

FINAL REPORT
PAVEMENT MARKING EXTENSIONS FOR DECELERATION LANES

by

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(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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ABSTRACT

Pavement markings have definite and important functions in a proper scheme of traffic control. One such marking, the pavement edge line, has received much favorable public reaction. One of the limitations of the edge line as conventionally applied is that it is broken at all intersecting roads and streets, which leaves the motorist without marking guidance through the intersection. Frequently, the absence of this marking tends to lead motorists off the pavement.

The purpose of this study was to evaluate the effectiveness of pavement marking extensions for deceleration lanes to ensure vehicle guidance through an intersection. The study concluded that there was a significant reduction in the number of vehicles running off the edge of the pavement after these marking extensions were installed.

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INTRODUCTION

Pavement markings have definite and important functions in a proper scheme of traffic control. In some cases they are used to supplement the regulations or warnings of other devices such as traffic signals or signs. In other instances, they are used alone and produce results that cannot be obtained by the use of any other device. They also serve as a very effective means of conveying certain regulations and warnings that could not otherwise be made clearly understandable.

However, pavement markings do have limitations. They are obliterated by snow, may not be clearly visible when wet, and may not be very durable when subjected to heavy traffic. In spite of these limitations, under favorable conditions they have the advantage of conveying warnings or information to the driver without diverting his attention from the roadway. ⁽¹⁾

Among the many types of markings in use, pavement edge lines have received much favorable public reaction. Edge lines are markings along the sides of the roadway to indicate the safe approach to the edge of the pavement. The purpose of edge line markings is generally threefold; (1) to reduce travel, particularly by heavier vehicles, on shoulders of lesser structural capacity than the pavement, (2) to make driving more comfortable, particularly during night and inclement weather, by providing a continuous guide for the driver, and (3) to reduce accidents. ⁽²⁾

In addition to the general limitations mentioned above for all markings, the edge line markings as conventionally applied are broken at intersecting roads and streets, which leaves the driver of a vehicle without marking guidance through the intersection. Frequently, at intersections with unusual geometrics, vehicles run off the edge of the pavement on the far side of the intersecting road. This has been the situation at many locations in Virginia especially where a right-turn deceleration lane taper has been provided to facilitate right-turn maneuvers. In addition to the accident potential created by vehicles running off the pavement, there has been a constant maintenance problem along the unpaved shoulders. To alleviate this traffic hazard, the Manual on Uniform Traffic Control Devices, revised in 1971, stated that "... to guide vehicles through an interchange or intersection, a dotted line may be used to extend markings as necessary through the interchange or intersection area". ⁽³⁾ This study was initiated to investigate the utilization of pavement marking extensions for deceleration lanes.

OBJECTIVE AND SCOPE

The objective of this study was to determine the effectiveness of the pavement marking extensions (dotted lines) along deceleration lanes in guiding vehicles through the intersections as suggested in the Manual on Uniform Traffic Control Devices. The scope of the project was limited to one intersection due to manpower and time constraints.

STUDY SITE

The intersection of State Route 147 (W. Huguenot Road) and Route 1989 (Dolefield Road) in Chesterfield County was selected for study at the recommendation of field engineers, who reported that many erratic maneuvers were being made at this location and the unpaved shoulder constantly needed repairs due to vehicles running off the pavement.

Characteristics of the Intersection

Route 147 is a 4-lane divided facility with deceleration lanes for left-turn movements in each direction and a 200' taper to facilitate right-turn movements from Route 147 onto Dolefield Road. Dolefield Road intersects with Route 147 on the inside of a horizontal curve. During school hours the speed limit on Route 147 is 25 mph because of an adjacent school, however, at all other times the speed limit is 55 mph. The markings on Route 147 consisted of a standard centerline and a pavement edge line that continued along the right-turn deceleration taper as shown in Figure 1. Many drivers of vehicles traveling on Route 147 had a tendency to follow the edge line on the taper and, subsequently, to run off the pavement on the far side of the intersection.

Dolefield Road is a 2-lane facility without pavement markings, and apparently was not a contributing factor to the erratic maneuvers being made at this location.

