The Influence of Traffic Calming Devices upon Fire Vehicle Travel Times

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INTRODUCTION

The City of Portland is well known for its high quality of life and the efforts that have been made to maintain and enhance neighborhood livability. Part of this success is a result of the City's Traffic Calming Program which has been effective in minimizing the impacts of traffic on neighborhood streets. The program's primary goal is to reduce overall traffic speeds on residential streets and in school zones. Traffic circles and speed bumps are the program's most effective tools. To date, 65 traffic circles and approximately 300 speed bumps have been installed on numerous neighborhood collector and local service streets throughout the City.

Unfortunately, traffic calming devices that reduce overall vehicular speeds can also impact some emergency response vehicles by increasing their response times. Given the number of existing and planned traffic calming devices, the City of Portland's Fire Bureau has become more concerned in recent years about the cumulative impact of these devices on their ability to respond quickly to emergencies. Neighborhoods are also struggling with how to best address the problem of speeding traffic on their neighborhood streets while not significantly reducing response times for emergency service providers.

A survey of other cities found no information on this subject that would help Portland deal with it's problem. Thus, to gain a better understanding of the impacts of traffic calming, the City conducted a research project to measure the affects of both traffic circles and speed bumps on response times for various types of fire apparatus. This information is now available for planning and designing individual traffic calming projects. More importantly, though, it will be useful as part of community-wide discussions on the broader public safety policy issue; this being the implications associated with slowing vehicular traffic on neighborhood streets while increasing emergency vehicle response times.

The City is currently addressing this policy issue with an 18-month planning process that will take this question out to the community for a public discussion and review of the competing safety issues. From this, an adopted set of emergency response routes will be incorporated into the City's transportation master plan. Policies will be written based on the type of emergency response route and the extent to which traffic calming may be used on those routes.

PURPOSE

There are two purposes for this paper. The first is to show how traffic calming devices affect fire vehicle travel times and to describe the testing that quantified the relationship between the two. The second purpose is to describe the City of Portland's planning-based approach to addressing the conflict between traffic calming and emergency service response.

CALMING DEVICE IMPACTS ON FIRE RESPONSE TIMES

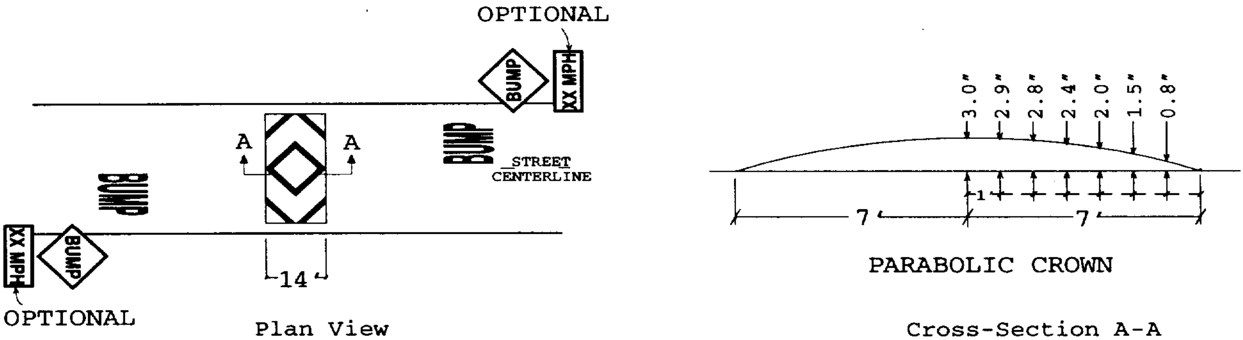
During the Fall of 1995 Portland's Fire Bureau and Bureau of Traffic Management conducted a thorough data collection effort to help quantify the relationship between three types of traffic calming devices and fire vehicle travel times. Six different types of fire vehicles were driven on streets calmed with traffic circles, 22-foot speed bumps, and 14-foot speed bumps. The resulting test data were the basis for determining the travel time impacts of the calming devices. Figures 1, 2, and 3 illustrate the three devices. Table 1 lists basic information about the fire vehicles used in the study.

