important elements in short-range transportation planning, and thus are being coordinated and incorporated into the overall plan of transportation improvements.

Chicago's most important recent construction project has been the reconstruction and relocation of Lake Shore Drive between Huron and Monroe Streets. The major portion of this project began in May 1984, and was scheduled for completion late 1986. The project consists of the complete reconstruction of Lake Shore Drive between Huron and Monroe Streets, including the elimination of the dangerous S-curve just south of the Chicago River. The reconstruction will also eliminate four intersections with signals, which will be replaced with a complicated ramping system, including a two-level bridge and roadway over the Chicago River north to Grand Avenue.

PLANNED DEVELOPMENT AND POLICY ISSUES

In the early planning for this project it was decided that the high volume of traffic crossing the Chicago River at this point (up to 90,000 vehicles per day) precluded the possibility of significantly reducing the number of traffic lanes. However, since this project was part of a larger project to provide new roadways serving the entire Illinois Central Air Rights Development and proposed Ogden Slip Development south and north of the Chicago River, including a new bridge across the river at Columbus Drive, it was possible to devise a detour routing plan that would make use of the newly constructed Columbus Drive Bridge for all of the southbound Lake Shore Drive traffic, while routing the northbound traffic on existing Lake Shore Drive. Although this allowed Lake Shore Drive to be constructed half at a time, it did require delaying the Lake Shore Drive reconstruction until the Columbus Drive Bridge had been completed.

TSM MEASURES

During the construction period, *all* southbound Lake Shore Drive traffic was detoured west on Ontario Street, south on Fairbanks Court and Columbus Drive (both made one-way southbound) across the Chicago River, and back east on Monroe Street to Lake Shore Drive. Northbound traffic remained on Lake Shore Drive, using whichever half of the roadway was available at the time.

Before starting construction, planners met with transit agencies to work out any necessary bus route changes, to develop a program for encouraging the public to switch to mass transit, and to make any schedule changes that might make it easier for them to do so. They also met with Chicago Park District officials to insure adequate access at all times to the Monroe Street underground parking garage.

An intense towing program was instituted on Ontario Street. This was preceded by a warning ticket program one week before the detour went into effect, to alert motorists to the impending towing.

PLAN IMPLEMENTATION AND MANAGEMENT

Immediately before the detour went into effect, project planners met with the traffic patrol servicemen, the police, and the radio room personnel to make sure that everyone understood the extent of the detour plan and the need for good communication throughout this project.

Since that time, the officials involved discuss and review this project at the Mayor's Traffic Management Task Force weekly meetings and the bi-monthly meetings of the Chicago Area Transportation Study Traffic Operations Committee.

Key traffic monitoring stations on Columbus Drive, Lake Shore Drive, and Michigan Avenue are being kept in operation to keep track of traffic volume changes. In addition, traffic speed trial runs on both southbound and northbound Lake Shore Drive were conducted before the project began, so that adequate data would be available for comparison during construction.

CONSTRUCTION AND CONTRACTING ISSUES

Before construction began, meetings were set up with all three contractors and appropriate resident engineers, project engineers, police, and traffic personnel to make sure that everyone understood the contract provisions that covered installation and maintenance of the detour signs, markings, and barricades. These meetings were also used to set up direct communication links so that any problems or breakdowns could be immediately addressed and corrected.

A Lake Shore Drive Monitoring Task Force composed of all the project engineers and resident engineers, along with appropriate contractor representatives, met approximately once a month to monitor construction progress and resolve any problems.

PUBLIC INFORMATION

The public information campaign began with meetings with aldermen whose districts were affected by the project. These meetings were opportunities to discuss the proposed plan and possible sources of complaints.

Meetings were then held with residential and commercial building managers in the area to work out access problems caused by Lake Shore Drive congestion and/or the Columbus-Fairbanks one-way operation.

Motorists were alerted to the upcoming detour through a comprehensive media campaign. They were actively discouraged from using Lake Shore Drive, particularly during the peak periods. During the campaign, department staff sent information packets to the media, assisted with live broadcasts and interviews with knowledgeable city representatives, held special briefings for radio and TV personnel responsible for broadcasting the daily rush period traffic reports, and made full use of the facilities provided by the city's transportation media consultant, Central Transportation Bureau, Inc. The facilities included weekly bulletin updates, daily hotline information, and up-to-the-minute radio announcements of developing conditions.

Department staff members established a system for maintaining media contact so that the public could be informed of detour changes. And problems or questions by the media could be quickly and correctly answered. Department staff answered questions about project progress and construction problems, while the Central Transportation Bureau dealt with questions about immediate traffic conditions.

EFFECTIVENESS AND LESSONS LEARNED

The results of this effort were evident in the public acceptance of the detour and the relatively few traffic problems observed after the detour began. The initial 40 percent decrease in peak hour through traffic volumes was followed by slow increases in volume, so that by the end of the project, there was only 10 to 15 percent difference between before and after peak hour volumes. On a 24-hour basis, there has been no change in traffic, which ranges from 80,000 to 90,000 ADT. Traffic has increased on parallel arterial streets (Michigan, Clark, and LaSalle), particularly during the morning rush period.

Travel times through the detour area have not changed during the morning peak period. However, four minutes have been added to travel time during the evening peak. Traffic volume and travel speed data are still being collected, and further monitoring reports will be forthcoming.

This reconstruction taught Chicago officials two key lessons. First, it is important to adequately plan the various TSM and public information measures that must be taken before construction begins. Second, such projects absolutely need some sort of on-going interdisciplinary traffic management group that can meet regularly to resolve the inevitable problems that arise during any large construction project.

Los Angeles, 1984 Olympic Games

David H. Roper
CALIFORNIA DEPARTMENT OF TRANSPORTATION

Years of planning and coordination culminated in 16 days of perhaps the most successful Olympiad ever staged. From every perspective there is agreement that the 1984 Summer Games were a success. This was clearly evident from a transportation and traffic view.

