

CHANGEABLE-MESSAGE SIGNS IN OHIO

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In Ohio we are involved in several active freeway operational projects that present challenging opportunities for the traffic engineer. One such project in Cincinnati is a proposed experimental freeway surveillance and traffic control project.

Downtown Cincinnati is served by the freeways shown in Figure 1: I-75, which is a north-south route; US-50, which is a west (Sixth Street Expressway) and east (Columbia Parkway) route; I-71, which is opened north of the proposed stadium to Broadway and ultimately will be constructed to serve the northeastern area of metropolitan Cincinnati; and I-471, which will serve the eastern and southeastern area after it is entirely completed. I-71 and I-75 now carry or will carry most of the traffic into downtown Cincinnati.

The initial section of freeway designated as an Interstate route in Cincinnati is a portion of I-71 approximately 3/4 mile in length running east and west between the central business district and the Ohio River from Central Avenue to Broadway. It is a 6-lane, depressed freeway and is locally designated as Fort Washington Way. It currently carries US-50 and was designed and built to standards considerably lower than those used for current Interstate routes.

I-75 (Mill Creek Expressway) immediately west of Fort Washington Way is an 8-lane, north-south freeway constructed to Interstate standards and was opened to traffic approximately 6 years ago. This freeway junctions and overlaps I-71 south over the 2-level Brent Spence Bridge across the Ohio River into Kentucky. The bridge carries 3 lanes directional southbound (upper deck) and northbound (lower deck). Although designed to Interstate standards, I-75 temporarily carries I-71 traffic to and through the city as the only north-south freeway. This situation will continue until approximately 1973 when I-71 will have been completed in Hamilton County.

EXISTING TRAFFIC AND OPERATIONAL CONDITIONS

At the present time there are daily afternoon peak-hour breakdowns in traffic flow on I-75 southbound approaching the I-71 junction and downtown Cincinnati (Fig. 2). The congestion can be attributed to

1. Close proximity of exits to Seventh Street, Fifth Street, and I-71 to each other;
2. Left exits to Fifth Street and I-71 connection;

Figure 1. Cincinnati freeway system.

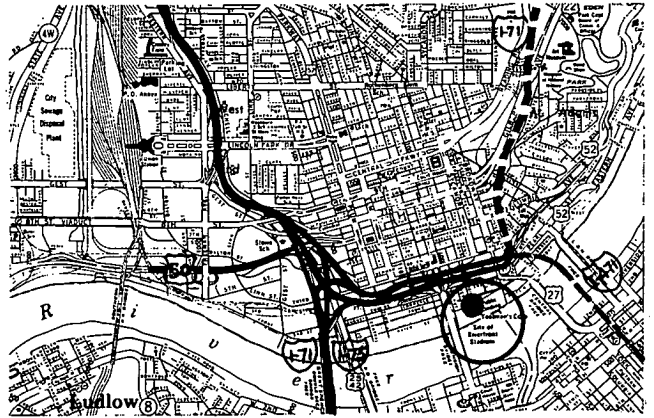


Figure 2. Junction of I-75 southbound with I-71.

