Roundabouts: impact on accidents

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About forty roundabouts have been installed at junctions in London in the last four years, many of which are the new mini or small type. The impact of these roundabouts on accidents, particularly to pedestrians, right-turning vehicles and vehicles emerging from different roads, is assessed. Factors such as the diameter of the roundabout island, its construction, the road surface, and weather conditions prevailing at the time of the accident are taken into account. Concludes that the introduction of roundabouts appears to have a considerable impact, reducing accidents to both vehicles and pedestrians.

Background

A preliminary study assessing the impact on accidents of the introduction of roundabouts has recently been conducted by the Transport and Road Research Laboratory (1975). The study included data for 78 sites throughout Britain where major/minor priority had been replaced by offside priority (give way to traffic from the right) roundabouts of various sizes. The findings included the following:

(a) Total accidents fell by 31 per cent;

(b) Accidents involving two-wheeled vehicles fell from 23 to 16 per cent of the total;

(c) Accident severity (i.e. the proportion of the total number of accidents that were fatal or serious) fell from 25 to 18 per cent of the total.

To ascertain whether or not these results could be extended to the urban conditions prevalent in Greater London, the GLC has analysed accident data for new roundabouts in Greater London. Accidents involving pedestrians, right-turning vehicles and vehicles emerging from different roads were of particular interest. The study also aimed at highlighting various features of roundabout design which may have had an important impact on accidents. These included lighting, construction and, in particular, the size of the roundabout island, as many were of the newer small or mini type which had been sanctioned by the Department of the Environment in 1971 (see Department of the Environment, 1971). Examples of mini-roundabout layouts are shown in Figure 1.

Description of study

Selection of sites

All sites where offside priority roundabouts had been installed in Greater London between January 1970 and March 1975 were included in the study. With few exceptions all the sites were located in built-up areas. No limit was placed on the size of the diameter of the roundabout island; there were 20 mini-roundabouts (1.0 to 4.0 metres island diameter), 9 small roundabouts (4.1 to 7.9 metres island diameter), 5 large roundabouts (8.0 or more metres island diameter) and 4 double mini-roundabouts (a junction with two mini-roundabouts either contiguous or connected by a short link road; see, Department of the Environment, 1975). No discrimination was made between sites where the island had been installed to prevent accidents and those where installation was to improve the capacity of a junction. The initiative to install the roundabouts had come in some instances from the GLC and in others from the Metropolitan Police Force and the London boroughs.

Time period limitations

Suitable accident data from the GLC Accident Statistics System* were limited to the period from January 1970 to May 1975. Seasonal variations were reduced by using data for exactly similar before and after calendar periods i.e. if a roundabout was installed in August 1971 the before data relate to the period January 1970 to August 1971 and the after data to the period January 1972 to August 1973. Accident data at each site were therefore limited by the proximity of the implementation date to the data limits, i.e. January 1970 or May 1975, and this limitation on the length of the before and after periods meant that the maximum amount of data available for each site could not always be used. Sites with before and after periods of less than five months were excluded from the study.

Site data

Each site was visited and information collected about the following items:

(a) Exact location of roundabout

(b) Size of roundabout island

* For a detailed description of the GLC Accident Statistics System see Turner (1972).

FIGURE 1 A mini roundabout

FIGURE 2 A small roundabout

(c) Construction of roundabout island

(d) Number of arms constituting the junction

(e) Guard rail

(f) Anti-skid surfacing

(g) Island lighting

(h) Pedestrian refuges at stop lines of junction arms

(i) Photograph of layout

(j) Width of approaches to roundabout

(k) Number of roundabouts.

Analysis of accidents

Selection of relevant accidents

The study area was defined as that encompassing the junction and 50 metres along each arm of the junction. The grid references provided for each accident by the GLC Accident Statistics System were used as a rough guide to locate the accidents on 1:1250 scale maps showing the study area. Precise locations were established by the 'in clear' locations* provided by the Metropolitan Police Force accident report.

Personal injury accidents were broken down into the following main categories:

(a) Pedestrian accidents within (i) 50 metres of the junction, (ii) up to 20 metres from the junction, and (iii) 20 to 50 metres from the junction.

(b) Vehicle accidents including sub-divisions for nose-to-tail, right-turning and cross-road type accidents.

(c) Fatal and serious accidents; accidents occurring in wet and dark conditions.

Accident data tabulation

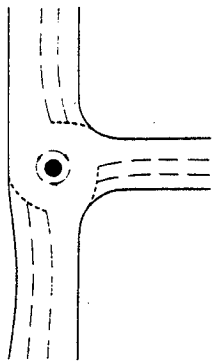
To evaluate the important effect of the roundabout diameter on accidents, those with diameters in certain preselected ranges were grouped together and the results tabulated for each group. To evaluate the effect of other site features, all sites with a common feature, such as a guard rail, were also aggregated. Some of the more interesting findings are discussed in the results section below. Full tables of results are presented in the GLC Road Safety Section report ATWP 16 (Lalani, 1975).