The possibility of essentially congestion-free operation of the Los Angeles transportation system was not so evident when transportation agencies first assembled in 1982 to begin planning for Olympic traffic. On the freeway system alone, motorists experience daily congestion on nearly 225 of the 700 miles in the morning peak and 275 miles in the afternoon/evening peak. The Olympics would hit this system with an estimated 6 million spectators at 24 venues spread throughout the basin with events scheduled throughout the day and nearly 25,000 athletes, world media, and Olympic family members transported to the venues on set timetables.

From the beginning, it was clear that planners had neither time nor money to develop major new transportation facilities. This left public transportation agencies with the task of planning and managing Olympic traffic essentially through transportation system management techniques. Similarly, it became clear that there could be no single Olympic traffic director. The success of any plan would depend upon the willingness of each transportation and law enforcement agency to perform its traditional functions in cooperation with each other. Under the overall umbrella of the Integrated Planning Group, over 50 federal, state, county, and local agencies coordinated their Olympic planning efforts. Caltrans' Olympic Task Force, functioning through the Traffic Control Subcommittee of the Olympic Security Coordinating Committee, coordinated and stimulated the development of Olympic transportation plans with the California Highway Patrol (CHP), the Los Angeles City Department of Transportation (LADOT), the Los Angeles City Police Department (LAPD), the Los Angeles Olympic Organizing Committee (LAOOC), the Southern California Rapid Transit District (SCRTD), and numerous other government and private transportation planners and operators.

Initial planning began with the development of an inventory of transportation conditions and needs at each venue. Following this, planners identified Olympic event requirements and desired operational characteristics for each venue and related the resulting individual plans to the transportation system as a whole. These venue transportation concepts led to the cooperative development of three primary transportation management tools:

- venue traffic management plans (19 plans)
- freeway traffic condition maps (12 maps)
- bus system plan (24 routes)

Typically, the venue traffic management plans provided such details as preferred spectator routes, bus priority streets and ramps, one-way streets, designated parking, parking restrictions, signing, traffic officer placement, signal timing, and other traffic management requirements. The major effects on traffic were around the Los Angeles Coliseum area and the Westwood/Los Angeles International Airport area. Daily operational strategies were developed to carry out each plan.

The traffic condition maps depicted the congestion that could be expected on the freeway system with no adjustments to traffic demand and travel patterns. These congestion forecasts were based on historical data for typical August traffic, upon which the best estimate of the effect of Olympic traffic was superimposed. Event capacity, expected attendance, spectator arrival time, vehicle occupancy, modal split, and route assignments (O&D) were the elements used in predicting the Olympic traffic demands. Three different Olympic event days were selected as typical, and estimated limits of congestion at 8 a.m., 11 a.m., 3 p.m., and 6 p.m. were developed for each. These typical days were weekends, non-Coliseum event weekdays, and Coliseum event weekdays (maximum Olympic traffic days). Congestion was defined as slow-and-go traffic, 10 to 30 mph.

The estimate of available parking and the transportation system capacity at each venue led to the development of modal split targets, and set the desired bus use as a function of the shortfalls. The resulting Olympic bus systems plan consisted of 24 routes for spectators using a fleet of 500 extra buses to supplement the regular public bus service. This plan provided three types of service—shuttle, park-and-ride, and express—from major activity centers in the region to and from Olympic venues. Each day's bus system and schedule was tailored to that day's Olympic event schedule and spectator needs. Part of the desired bus use was assigned to private charter services.

As the planning continued, it became apparent that success would require cooperation from the entire region. Caltrans took the lead in establishing an ad hoc committee to accomplish this goal of public awareness. Numerous public and private agencies from Los Angeles, Orange and Ventura Counties, meeting regularly, developed and carried out an Olympic traffic communications plan. The committee developed specific information for the business and industrial communities, daily commuters, Olympic spectators, and the general public describing traffic management plans and expected traffic conditions and suggesting techniques such as flex time, four-day work week, vacations, and changes in delivery schedules to help businesses operate and at the same time alter traffic patterns during the games. "Operation Breezeway," a joint Caltrans/CHP outreach program, provided information specifically for the trucking industry.

Telephone hotlines were set up to keep the general public informed. A permanent public display of venue traffic management and Olympic bus plans was placed in the lobby of the Caltrans District 7 office. A Caltrans mobile information van provided a traveling display at shopping and other community centers to get the word out to the general public. As a result, the business community and the public knew that normal travel patterns would have to be modified during the Olympics to prevent normal congestion patterns from worsening.

As the Olympic period approached, all agencies noticed that the media wanted more information about an anticipated Olympic traffic problem. Caltrans developed numerous media contacts, provided special interviews, and opened the Traffic Operations Center (TOC) to full press access. A media center was established in the district office building for use immediately before and during the Olympics. Caltrans, LADOT, CHP, and SCRTD held regular 9 a.m. and 1 p.m. press briefings at which time information on the prior day's traffic conditions, today's traffic experience, and forecasts of tomorrow's traffic conditions were discussed. The interest level at these media briefings and for special interviews remained high throughout the 16 days of the Games.

As the Games drew near, the transition from planning to operation began to take place. At a level of interagency coordination never before experienced, each agency put their Olympic personnel, equipment and facilities into action.

The Caltrans District 7 office became the Olympic Traffic Center for the region. A unique interagency operation—the Traffic Coordination Center (TCC)—was housed here, close to the district's Traffic Operations Center (TOC). The TCC was staffed on a 24-hour schedule by the operating public and private transportation agencies who used new traffic information to adjust their operations and manage the system. Traffic situations affecting the Olympics were managed through the TCC.

Major incident response teams were on continuous full alert. Maintenance and hazardous material identification teams were on standby, poised to support the rapid clearance of a spilled load or overturned truck or help manage traffic in a "SWAT"-like manner.

Almost the entire freeway system had been cleared of maintenance, construction, and encroachment permit activities that could affect traffic, even by gawking. All available lanes were placed in service, including peak hour shoulder lanes. The system was at maximum capacity.

Ramp metering, on those freeways leading to and through the Westwood/LAX and the Los Angeles Coliseum/downtown areas, was expanded to operate all day every day. The metering plan, tailored to each freeway segment, operated from as early as 5 a.m. to as late as 9 p.m.

