Interchange Ramp Color Delineation and Marking Study

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At two study locations, color coding was applied to edgemarking, delineation, and signing; blue was used for advance exit signing. Although white coding was applied to the through roadway and yellow to the entrance ramps, evaluation was made only on the blue coding for the exit ramps. Evaluation was based on observations made before and after color installation, with emphasis on erratic driving practices and lane change movements. Night- and daytime comparisons were made. Driver interviews were conducted to determine public reaction to the general principle of color coding and the specific devices used.

Analysis of the results revealed that channeling of traffic into exiting lanes occurred farther in advance of the exit ramp with a reduction of 30 to 32 percent in erratic driving maneuvers. Public acceptance is indicated by the fact that 90 percent of the motorists interviewed stated they received definite benefit from the color scheme.

•THE ADVENT of the freeway system with its variety of interchange designs and higher travel speeds has created a need for instant communication to provide guidance to motorists at interchange areas. High-speed traffic requires "glance" notification to permit advance positioning for exit maneuvers. This system of communication must result in increased convenience and comfort and reduced confusion, and by so doing, contribute to the overall safety of freeway motorists.

A system of color coding of interchange ramps has been proposed to provide this means of notification, communication, and guidance for the motoring public. This pilot project was conducted to determine its effectiveness.

PURPOSE

The purpose of the pilot project was to evaluate a color coding system, consisting of edgemarking, delineation, and signing, and to determine whether further research into possible general application of the system is warranted.

RELATED RESEARCH

Experimentation with color coding at interchange ramps has been conducted by the Minnesota Department of Highways and the Florida State Road Department. In the Minnesota experiment (conducted in cooperation with the Minnesota Mining and Manufacturing Co. and reported by Mathew J. Huber, Yale Traffic Bureau, 1960), colored paint was applied to the entire surface of the ramps and corresponding delineators were installed. In the Florida experiment (1), only colored edgemarking was applied with corresponding delineators. In both experiments, white color indicated through roadway, yellow was used for on-ramps, and blue for the off-ramps. Both experiments

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reported that the application of color coding provided definite benefits for motorists. There was a decided reduction in confusion for both exiting and through traffic. "Glance" notification in advance of the interchange permitted earlier alignment of exiting traffic.

These experiments generated widespread interest in the color coding of interchange ramps for better notification and guidance to freeway motorists. This project was planned in 1961 and initiated in 1962 with preliminary material investigations Michigan added the factor of color coding to the exit and directional signs, whereas the previous projects were concerned only with edgemarking and delineation. Since then, other states have become interested in similar projects. Ohio has experimented with color edgemarking at interchange ramps on a limited basis. Oregon initiated a project in the summer of 1964 consisting of the application of color coding to five successive interchanges. This project included the exit signs at the ramps in the color system. Vehicle placement and speed measurements will be conducted in the Oregon study.

These latter projects continued the color designations in the color system initiated in Minnesota and used in the Florida and Michigan projects

SELECTION OF COLORS

The selection of colors for this pilot project was based on compatibility and consistency with present highway usage, the colors already selected in the related projects, and a review of colors available for use. This review resulted in the retention of white for the through roadway, blue for the exit ramps, and yellow for the entrance ramps. The white edgemarking and clear delineators are already used to delineate the through roadway. The use of yellow for the entrance ramps is a natural extension of its use as a warning or caution color. Blue for exit ramps provided a distinct contrast to the white and yellow; its subdued characteristic emphasized the white of the through roadway and still provided sufficient differentiation and attraction. In addition, blue is the standard background color for Interstate "Rest Area" and "Gas-Food-Lodging" signs, as well as "State Police" signs in Michigan All of these signs imply an exiting movement from the freeway. The selection of the colors for the Michigan project was also influenced by the Minnesota and Florida projects. The selection by these projects was definitely supported by this review, and their use in the Michigan project indicates complete agreement with their choice.

REVIEW OF MATERIALS

A review of existing materials for edgemarking and delineators was conducted to insure a high level of reflectorization, particularly for the yellow and blue. As a result of this review, it was decided to experiment with the high-intensity edgemarking paint mixes which had recently become available in all three colors.

Review of the delineators was also necessary. The standard white or clear 3-in. delineator presently used on Michigan highways was entirely satisfactory for the through roadway delineation. Further investigation of the yellow and blue delineators was carried on to find an economical and easily applied material with satisfactory reflectance. From inspection of several types of material sizes and shades of colors, the materials which filled these requirements were those with exposed-lens reflectorization of white plastic sealed to yellow or blue plastic plaques. (New types have been developed subsequent to this investigation and will be inspected.) The yellow and blue delineators were 4- by 10-in. plaques using signal sheeting material constructed as above. This material and construction alone provided sufficient reflectance for the yellow and blue delineators.

To complete this evaluation, blue, yellow, and white high-intensity reflectorized edgemarking was placed at the study locations in the fall of 1962 to observe placement and performance. Blue and yellow delineators were also installed for experimental observations. Inspection of this experimental painting after 1 yr revealed that the white edgemarking had retained its effectiveness, the yellow edgemarking had become slightly deteriorated, and the blue edgemarking had deteriorated to the point that it had become almost indiscernible. Further inspection revealed that the blue and yellow edgemarking had been placed on rather new concrete, and surface scaling had caused this condition.

