Abridgment

Field Evaluation of Highway Advisory Radio for Traffic Management in Work Zones

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Studies were conducted at a major maintenance work zone on a rural Interstate highway in Texas to evaluate the use of Highway Advisory Radio (HAR) for traffic management in work zones. The studies consisted of lane distribution, volume and vehicle classification counts conducted before and after installation of the HAR, and a questionnaire survey administered to motorists observed traveling through the work zone. The studies revealed that the HAR had little or no effect on traffic operations in the work zone because of two factors. First, the conventional signing at the work zone was excellent and HAR functioned only as a supplemental source of information. Second, the advanced signing used to encourage motorists to tune to the HAR broadcasts was inadequate in terms of legibility and visibility. Almost 40 percent of the motorists who entered the work zone reported that they did not even see the signing. Even though the HAR system did not significantly affect traffic operations in the work zone, the studies indicate that HAR may have good potential for traffic management in the work zone for certain applications. The HAR hardware performed adequately. Generally speaking, motorists were satisfied with the quality of the broadcasts and supportive of this innovative approach to traffic management in work zones.

Highway advisory radio (HAR) is a means of providing motorists with pertinent travel-related information over their standard AM car radios. Motorists on a freeway are instructed by signs to tune their car radios to a specially designated frequency (usually 530 or 1610 kHz). At that frequency they hear a live or prerecorded message broadcast from a field transmitter. HAR is intended to supplement visual signing (e.g., conventional highway signs and changeable message signs) where signing alone is inadequate, inappropriate, or inefficient.

HAR has been used in at least eight states with varying degrees of success for applications that range from airport parking control to hazard warning. Most installations have been permanent. In the past, the use of HAR has been restricted somewhat by Federal Communication Commission (FCC) regulations. Its use has also been discouraged by certain operational problems (1).

In 1978, the FCC relaxed some of its restrictions on HAR and thus encouraged the use of HAR at temporary work zones. There have also been advancements in hardware and operational technology in recent years (2). HAR now appears to have great potential as a traffic-management tool at some types of work zones; however, experience with HAR at work zones has been limited.

One of the first work zone applications of HAR in the United States was on a four-lane rural section of Interstate 10, midway between Houston and Beaumont, Texas. A temporary HAR system was used to divert traffic around a resurfacing work site. District 20 of the Texas State Department of Highways and Public Transportation (SDHPT) installed and operated this HAR system.

DESCRIPTION OF WORK ZONE

The work zone where the HAR was installed was approximately 14 miles long. There were continuous frontage roads through the work area. The resurfacing work required six months to complete.

The work zone had an average daily traffic rate of 20 000 vehicles. Approximately 20 percent of this traffic was truck traffic and a large percentage was commuter traffic.

Figure 1 shows the innovative traffic-control strategy used to handle traffic at the work site. The use of this strategy was prompted by the heavy traffic volumes at the work site, the large percentage of trucks in the traffic stream, and that the existing frontage roads could not structurally withstand heavy truck loads.

All trucks and buses that weighed more than 5 tons were required to use one side of the mainlanes, which were temporarily converted to a two-lane, two-way roadway. Passing was prohibited for the entire length of this two-way section, and the posted speed limit was reduced from 55 to 50 mph.

Passenger cars, pickup trucks, and vans were diverted from the mainlanes and required to use the parallel frontage roads to travel around the work area. The frontage roads, which normally carried two-way traffic, were temporarily converted to one-way operation. The posted speed limit on the frontage roads was reduced from 55 to 50 mph.

To inform motorists of the special traffic conditions and diversion routes at the work zone, an elaborate system of signs was installed at the work site. Channelization devices, including barrels, vertical panels, and paint markings, were also installed at the diversion points on both ends of the work area.

HAR

From the inception of the innovative traffic-control strategy, it was recognized that the strategy could create a new and unexpected driving experience for motorists. There was considerable uncertainty regarding the safety and operational efficiency of the strategy; therefore, plans were made to use a HAR system to supplement the signs and channelizing devices.

The decision to use HAR was made just before the project began. By the time the HAR equipment had been ordered and installed, and the system licensed, most of the work had been completed. The HAR system was in operation at the work site for less than one month.