Special temporary park-and-ride facilities were established throughout the region. Working through the individual school districts, planners converted school parking lots into carpool and bus parking facilities for commuters and spectators to use within the neighborhoods.

Olympic guide signs in each area pointed spectators to each sport. Guide panels, identifying the sport, were installed atop the freeway overhead signs and on the off-ramps and local streets in a pattern delineating the spectator routes identified in the venue traffic management plans. The signs were essential to the effective operation of the traffic management plans.

In addition to the fixed message venue guide signs, 50 ground-mounted changeable message signs (CMS) informed motorists of trouble locations and impending congestion on the system and suggested ways to avoid delay and alternate routes to the venues. At several locations, the CMS were integrated into the venue traffic management plans and were used daily to establish and adjust the operation. The signs were operated through the TOC with input from field units.

Each day the operating agencies put a specific traffic management plan into motion. On pre-set timetables, traffic management teams consisting of traffic engineers in sedans, trucks and trailers, and maintenance field units carried out Caltrans' portion of the plans on the freeways and state highways at the venue sites. Traffic patterns were altered, bus-only ramps established, ramps closed and opened, and motorists informed of the current traffic situation. Field operations were closely coordinated with the CHP and local traffic and law enforcement units. Caltrans operations personnel ran field command posts at the venues, maintaining radio contact to field units and the TOC. In all, about 15 sedans, 20 CMS trucks and trailers, and numerous maintenance units were deployed.

On six separate occasions, urban freeways were used as sites for cycling and marathon practices and events. Segments of three different freeways, including a 17-mile stretch of one major freeway, were closed to all public traffic in both directions. The major closures were on weekends. During each closure traffic management strategies consisting primarily of diversion plans and signed detours were put into effect. Congestion on the system as a result of the closures was insignificant.

The TOC operated around the clock and was the center for Caltrans' traffic management activities. All incoming and outgoing information was funneled through the TOC for centralization and continuity. Over 200 miles of electronic surveillance supplied current, detailed traffic information to use in making and monitoring sound traffic management decisions. This information also provided a base for analyzing how the system was operating. Fifteen closed circuit television cameras (CCTV) instantly verified incidents and traffic situations at several key locations in the central Los Angeles area. The TOC was the radio link for all Caltrans field units and also the link, by telephone, for the flow of selected information to and from the TCC. Ground and air traffic observers further improved monitoring of the system. At 24 key locations along freeway routes, volunteers from all branches in the district monitored traffic from commercial and office buildings and sent incident and congestion information to the TOC hand-held radios. The Department of Defense (DOD) provided six helicopters for exclusive use in traffic management. Volunteer air observers responded to incidents and trouble spots and radioed detailed information to the TOC. The ground and air teams were indispensable for verifying how the system was operating during the Games.

Each day, officials compared levels of congestion in the system, identified by various monitoring techniques, to the pre-Olympic forecasts. Using the freeway traffic condition maps and the available traffic information from the TOC, a pictorial comparison was developed for each of the four time frames for each of the 16 days of the games. Six of the 64 maps have been selected as typical and are presented in Figures 1 through 6. Appropriate maps were displayed each day at the 9 a.m. and 1 p.m. press briefings held in the media center.

As the Olympics approached, the entire freeway system began operating with essentially no congestion, with total daily volumes (ADT) down about 2-3 percent. More important, the morning peak flattened, beginning some 30 to 45 minutes earlier. Peak-hour volumes were down about 7 percent with a noticeable decrease in the number of trucks.

The free-flow conditions continued through the first week of the Games. At that point, some evidence showed that the shifts in peak hour flows were beginning to slip back to pre-Olympic patterns. Light localized congestion began to appear in some areas. By Wednesday, the combined background and Olympics traffic was about equal to the pre-Olympic normal. On Friday, August 3, the Coliseum events began, and ADT rose to slightly above normal levels. The system continued to operate with very little congestion. Bus patronage to the Coliseum area was reasonably good, and the city streets operated quite well.

The second week began with about a plus 5 percent ADT and moderate congestion here and there. Bus patronage to the Coliseum continued to be good, and surface street operations improved as minor operational adjustments took effect. On Wednes-