LOCATION OF PROJECT

The testing was conducted on US 27 at two freeway interchanges involving left-hand business route exits into Mount Pleasant and Clare, Mich. The interchange design at

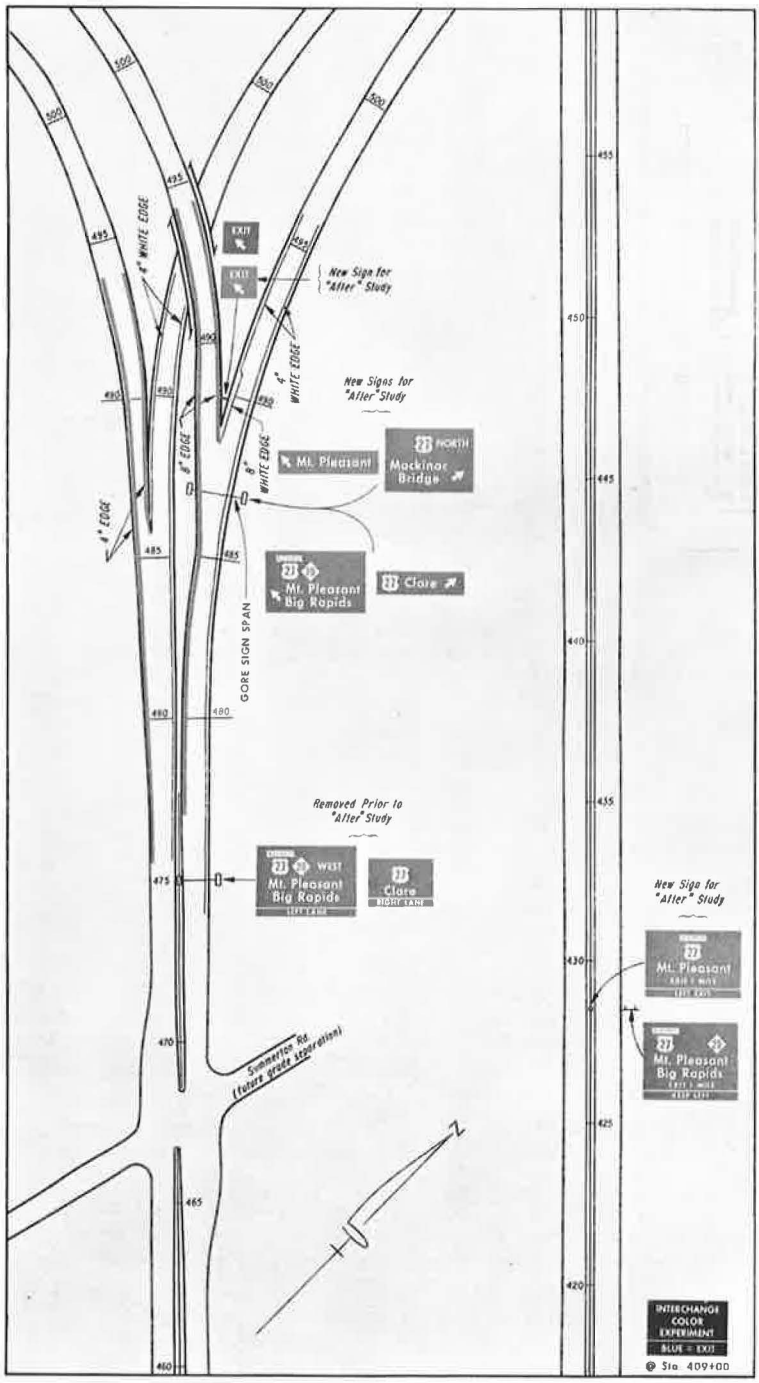

Figure 1. Mount Pleasant interchange.

these locations consists of a 2-lane exit straight ahead and a 2-lane through route with sufficient curvature to conceal its continuation. This design creates difficulty for motorists trying to distinguish the exit ramp from the through roadway. Figures 1 and 2 show the geometric design of these locations and the application of the color system.