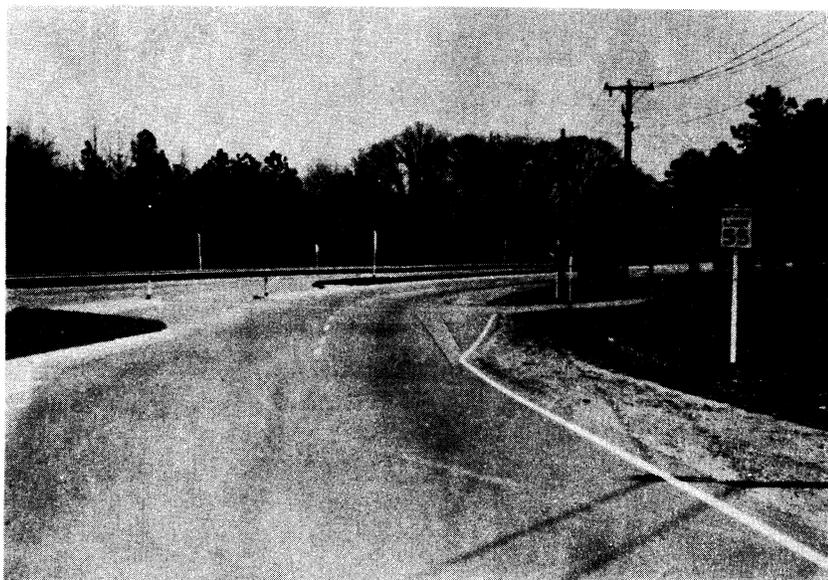


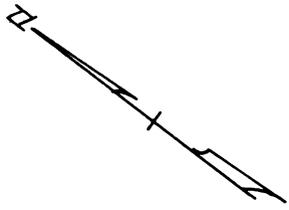
Figure 1. Intersection of Route 147 and Dolefield Road.
Pavement marking for "before" conditions.

STUDY PROCEDURE

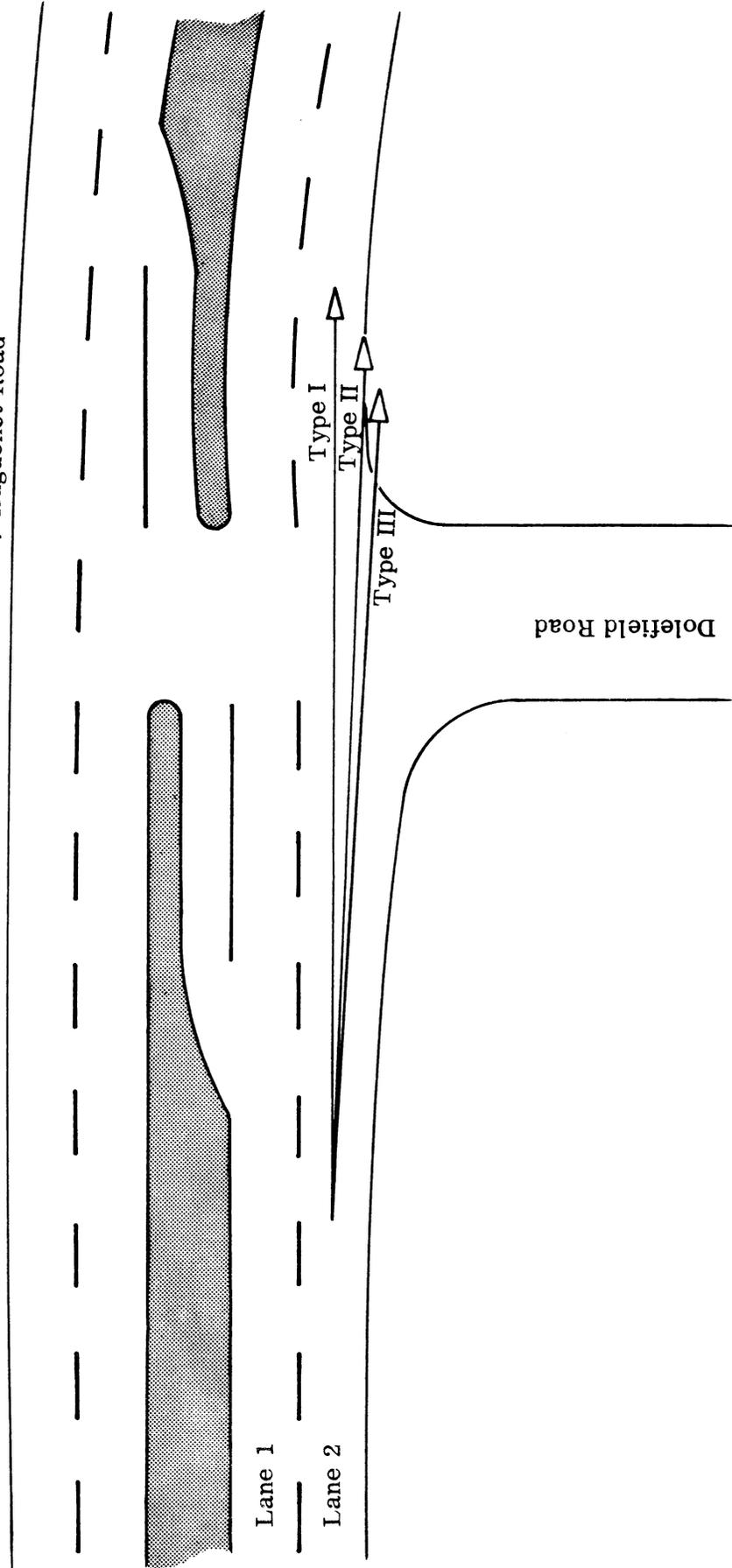
To determine the effects of the pavement marking extensions for a deceleration lane, the "comparative vehicle maneuver" technique of analysis was used. The vehicle maneuvers observed in this study are shown in Figure 2 and are designated as follows:

- Type I — Vehicles that stayed in lane 2.
- Type II — Vehicles that traveled on the edge line marking.
- Type III — Vehicles that ran off the pavement.

The vehicular maneuver data were recorded for one-half hour intervals including the morning and evening rush hours. Observations started as early as 8:30 a.m. and continued until 10:00 p.m. Data were collected in late February 1972 to evaluate the "before" traffic characteristics utilizing the pavement markings shown in Figure 1. After the new pavement marking extensions were installed along the deceleration lane taper (shown in Figure 3), the "after" data were gathered during May 1972.



Route 147 W. Huguenot Road



Lane 1

Lane 2

Type I

Type II

Type III

Dolefield Road

Figure 2. Observed vehicle maneuvers.

The pavement marking extension was a broken line consisting of 5-foot painted dashes separated by 8-foot unpainted skips. The marking was applied along the entire length (200 ft.) of the deceleration lane taper.

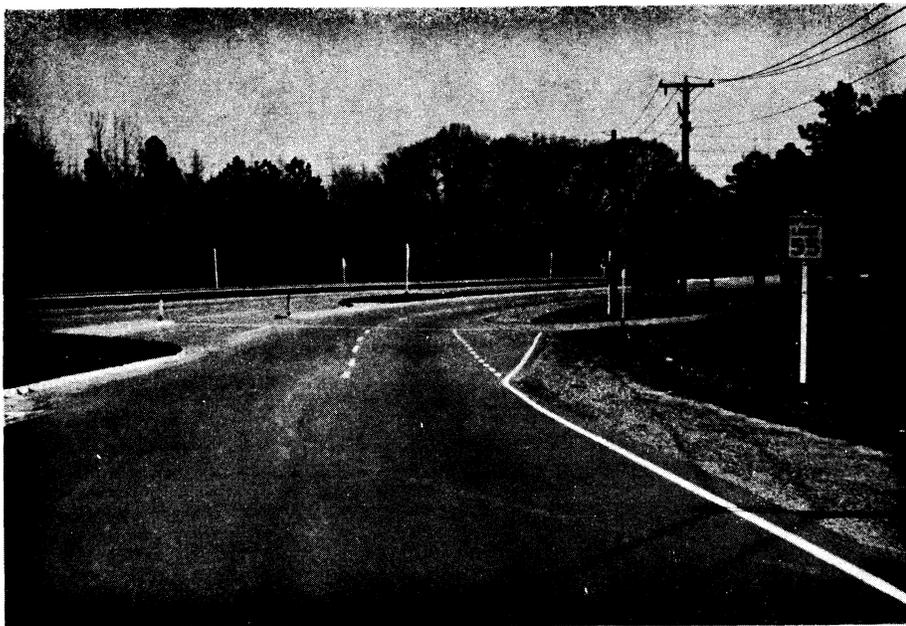


Figure 3. Intersection of Route 147 and Dolefield Road. Pavement marking for "after" conditions.

DATA ANALYSIS

The analysis was based on observations of traffic on Route 147 at the Dolefield Road intersection during a period of four days. The vehicles traveling in lane 1 were not considered as they were not influenced by the pavement marking extensions on the right side of the roadway. In lane 2, 2,406 vehicles were observed before the new markings were installed, and 3,270 were observed during the two-day "after" period. An average of 15.12 percent of all vehicles passing through the intersection in lane 2 made erratic maneuvers, thereby affording an adequate sample size for analyzing behavioral patterns of motorists. The before and after data and results of preliminary calculations appear in Appendixes A and B, respectively.

Traffic maneuvers during the before and after conditions were compared in time periods during the day. The comparisons of the maneuvers during the morning (8:30 a.m. — 12:00 M.), afternoon (1:30 p.m. — 6:00 p.m.) and evening (6:00 p.m. — 10:00 p.m.) are shown in Table 1. The variables, the observation volumes for the before and after conditions, and the significance of the statistical test are all related in this table.

Table 1
Summary of Data and Statistical Comparisons