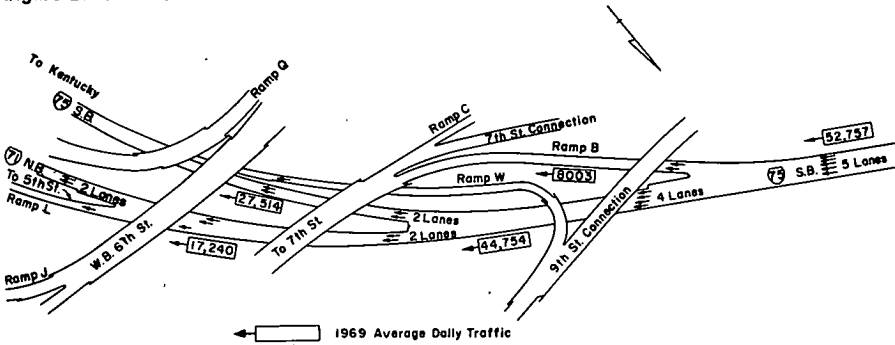
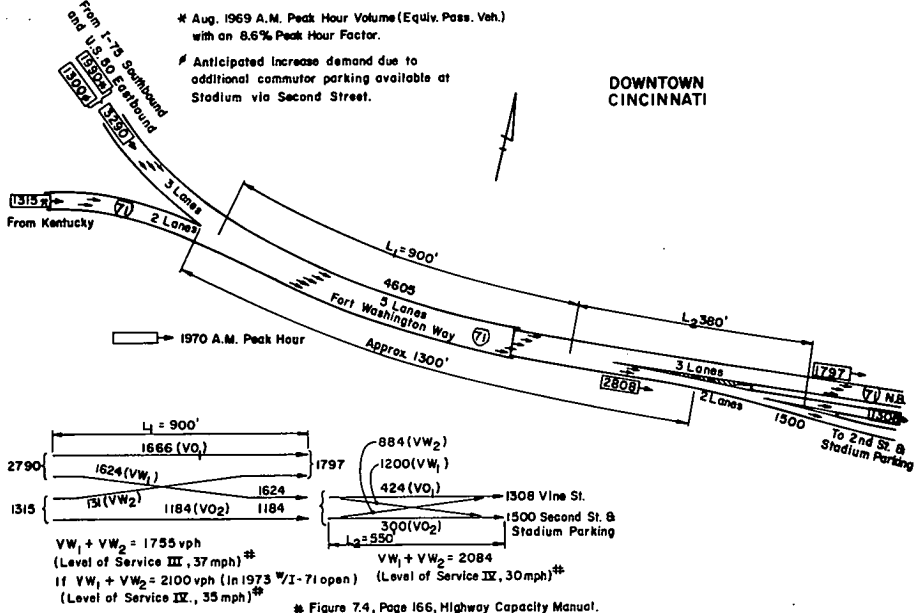


Figure 3. I-71 northbound compound weave section.



3. Lack of route sign continuity at the I-71 junction, which occurs on a horizontal curve to the right (four directional lanes diverge, and the left 2 lanes connect to I-71 northbound and the right 2 lanes carry through traffic on I-75); and

4. Limited capacity on the I-71 and I-75 Brent Spence Bridge over the Ohio River where 3 lanes reduce to 2 immediately south of the bridge.

The alignment of the freeway and the lane reduction at the junction have trapped many motorists who desire to remain on I-75 but, in spite of directional signs, find that left lanes depart to I-71. No degree of traffic control measures can ever completely overcome the unusual geometrics confronting motorists unfamiliar with this situation at that location.

A potential operational problem exists on I-71 northbound (Fort Washington Way) for traffic entering from the left from I-75 southbound and destined to the Second and the Vine Streets exit on the right (Fig. 3). Exiting traffic must execute a compound weave across I-71 northbound traffic in a weaving section where there is a dropped-lane condition because of the local exit. That particular weaving section is operating at approximately 25 mph at the present time during the morning peak periods even though it carries only local traffic from Kentucky traveling north on I-71 into downtown Cincinnati. Through traffic on I-71 is temporarily carried on I-75 as previously mentioned. Because of the lack of route sign continuity on I-71 on Fort Washington Way, this compound weaving section will be severely taxed operationally when through traffic is permanently carried on I-71.

SPORTS STADIUM PARKING FACILITY AND ITS EFFECT ON TRAFFIC

The Sports Stadium seats approximately 55,000 people at capacity and has on-site parking provisions for only about 4,500 vehicles. Additional parking is available in the central business district in public and private garages. The city also operates the on-site parking facility at a very reasonable cost rate for daily commuter parking, and most of the 4,500 parking stalls are in demand for this purpose.

The need for a freeway surveillance and control system is, therefore, based on an analysis of the cumulative effects on freeway operation of normal daily peak-hour and peak-period volumes occurring just prior to and following major stadium events.

