TRL IRC

ROAD SAFETY BENEFITS OF PUFFIN FACILITIES

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1 Introduction

Puffin pedestrian facilities have been developed to provide improved operation for pedestrians and cyclists and to reduce delay for both drivers and pedestrians at mid block crossings and junction traffic signals. This is achieved by:

- using positive and unambiguous nearside pedestrian displays located so that waiting pedestrians viewing the pedestrian signals also have approaching nearside traffic in their line of sight;
- providing consistent displays to pedestrians and drivers;
- varying the clearance time after the pedestrian green signal to allow slow pedestrians to cross in safety but the signals revert to traffic after pedestrians clear the crossings thus reducing lost time; and
- cancelling pedestrian demands when pedestrians cross in gaps.

A number of studies have demonstrated the benefits of Puffin facilities including pedestrian convenience and reduction in traffic and pedestrian delays. Some studies, including one carried out for TfL in 2006, have investigated changes in accident frequency and shown benefits but no large scale definitive study of the safety benefits of Puffin facilities at mid block crossings and junction signals has yet been concluded. The overall objective of the Puffin Pedestrian Crossing Accident Study was to address this omission and assess the road safety benefits, in terms of accident frequencies, for correctly installed and operated Puffin facilities compared to the traditional far side pedestrian signals and Pelican crossings for mid block crossings and junction traffic signals.

The project was commissioned by the Department for Transport (DfT) and undertaken by the TRL with support from the Ian Routledge Consultancy (IRC). The analysis of the data is still ongoing; however, this paper presents the initial conclusions of the study.

2 Site identification and selection

To assess the change in accident frequencies at mid block and junction signals, sites were sought where farside pedestrian facilities were changed to nearside Puffin. To ensure a realistic assessment of the safety benefits of Puffin facilities only sites that substantially complied with DfT's current advice for the design and implementation of Puffin facilities as set out in the Puffin Good Practice Guide were considered. In addition there needed to be sufficient 'after' accident data – ideally at least three years, without significant changes to the local infrastructure or the method of signal control that could affect the results. Sites were to be selected so that they:

- had a good geographical spread;
- included examples of 3 and 4-arm junctions and mid block crossings;
- contained example of different types of pedestrian provision (e.g. all-red phase, parallel, staggered); and
- included different control strategies.

To provide an acceptable level of statistical robustness to the results a large a number of sites as possible were required. Following an initial call to local authorities, study sites were selected that best suited the project criteria. Whilst the sites are clustered within a relatively small number of local authorities, they offer a reasonable distribution across the country. The sites chosen were from the following local authorities:

- Cheshire;
- Devon;
- East Sussex;
- Essex;
- Greater Manchester;
- Hampshire;
- London; and
- York.

In order to ensure their quality, a large number of possible study sites were visited but only those that substantially followed current DfT guidance were selected. To be included, sites had to comply in terms of:

- the overall design;
- timings;
- set up and operation of traffic and pedestrian detection; and
- overall compliance with the requirements of DfT guidance.

Whilst this site assessment only gave a snapshot of the current status of each site rather than a full historical record, the methodology proved effective at identifying sites where issues that may impact on the safety record were present. In total 50 sites were selected that met the criteria.

3 Accident data and analysis

Accident data was collected for the box surrounding the mid block crossing or junction concerned, intended to include the mid block crossing or junction plus 100m either side. Additional data was obtained for a set of three further boxes which steadily increased in size. In some instances, however, these larger boxes contained data relating to adjacent crossings or junctions and therefore only the original box and the next larger one (an increase of 20m in each direction of the box) were tested. Results showed the larger box made little difference and therefore the results are presented for the smallest box only. There were three years of 'before' data and for all but two sites, three years 'after' data, most sites having several extra years. Table 3.1 shows details of accident numbers. The accidents have been grouped by type of accident (pedestrian or vehicle) and by site type (mid block crossing or junction signals).

Table 3.1 Numbers of accidents at study sites

Accident group	Site years	Number of accidents	Accident frequency (accidents /year / site)
All accidents	700	1129	1.61
All accidents at junctions	140	214	1.53
All accidents at mid block crossings	560	915	1.63
All vehicle accidents	700	828	1.18
All pedestrian accidents	700	301	0.43
All pedestrian accidents at junctions	140	47	0.34
All pedestrian accidents at mid block crossings	560	254	0.45

Table 3.2 shows the number of accidents by severity grouped by site type (mid block crossing or junction signals) and severity. Table 3.3 shows the annual accident frequency by severity.

Table 3.2 Number of accidents by severity

Accident group	Number of accidents by severity				% serious & fatal
	Fatal	Serious	Slight	Total	
All accidents	12	117	1000	1129	11.4%
All junction accidents	2	22	190	214	11.2%
All accidents at mid block crossings	10	95	810	915	11.5%

Table 3.3 Accident severity (accidents per year per site)

	Farside	Puffin
Serious and fatal accidents / year / site	0.20	0.12
Slight accidents / year / site	1.54	1.40

Table 3.4 gives the interim results of statistical analysis using paired linear regression.

Table 3.4 Interim results of statistical analysis

Accident Group	Reduction in accident rate*
All accidents	**19%**
Junction accidents	26%
Mid block accidents	**17%**
Pedestrian accidents	27%
Pedestrian accidents at junctions	39%
Pedestrian accidents at mid blocks	25%
All vehicle accidents	16%

*Reductions in **bold** statistically significant at 95% level and all other accident groups significant at 90% level.