	Volume Lane 2	Vehicles off pavement		X^2	Significance	Vehicles on edge line		X^2	Significance
		Volume	%			Volume	%		
Morning									
Before	846	27	3.19			172	20.30		
After	1,139	18	1.58	7.89*	Yes	99	8.69	104.19*	Yes
Afternoon									
Before	1,088	39	3.58			186	17.09		
After	1,567	36	2.29	11.83*	Yes	156	9.95	72.27*	Yes
Evening									
Before	472	6	1.27			56	11.86		
After	564	6	1.06	0.02	No	57	10.10	0.37	No

*Significant Value = 0.05

Inspection of Table 1 leads to the conclusion that the installation of pavement marking extensions did significantly improve the traffic flow during the morning and afternoon time periods. During the evening hours there was not a statistically significant difference. Intuitively, this last finding was not expected; however, current research reveals that motorists have a tendency to drive near the center of the road during the hours of darkness, regardless of the type of markings along the highway. (4)

A comparison of the before and after data secured during the morning hours revealed that there were large reductions in the percentages of vehicles running off the pavement and the vehicles traveling on the edge line. In the before period, 3.19 percent of all vehicles ran off the pavement, while after the markings were installed only 1.58 percent made this erratic maneuver. Of more significance is the reduction in the number of vehicles that traveled along the edge line. In the before period, 20.3 percent of the total vehicles in lane 2 made this maneuver, while the same statistic for the after period was only 8.69 percent.

Similar results were experienced during the afternoon time period. After the installation of the pavement marking extensions, there was a decrease of 1.29 percent in the number of vehicles running off the pavement and a 7.14 percent reduction in the number of vehicles traveling on the edge line markings. During the evening hours, there was only a 0.21 percent reduction in the number of vehicles running off the pavement, while the number of vehicles traveling on the edge line decreased by 1.76 percent.

To further aid in determining the effect of pavement marking extensions for the deceleration lane, several observations were made relative to the maintenance of the unpaved shoulder just beyond the intersection. During the before period, many potholes were common, while the inspections during the after period revealed no maintenance problems.