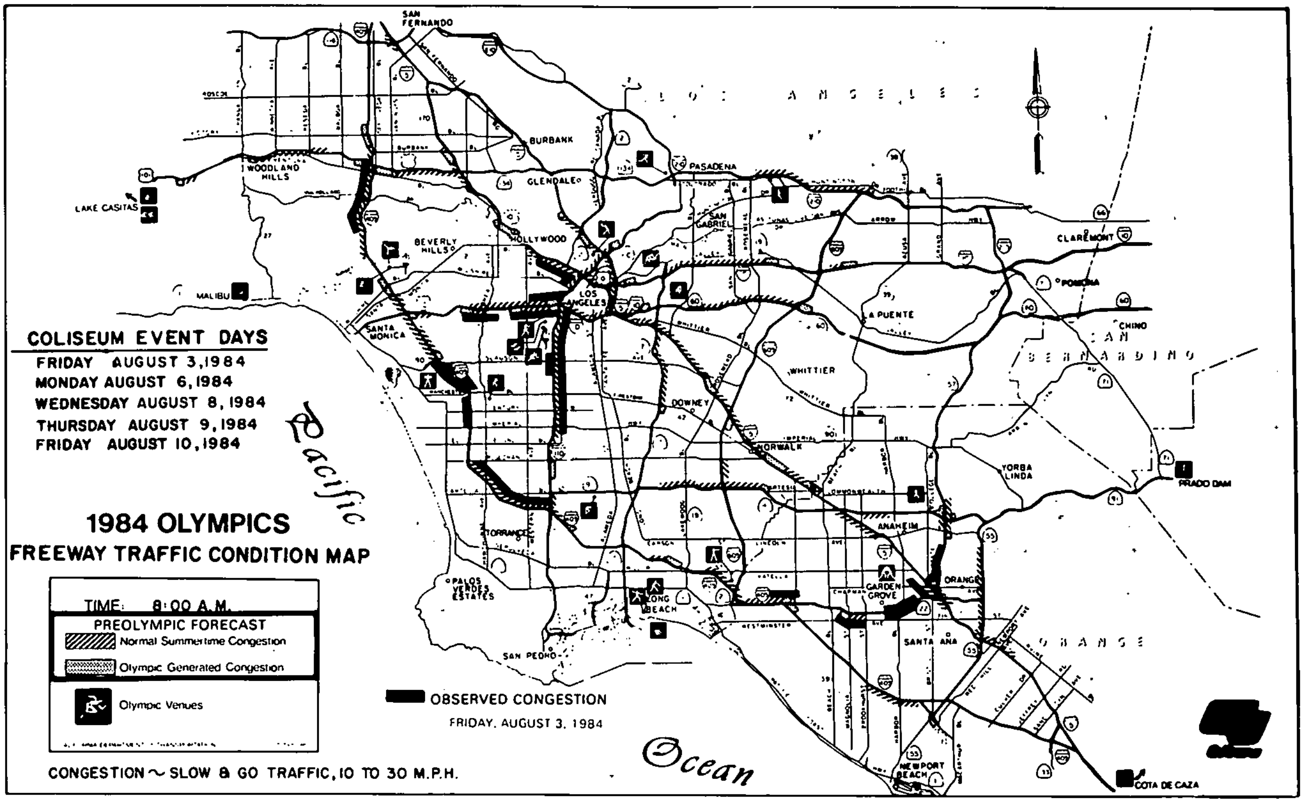

FIGURE 1 Freeway traffic condition map, August 3, 1984, 8:00 a.m.

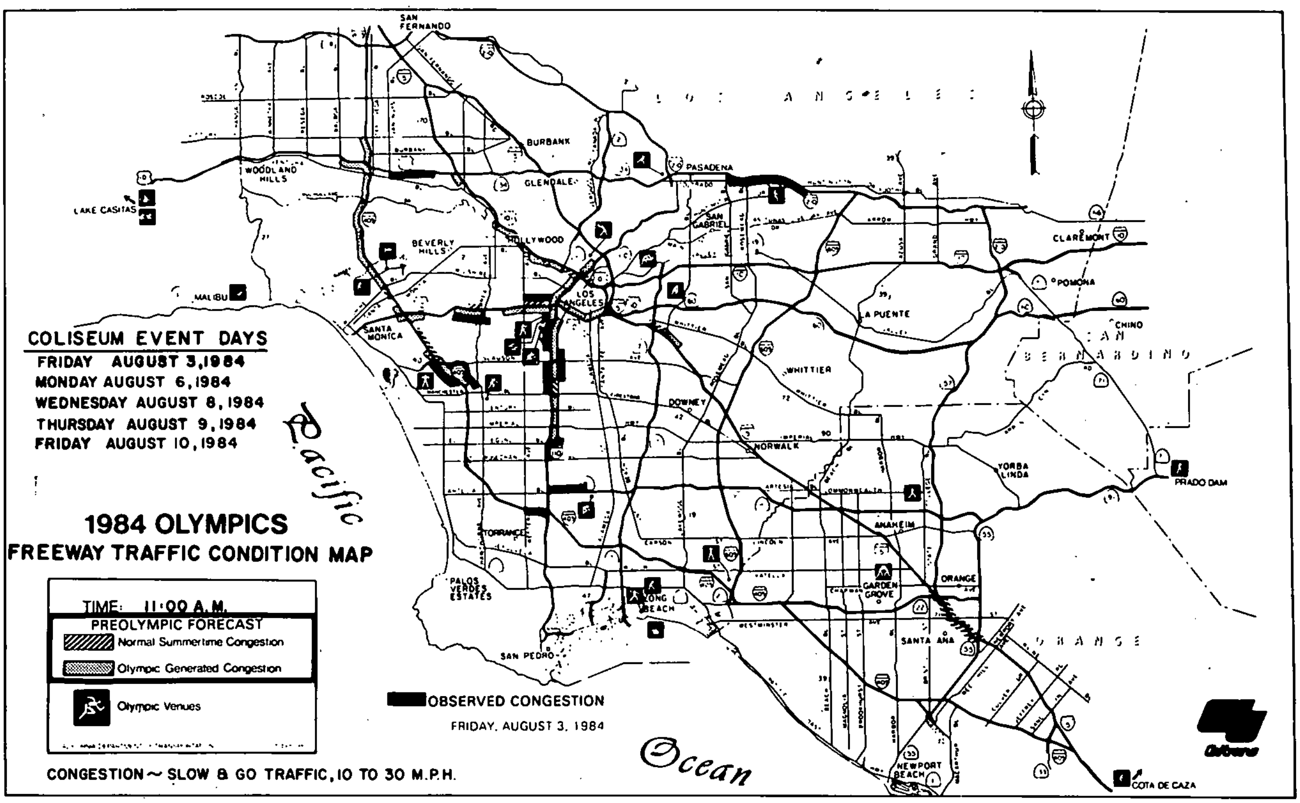

FIGURE 2 Freeway traffic condition map, August 3, 1984, 11:00 a.m.