Table 1
Fire Vehicle Specifications

Vehicle	Overall Length	Wheel-base	Weight (lbs)	Horse-power (HP)	Wt./HP Ratio (lbs/HP)	0-40 mph Accel. Time (sec)
Engine 18	29'10"	15'5"	34,860	185	188	19
Rescue 41	21'0"	11'6"	na	185	na	12
Squad 1	27'0"	14'6"	23,170	275	84	17
Truck 1	48'0"	21'0"	53,000	450	118	20
Truck 4	57'0"	13'0"	53,960	450	120	22
Truck 41	37'6"	16'9"	42,100	350	120	27

The testing attempted to take into account four factors that might influence the speed at which fire vehicles are driven around traffic circles or across speed bumps. The four factors were: the driver, the type of fire vehicle, the desirable vehicle speed, and the type of calming device.

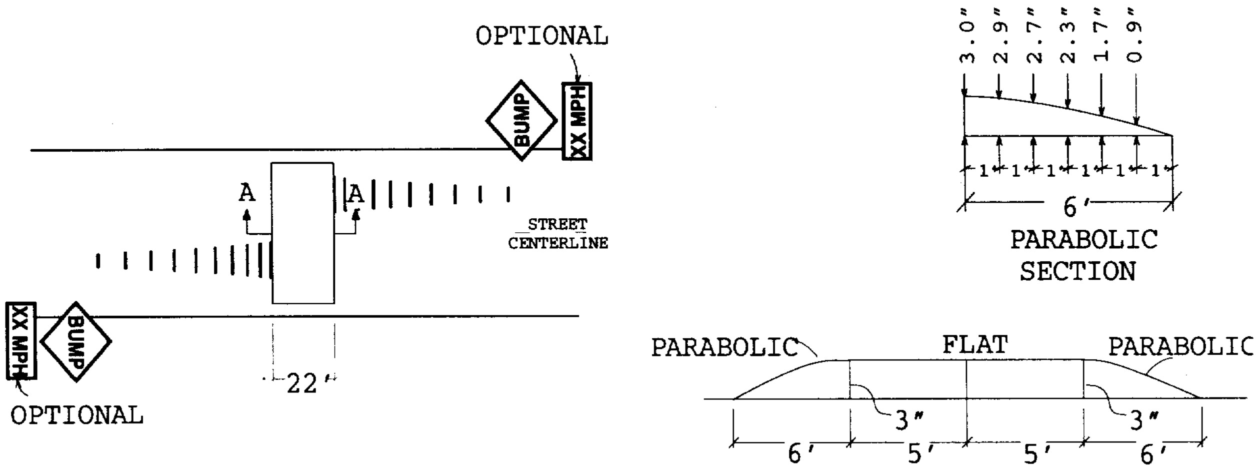
Six different fire vehicles were tested. Test runs were conducted on a total of six streets. Two streets had 22-foot speed bumps. Two streets had 14-foot speed bumps, and two had traffic circles. A total of 36 different drivers participated in the testing. The total number of test runs on each street was four per vehicle, or 24 runs per street.



Plan View

Cross-Section A-A

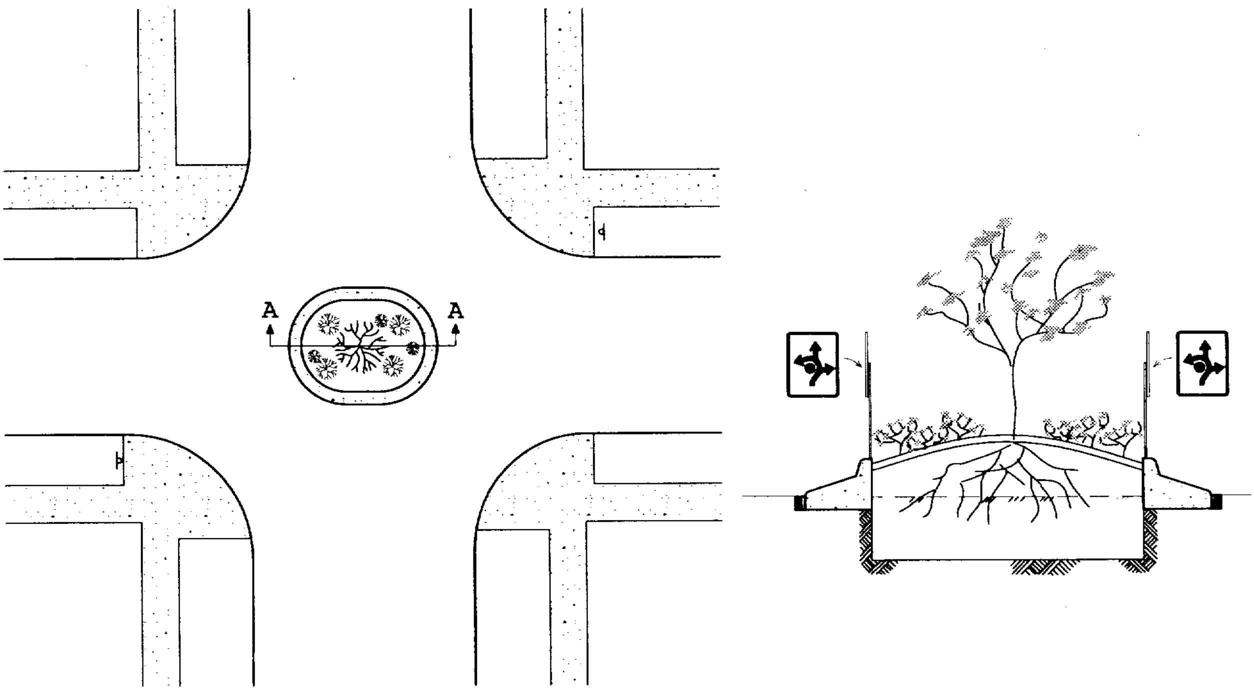
Figure 1: 14' Speed Bump (Typical)