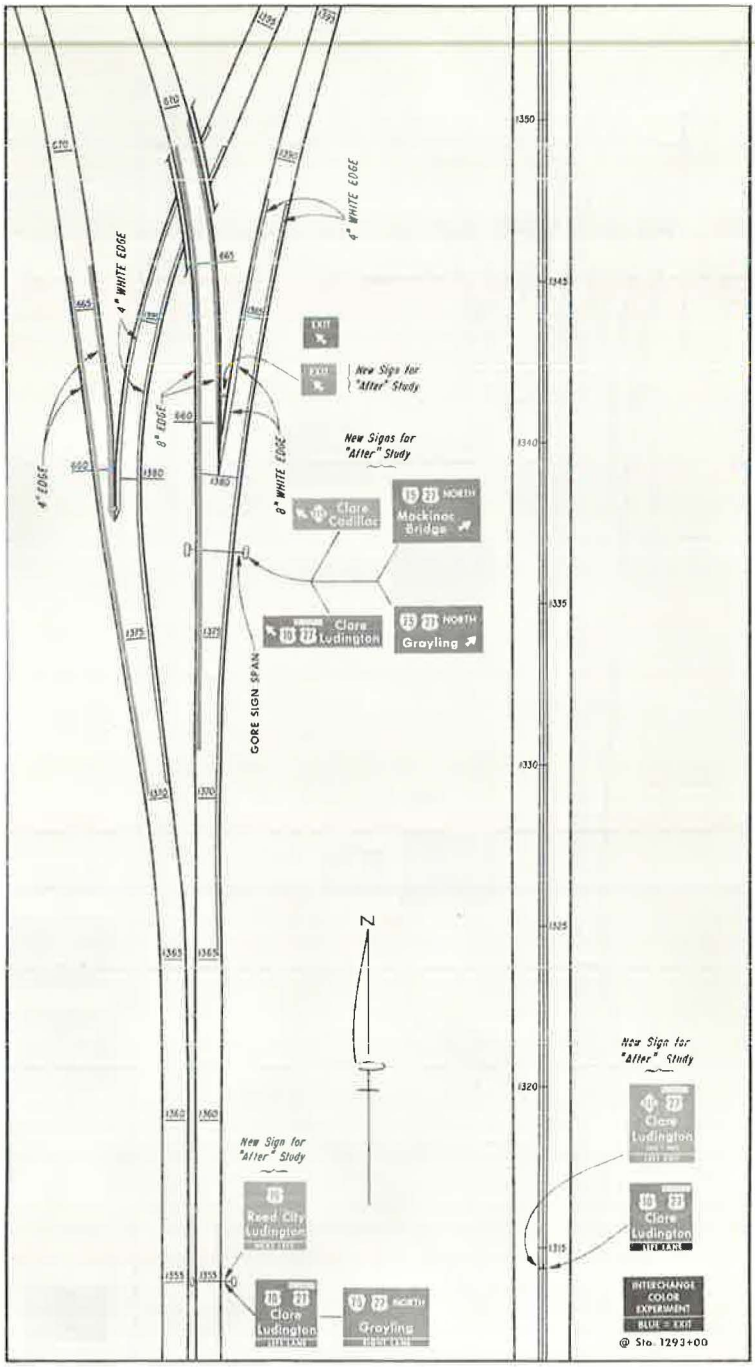

Figure 2. Clare interchange.

In view of the existing difficulty, changes in signing had been contemplated. These interchanges permitted the use of blue background for exit and directional signing as an added feature. The left-hand exits, their unfamiliarity to motorists, and the alignment perspective of the through roadway and the 2-lane ramp provided an extreme test for the color coding system.

COLOR SYSTEM DETAILS

Edgemarking

The edgemarking for the exit ramps consisted of an 8-in. high-intensity blue reflectorized stripe which started about 1,000 ft in advance of the gore and continued along the left side of each exit to approximately 750 ft beyond the gore. On the right side of the ramp, the blue edgemarking was applied from the gore to about 750 ft beyond.

A 4-in. high-intensity white reflectorized edgemarking was applied on the right edge of the through roadway from about 1,500 ft in advance of the gore to 750 ft beyond. On the left side, the white edgemarking was applied for 750 ft beyond the gore.

For the entrance ramps in the southbound direction, a 4-in. high-intensity yellow reflectorized stripe was applied on both sides of the roadway from 750 ft in advance of the gore to the edge of the through roadway on the acceleration lane. The southbound through roadway was edgemarked on both sides with 4-in. high-intensity white for approximately 1,100 ft in advance of the entrance ramp. The right side marking ended at the near side of the entrance ramp. The marking on the left side continued to a point opposite the yellow marking at the end of the entrance-ramp acceleration lane.

Delineators

Delineators of corresponding colors were used as follows: 3-in. white or clear for through roadway and 4- by 10-in. plaques of yellow and blue for the on- and off-ramps, respectively. In addition, the blue and yellow delineator posts were painted with corresponding nonreflectorized paint to assist in daytime delineation.

It should be noted that the experimental delineators had been removed through the assistance of an interested public. Thus, the original conditions were present for the before-study observations.

Signing

The new exit and directional signs at the two study locations were replaced utilizing blue Scotch-Lite background with directly applied signal sheeting legend.

The advance directional signs were installed on the median or left side of the roadway to serve the left exits at both study sites.

Overhead signing with a blue background pertaining to the exit ramps was placed over the left lane. A sign span at Mount Pleasant was in place 1,200 ft in advance of the gore sign during the before phase. However, this span was removed before the after observations because a grade separation to be constructed in 1964 would hide the sign's message from the driver. This sign, as shown in Figure 1, directed left-lane traffic to Business US 27 and M-20 west, Mount Pleasant and Big Rapids and right-lane traffic to US 27, Clare.

Legend changes were also incorporated in the new directional signs. In the before phase at Clare, all three directional signs, including the ½-mi advance sign, showed US 10, Business US 27, Clare, and Ludington as the exit destination. In the after phase, the 1-mi and the gore signs presented the directional information for Clare and Cadillac. At the gore, Mackinac Bridge replaced Grayling as a confirming through message. The ½-mi sign was changed to read: "REED CITY AND LUDINGTON NEXT LEFT." All legend changes are shown in Figures 1 and 2. Signs reading "INTERCHANGE COLOR EXPERIMENT" were installed in advance of the study locations.

EVALUATION OF COLOR SYSTEM

Study Procedure

The evaluation of the color system was limited to the northbound interchange areas including the two left-exit business routes into Mount Pleasant and Clare, respectively. This evaluation was based on a vehicle movement study and on driver interviews.