Daily Peak-Hour Freeway Operation

Figure 2 shows that the daily volume of traffic carried on southbound I-75 indicates that the freeway is currently experiencing restrictions and resultant congestion due to traffic and the operational factors previously described.

The addition of traffic to the parking facilities is analyzed (Fig. 3) with a "theoretical" compound-weave operating speed of 30 mph, assuming conservatively that there are only 1,500 vehicles during the morning peak hour desiring to travel via I-75 southbound and to make the connection to I-71 northbound and weave across traffic to the Second Street exit. This is the shortest and most direct route to the stadium parking site, and the weaving speed will be drastically reduced if, say, 2,000 to 3,000 vehicles desire to make that maneuver. There is also a likelihood of weaving accidents, and the ramp capacity at the Second Street exit (approximately 1,600 vph) will be exceeded.

Unfortunately, the problem that must be solved if there is any breakdown in traffic flow in the weaving section or the ramp terminal (Second Street) is that motorists on a separate freeway, I-75, must be alerted to the problem and notified sufficiently in advance to permit choice of an alternate route to their destination.

As pointed out previously, the geometrics facing motorists on I-75 southbound approaching I-71 and downtown Cincinnati are not conducive to satisfactory traffic operation and indicate that a surveillance and control system would be of considerable help to traffic engineers, enforcement officials, and motorists when congestion occurs. Similarly, Figure 3 shows that the lack of correlation of the through route (I-71 northbound) with the geometrics forces an unusual maneuver for motorists desiring to remain on the freeway to avoid the exit to Vine and Second Streets. The accident potential on this weaving section will not be fully realized until I-71 is opened to through traffic. At that time, optimum surveillance and control measures will be essential.

Peak Periods Prior to and Following Stadium Events

I-75 southbound is expected to bring 46 percent of the existing traffic to the stadium, and the Second Street exit from I-71 northbound will be severely taxed even for those fortunate few who arrive in time to park in one of the 4,500 spaces available at the stadium site. Parking will also be available in the central business district. However, it will be necessary to keep motorists on all freeway approaches to downtown Cincinnati advised as to which exits may be taken to obtain parking for the stadium event. This dictates a need for surveillance and control of traffic to properly accomplish the objective and to minimize delays and congestion both on the freeway and the city street systems.

Similarly, following stadium events, the routing of traffic and control of freeway entrance ramp traffic will also be necessary to handle traffic as efficiently as possible for freeway-destined vehicles.

Surveillance and Control System Needs

The analyses given above indicate the need for a system of traffic control and surveillance that is flexible enough to handle the following operational needs:

1. Warn and guide motorists to diversion routes during peak and normal hours of the day when an accident or congestion occurs, and
2. Guide motorists to diversion routes for parking when events are held at the Sports Stadium and capacity of the on-site parking or Second Street ramp is exceeded.

PROPOSED FREEWAY SURVEILLANCE AND TRAFFIC CONTROL SYSTEM

The primary objectives of the surveillance and traffic control system are related to the traffic demands or congestion generated by the major events that will occur at the Sports Stadium; integrated features permit normal weekday peak-hour surveillance and traffic control measures to minimize congestion.

The original freeway traffic surveillance and guide sign system proposed by the City of Cincinnati pertained only to needs for controlling traffic for the major stadium events such as football or baseball. Through a series of meetings among city representatives, its consultant, and the Ohio Department of Highways staff, a system was developed and agreed to. The proposed freeway surveillance and traffic control system will consist of the elements listed in the following sections. They incorporate the features discussed above and consider a minimum number of separate sign-support hazards to the motoring public.

Traffic Control System

The traffic control system will utilize a series of changeable-message, matrix sign units located strategically on the freeway system approaching the downtown Cincinnati area. The 2 critical freeway sections involved are located at the southbound I-75 junction with I-71 and the northbound I-71 (Fort Washington Way) compound weave approaching the Second Street exit.