* Locations defined in clear English using road names and measured distances from junctions or well known landmarks e.g. 'Lillie Road 10 yards west of Munster Road'.

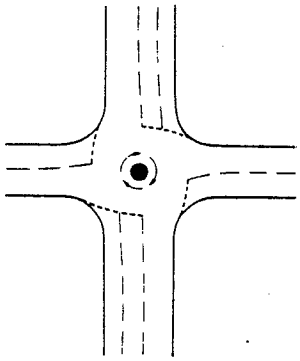
Statistical tests

Statistical significance tests were carried out on some of the results of the studies. Significant variations between changes in accidents at the sites in the study and changes in similar types of accidents in the whole

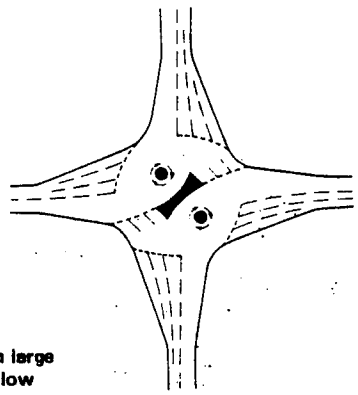
FIGURE 3 Examples of mini-roundabout layouts



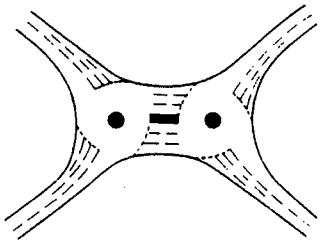
T junction



Crossroad



Crossroad with large right-turning flow



Scissor junction

TABLE 1 **Accidents at all 38 roundabouts included in the study**

Type of accident	*Before*	*After*	*Percentage change*
Total pedestrian within 50 metres	**39**	**21**	**−46.2†**
Pedestrian within 20 metres	33	16	−51.5
Pedestrian within 20-50 metres	6	5	−16.67
Pedestrian within 50 metres in light	30	14	−53.3‡
Pedestrian within 50 metres in dark	9	7	−22.2‡
Fatal and serious pedestrian within 50 metres	10	3	−70.0
All vehicle within 50 metres	**195**	**118**	**−39.5***
Cross-road within 50 metres	108		
Nose-to-tail within 50 metres	25	22	−12.0
Single vehicle within 50 metres	11	13	+9.1
Right-turning/head-on on same road within 50 metres	42		
Vehicle within 50 metres in light	126	69	−45.2
Vehicle within 50 metres in dark	69	49	−30.0
Vehicle involving vehicle from another junction within 50 metres	9	3	−66.7
Fatal and serious vehicle within 50 metres	32	10	−68.8
Public service vehicle passenger within 50 metres	7	8	+14.3
Two-wheeled vehicles within 50 metres	61	48	−21.3
Total fatal and serious within 50 metres	**42**	**15**	**−64.3**
Total in wet conditions within 50 metres	**84**	**41**	**−51.2**
Total in light conditions within 50 metres	**163**	**90**	**−44.8**
Total in dark conditions within 50 metres	**78**	**57**	**−26.9**
Total within 50 metres	**241**	**147**	**−39.0***

Notes

*Significant change at the five per cent level

†Significant change at the ten per cent level

There were 20 mini, 9 small, 5 large and 4 double mini-roundabouts included in the study.

The average number of months in the before and after periods was 19.

The average number of accidents per site per year was 4.0 in the before period and 2.4 in the after period.

Prevailing conditions

8 sites had two or more approaches of more than single lane width
6 sites were without stop line pedestrian refuges on any junction arms
5 sites had guard rails
12 sites had kerbless roundabouts
14 sites had 3-arm junctions
19 sites had 4-arm junctions
5 sites had 5-arm junctions
6 sites had street lighting on the island

of Greater London were noted. Changes in Tables 1 and 2 which are significant at the 5 per cent level (the probability of such a change happening by chance is 1 in 20) are marked * and significant changes at the 10 per cent level by †.

Tests for significance were limited to changes in the following types of accidents:

(a) All pedestrian accidents at, or within 50 metres of, a junction;

(b) All vehicle accidents at, or within 50 metres of, a junction;

(c) All two-wheeler accidents at, or within 50 metres of, a junction;

(d) All accidents at, or within 50 metres of, a junction.

Results

Detailed results of the study are shown in Tables 1 and 2. Some of the main findings are as follows:

(a) Total accidents at all 38 sites included in the study fell by 39 per cent; at mini-roundabouts by 30 per cent, at small roundabouts by 43 per cent, at large roundabouts by 52 per cent, and at double mini-roundabouts by 40 per cent.