Vehicle Movement Study. —Vehicle movement observations were made before and after the color installation, with emphasis on the erratic driver maneuvers and lane changes. These vehicle movements were recorded on a field sheet similar to that shown in Figure 3, which presents the study section in advance of the bifurcation and is

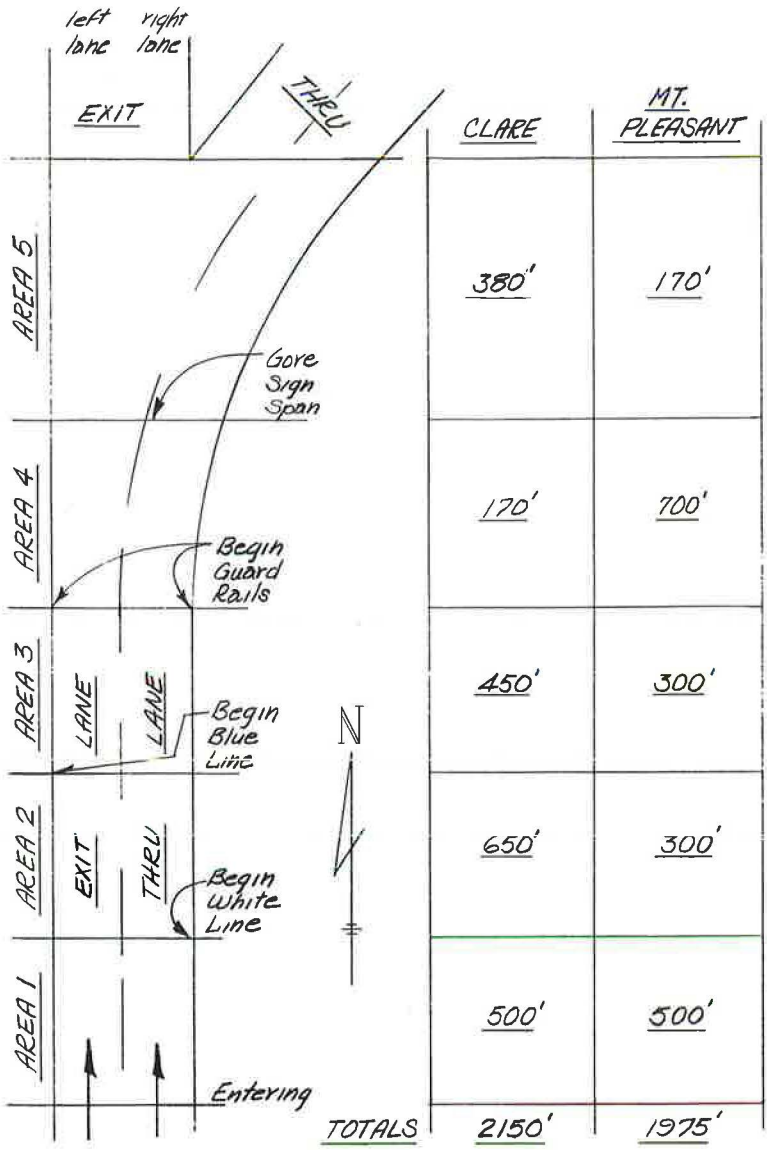

Figure 3. Vehicle placement study field sheet.

broken down into Areas 1 through 5. The movements of vehicles as they entered the study section were traced through the five areas. Vehicle movements were observed during the day and at night. Vehicles obviously making a passing maneuver were not recorded. Vehicle movements through the area to the through roadway or the exit ramp that did not involve a lane change were also recorded.

Extreme erratic driving maneuvers were recorded separately. To avoid any question of judgment regarding what constituted an erratic maneuver, it was decided that unless it was an obvious movement, any vehicle that made two lane changes within the study section would be so classified. Within the length of the study sections, two lane changes would realistically constitute an erratic maneuver. This classification, therefore, included any extreme movements such as stopping and backing up from either the exit ramp or through roadway, radical movements across the gore, and vehicles stopping on the freeway proper and then proceeding. It is easily apparent that difficulty would arise in judging as an erratic maneuver a vehicle movement that appeared to be hesitant, moved laterally within a lane, or reduced speed. These could have resulted from other causes. This classification could not detect this sort of maneuver or the confused or lost driver who may have appeared to an observer to be fully aware of his direction of travel. This erratic maneuver classification was based on an objective indication as much as possible.

Traffic volumes were obtained during vehicle movement observations before and after to provide a control for comparison. The vehicle movement observations before and after were taken in July and October 1963, respectively. This resulted in a difference in traffic volumes since the after vehicle movement observations were not taken during the summer tourist traffic. The time required for the application of the color coding system caused this scheduling. Since the reduction in traffic volume of the after phase may have influenced vehicle movements, the movements were calculated and compared as a rate of movement per 1,000 veh of the total traffic. The vehicle movements were observed during four daytime hours (9:00 a.m. to 11:00 a.m. and 2:00 p.m. to 4:00 p.m.) and three nighttime hours (9:00 p.m. to midnight) for 2 days each before and after the color system was installed. These observations covered a total period of 1 wk.