Plan View

Cross-Section A-A

Figure 2: 22' Speed Bump (Typical)



Plan View

Cross-Section A-A

Figure 3: Traffic Circle (Typical)

Each test run was video taped. The camera recorded the vehicle speeds that were detected and displayed by a radar gun. Also the time of day, to the nearest second, was superimposed on the recording.

The speed and time information for each test run was transcribed from the video tapes to a spreadsheet. The data was manipulated to create a table of speed-vs-time and speed-vs-distance information for each test run.

For the various combinations of the four variables, the time needed to travel a length of street that had no calming device was compared to the time needed to travel the same length with a calming device. The average time and distance required for each vehicle to decelerate from a desirable response speed, negotiate the calming device, and accelerate back to the desirable speed was determined from the data. The time required to travel the same distance without a calming device's influence was calculated. The difference between the two travel times equals the delay associated with the calming device. This delay-per-device was determined for all six vehicles as they negotiated every calming device on the six test streets. Delays-per-device were calculated for desirable response speeds of 25, 30, 35, and 40 mph.

RESEARCH FINDINGS

The results of the testing are presented in Tables 2, 3, and 4. As one would expect, the delay-per-device increases as the desirable response speed increases. Depending on the type of fire vehicle and the desirable response speed, the three devices were found to create a range of delays:

22-foot bumps:	0.0 to 9.2 seconds of delay per bump
14-foot bumps:	1.0 to 9.4 seconds of delay per bump
Traffic circles:	1.3 to 10.7 seconds of delay per circle

The drivers' performances did not appear to significantly influence the results. Their choices of deceleration and acceleration rates as well as their choices of minimum speeds near the devices were very consistent.

Of the three traffic calming devices, the 22-foot bumps had the least impact on vehicle travel times. For the longer heavier vehicles the traffic circles impacted travel times the most. For the shorter more maneuverable vehicles the 14-foot bumps had the most impact.

For a given emergency response route, the test results can be used to predict the impacts of one or more traffic calming devices on fire response times.

The results provide new quantitative data to help weigh the pros and cons of traffic calming. The findings can be added to the findings already confirming that traffic circles and speed bumps effectively reduce the frequency of collisions, the speed of passenger cars, and the amount of traffic on a street.

Table 2
Typical Impacts of Traffic Circles on Emergency Vehicles

Vehicle	Lowest Speed (mph)	Desirable Speed (mph)	Travel Time Delay (seconds)	Impact Distance (feet)
Engine 18	14	25	2.8	260
	14	30	4.3	490
	14	35	6.1	670
	14	40	8.5	810
Rescue 41	16	25	1.3	170
	16	30	2.3	300
	16	35	3.1	470
	16	40	5.1	610
Squad 1	17	25	1.2	170
	17	30	2.3	330
	17	35	3.7	500
	17	40	5.3	780
Truck 1	10	25	4.8	320
	10	30	6.4	520
	10	35	8.4	750
	10	40	10.7	1030
Truck 4	11	25	4.3	320
	11	30	6.2	550
	11	35	8.1	800
	11	40	10.3	1140
Truck 41	11	25	3.9	340
	11	30	5.2	560
	11	35	7.3	850
	11	40	9.2	1260

Lowest Speed: This is the lowest speed at which a vehicle travels when driven around a traffic circle.

Desirable Speed: This is the speed at which a driver might wish to travel if there were no traffic circles.