To provide adequate warning to motorists, the proposed changeable-message sign units will be located on I-75 north of the I-71 junction, on US-50 west of I-75, and on I-71 northbound (Fort Washington Way in advance of the Second Street exit). The proposed locations and several typical alternate sign messages are shown in Figure 4.

The proposed system will provide separate advance-warning matrix sign units, as shown in Figure 5, to notify motorists of any adverse freeway conditions ahead and to give exit numbers for parking accommodations for Sports Stadium events, alternate traffic diversion routes, lane closures if the freeway is congested, and commuter parking diversion routes. Matrix signs are proposed in order to permit maximum flexibility in messages that might be required.

Confirmation changeable-message units will be incorporated into the ramp exit gore directional signs as shown in Figure 6 to maintain fluid and current information to motorists if conditions change beyond the previous warning or guidance message observed.

Figure 4. Typical variable-message sign displays.

LOCATION	SIGN NO.	CONGESTION BACKED UP FROM BRIDGE, PAST EXIT 5	FT. WASHINGTON WAY BLOCKED INCL EXIT 1	CONGESTION BACKED UP, PAST EXIT 7	(FOOTBALL) STADIUM PKING PRPD DTWN.PKG FULL TO SEV7TH
OVERHEAD (EXIT 2) AT VINE-2 ND (VINE SB EXIT 15 (2 ND))	1b	DNTOWN	DNTOWN	DNTOWN	DNTOWN PKING
	1c	ALT I-75	DNTOWN	ALT I-75	DNTOWN PKING
	1d	STADIUM	ALT I-7I, US-50	STADIUM	STADIUM PKING
OVERHEAD (EXIT 2) IN ADVANCE OF (EXIT IN) VINE-2 ND EXIT	3b	DNTOWN	DNTOWN	DNTOWN	DNTOWN PKING
	3c	ALT I-75	DNTOWN	ALT I-75	DNTOWN PKING
	3d	STADIUM	ALT I-7I, US-50	STADIUM	STADIUM PKING
E. B. FT. WASHINGTON WAY	12-1	ALT I-75 EXIT IN DNTOWN EXITS 2,1N	ALT I-7I, US-50 KEEP LEFT DNTOWN EXITS 2,1N	ALT I-75 EXIT IN DNTOWN EXITS 2,1N	STADIUM PKING PREPAID ONLY DNTOWN PKING EXITS 2,1N
FIFTH ST. GORE (EXIT 3)	21a	DNTOWN	DNTOWN	DNTOWN	DNTOWN PKING
SEVENTH ST. GORE (EXIT 4)	33c	DNTOWN	DNTOWN	DNTOWN	DNTOWN PKING
OVERHEAD IN ADVANCE OF	41b	(blank) (blank) ALT I-75 USE EXIT 1	I-7IN, US-50E BLOCKED USE EXIT 3	(blank) (blank) ALT I-75 USE EXIT 1	STADIUM PKING PREPAID ONLY DNTOWN PKING EXIT 4
FREEMAN AVE. GORE (EXIT 5)	45c	ALT I-75	ALT I-7IN, US-50E	ALT I-75	STADIUM PKING
LINCOLN PK. DR. GORE (EXIT)	49c	ALT I-75	DNTOWN	ALT I-75	DNTOWN PKING
AT FINDLEY	50a	I-75 CONGESTED ALT I-75 USE EXITS 6,1	I-7IN, US-50E BLOCKED USE EXITS 5,3	I-75 CONGESTED ALT I-75 USE EXITS 6,1	STADIUM PKING PREPAID EXITS 5,1 DNTOWN PKING EXITS 6,5,4
WESTERN GORE (EXIT 7)	52b	ALT I-75	(blank)	ALT I-75	(blank)
S. OF MARSHALL	64a	I-75 CONGESTED ALT I-75 USE EXITS 7,1	I-7IN, US-50E EXITS 5,3 DNTOWN EXITS 6,4	I-75 CONGESTED ALT I-75 USE EXITS 7,1	STADIUM PKING PREPAID EXITS 5,1 DNTOWN PKING EXITS 6,5,4
AT HOPPLE	71-1	I-75 CONGESTED ALT I-75 USE EXITS 7,1	I-7IN, US-50E BLOCKED USE EXITS 5,3	I-75 CONGESTED ALT I-75 USE EXITS 7,1	STADIUM & DNTOWN PKING USE EXITS SHOWN
E. B. 6TH ST. EXPWY	201c	I-75 SOUTH CONGESTED USE I-7I EXIT IN	I-7I, US-50E BLOCKED USE MEHRING WAY	I-75 SOUTH CONGESTED USE I-7I EXIT IN	STADIUM PKING PREPAID ONLY DNTOWN PKING EXIT 5 TH. ST.
E. B. 6 TH. ST. EXPWY at I-7I, US-50	209c	ALT I-75	BLOCKED	ALT I-75	(blank)
E. B. 6 TH. ST. EXPWY at 5TH. ST. EXIT	209c	(blank)	ALT I-7IN, US-50E	(blank)	DNTOWN PKING