Driver Interviews. —Driver interviews were conducted to determine public reaction to the general principle of color coding interchange ramps. Interviews were conducted day and night over a 1-wk period (third week of September 1963) following the installation of the color. Interviews were separated by driver's knowledge of the area. Familiar drivers were classified as those drivers who had driven the area 5 times or more, and unfamiliar drivers were those who had driven the area 4 times or less. Figure 4 is the interview form used.

Study Results

Vehicle Movement Study. —Vehicle movements for Mount Pleasant and Clare were considered separately since the geometric characteristics are quite different. Also, for purposes of analysis, erratic maneuvers were considered independently of the total vehicle movements.

Table 1 gives a comparison of the total erratic maneuvers observed at Mount Pleasant and Clare, respectively. The day and night erratic maneuvers are combined due to the limited nighttime data. The indicated reductions in total erratic maneuvers are highly significant. In addition, no extreme vehicle maneuvers, such as a vehicle stopping on the freeway and backing up, occurred in the after phase. It should be noted again that vehicle movements involving two or more lane changes, stopping and backing up on the freeway, etc., were classified as erratic maneuvers.

Table 2 summarizes vehicle movements comprising lane changes by areas for Mount Pleasant and Clare. The vehicle movements consist of those vehicles moving to the median or exit lane and proceeding to the exit ramp, and are recorded by the area in which the movement was made. The rates of this vehicle movement per 1,000 veh for each study section can be seen to increase. These increases in total vehicle movements, as classified, were significant. Thus, with the color system, more drivers were apparently positioning themselves earlier for the exit movement. By individual

Date	Recorder	Interview #
Location: Mt. Pleasant (Thru____ (Exit____ Clare (Thru____ (Exit____	Vehicle Type: Car_____ Truck____	License: Local_____ State_____ Out of State____
1. Have you travelled this route before?	No_____ 1-5_____ 5-10_____ (omit question #2) Often_____ (omit question #2)	
2. Did you have any difficulty in determining your desired direction of travel?	Yes_____ (ask A B C) No_____ (ask A B D)	
(A) What was the desired direction of travel?	Thru_____ Exit_____	
(B) Did you know that blue signing and painting directed you to the exit?	Yes_____ No_____	
(C) What confused the driver?		
(D) Was the colored signing and painting a benefit to you in determining your direction of travel?	Yes_____ No_____	
What was of a definite assistance? (color, legend, etc.)		
3. What is your opinion of using a color scheme at all interchanges? Such as blue at exits, yellow entrance, white silver thru.		

Figure 4. Interview field sheet.

TABLE 1

RATE OF ERRATIC MANEUVERS[a]

Interchange	Before			After			Decrease (%)
	Total Veh	No. Erratic Veh	Rate (per 1,000 veh)	Total Veh	No. Erratic Veh	Rate (per 1,000 veh)	
Mt. Pleasant	2,365	49	20.7	1,708	22	12.8	38.2
Clare	2,085	46	22.1	1,420	21	14.8	33.5

[a]Classified by two or more lane changes.

areas, the rate increases for this movement were particularly evident in Areas 3 and 4. This proved true for daytime and particularly for nighttime traffic. It should be noted that the "blue" color coding for the exit ramp begins with Area 3. This is where an increase in vehicle movements to the exit lane would be expected.

TABLE 2
VEHICLE MOVEMENT SUMMARY[a]

Movement	Interchange	Area	Day					Night					Total				
			Before		After		Rate Change (%)	Before		After		Rate Change (%)	Before		After		Rate Change (%)
			No.	Rate	No.	Rate		No.	Rate	No.	Rate		No.	Rate	No.	Rate	
To exit ramp	Mt. Pleasant[b]	1	32	13.5	21	12.3	–	0	0	0	0	–	32	13.5	21	12.3	–
		2	66	27.9	53	31.0	–	7	3.0	4	2.3	–	73	30.9	57	33.4	–
		3	80	33.8	87	50.9	–	22	9.3	26	15.2	–	102	43.1	113	66.2	–
		4	104	44.0	94	55.0	–	40	16.9	39	22.8	–	144	60.9	133	77.9	–
		5	38	16.1	30	17.6	–	20	8.5	12	7.0	–	58	24.5	42	24.6	–
		Total	320	135.3	285	166.9	+23.4	89	37.6	81	47.4	+26.1	409	172.9	366	214.3	+23.9
	Clare[c]	1	48	23.0	25	17.6	–	2	1.0	2	1.4	–	50	24.0	27	19.0	–
		2	84	40.3	47	33.1	–	31	14.9	15	10.6	–	115	55.2	62	43.7	–
		3	122	58.5	128	90.1	–	30	14.4	18	12.7	–	152	72.9	146	102.8	–
		4	92	44.1	113	79.6	–	14	6.7	26	18.3	–	106	50.8	139	97.9	–
		5	34	16.3	36	25.4	–	8	3.8	20	14.1	–	42	20.1	56	39.4	–
		Total	380	182.3	349	245.8	+34.8	85	40.8	81	57.0	+39.7	465	223.0	430	302.8	+35.8
To through roadway	Mt. Pleasant[b]	Total[d]	47	19.9	44	25.8	+29.6	9	3.8	4	2.3	-6.1	56	23.7	48	28.1	+18.6
	Clare[c]	Total[c]	31	14.9	9	6.3	-4.2	3	1.4	1	0.7	-50.0	34	16.3	10	7.0	-42.9

[a]Per 1,000 veh.
[b]Traffic volume: before, 2,365 veh; after, 1,708 veh (28 percent reduction).
[c]Traffic volume: before 2,085 veh; after, 1,420 veh (32 percent reduction).
[d]Number of vehicle movements to through roadway small, so area totals combined.