Travel Time Delay: This is the additional time required to travel to a destination because of a traffic circle's influence.

Impact Distance: This is the length of street where a given vehicle cannot be driven at a given desirable speed because of a traffic circle's influence.

Table 3
Typical Impacts of 14-foot Speed Bumps on Emergency Vehicles

Vehicle	Lowest Speed (mph)	Desirable Speed (mph)	Travel Time Delay (seconds)	Impact Distance (feet)
Engine 18	13	25	2.3	240
	13	30	3.7	400
	13	35	5.2	580
	13	40	7.7	810
Rescue 41	17	25	1.0	150
	17	30	1.7	270
	17	35	2.9	480
	17	40	4.9	630
Squad 1	12	25	2.7	240
	12	30	4.1	440
	12	35	5.9	610
	12	40	8.3	850
Truck 1	11	25	3.4	270
	11	30	4.9	460
	11	35	6.6	650
	11	40	9.4	930
Truck 4	12	25	3.4	320
	12	30	4.9	490
	12	35	6.8	730
	12	40	9.1	1050
Truck 41	12	25	3.5	330
	12	30	4.7	470
	12	35	6.6	760
	12	40	8.6	1150

Lowest Speed: This is the lowest speed at which a vehicle travels when crossing a 14-foot speed bump.

Desirable Speed: This is the speed at which a driver might wish to travel if there were no speed bumps.

Travel Time Delay: This is the additional time required to travel to a destination because of a 14-foot speed bump's influence.

Impact Distance: This is the length of street where a given vehicle cannot be driven at a given desirable speed because of a speed bump's influence.

Table 4
Typical Impacts of 22-foot Speed Bumps on Emergency Vehicles

Vehicle	Lowest Speed (mph)	Desirable Speed (mph)	Travel Time Delay (seconds)	Impact Distance (feet)
Engine 18	21	25	0.8	140
	21	30	1.7	320
	21	35	3.0	510
	21	40	5.0	750
Rescue 41	34	25	0.0	0
	34	30	0.0	0
	34	35	0.3	120
	34	40	1.5	260
Squad 1	24	25	0.4	80
	24	30	1.0	210
	24	35	2.1	430
	24	40	3.4	710
Truck 1	22	25	0.6	140
	22	30	1.4	320
	22	35	3.0	600
	22	40	4.9	890
Truck 4	16	25	1.8	250
	16	30	3.4	450
	16	35	5.9	670
	16	40	7.7	1040
Truck 41	14	25	3.0	320
	14	30	4.8	620
	14	35	7.2	910
	14	40	9.2	1320

Lowest Speed: This is the lowest speed at which a vehicle travels when crossing a 22-foot speed bump.

Desirable Speed: This is the speed at which a driver might wish to travel if there were no speed bumps.

Travel Time Delay: This is the additional time required to travel to a destination because of a 22-foot speed bump's influence.

Impact Distance: This is the length of street where a given vehicle cannot be driven at a given desirable speed because of a speed bump's influence.

PUBLIC POLICY DEVELOPMENT

In an effort to provide both good emergency service response times and slower overall traffic speeds on neighborhood streets, a public process has been undertaken to address the trade-offs between these two community values and to provide policy direction for implementing traffic calming on a city-wide basis. This is being done by revising the Transportation Element of Portland's Comprehensive Plan to include a network of emergency response routes and policies to guide the treatment and operation of those routes.

The Transportation Element classifies Portland's streets according to their intended role in serving the various transportation modes and provides policies meant to accomplish the objectives of each classification. The Transportation Element currently defines networks and policies for serving pedestrians, traffic, bikes, transit, and trucks.

A classification system and set of policies is now being developed for emergency response routes and will be added to the Transportation Element upon its completion. Transportation and Fire Bureau staff are working together to develop a draft version of the "Emergency Response" classification. A citizen advisory committee has also been established to advise the two bureaus in the following areas:

- defining the criteria to be used in selecting emergency response routes
- applying the criteria to identify the recommended routes
- developing a hierarchy of emergency response routes
- developing classification policies and procedures
- recommending ways to manage and mitigate conflicts between traffic calming and prompt response.

The final product will be a written report recommending changes to the Transportation Element of the Comprehensive Plan . It will include the criteria, definition, and policies for the response routes, as well as a map that identifies the network of routes. A series of public meetings will be held to present the recommendations and take testimony. The resulting final version of the report will be presented to the Portland City Council which has the final approval authority.

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