At the time of the spill, Contra Costa Area personnel had completed the initial eight-hour hazardous materials awareness course. The second portion of the training, concentrating on on-site tactical management problems, had been planned but had not yet been presented. It was determined by the After-Incident evaluation that there was insufficient internal and external training in the management of a complex hazardous material spill incident. Since that time, the training situation has been rectified with the completion of the third portion of training for both Departmental personnel and allied agencies.

Summary

The successful management of emergency freeway incidents in California is dependent upon effective planning for use of multi-agency resources. Through legislation designating scene management responsibilities and through open communications between the CHP, Caltrans, and local fire, police, and other emergency response agencies, California has developed a high degree of cooperation in handling these incidents. The CHP and Caltrans meet regularly on an informal basis in order to resolve problems as they occur and to maintain clear lines of communication regarding multi-agency responsibilities. In addition, the statewide multi-agency training conducted by the CHP for police and fire personnel has contributed substantially to successful cooperation and coordination among responding agencies.

REAL-TIME TRAFFIC CONTROL FOR MAINTENANCE WORK ZONES

S. Z. Levine, Texas State Department of Highways and Public Transportation

Introduction

Between 1979 and 1981, the need for remedial work on Houston area freeways (particularly those over twenty years old with traffic volumes near 200,000 vehicles per day) increased markedly. Complaints from the public about traffic jams caused by such work led to one legislative suggestion that all freeway work in the Houston area be limited to night operations. This did not pass, but led to work zone operations being restricted to nighttime hours and weekends. It is during these time periods that speeds are high and the chance for errant driver behavior increases. In 1980 and 1981, 12 highway workers were killed and 34 injured while working on Houston's freeways. Most of these casualties were caused by drunk drivers and speeding motorists.

The Problem

With almost 600 miles of state-maintained roads in Harris County and work predominantly restricted to weekends, the rate of maintenance activity had fallen far behind the needed rate. This situation became increasingly critical with funding limitations and extensive red tape facing the initiation of major roadway rehabilitation efforts. In the spring of 1982, the State District Office decided a means for performing maintenance operations on even the highest-volume roadways during the previously restricted hours must be found. The objectives of this strategy were threefold:

1. Allow time for the needed remedial maintenance to be performed.
2. Insure worker safety.
3. Prevent intolerable delay to the traveling public.

Deployment of Special Traffic Handling Crew

Research studies have been conducted (2, 3, 4) on "traffic management type" capacity improvements for work zone operations. These have included the temporary use of shoulders as a travel lane, modifying intersection signal timing, encouraging traffic to divert to alternate routes, and closing entrance ramps within the work zone area. Some of these measures have been successfully implemented on major rehabilitation efforts on the Edens Expressway in Chicago and the Gulf Freeway in Houston. However, these techniques have been used only on a limited basis for short-term operations.

A specially trained crew was formed and assigned the task of handling traffic during maintenance operations on high-volume roadway pavements, thereby increasing the hours available for maintenance activity. The crew has the authority and capability of implementing proven work-zone traffic management techniques (in a manner consistent with the "Manual of Uniform Traffic Control Devices"). A major advantage of the special crew is its ability to actively manage traffic during the maintenance operation.

Prior to this, a traffic control plan was prepared based upon traffic flow-rates through a proposed work zone. The traffic data indicated the number of lanes needed to minimize motorist delay. Shoulder signing would be deployed at the outset of the operation and remain until the operation was complete.

With the special crew, the traffic control plan would be modified to react to changing traffic conditions. Excessive speeds adjacent to and in the work zone is a contributing factor to accidents. The use of the shoulder to provide additional capacity at work sites may actually contribute to speeds higher than desirable during "lulls" in traffic and thus compromise worker safety. The crew could react to this situation and "turn off" the shoulder-use signing, thus lowering speeds. This method of handling traffic has been termed "Active Traffic Management."

The District Office tried the special crew concept on an experimental basis. An urban freeway in Houston carrying 175,000 to 200,000 vehicles per day was badly in need of pavement repair and rehabilitation; but a major contract could not be let for several months. Some of the needed repairs were critical, but high traffic volumes precluded use of typical maintenance techniques. Interim repairs were needed and this site provided the first test for the special traffic handling crew.