SUMMARY OF FINDINGS

The findings of this study may be summarized as follows:

1. During daylight hours there was a significant reduction in the number of vehicles running off the pavement after the installation of the pavement marking extensions along the deceleration lane.
2. There was a significant reduction in the percentages of vehicles traveling along the edge line during the daylight hours after the installation of the pavement markings.
3. The statistical Chi-square test indicated that the pavement markings made no significant difference during the nighttime hours.
4. Periodic inspections have revealed that the maintenance of the unpaved shoulder along Route 147 at this intersection has not been critical since the installation of the pavement marking extensions.

CONCLUSIONS AND RECOMMENDATIONS

(The findings of this study revealed that the utilization of pavement marking extensions for deceleration lanes can alleviate the serious traffic hazard of running off the pavement. Furthermore, the markings provided a smoother flow of traffic through the intersection as the vehicles were centered in the travel lane rather than along the edge of pavement. In conjunction with the the improved safety, many maintenance operations were facilitated, which resulted in cost savings and allowed maintenance personnel additional time to perform more important duties.)

It is recommended that greater utilization be made of the pavement marking extensions of deceleration lanes.

REFERENCES

1. Virginia Manual on Uniform Traffic Control Devices, Virginia Department of Highways, Traffic and Safety Division, Richmond, Virginia, 1971.
2. Baerwald, John E., (ed.); Traffic Engineering Handbook, 3rd Edition, Washington, D. C., Institute of Traffic Engineers, 1965.
3. Manual on Uniform Traffic Control Devices, Federal Highway Administration, U. S. Department of Transportation, 1971.
4. Parker, Martin R., Jr., "The Feasibility of Centerlining and Edgelining Narrow Rural Roads in Virginia, " Virginia Highway Research Council, Charlottesville, Virginia. (To be published.)

APPENDIX A

VEHICLE MANEUVERS DURING BEFORE CONDITIONS

Date & Hour	Lane 2 Volume	Vehicles Off Pavement	% Off Pavement	Vehicles On Edge Line	% On Edge Line
<u>Aug. 28, 1972</u>					
8:30 - 9:00					
9:00 - 9:30					
9:30 - 10:00	73	1	1.36	16	21.91
10:00 - 10:30	64	2	3.12	12	18.75
10:30 - 11:00	64	2	3.12	18	28.12
11:00 - 11:30	60	3	5.00	8	13.33
11:30 - 12:00 M.	54	1	1.85	9	16.66
Total	315	9	2.85	63	20.00
1:30 - 2:00					
2:00 - 2:30					
2:30 - 3:00					
3:00 - 3:30					
3:30 - 4:00	115	5	4.34	25	21.73
4:00 - 4:30	128	3	2.34	17	13.28
4:30 - 5:00	81	4	4.93	10	12.34
5:00 - 5:30	78	2	2.56	13	16.66
5:30 - 6:00	54	3	5.55	11	20.37
Total	456	17	3.72	76	16.66
6:00 - 6:30	71	0	0.00	7	9.85
6:30 - 7:00	88	1	1.13	11	12.50
7:00 - 7:30	66	2	3.03	7	10.60
7:30 - 8:00	55	1	1.81	7	12.72
8:00 - 8:30	39	1	2.56	7	17.94
8:30 - 9:00					
9:00 - 9:30					
9:30 - 10:00					
Total	319	5	1.56	39	12.23
<u>Feb. 29, 1972</u>					
8:30 - 9:00	83	3	3.61	17	20.48
9:00 - 9:30	84	1	1.19	15	17.85
9:30 - 10:00	77	3	3.89	18	23.37
10:00 - 10:30	76	1	1.31	16	21.05
10:30 - 11:00	76	3	3.94	17	22.36
11:00 - 11:30	73	6	8.21	14	19.17
11:30 - 12:00 M.	62	1	1.61	12	19.35
Total	531	18	3.38	109	20.52

APPENDIX A (cont.)

