



Effect of Side Raised Entry Treatments on Road Safety in London

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Overview

Side entry treatments are road sections at junctions of side roads with major roads that have been designed as a form of gateway. They are placed either at the entrance to the junction or within a short distance of it. Where the road surface has been brought up to the level of the pavement, it is called a side raised entry treatment (SRET).

SRETs are a common feature on London's roads and many of them are on the Transport for London Road Network (TLRN). SRETs were installed to improve pedestrian accessibility and were also expected to have some effects on road safety. Therefore, a large and systematic study of their effect on collisions and on road user behaviour was commissioned from Transport Research Laboratory.

In the first part of this study, 777 SRET sites on the TLRN and 275 SRET sites on Borough roads were studied in a before-after collision study. Analysis was undertaken for various collision categories. The findings indicate that the road safety effect of SRETs differs on TLRN and Borough SRET sites. While no significant changes in overall collisions were observed on TLRN sites, overall collisions significantly reduced (-21%) on Borough sites. This difference may be

due to a number of issues. Further collision categories were investigated.

In the second part of this study, road user behaviour was observed at eight SRET sites and three control sites. The observations suggest that pedestrians appreciate the level crossing at SRETs.

However, the analysis indicates that pedestrians are less likely to be looking for traffic at SRET sites. The analysis also indicates that vehicles turning into side roads via a SRET are more likely to be delayed by a vehicle on the SRET.

Background

Many SRETs were installed as part of the TLRN, originally called the Red Routes. They were installed to provide a convenient level crossing for pedestrians walking along a main road in London. SRETs were also considered to have safety benefits by acting as a warning to drivers that they are entering or leaving a road environment which is quieter.

Reports, dating back to when the Red Route Network was originally planned, confirm that SRETs were installed as part of a mass-action scheme to improve pedestrian accessibility:



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“These measures will contribute towards achieving the new target of increasing by 30% the number of pedestrians who find it easier to cross the road after the introduction of Red Routes” (Traffic Director’s Annual Report 1998/99).

On Borough roads, SRET installation criteria appear to be more varied:

- As part of a traffic calming scheme;
- To slow traffic;
- To reduce collisions;
- To improve intervisibility of cyclists;
- To improve pedestrian accessibility.

Design, application, and performance of SRETs was studied before they were widely installed across London (2). This original study investigated collisions over a five-year period (1989 to 1993) at 107 early SRET sites and found a reduction of collisions involving vulnerable road users (-16%) and an increase in collisions involving all car users (+8%). However, because the sample size was too small at that stage, statistical power was too low and none of the results were found to be statistically significant.

The original SRET study also observed road user behaviour and found that pedestrians walking across a SRET were less often looking out for traffic. This original study summarised the benefits of SRETs as a combination of threshold treatment, speed reduction measure, and pedestrian crossing facility.

The study recommended that SRETs should not be considered on main roads with high traffic flows and high vehicle speeds to avoid shunt collisions on the main road. This is why most SRETs on the TLRN are in inner London.

The study concludes with guidelines on where SRETs are of most value depending on pedestrian activity, vehicle turning speeds, and conflicts between pedestrians and vehicles.

Objectives

Details in design (e.g. radius, gradient, width, material) had been addressed by the original SRET study. This study examined the effects of SRETs for different types of road users and vehicle manoeuvres, which had not been covered in the original study.

Building on previous research and comments from technical road safety experts, the following main research questions were formulated:

1. Are SRETs beneficial to pedestrian safety on the feature itself?
2. Are SRETs beneficial to road safety at the junction and on the side road?

The study also observed how road user behaviour is influenced by SRETs. In particular, it was investigated whether pedestrians were less likely to look out for traffic when walking across a SRET.

Methods

To investigate the effect of SRETs on collisions in London, a before-after study design was chosen for the main part of the study. To ensure adequate statistical power*, power calculations were undertaken and a minimum sample size of 1000 study sites determined. This sample size would provide robust statistical findings for most collision categories, including those involving vulnerable road users.

Using TfL’s asset management database (AIMS), SRETs on the TLRN were identified from the study. For confirmation, all sites were visited. For the study, 777 SRET sites with complete information were selected, of which 632 (81%) were located in inner London.

To investigate SRETs across London, each London Borough was contacted

* probability of rejecting a false positive finding

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and asked for information on SRETs on their roads. Complete site information was received from:

- Five outer London Boroughs (249 SRETs), and;
- One inner London Borough (26 SRETs).

In total, 275 SRETs on Borough roads were included in this study. Installation dates for these sites were provided by the Boroughs. Installation dates ranged from 1991 to 2004. For the TLRN sites, the installation dates were taken from previous work (Priority Route Accident Monitoring System). Most of these sites were installed between 1998 and 2000.