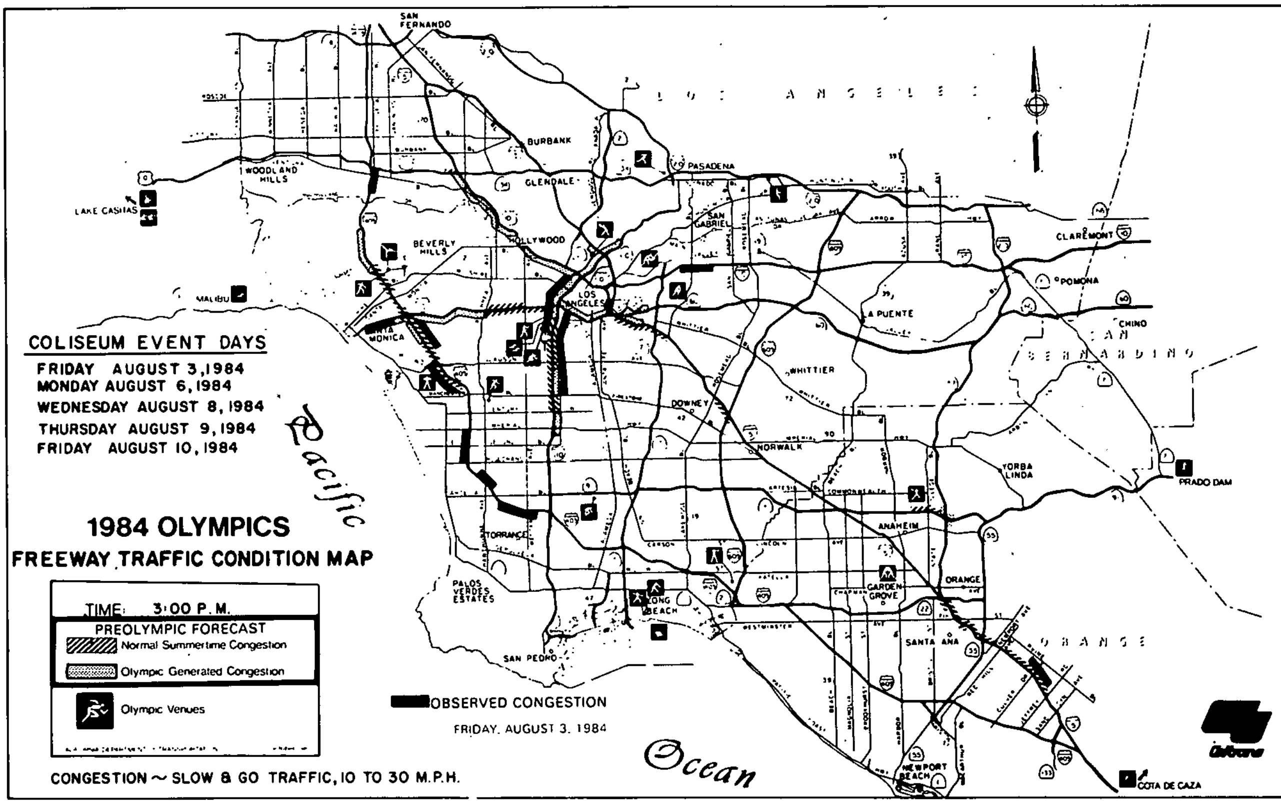

FIGURE 3 *Freeway traffic condition map, August 3, 1984, 3:00 p.m.*

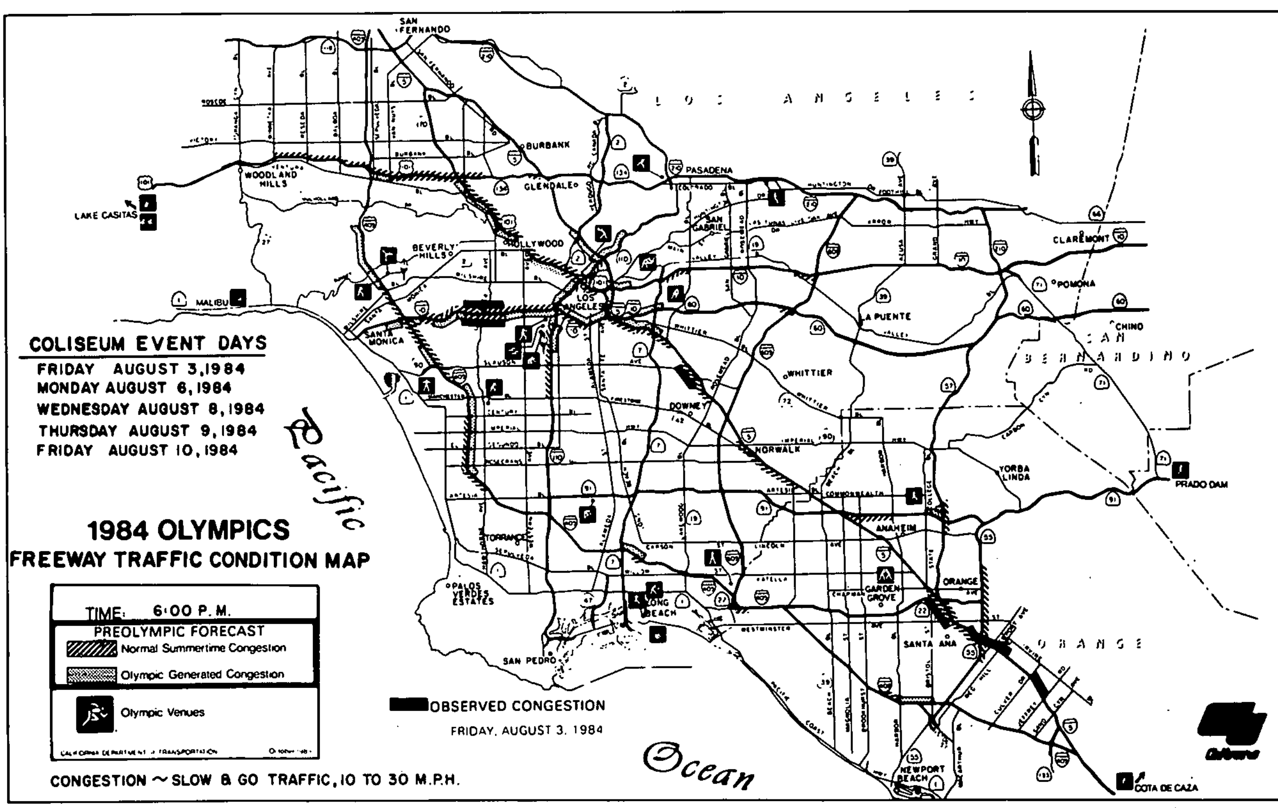

FIGURE 4 *Freeway traffic condition map, August 3, 1984, 6:00 p.m.*

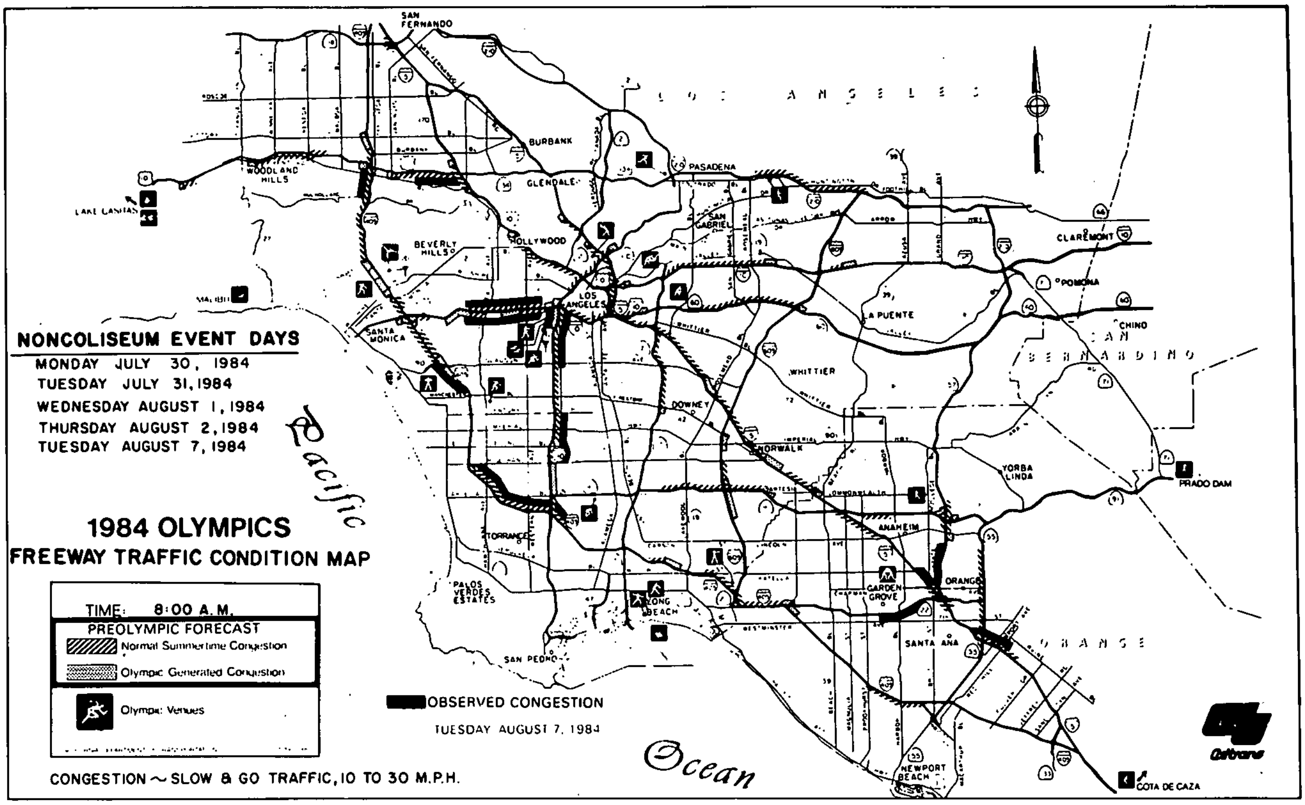

FIGURE 5 *Freeway traffic condition map, August 7, 1984, 8:00 a.m.*

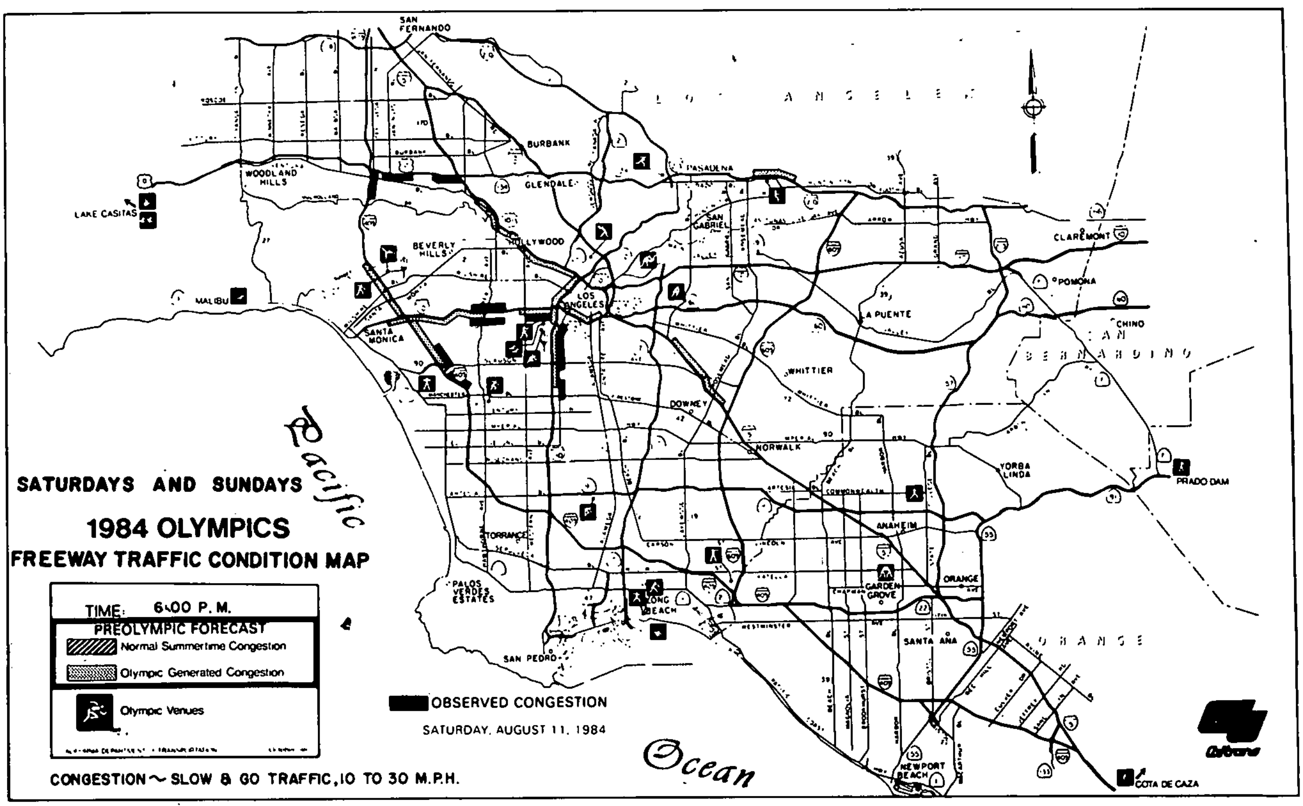

FIGURE 6 *Freeway traffic condition map, August 11, 1984, 6:00 p.m.*

day, August 8, the system operated well through the morning and into the afternoon with ADT at about plus 8 percent. That evening, with over 97,000 spectators attending the soccer game at the Pasadena Rose Bowl, the first patterns of extensive congestion occurred. The early 6 p.m. starting time and the low spectator bus patronage (only 6 percent) were the most likely causes.

Through the remainder of the week, the system continued to operate well, although ADT continued to climb and more congestion—still moderate—began to show, particularly in the evening peak. On Friday, ADT was at plus 11 percent. That evening, the Rose Bowl area operated with very little congestion. The Coliseum operation continued to work well. The Westwood area, however, experienced some heavy congestion as spectator and onlooker traffic mixed. There were no real problems during the