4 Further Analysis

Analysis of the accident data is on-going, the results shown here are therefore interim results. The further work planned involves investigation of plain language accident descriptions. The aim of investigating this aspect is to;

- Potentially eliminate accidents that are definitely not associated with the crossing (e.g. potentially those on a nearby side road)
- investigate any changes in accident causation trends

5 Discussion of results

Over all sites taken together, the interim results show a clear reduction in accident frequency after conversion from farside to Puffin facilities. The reductions in accident frequencies (accidents per year per site) following conversion from farside pedestrian facilities to Puffin are as follows

- for all accidents there was a 19% reduction, statistically significant at the 5% level;
- at mid block crossings the accident frequency was 17% lower and the difference was also statistically significant at the 5% level; and
- at junctions the accident frequency was 26% lower but significant only at the 10% level.

The frequency of serious and fatal accidents fell from 0.20/site/year to 0.12, a reduction of 40% whilst the slight accident frequency fell by 9%.

Junction accident frequencies fell by 26% but mid block crossing frequencies by only 17% when farside pedestrian facilities were replaced by nearside Puffin facilities. It is considered this reflects the efficiency gains at junction signals resulting from on-crossing and kerbside detection.

With Puffin facilities pedestrians look towards approaching traffic

The interim results support the long held opinion that Puffins are safer than farside pedestrian facilities. Possible reasons include the following:

- with Puffins, pedestrians look towards approaching traffic;
- absence of the flashing green man / flashing amber to vehicles that may lead to potential conflicts; and
- detection of pedestrians still crossing at the end of the green man

Further analysis is ongoing and the final report is expected to be published early next year.

6 Conclusions

The interim results of the study show that correctly designed, installed and operated Puffin facilities reduce accident frequency and accident severity compared to traditional farside pedestrian facilities. Changes in accident frequencies show:

- a 19% reduction at all sites;
- a reduction of 17% at mid block crossings; and
- a 26% reduction at junction signals.

The frequency of serious and fatal accidents reduced by 40% whilst the slight accident frequency fell by 9%.

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Appendix A - Accident analysis

Analysis was undertaken by fitting generalised linear models using the GENSTAT program (Alvey *et al*, 1977). The model form adopted was as follows:

$A_{ijm} = k.\ T_m^{\alpha} \exp\{ \beta S_i + \gamma M + \delta Q_j \}$ Equation 1

where :

A_{ijm} is the number of accidents at site i (i = 1…50) in quarter j (j=1…4) and quarter year m (m=1…56)

k, α, β, γ, δ are constants to be determined by the regression

S_i is the site factor (i = 1…50)

M is the type of signal control

1=Pelican
2=mixed (control during quarter when conversion occurred)
3=Puffin
4=unknown (more than 3 years before conversion)

T_m is the time in quarter years from the start of the data (m=1…56)

Q_j is the quarter factor in the year (j=1…4)

The site factor S takes account of changes over time at individual sites. The time factor T is included to allow for any time trends over the 14 year period. The quarter factor Q is included to take account of any seasonality in the data The type of signal control is given by the factor M as one of four levels, Pelican (or equivalent at signal-controlled junctions), mixed (control during quarter with conversion to Puffin), Puffin and, unknown (more than 3 years prior to conversion). The exponential value corresponding to the third level of M gives the multiplicative effect of Puffins relative to Pelicans. Because local authorities were only asked to check that the signals were in operation three years before conversion to Puffins, data from earlier years was not used. Each site therefore has a full three years before data and a minimum of three years after data.

In a regression analysis the effect of additional site factors (such as whether the junction or mid block crossing is on a single or dual carriageway) can be taken into account explicitly. However, in the model above, the site factor S implicitly includes this type of effect, since it automatically pairs the before and after data for the same site, and no additional factors were used. The effect of vehicle flow was not included in the analysis for two reasons. Firstly, it was assumed that any changes in flow would be taken into account by including the site and time factors (S and T) in the model. Secondly, Local Authorities would be unlikely to have flow records for the full 14-year accident period. The 95 per cent confidence intervals for the effect of Puffins compared to Pelicans can be calculated from the estimated value and its corresponding standard error:

Lower limit $\exp\{L\}$ where $L = \text{estimate} - 1.96 \times \text{standard error}$

Upper limit exp{U} where U = estimate + 1.96 × standard error

Table A-1 gives the estimated effect of Puffins compared to Pelicans (the second level of the signal control factor M) for each of the accident groups. Within each group, the value of exp {estimate} gives the multiplicative effect of Puffins relative to Pelicans. A positive estimate therefore indicates a higher accident frequency under Puffins than Pelicans, whereas a negative value indicates a lower accident frequency. The confidence interval for the estimated multiplicative effect is also shown. If the interval contains the value 1, then the results are not statistically significant. Results which are significant are marked with an asterisk.

The time trend T_m was not statistically significant in any of the models and has therefore been omitted from the results. For simplicity, the results include the effects of Q_j whether or not this parameter was significant, as it had little effect on the model parameters.

Table A-1 Model parameters for Puffins compared with Pelicans by site

Accident group	Estimate[1]	Standard error[2]	Ratio of effect of Puffins to effect of Pelicans[3]	Lower confidence limit for ratio	Upper confidence limit for ratio
All accidents	-0.210	0.083	0.811*	0.69	0.96
Junction accidents	-0.308	0.194	0.735	0.48	1.08
Crossing accidents	-0.189	0.0919	0.828*	0.69	1
Pedestrian accidents	-0.309	0.159	0.734	0.53	1.01
Pedestrian accidents at junctions	-0.499	0.451	0.607	0.25	1.50
Pedestrian accidents at crossings	-0.281	0.170	0.755	0.54	1.06
All vehicle accidents	-0.174	0.0.0974	0.841	0.69	1.02

1 Estimate of effect of Puffins (i.e. second level of parameter M in equation 1);
2 Standard error of estimate;
3 Exponential value of Puffin estimate (i.e. second level of parameter M); and
4 * indicates result was statistically significant at 5% level.