For all SRET sites, collision data for all injury severities were extracted from London's Stats19 collision and casualty database, using a two-stage process:

1. Collisions within 30 metre radius of SRET site; and
2. Collisions coded as "occurring within 20 metres of junction".

The control data were the total collisions at all non-signalised T-junctions or crossroads on the TLRN (for TLRN sites) or on Borough roads (for the Borough sites). To control for regression to mean effects, expected to be limited for most SRETs, collision data extending from 1982 to 2004 was used. This reduces the impact of selection bias due to the regression to mean effect.

Because conditions and installation criteria were different for TLRN SRETs and Borough SRETs, the collision data were analysed separately. Statistical regression analysis, using quasi-Poisson models, allowed for different site installation dates and controlled for background collision trends.

In addition to the collision analyses, road user behaviour was observed, categorised, and analysed. Site visits

were undertaken to identify suitable study sites. After obtaining permission from Highway Authorities for mounting cameras, filming was carried out at:

- Eight SRET sites, representative of London's SRET sites; and
- Three untreated control sites, comparable to the SRET sites.

At each site, road user behaviour was filmed for twelve hours on one weekday in October 2005. Suitable behavioural categories and severity of interactions between pedestrians and vehicles were defined. Then the films were watched and coded by trained observers. To investigate differences between SRET and control sites, the t-Test for proportions was used.

Results from the collision analyses

Preliminary data investigation

To determine the relative importance of the collision categories to be included in the statistical analysis, collision data from 1982 to 2004 were investigated at all 1052 study sites where SRETs were installed (Table 1).

The data of 30,377 collisions at the 1052 study sites over the 23 year period indicate that, on average, 1.26 collisions occurred at a study site per year. At study sites, 17% of collisions resulted in a serious or fatal injury, 26% involved pedestrians, 13% involved cyclists, and 29% involved a Powered Two Wheeler (P2W). Collisions involving turning movements represented 31% of all collisions at study sites.

Installation dates for SRETs vary widely across the study sites. Unlike the statistical data analysis, the preliminary data investigation of collisions at study sites does not take account of installation date.

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Statistical data analysis

Several regression models were tested for both the TLRN and the Borough sites. The most suitable regression model for each dataset was selected and interpreted. The analyses take account of varying SRET installation dates and general collision reductions (i.e. background changes). The results for each model are presented by collision category (Table 2). Only changes for which there is 95% certainty that they are not due to chance are reported ($p=0.05$). Results which were not statistically significant indicate no change.

1. Differences between TLRN and Borough sites

SRETs appear to have different effects on the TLRN and the Borough sites.

This finding confirms that separate analysis of the two datasets was appropriate. The difference in effect estimated for the SRETs on the TLRN and the Borough roads is difficult to explain. The explanation may be related to a number of issues:

- Different traffic characteristics between TLRN and Borough SRETs (e.g. speed, volume);
- Difference between inner and outer London (e.g. land use, pedestrians);
- SRETs on the TLRN may be affected by a wider “Red Route effect”: changes in collisions may have occurred on the TLRN and not just on the SRETs;
- SRETs on Borough roads may be affected by a regression to mean effect: they were more likely to be treated because of high collisions.

2. Collision analysis for TLRN sites

On the TLRN, SRETs have no effect on collision levels overall.

The TLRN regression model estimates that there was no overall change in the

number of collision due to the installation of SRETs. Most relevantly, collisions involving pedestrians don't appear to be affected by SRETs: no significant changes are estimated for these collisions categories.

On the TLRN, collisions involving pedal cyclists reduced.

The regression model estimates a statistically significant reduction for collisions involving pedal cyclists (-20%).

On the TLRN, collisions increased for several collision categories. Collisions involving P2Ws increased, collisions involving turning manoeuvres increased, and collisions occurring on the minor road also increased.

The regression model estimates a statistically significant increase for collisions involving motorcyclists (+66%). For collisions involving turning manoeuvres a statistically significant increase was also estimated (+18%), particularly right turns from the main road into the side road (+21%). A statistically significant increase for collisions on the side road (+18%) was estimated.

3. Collision analysis for Borough sites

On Borough roads, SRETs have reduced collisions overall.

The Borough road regression model estimates a statistically significant reduction for all collisions due to the installation of SRETs (-21%).

As on the TLRN, collisions involving pedestrians don't appear to be affected by SRETs: no significant changes are estimated for these collision categories.

On Borough roads, collisions reduced for several collision categories. Collisions involving turning manoeuvres reduced, in particular right turns from the side road into the main road. Collisions occurring on the minor road also reduced.

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The regression model estimates a statistically significant reduction for collisions involving pedal cyclists (-51%).

For collisions involving turning manoeuvres collisions significantly decreased (-25%), particularly right turns from the side into the main road (-41%). A statistically significant reduction for collisions on the side road (-27%) was estimated.

Results from the road user behaviour observations

Interactions between pedestrians and vehicles were observed at:

- Eight SRET sites: 3,272 interactions
- Three control sites: 1,279 interactions

There was some variation between the sites in the types of pedestrians being observed, but overall the SRET and control sites were adequately matched.