EXIT NUMBERS
S. B. & E. B. EXIT NO. CODE
15-SECOND ST.
1N-VINE ST.
2-MAIN ST.
3-FIFTH ST.
4-SEVENTH ST.
5-FREEMAN AVE.
6-LINCOLN PARK
7-WESTERN AVE.

Figure 5. Variable message of full matrix sign unit.

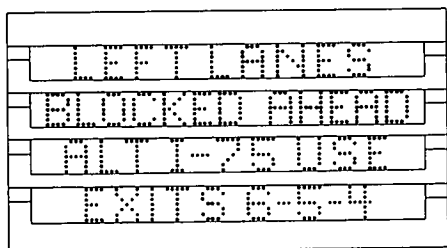
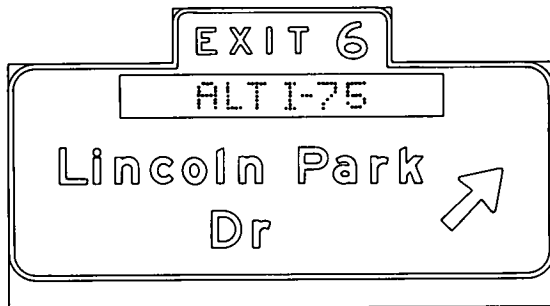


Figure 6. Variable message of one-line matrix sign unit.



Several units will be incorporated into advance directional signs on I-71 (Fort Washington Way) because of inadequate longitudinal placement opportunities on the freeway.

The proposed integrated system has the following advantages:

1. Minimizes the need for additional sign-support hazards to motorists,
2. Has economy in cost of installation by requiring fewer sign supports, and
3. Uses exit numbers to simplify the reference to specific exit names.

Surveillance System

Television cameras are placed at 5 strategic locations to provide visual aid to control system operators in order to provide immediate observation of freeway congestion or accidents and permit expeditious alleviation of cause of delay and dispatch of enforcement or emergency vehicles. The cameras were installed by the City of Cincinnati and are currently operational.

The field detection of real-time conditions will be accomplished by installation of loop detectors at appropriate locations on the freeway system including ramps where volume and speed factors are considered significant. Double-loop installations on the freeway will be utilized to obtain speed data at locations considered to be essential to the operation of the system.

Traffic Control Center

The control center is located in the Sports Stadium and will have facilities for receiving detection data and television pictures and for transmitting appropriate variations to changeable-message sign units for control of traffic by computer. Capabilities will also be available to alert enforcement officials for dispatch of emergency vehicles when required.

MAINTENANCE AND OPERATION

The City of Cincinnati will be responsible for maintaining the operation of the proposed freeway surveillance and traffic control system.

SUMMARY

It is believed that the experimental freeway surveillance and traffic control system will provide meaningful practical benefits to motorists by increasing operational freeway efficiency and minimizing delay through use of variable-message warning and guidance signs for traffic diversion by an automated traffic responsive system.

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