final weekend, other than a helicopter crash early Sunday afternoon on the Harbor Freeway near the Coliseum. Quick clearance of the helicopter averted a major convergence with the closing ceremonies crowd.

For each day of the Olympics, daily traffic volumes and delays were compared to the normal summer conditions (August 1983 traffic data) for a portion of the freeway system known as the 42-mile loop. (See Figure 7, upper portion.) The 42-mile loop is a triangular network, located in central and west Los Angeles, consisting of the Santa Monica Freeway (I-10), the Harbor Freeway (I-110), and the San Diego Freeway (I-405). The loop is heavily equipped with electronic sensors embedded in the roadway pavement, which provide vehicular volume and speed data to a central computer in the TOC. Data are transformed into bar graphs depicting a percentage comparison of the volumes and delays (see Figure 8).

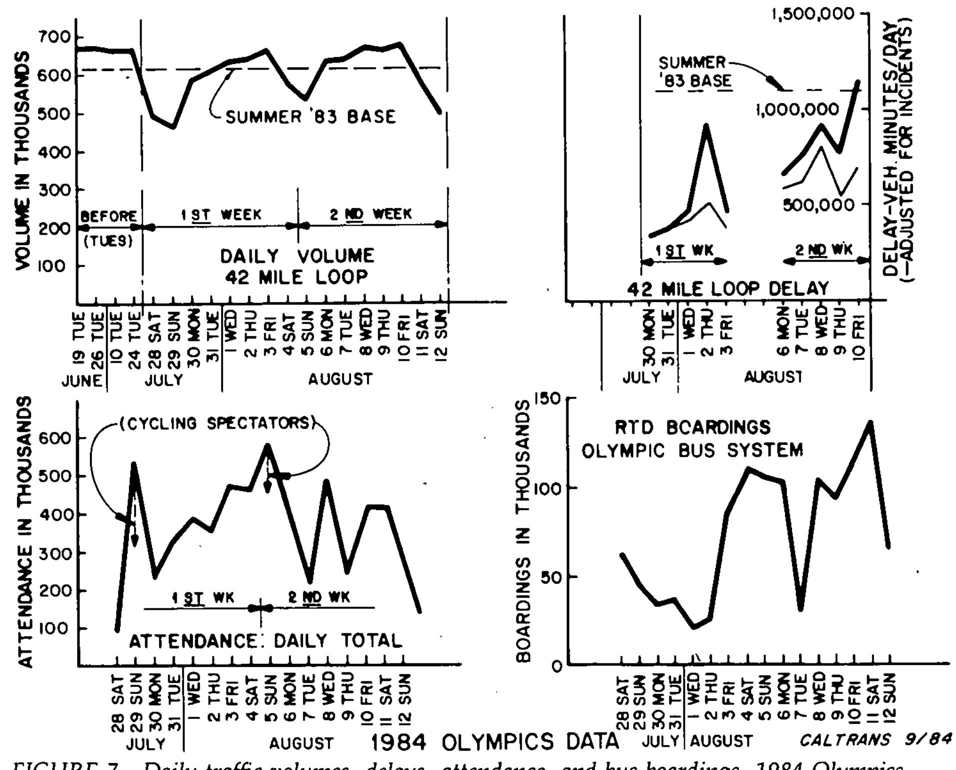

FIGURE 7 Daily traffic volumes, delays, attendance, and bus boardings, 1984 Olympics.

To benefit from the Olympic experience, we must pay closest attention to those factors that contributed the most to its success. Selective application of the lessons learned can improve day-to-day travel patterns.

First and foremost, the entire transportation system was in a maximum state of readiness. Traffic management strategies, techniques, and systems were in full operation. Venue traffic plans designed for special events were used daily, precisely and when needed. Motorist information systems kept commuters and spectators informed of the best routes. Accurate and up-to-date traffic condition information was shared by numerous agencies, each performing their traditional functions. Many agencies used the information to improve their daily operation. Joint decisions were made and plans adjusted accordingly. Public awareness was at its zenith. The system would have performed well even under worse conditions than were experienced.

A shift in the commuter travel patterns broadened and flattened the peak periods. Hourly volumes were down about 7 percent. The result—congestion was down by as much as 60 percent. A very light shift and reduction in peak hour volumes produced dramatic reductions in congestion. This concept, well known to transportation managers, was very clearly demonstrated.

Truck traffic was down, particularly during peak hours. Overall reduction was about 6 percent, as much as 16 percent during peak periods. With an estimated 1-to-5 ratio, trucks to automobiles, heavy dividends can be realized by shifting trucks to the non peak periods.