Equipment

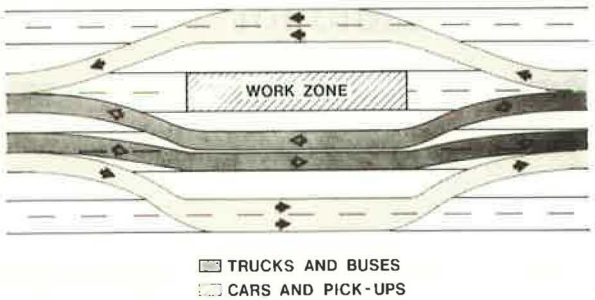
Two 10-watt field transmitters, each with a single, monopole antenna, were installed at the work zone (one on each end of the project). The transmitters broadcast independently but on the same frequency (1610 kHz). The same message was broadcast from each transmitter. The message was recorded on 8-track tapes and played continuously.

The work zone HAR system was operated on a special temporary authority license. The temporary licensing did not require submission of an FCC form 400 or review of the license application by the International Telecommunication Union. The temporary license was granted 63 days after submission of the application.

Messages

The following message was broadcast continuously to

Figure 1. Traffic control strategy in the work zone.



both east- and west-bound traffic from the two field transmitters:

> Attention Interstate Highway 10 traffic: Due to road construction, all traffic must detour three miles ahead. Cars, pickups, and recreational vehicles move to the right lane and prepare to detour to frontage road. Trucks and buses move to left lane and remain on freeway and on the truck detour route. The truck detour route is carrying two-way traffic so do not pass. The detour is about seven miles in length and all traffic will be returned to the freeway after the detour.

There was a 3-4 s silent pause between each repetition of the messages.

Two versions of the message were evaluated during the study. In one version, the message was read alternately by a man and woman who had no experience in public announcing. They spoke at a speech rate of approximately 130 word/min. In the second version, the message was read by a male professional radio announcer who recited the message at a speed rate of 190 word/min.

Both transmitters broadcast an audible message over a distance of several miles. In fact, HAR broadcasts could at times be heard in Beaumont, which was 20 miles from the work zone. This phenomenon was attributed to the presence of high-voltage power lines near the work zone, which amplified the radio signals. The two independent transmissions could be received simultaneously in the middle of the work zone and a jumbled, inaudible message resulted.

HAR Signing

Motorists who approached the work zone from either direction were informed of the HAR broadcasts by three advance-warning signs. The black-on-orange signs had 6-in letters and were mounted just off the right shoulder.

The first sign, located 1.5 miles upstream of the transmitter, instructed drivers to tune to 1610 kHz 1 mile ahead for a radio traffic alert. The next sign was located 0.75 mile upstream of the transmitter and it designated the beginning of the radio broadcast zone. The third sign was 1.5 miles farther downstream and it designated the end of the radio zone.

STUDY OF HAR SYSTEM

Field studies were conducted to evaluate the effectiveness of the HAR system in warning motorists of conditions at the work zone. The studies included lane distribution, volume, vehicle classification counts, and a motorist questionnaire survey. Studies were conducted the week before the HAR system was installed and the week after.

A limited questionnaire survey was developed and administered to 53 motorists in the work zone to evaluate: (a) percentage of motorists who have an operative AM radio, (b) driver familiarity with the work zone, (c) motorist's opinion of the HAR signing, and (d) motorist's opinion of the HAR messages. The questionnaire also was designed to estimate the percentage of motorists who saw the HAR signing and the percentage that attempted to tune to the HAR station.

Results

Lane distribution, volume, and vehicle classification counts revealed that the innovative traffic-control strategy used at the work zone was very successful. The conventional signs and channelizing devices used at the work zone encouraged up to 94 percent of all cars, pickup trucks, and vans to use the frontage roads and the same high percentage of trucks to use the mainlanes. When the HAR system was installed, these percentages rose slightly to 97 percent.

The effectiveness of the conventional signs and channelization devices made it difficult to evaluate the influence of the HAR on traffic-flow patterns in the work zone. The results of the questionnaire survey, however, provide insight into driver reaction to the HAR signing and messages. The survey results also suggest some apparent deficiencies in the HAR system.

Survey Findings

Apparently, the HAR signs were too small and lacked target value. Twenty-one of the 53 motorists (40 percent) surveyed said they did not see the HAR advance signing. Many motorists who saw the signs complained that they were too small or hidden by larger, more conspicuous work-zone and freeway guide signs. Advance signing for an HAR system must be adequate if the system is to be effective.