(b) Pedestrian accidents fell by 46 per cent (Table 1).

(c) Vehicle accidents fell by 39 per cent; since nose-to-tail and single-vehicle accidents remained more or less the same, the main fall can be attributed to accidents which were formally of the cross-road and right-turning types (Table 1).

(d) Fatal and serious vehicle accidents showed a 69 per cent decrease and represented a fall from 17 per cent of all accidents to 10 per cent (Table 1).

(e) Wet road accidents dropped by 51 per cent (very few sites had been provided with anti-skid surfacing on approaches) (Table 1).

(f) At roundabouts constructed using a kerbless island total accidents fell by 23 per cent, nose-to-tail collisions rose by 60 per cent and two-wheeled vehicle accidents rose by 7 per cent.

TABLE 2 **Accidents at the 20 mini-roundabouts included in the study**

Type of accident	*Before*	*After*	*Percentage change*
Total pedestrian within 50 metres	**16**	**10**	**−37.5**
Pedestrian within 20 metres	14	7	−50.0
Pedestrian within 20-50 metres	2	3	+50.0
Pedestrian within 50 metres in light	10	8	−20.0
Pedestrian within 50 metres in dark	6	2	−66.7
Fatal and serious pedestrian within 50 metres	5	2	−60.0
All vehicle within 50 metres	**78**	**55**	**−29.5**
Cross-road within 50 metres	41		
Nose-to-tail within 50 metres	10	8	−20.0
Single vehicle within 50 metres	5	7	+40.0
Right-turning/head-on on same road within 50 metres	21		
Vehicle within 50 metres in light	51	31	−39.2
Vehicle within 50 metres in dark	27	24	−11.1
Vehicle involving vehicle from another junction within 50 metres	1	1	0
Fatal and serious vehicle within 50 metres	10	8	−20.0
Public service vehicle passenger within 50 metres	5	4	−20.0
Two-wheeled vehicles within 50 metres	23	21	−8.7
Total fatal and serious within 50 metres	**15**	**11**	**−26.7**
Total in wet conditions within 50 metres	**37**	**16**	**−56.8**
Total in light conditions within 50 metres	**66**	**43**	**−34.8**
Total in dark conditions within 50 metres	**33**	**26**	**−21.2**
Total within 50 metres	**99**	**69**	**−30.3†**

Notes

*Significant change at the five per cent level

†Significant change at the ten per cent level

The average number of months in the before and after periods was 19.

The average number of accidents per site per year was 3.1 in the before period and 2.2 in the after period.

Prevailing conditions

3 sites had two or more approaches of more than single lane width
4 sites were without stop line pedestrian refuges on any junction arms
3 sites had guard rails
11 sites had kerbless roundabouts
10 sites had 3-arm junctions
8 sites had 4-arm junctions
2 sites had 5-arm junctions
No sites had street lighting on the island

Conclusions

Introduction of offside priority roundabouts at major/minor priority junctions appears to have a considerable impact on accidents of most types. It appears that the large reductions in vehicle accidents consist of those of the cross-road and right-turning vehicle type. The safety performance of the roundabout seems to improve as the island size increases, possibly reflecting the necessity of providing adequate deflection to traffic as a roundabout feature. The smallest improvement in safety was at sites where the islands were of kerbless construction. Fears of increased danger to pedestrians have not been substantiated as both the numbers and severity of pedestrian accidents fell.

Considerations for future implementation

New roundabouts, including small and mini-roundabouts, would appear to be a worthwhile safety measure at accident blackspot sites. For best results the size of the island should be such that adequate deflection is obtained and the island itself should be raised. Mini-roundabouts with kerbless islands do not appear to affect safety adversely. However, the greater use of semi-raised islands (as opposed to domed islands) may be better compromise in that they should ensure some deflection and speed reduction by smaller, faster vehicles, such as cars, whilst catering for the turning requirements of very large vehicles.

New mini-roundabouts at accident blackspot sites should be most effective when existing accidents are primarily of the cross-road collision or right-turning type.

References

Department of the Environment (1971).
Junction Design (Interim).
Technical Memorandum no H7/71, 18 pp

Department of the Environment (1975).
Roundabout Design
Technical Memorandum no H2/75, 20 pp

Lalani, N. (1975)
Introduction of mini, small and large roundabouts at major/minor priority junctions — impact on accidents
Accident Technical Working Party Report no 16, 18 pp
[Unpublished but obtainable from the GLC Department of Planning and Transportation Road Safety Section]

Transport and Road Research Laboratory (1975).
Accidents at offside priority roundabouts.
TRRL Leaflet LF 393, Issue 2, 2 pp

Turner, E. D. (1972).
A computerised system for road accident statistics in London: development and use
GLC Intelligence Unit Quarterly Bulletin no 18, March 1972, pp 22-37

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Editor's note

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