Very few major incidents occurred at critical times or locations. Undoubtedly, free-flow conditions and fewer trucks were key factors. With major incidents contributing heavily to the total congestion experienced each day, again, a small adjustment can have a dramatic impact.

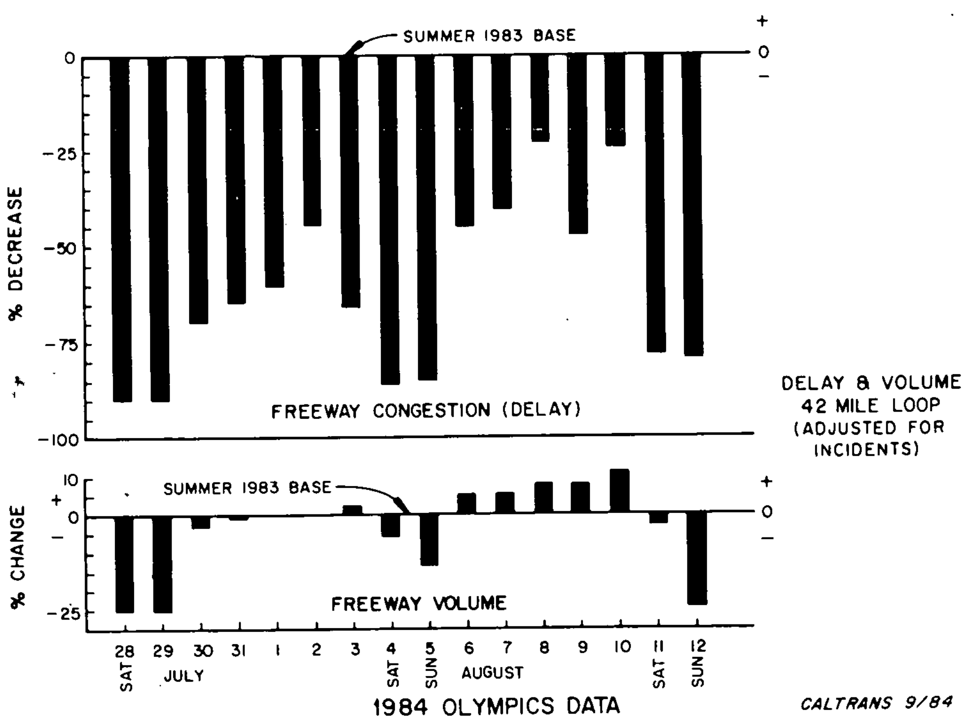

FIGURE 8 *Percentage comparison of traffic volume and delay.*

Commuter carpooling/ridesharing remained essentially unchanged. The only noticeable increase in vehicle occupancy was in spectator vehicles going to the Coliseum area.

Spectators used the SCRTD Olympic bus system extensively, particularly at the Coliseum and Westwood areas. Total ridership was 1,145,350 with a peak day of 135,000 (8/11/84). This was an essential element of the traffic management plan. During the one major congestion experience of the Olympics, the evening of August 8th at the Rose Bowl, bus patronage was a disappointing 6 percent. (See Figure 7 for daily spectator attendance at the games and daily bus boardings.)

Bibliography of Conference Handouts

The following publications were distributed at the conference.

1. The Commuter's Guide, Southeastern Expressway, How to Get In and Out of Boston During the Expressway Construction. *The Patriot Ledger,* George W. Prescott Publishing Co., Boston, MA, March 1984, 48 pages, 5 × 7 ½ inches.

2. "The Southeast Expressway Reconstruction Project, Everything You Always Wanted to Know But Were Afraid to Ask About." Massachusetts Department of Public Works, Bureau of Transportation Planning and Development, February 1984, 1 page folded pocket-sized pamphlet.

3. "I-394 Commuter's Guide (Read this while you're stuck in traffic on Highway 12)," District 5—Golden Valley, Minnesota Department of Transportation, undated, 1-page folded pocket-sized pamphlet.

4. Strgar-Roscoe-Fausch, Inc., "Transportation System Management Plan for I-394, Executive Summary." Minnesota Department of Transportation, undated large folded brochure.

5. "The New Lodge." Michigan Department of Transportation, double-pocketed, conference-sized brochure containing fact sheet; carpooling information; "lodge-ability" ("the ability to get through, over and around the construction we've all been waiting for on the John C. Lodge Freeway during the summers of 1986 and 1987"); information about alternative routes, buses and ridesharing; and the first of many informational news releases.

6. "Three Ways to Beat the Maze." Syracuse Metropolitan Transportation Council, four-page brochure about the reconstruction of I-81 through downtown Syracuse, undated.

7. "I-80 Repairs, Totawa to Elmwood Park." New Jersey Department of Transportation," 4-page newspaper suggesting ways for motorists to avoid construction-related congestion in the Paterson, NJ area, undated.

8. "Schuylkill Expressway Improvement Project Commuters' Guide" and "Schuylkill Expressway Improvement Project Visitors' Guide." Separate guides were published for each category in 1985 and 1986 by the Pennsylvania Department of Transportation for the rehabilitation of I-76 in Montgomery and Philadelphia counties. Information includes four-color maps of the ramp detours and a four-color map of the construction area and major alternate routes. Overall size is approximately 4 by

9 in.; fold varies according to which brochure and which year. Available from Pennsylvania Department of Transportation, Public Relations Office, District 6-0, 200 Radnor-Chester Road, St. Davids, PA 19087.

9. *Transportation Management for Corridors and Activity Centers: Opportunities and Experiences.* FHWA, U.S. Department of Transportation, May 1986, 51 pp. Available free of charge from the Technology Sharing Program, Office of the U.S. Secretary of Transportation, Washington, DC 20590.

10. *Corridor Traffic Management for Major Highway Reconstruction, A Compilation of Case Studies.* FHWA, U.S. Department of Transportation, Sept., 1986, 277 pp.

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ADDRESS CORRECTION REQUESTED

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