Total vehicle movements to the through route are also given in Table 2 for information only, since the total sample for all areas proved inadequate to reveal any conclusive effects on these vehicle movements.

Figures 5 and 6 show the vehicle movements to the exit ramps by the area in which the vehicle made its movement to the exit lane. These figures indicate the shift in location of the vehicle movements through the study section. Erratic maneuvers are also shown in this manner.

Table 3 gives the vehicle movements to the exit ramp according to the lane of the exit ramp used for exiting, including exiting traffic that did not make any lane change through the study sections but exited from the freeway. It can be seen that use of the

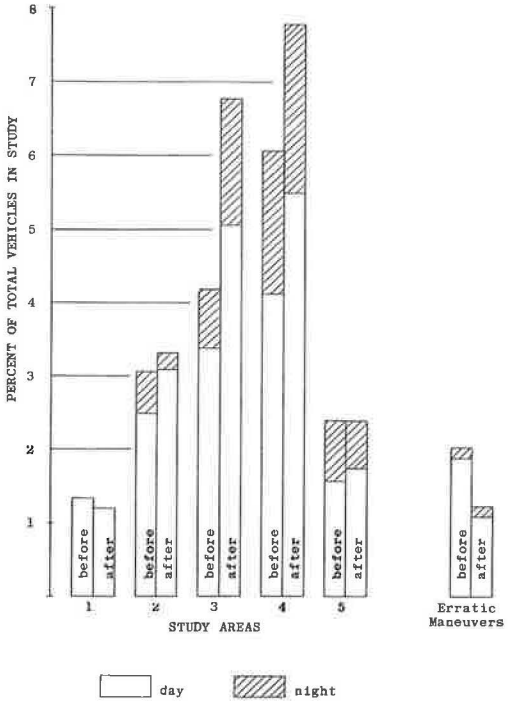

Figure 5. Vehicle movements to exit ramp and erratic maneuvers at Mount Pleasant.

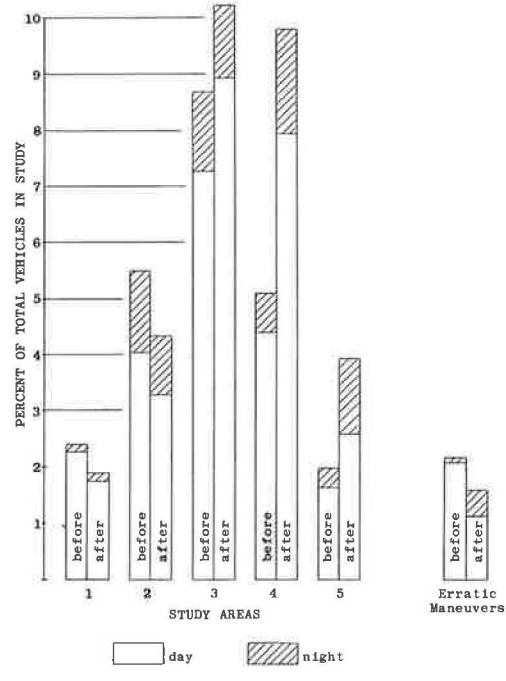

Figure 6. Vehicle movements to exit ramp and erratic maneuvers at Clare.

TABLE 3

EXITING VEHICLE MOVEMENTS[a]

Movement	Interchange	Area	Time	Right Lane Exit					Left Lane Exit					Exit Total				
				Before		After		Rate Change (%)	Before		After		Rate Change (%)	Before		After		Rate Change (%)
				No.	Rate	No.	Rate		No.	Rate	No.	Rate		No.	Rate	No.	Rate	
To exit ramp	Mt. Pleasant	1	Day	16	21	3	5	—	16	21	18	28	—	32	42	21	33	—
			Night	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		2	Day	33	43	12	19	—	33	43	41	63	—	66	86	53	82	—
			Night	3	4	2	3	—	4	5	2	3	—	7	9	4	6	—
		3	Day	49	64	35	54	—	31	41	52	81	—	80	105	87	135	—
			Night	42	16	17	26	—	10	13	9	14	—	22	29	26	40	—
		4	Day	80	105	64	99	—	24	31	30	47	—	104	136	94	146	—
			Night	25	33	19	29	—	15	20	20	31	—	40	53	39	60	—
		5	Day	38	50	28	43	—	—	—	2	3	—	38	50	30	46	—
			Night	20	26	11	17	—	—	—	1	2	—	20	26	12	19	—
			Total	276	361	191	296	-18.0	133	174	175	271	+55.7	409	535	366	567	+6.0
	Clare	1	Day	34	36	10	14	—	14	15	15	20	—	48	51	25	34	—
			Night	2	2	2	3	—	—	—	—	—	—	2	2	2	3	—
		2	Day	70	74	27	37	—	14	15	20	27	—	84	89	47	64	—
			Night	29	31	15	20	—	2	2	—	—	—	31	33	15	20	—
		3	Day	108	114	103	139	—	14	15	25	34	—	122	129	128	173	—
			Night	23	24	14	19	—	7	7	4	5	—	30	31	18	24	—
		4	Day	83	88	101	137	—	9	9	12	16	—	92	97	113	153	—
			Night	14	15	24	32	—	—	—	2	3	—	14	15	26	35	—
		5	Day	34	36	36	49	—	—	—	—	—	—	34	36	36	49	—
			Night	8	8	20	27	—	—	—	—	—	—	8	8	20	27	—
			Total	405	428	352	476	+11.2	60	63	78	106	+68.3	465	491	430	582	+18.5
From exit lane, no lane change	Mt. Pleasant	All	Day	67	88	31	48	—	245	320	190	295	—	312	408	221	343	—
			Night	15	20	12	19	—	28	36	46	71	—	43	56	58	90	—
			Total	82	107	43	67	-37.4	273	357	236	366	+2.5	355	464	279	433	-6.9
	Clare	All	Day	201	212	58	78	—	230	243	204	276	—	431	455	262	355	—
			Night	27	29	16	22	—	24	25	31	42	—	51	54	47	64	—
			Total	228	241	74	100	-58.5	254	269	235	318	+18.7	482	509	309	418	+17.9
Total	Mt. Pleasant	—	—	358	469	234	363	-22.6	406	531	411	637	+20.0	764	1,000	645	1,000	—
	Clare	—	—	633	668	426	576	-13.8	314	332	313	424	+27.7	947	1,000	739	1,000	—