Individuals experienced in traffic management techniques were asked to handle traffic while the interim maintenance was performed. A job of this magnitude normally would have required at least two months if work were restricted to Sunday mornings. Workload analysis showed that working Monday through Thursday during daytime off-peak hours for two consecutive weeks and one weekend would provide enough time to make the interim repairs. This schedule required three road-work crews to be available to work simultaneously. Motorist delay

would be kept to an acceptable level under 20 minutes (5).

Specifically, the crew was responsible for the following:

1. Coordinating daily the scheduled hours and areas of work zone activity with the Department Public Affairs Section, who would disseminate the information to the public through press releases and radio broadcasts.

2. Coordinating with the City's Traffic and Transportation Department for aid in modifying affected intersection signal timings at city-operated signals on frontage roads.

3. Arranging for the use of Selective Traffic Enforcement Program officers for the project.

4. Actively managing traffic by using the shoulder as a travel lane; closing entrance ramps as required, and utilizing other "active" traffic management techniques.

The project was successful. On only one day did a long queue develop, and it was quickly dissipated when the special crew adjusted work-site traffic control. The "ultimate" measure of project success was achieved -- not one phone call of complaint from the public!

Managing Traffic During Special Sequences in Long-Term Construction Projects

Some construction sequences in freeway rehabilitation projects require closing of the freeway in one direction for 12 to 36 hours. By closing the freeway, sufficient work can be performed without endangering the workers. Tasks typically consist of the placement of concrete median barriers, striping placement and removal, and pavement repair.

Active traffic management permits the successful closure of lanes during the daytime weekday off-peak hours and also on weekends where volumes are high. An example of this took place on the Gulf Freeway. In order to place a concrete median barrier and restripe a section of this 75,000 ADT freeway, a freeway closure of 36 hours was needed during a weekend.

Traffic was detoured from the freeway onto the parallel three-lane frontage road. An exit lamp was temporarily modified to two lanes of capacity (which was never totally utilized). Traffic proceeded through at least two signalized intersections before being allowed to reenter the freeway. The signal timings at these intersections were modified by the City of Houston Traffic and Transportation Department and monitored by the City of Houston Police Department. The entrance ramp could not be modified to two lanes. Through the use of cones and the active presence of police officers, traffic in the middle and right lanes of the frontage road were directed to the next downstream entrance ramp.

Alternative routes also existed. An expansive public information program was executed to increase diversion. Static changeable message signs identifying these alternative routes were placed seven days in advance of the closure. On the day of the closure, the traffic control strategy was supplemented with electronic changeable message signs. In addition, a right-lane closure of the northbound Gulf Freeway was implemented at the I-610 interchange. This lane closure was three miles upstream of the start of the freeway closure setup, and was terminated 1500 feet downstream from I-610. However, the lane closure presented an impression of work zone activity in the area and did increase diversion to I-610.

Because of these measures, it was estimated that over 50 percent of the traveling public that normally would have used I-45 avoided this section on this particular day. Traffic delays never exceeded 10 minutes, which is an acceptable level.

With the contractor increasing equipment and manpower for this operation and the active traffic management strategies utilized, the work was accomplished in 12 hours, which was far less than the original 36-hour estimate. Again, no public complaints were received.

A second application of active traffic management to a construction sequence operation took place on I-10 (Katy Freeway). The ADT in this section was over 100,000. The principal difference between this operation and the one on the Gulf Freeway was the lack of a good alternative freeway route. The operation started at 10:00 p.m. on Saturday and extended to midnight on Sunday. By working during this time period, by executing an expansive public information program, and by actively managing traffic, the needed work was accomplished without incurring an intolerable delay to the motorists. A layout of the detour, which is shown in Figure 1, was circulated to the media.

Conclusions

Several conclusions can be drawn from the use of active traffic management in Houston:

1. Advance public information of impending work zone activity can minimize public complaints and erratic behavior by motorists.

2. The active presence of law enforcement officers in urban highway work zones can minimize erratic behavior by motorists.

3. Carefully planned "active traffic management techniques" can allow work zone activity to be done on high-volume urban highways during daylight hours without severely inconveniencing the traveling public and while providing protection to workers from errant motorists.