Only 14 of the 32 motorists (44 percent) who saw the signs attempted to tune to the HAR broadcast. The work zone was on a heavily traveled commuter route and more than half of the drivers surveyed had traveled through the work zone several times. Many of these motorists said they failed to tune in because they did not desire additional information about the work zone. This finding suggests that HAR should not be used to broadcast repetitious information to familiar drivers. A few motorists who saw the signs did not tune in because their car radios were broken.

Most of the drivers who attempted to tune to the HAR broadcasts were able to hear the message, and they rated the message quality as fair to good. Generally speaking, most motorists surveyed favored the use of HAR at some work zones.

DISCUSSION OF RESULTS

HAR has potential as an effective tool for traffic management in work zones. Guidelines need to be developed for the use and operation of HAR in work zones, however. These guidelines should identify conditions that warrant the use of HAR at work zones. These conditions might include the following:

1. Delay--work zones where delay is excessive and more favorable alternate routes exist,
2. Signing effectiveness--work zones where normal construction warning techniques are ineffective or inappropriate, and

3. Accidents--work zones that have higher than normal accident or fatality rates.

These HAR conditions should be established for each specific work zone and should be contained in the traffic control plan. Field studies should also be developed and scheduled routinely throughout the life of the project. These field studies would determine the need for additional information for the motorist and when an HAR system may be applicable in terms of the defined conditions.

In addition to the guidelines, HAR licensing procedures need to be improved. A license for an HAR system currently takes up to six months to obtain. This time should be reduced if HAR and HAR guidelines are to be used effectively and regularly at work zones.

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REFERENCES

1. S.H. Richards, C.L. Dudek, and J.M. Mounce. Human Factors Requirements for Real-Time Motorist Information Displays, Vol. 16: Feasibilty of Audio Signing Techniques. Texas Transportation Institute, College Station, Res. Rept. FHWA-RD-78-20, Aug. 1978.
2. W.F. Dorsey. Highway Advisory Radio Potential Site Survey and Broadcast Equipment Guide. Office of Research and Development, Federal Highway Administration, April 1979.

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Abridgment

Use of Chevron Patterns on Traffic Control Devices in Work Zones

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The objectives of the research were to select the most effective design for the chevron pattern and to evaluate the effectiveness of selected chevron designs under road conditions as compared with currently used designs. In a supplemental test, the effectiveness of the New Jersey concrete barrier was compared with that of the channelizing devices studied. In general, the selected chevron designs were preferred over the currently used patterns. Driver response was found to be not strongly dependent on the channelizing device employed in the taper. A supplemental taper of channelizing devices was found effective for use with the New Jersey concrete barrier.

The objectives of this research were to select the most effective design of the chevron pattern and to evaluate the effectiveness of selected chevron designs under road conditions. The evaluation compared the effectiveness of traffic control devices bearing the chevron design with that of barricades and channelizing devices that bear the currently used stripings.

The scope of the research was limited to the use of barricades and channelizing devices to provide directional guidance.

SELECTION OF A CHEVRON DESIGN

The groups of chevron designs shown in Figure 1 were rated subjectively by observers in vehicles at two points--the point of detection (500 ft) and the point of legibility (300 ft). The demonstrations were conducted under both day and night conditions; 32 observers participated. At night, the groups of designs were observed under both high- and low-beam headlights.

The observers rated the pattern groups at the point of detection in terms of (a) the ability to command attention, (b) the ability to warn and alert, and (c) overall appearance. At the point of legibility the pattern groups were rated for (a) the ability to convey a clear, distinct message; (b) the ability to guide and direct; and (c) overall appearance. The sets of parameters were summed for each pattern to obtain two cumulative measures that were compared with those for the other patterns in the group. The mean and standard deviation were calculated and the Wilcoxon ranked sign test was used to statistically rank the patterns with a 0.05 level of significance for a two-sided test. The patterns identified by an asterisk in Figure 1 were selected for field testing.

FIELD TESTS

The measure of effectiveness deemed most appropriate for the evaluation of channelizing devices under road conditions was the position of the motorists' lane changes. A right-lane closure on a four-lane divided highway was desired because most motorists drive in the right lane and for them a lane change in the work zone would, therefore, be necessitated.

Procedure

The zonal system shown in Figure 2 was devised to facilitate the collection of data on a driver's lane change as a response to a specific channelizing device. The 350-ft length of the zones is based on the estimated time required to change lanes, which is 4-5 s (1). Zone 1 included the point of detection (500 ft), and zone 2 included the point of leg-