[a]Per 1,000 exiting veh.

left lane of the exit ramp increased with the color system. The exit lane (left, in this case) on the freeway which proceeds to the exit ramp is, of course, color coded blue. A higher percentage of the exiting traffic in the exit lane, which made no lane change in the study section, utilized the left lane of the exit ramp with the color system.

The exiting vehicle data in Area 5 (Table 3) requires some clarification. Almost all of these movements to the exit, before and after, day and night, utilized the right lane of the ramp at both Mount Pleasant and Clare. Area 5 is 175 ft and 380 ft in advance of the gore at Mount Pleasant and at Clare, respectively. At Clare, there was an increase in this movement in Area 5. The difference in length of area may have some bearing on this movement. However, these movements to the exit were made by vehicles that proceeded in a continuous smooth movement in the through lane of the freeway to the right lane of the exit ramp. Rather than lane changes, these movements were actually lane crossings. Field data verified that these vehicles exited without altering their path. Considering the geometric design of both locations, this movement becomes natural and can be made with ease. It would be assumed that a motorist, well aware of the exiting facilities, would make this movement. If any unknowing drivers were among this group, it was impossible to detect them by their travel characteristics.

The nighttime observations for the vehicle movement study were very limited. The data indicate definite trends which show the favorable effects of the color coding system on vehicle movements, but are not sufficient to measure the system's full benefits.

Driver Interviews. —Table 4 summarizes the driver interviews conducted at the study locations at Mount Pleasant and Clare, with opinions classified according to the drivers' knowledge of the area. As indicated, 86 percent of the total drivers interviewed reported that the color scheme is of definite value to them. This result is further emphasized by the day and night drivers: 83 percent of the day drivers and 91 percent of the night drivers reported a benefit. The driver opinions at each study location revealed the consistent overall advantage of the color system.

Based on knowledge of the area, of the familiar drivers interviewed, 86.2 percent of daytime drivers and 93.5 percent of nighttime drivers reported that the color system was beneficial to them. Of the unfamiliar drivers interviewed, 82.5 percent daytime and 90.6 percent nighttime reported a definite benefit from the color system.

TABLE 4

DRIVERS' OPINIONS OF COLOR SYSTEM

Opinion	Knowledge of Area[a]	Mount Pleasant						Clare						Both Interchanges					
		Day		Night		Total		Day		Night		Total		Day		Night		Total	
		No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Benefit	Familiar	338	80.7	104	93.0	442	83.2	444	91.0	99	94.3	543	91.6	782	86.2	203	93.5	985	87.6
	Unfamiliar	295	81.1	91	69.2	386	82.8	305	84.0	93	92.1	398	85.8	600	82.5	184	90.6	784	84.3
	Total	633	80.8	195	91.1	828	83.1	749	88.0	192	93.2	941	89.0	1,382	84.6	387	92.2	1,769	86.1
No benefit	Familiar	40	9.5	4	3.5	44	8.3	20	4.1	2	1.9	22	3.7	60	6.6	6	2.8	66	5.9
	Unfamiliar	27	7.4	8	7.8	35	7.5	36	9.9	5	4.9	41	8.8	63	8.7	13	6.4	76	8.2
	Total	67	8.6	12	5.6	79	7.9	55	6.6	7	3.4	63	6.0	123	7.5	19	4.5	142	6.9
None	Familiar	41	9.8	4	3.5	45	0.5	24	4.9	4	3.0	28	4.7	65	7.2	8	3.7	73	6.5
	Unfamiliar	42	11.5	3	3.0	45	9.7	22	6.1	3	3.0	25	5.4	64	8.6	6	3.0	70	7.5
	Total	83	10.6	7	3.3	90	9.0	46	5.4	7	3.4	53	5.0	129	7.9	14	3.3	143	7.0
Total	Familiar	419	–	112	–	531	–	488	–	105	–	593	–	907	–	217	–	1,124	–
	Unfamiliar	364	–	102	–	466	–	363	–	101	–	464	–	727	–	203	–	930	–
	Total	783	–	214	–	997	–	851	–	206	–	1,057	–	1,634	–	420	–	2,054	–

[a] Familiar drivers considered, in this study, those who had driven area 5 or more times.