VEHICLE MANEUVERS DURING BEFORE CONDITIONS

Date & Hour	Lane 2 Volume	Vehicles Off Pavement	% Off Pavement	Vehicles On Edge Line	% On Edge Line
<u>Feb. 29, 1972</u> (cont.)					
1:30 - 2:00	55	3	5.45	11	20.00
2:00 - 2:30	49	1	2.04	9	18.36
2:30 - 3:00	77	3	3.89	16	20.77
3:00 - 3:30	102	3	2.94	23	22.54
3:30 - 4:00	141	5	3.54	24	17.02
4:00 - 4:30	131	4	3.05	16	12.21
4:30 - 5:00	77	3	3.89	11	14.28
5:00 - 5:30					
5:30 - 6:00					
Total	632	22	3.48	110	17.40
6:00 - 6:30					
6:30 - 7:00					
7:00 - 7:30					
<u>Feb. 16, 1972</u>					
7:30 - 8:00					
8:00 - 8:30	48	0	--	3	6.25
8:30 - 9:00	39	1	2.56	5	12.82
9:00 - 9:30	39	0	--	4	10.25
9:30 - 10:00	27	0	--	5	18.51
Total	153	1	0.65	17	11.11

APPENDIX B

VEHICLE MANEUVERS DURING AFTER CONDITIONS

Date & Hour	Lane 2 Volume	Vehicles Off Pavement	% Off Pavement	Vehicles On Edge Line	% On Edge Line
<u>May 17, 1972</u>					
8:00 - 8:30					
8:30 - 9:00					
9:00 - 9:30	117	1	0.85	7	5.98
9:30 - 10:00	113	2	1.76	7	6.19
10:00 - 10:30	93	1	1.07	10	10.75
10:30 - 11:00	86	0	--	9	10.46
11:00 - 11:30	78	2	2.56	11	14.10
11:30 - 12:00 M.	86	0	--	11	12.79
Total	573	6	1.04	55	9.59
1:30 - 2:00	87	4	4.59	5	5.74
2:00 - 2:30	87	1	1.14	13	14.94
2:30 - 3:00	95	0	--	9	9.47
3:00 - 3:30	145	4	2.75	17	11.72
3:30 - 4:00	150	2	1.33	14	9.33
4:00 - 4:30	152	3	1.97	14	9.21
4:30 - 5:00					
5:00 - 5:30					
5:30 - 6:00					
Total	716	14	1.95	72	10.05
6:00 - 6:30					
6:30 - 7:00					
7:00 - 7:30					
7:30 - 8:00					
8:00 - 8:30	108	2	1.85	12	11.11
8:30 - 9:00	104	1	0.96	7	6.73
9:00 - 9:30	76	1	1.31	6	7.89
9:30 - 10:00	60	1	1.66	7	11.66
Total	348	5	1.43	32	9.19

2567

APPENDIX B (cont.)

VEHICLE MANEUVERS DURING AFTER CONDITIONS

Date & Hour	Lane 2 Volume	Vehicles Off Pavement	% Off Pavement	Vehicles On Edge Line	% On Edge Line
<u>May 18, 1972</u>					
8:00 - 8:30					
8:30 - 9:00					
9:00 - 9:30	111	3	2.70	12	10.81
9:30 - 10:00	99	2	2.02	6	6.06
10:00 - 10:30	85	1	1.17	5	5.88
10:30 - 11:00	95	2	2.10	9	9.47
11:00 - 11:30	87	1	1.14	7	8.04
11:30 - 12:00 M.	89	3	3.37	5	5.61
Total	566	12	2.12	44	7.77
<u>May 16, 1972</u>					
1:30 - 2:00	91	1	1.09	9	9.89
2:00 - 2:30	92	3	3.26	7	7.60
2:30 - 3:00	93	4	4.30	13	13.97
3:00 - 3:30	134	3	2.23	14	10.44
3:30 - 4:00	158	5	3.16	15	9.49
4:00 - 4:30	162	4	2.46	16	9.87
4:30 - 5:00	121	2	1.65	10	8.26
5:00 - 5:30					
5:30 - 6:00					
Total	851	22	2.58	84	9.87
<u>May 16, 1972</u>					
6:00 - 6:30					
6:30 - 7:00					
7:00 - 7:30					
7:30 - 8:00					
8:00 - 8:30					
8:30 - 9:00	79	0	--	10	12.65
9:00 - 9:30	79	0	--	9	11.39
9:30 - 10:00	58	1	1.72	6	10.34
Total	216	1	0.46	25	11.57