The interactions were coded into relevant observational categories and analysed.

At SRETs, pedestrians were less likely to look for turning vehicles.

Comparing pedestrian behaviour at SRET and control sites indicates that at SRETs, pedestrians were more likely to obviously look for turning vehicles that may conflict with them when crossing a side road.

However, it was not clear whether pedestrians expect drivers to give way at SRETs. Drivers showed little difference in propensity to give way to pedestrians wishing to cross the side road at SRETs and at control sites.

At SRET sites, pedestrians were more likely to wait for a stationary vehicle to clear the side road and to cross on the SRET than to walk around the stationary vehicle. This indicates that pedestrians appreciate the convenience of crossing the side road on a SRET.

The severity of interactions (coded by increasing severity as interaction, encounter, conflict) between individual pedestrians and vehicles was low at all sites. A significantly greater proportion of encounters and conflicts with vehicles turning into the side road were observed at SRET sites compared to control sites. This difference was most marked for vehicles turning right into the side road.

The road user observations raise no particular issues for child pedestrians, older pedestrians, or mobility impaired pedestrians. There were too few P2Ws or cyclists observed at the sites to draw any conclusions.

The road user observations provide some insight into the findings from the collision analysis.

The study indicates that pedestrians are not at increased injury risks at SRET sites although pedestrians are less likely to be looking for vehicles when crossing a SRET. It may be that pedestrians' willingness to wait to cross along the SRET after a waiting vehicle had cleared rather than walking behind the vehicle to save delay, results in better visibility of pedestrians by vehicles turning into the side road.

The study estimates an increase in collisions involving turning vehicles on the TLRN. The observations show that vehicles turning into the side road are more likely to be delayed by another vehicle on the side road on SRET sites than elsewhere.

Conclusions

The collision analysis found that SRETs have different effects on different road users. The collision analysis also found that on the TLRN, SRETs have no effect on collisions overall and that on Borough roads, SRETs have a beneficial effect on collisions overall.

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The apparent difference of SRET effects on the TLRN and Borough roads may be explained by different traffic characteristics between TLRN and Borough; difference between inner and outer London; TLRN's "Red Route" effect; regression to mean effect for Borough sites. The study does not favour any of these explanations.

The road user observations found that pedestrians are less likely to look for traffic on SRETs. The observations found that pedestrians are more likely wait for traffic to clear at SRET sites, which suggests that pedestrians appreciate the convenience of crossing the side road on a SRET. This may also result in better visibility of pedestrians by turning vehicles and may contribute to pedestrian safety.

SRETs have been installed to achieve a combination of objectives (e.g. TfL streetscape guidance):

- Creating a strong visual threshold for traffic leaving or entering a minor road;
- Providing easier pedestrian movement by raising treatment;
- Assisting pedestrian priority;
- Deterring parking close to junctions;
- Slowing vehicle speeds;
- Reducing collisions involving vulnerable road users.

The findings suggest that SRETs do provide easier pedestrian movement and assist pedestrians in asserting priority. The findings further indicate that SRETs reduce collisions involving pedal cyclists but not those involving other vulnerable road users.

Selected References

1. Wood K, Summersgill I, Crinson L F, Castle J A (2006): Effect of side raised entry treatments on road safety in London. Transport Research Laboratory: Published Project Report.
2. Colin Buchanan and Partners (ca. 1995): Justification and Design of Entry Treatments. Assessment study for the London Transport Director.

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Table 1: Collision numbers at 1052 London study sties where SRETs were installed. Collision data covers 23 years (1982-2004)

Collision category	Collisions	Per site Per year*
Total collisions	30,377	1.26
Fatal collisions	250	0.01
Serious collisions	4,996	0.21
Slight collisions	25,161	1.04
Pedestrian	7,882	0.33
Non pedestrian	22,495	0.93
Pedal cycle	4,050	0.17
Pedal cycle turning	243	0.01
P2W	8,703	0.36
P2W turning	403	0.02
Left in	1,018	0.04
Left out	698	0.03
Right in	3,865	0.16
Right out	3,805	0.16
All turning	9,290	0.38

*number of collisions per site and per year

NB: The installation dates of SRETs vary across all study sites. The figures do not take into account installation dates.

Table 2: Summary results for 777 TLRN and 275 Borough SRET sites

Collision category	TLRN	Borough
Total collisions	ns	-21%
Fatal collisions	ns	ns
Serious collisions	ns	ns
Slight collisions	ns	-22%
Pedestrian	ns	ns
Non pedestrian	ns	-25%
Pedal cycle	-20%	-51%
Pedal cycle turning	ns	ns
P2W	+66%	ns
P2W turning	+76%	ns
Left in	ns	ns
Left out	ns	ns
Right in	+21%	ns
Right out	ns	-40%
All turning	+18%	-25%
Pedestrian major road	ns	ns
Pedestrian minor road	ns	ns
All minor road	+18%	-27%

ns= no significant result at 5% level (p=0.05)