Some drivers who have explicit knowledge of the interchange areas and ramps, perhaps through their clear perception of the area, would feel no need for the color system. However, the foregoing results show that the system is profitable to the familiar driver as well.

Aside from the purpose of obtaining the general public's reaction to the color system, the interviews were designed to reveal whether or not the color system (particularly the blue) would, without prior knowledge, be understandable to the motorists. Also, it was desirable to determine the nature and extent of any difficulty experienced with the color system. It was felt that motorists unfamiliar with the interchange areas would more appropriately reveal this information. Therefore, these drivers were asked specifically (a) whether or not they knew that blue meant exit and (b) whether any difficulty was experienced. Table 5 indicates that out of 930 unfamiliar drivers interviewed, 91 percent were aware that the "blue" meant exit. Also, out of this group, 39 drivers reported difficulty of some degree. It was reasonable to assume that all familiar drivers having passed through the interchange areas at least five times would be aware of what the blue meant. It also could be assumed that familiar drivers would experience much less difficulty than unfamiliar drivers. However, it is possible that some familiar drivers did experience great difficulty.

Several drivers reported that they experienced difficulty but could not state exactly the cause. As could be expected, the alignment or geometrics of the roadway was the factor most frequently listed as the source of difficulty. Lack of understanding of sign legend was reported by a few motorists (e.g., "LEFT EXIT" and "NEXT EXIT" referring to same exit). Lack of acquaintance with color system was reported by some. The small percentage of unfamiliar drivers who reported difficulty and the large percentage who recognized the significance of the blue color without prior exposure are indicative of the general success and understanding of the color system.

CONCLUSIONS AND RECOMMENDATIONS

From the results of this pilot project, the effectiveness of the color system as a means of communication and guidance to freeway motorists can be evaluated. The vehicle movement study indicated positively that the color coding system was, and can be, successful in communicating its intent to motorists and in obtaining the desired

TABLE 5

RESULTS OF INTERVIEWS OF UNFAMILIAR DRIVERS

Driver	Mount Pleasant						Clare						Both Interchanges					
	Day		Night		Total		Day		Night		Total		Day		Night		Total	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Total interviewed	364	–	102	–	466	–	363	–	101	–	464	–	727	–	203	–	930	–
Aware blue meant exit	334	92	93	91	427	91.5	328	91	95	94	423	91.5	662	91.5	188	93	850	91
Reported difficulty	8	2.2	5	4.9	13	2.8	22	6.1	4	4.0	26	5.6	30	4.1	9	4.4	39	4.2

reaction. The significant reduction in erratic driving maneuvers specifically showed the lessening of confusion at the exit ramps under study.

The color system can also provide the motorists with increased convenience in performing exiting maneuvers. The advance notification permits earlier positioning for these maneuvers. This factor is illustrated by the increase in the rate of vehicular movements which occurred in certain areas in advance of the exits. The change in these movements indicates the effect of the color system on traffic behavior for both day and night traffic. It is reasonable to conclude that providing the freeway motorist with advance notification permitting earlier positioning for exiting can result in greater convenience and safety.

The driver interviews revealed a general public acceptance of the color system. These interviews showed that 85 to 90 percent of the day and night drivers believed the color system was definitely beneficial. Only a small percentage of drivers reported any degree of travel difficulty at the two study locations following the installation of the color system. It is apparent that at interchanges of this design, some confusion to drivers is inescapable.

Public reaction to the color system was also clearly expressed by the many voluntary letters received by the Highway Department which were in favor of its use at the study locations and stated desire for its expanded use on a general basis.

The results of the pilot project clearly show that the color system was a successful means of communication and guidance to freeway motorists at the interchange areas under study. However, as a pilot project, several aspects of the research on this system remain to be explored.

The study sites are located on US 27, a rural freeway carrying an annual daily average traffic volume of 6,500 veh approaching Mount Pleasant and 5,100 veh approaching Clare. Although the traffic is higher during the summer tourist period, it would not be considered an extremely high-volume roadway. The total vehicle movement data were sufficient to illustrate the effects of the color system, but the nighttime data were rather limited. It would be desirable to conduct further research to gain experience under higher volumes and to supplement the nighttime observations. Research of this system under urban freeway traffic would also be of interest.

The study sites consisted of two isolated locations which were left-hand exits. Certainly, based on this pilot project, similar benefits from the color system could be anticipated at exit ramps of other types or design. Even greater benefits could be anticipated if the color system were applied to a series of ramps on a continuous length of roadway. Acclimatization of motorists to general use of the color system could result in greater benefit. Research along these lines is certainly warranted and recommended.

The pilot project was conducted applying a total system of color coding. Very little, if any, evaluation was possible of the independent effect and benefit of the elements of edgemarking, delineators, and signing. Comments obtained during driver interviews provided a limited insight in this matter. Some question remains as to the length of edgemarking on the exit approaches, the length of edgemarking extending beyond the gore, and the extent of the color code for advance directional and exit signing.

From the results of this pilot project, a continuation of this research project is proposed to investigate the general application of the color system to a length of freeway and satisfy the need for study in the specific areas cited in the foregoing discussion.

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