4. Cooperation with law enforcement agencies and other affected governmental agencies is a necessary part of the "active management strategies" employed.

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TRAFFIC MANAGEMENT FOR SPECIAL EVENTS

T. E. Young, City of Cincinnati, Ohio

Background

This paper describes the conception, development, construction, and early operational experience with a freeway surveillance and control system on Interstate 75 and the downtown portion of Interstate 71, in Cincinnati, Ohio. (See Figure 1.)

The system was conceived early in 1967, as a part of the Cincinnati transportation, economic, and development goals to locate new sports stadiums near the central riverfront area within walking distance of the Central Business District (CBD).

The Cincinnati CBD is adjacent to the Ohio River; I-71 and I-75 use a common bridge east of the 100-year-old Suspension Bridge. The CBD also has virtually no usable street system for major traffic volumes and, while immediately adjacent to the freeway, it was served directly by only one exit and no direct entrances. In general, the transportation system in the CBD is geographically constrained and has continuing problems because of growing demand. Special events in the CBD further exacerbated difficult traffic management problems.

A freeway surveillance and control system was developed to advise motorists of the traffic and parking conditions in the stadium area on occasions of stadium events, and alternate exits to use for downtown parking when stadium parking was filled. Initially, $1,000,000 was appropriated, upon the recommendation of the City Traffic Engineer, for the surveillance and control system and other traffic control requirements.

Description of Facilities

The major CBD transportation facilities are I-75 and I-71 which are briefly described below along with some of the traffic generation characteristics of the Riverfront Stadium.

I-75

I-75, from approximately four miles north of the downtown area to its junction with I-71 on the north side of the Ohio River, is an eight-lane freeway on which the highest weekday ADT was approximately 170,000 vehicles. Peak weekend traffic volumes exceeded 200,000 per day. The Ohio River bridge is a six-lane, two-level bridge, with three lanes in each direction. At the south end of the bridge is an interchange with a lane drop reducing the I-75 and I-71 combined flow to two through lanes in each direction.

The four-lane segment through the interchange has a capacity deficiency that resulted in a daily southbound backup of traffic of from one-half to two miles in length. On a major summer holiday weekend, backups of as long as twenty miles were recorded. Travel-time studies find four-mile backups represent about one-hour passage time.

By 1980, three additional Interstate bridges were completed and along with major repairs to a surface street bridge, Interstate bypass routes are now available around the metropolitan area, which has helped to reduce the ADT to 140,000.

I-71

I-71 is also a major distributor for traffic to and from the downtown CBD and the freeway system. It is a six-lane facility, with acceleration, deceleration, and/or weaving lanes throughout its downtown alignment. Completion of I-71 through Cincinnati occurred in 1974, and the facility at its highest point carries about 90,000 vehicles per day. A significant shift in volumes occurred with the completion of I-71. Operational problems do occur in both directions of I-71 since northbound traffic from the I-75/I-71 bridge must weave across the entire facility to proceed north on I-71, with the reverse movement required in the southbound direction.

Riverfront Stadium

The Cincinnati Riverfront Stadium was completed in 1970. The stadium provides baseball seating of 52,000 and football seating of 56,000, with standing-room crowds for football of over 60,000. The stadium is a circular structure, 800 feet in diameter, which is surrounded by a trapezoidal-shaped three-level parking garage. A plaza roof forms the primary bus and taxicab loading and parking area serving as the major pedestrian access to the stadium. The parking structure has a parking capacity of 3,000 vehicles, and city-owned surface parking at the site provides an additional 2,000 spaces. Other parking facilities within the immediate area of the stadium provide an additional 1,500 to 2,000 spaces.

Surveillance and Control System

Originally only a surveillance and changeable message sign system were planned for I-75 to assist stadium traffic approaching Riverfront Stadium. The system was to advise motorists of traffic congestion and suggest alternate freeway exits, as appropriate, thereby avoiding major freeway breakdowns. Sampling detectors located at strategic points would feed data on traffic flow to a central computer and base station located in the Stadium Traffic Control Room. The computer would select from a limited number of predetermined messages available at each changeable message sign, and transmit control demands.

After careful and extensive review it was decided in 1970 that the surveillance and changeable message sign system should be expanded and redesigned as a surveillance and control system. The expanded system would thus help manage daily