

1-2: Entering-circulating crashes

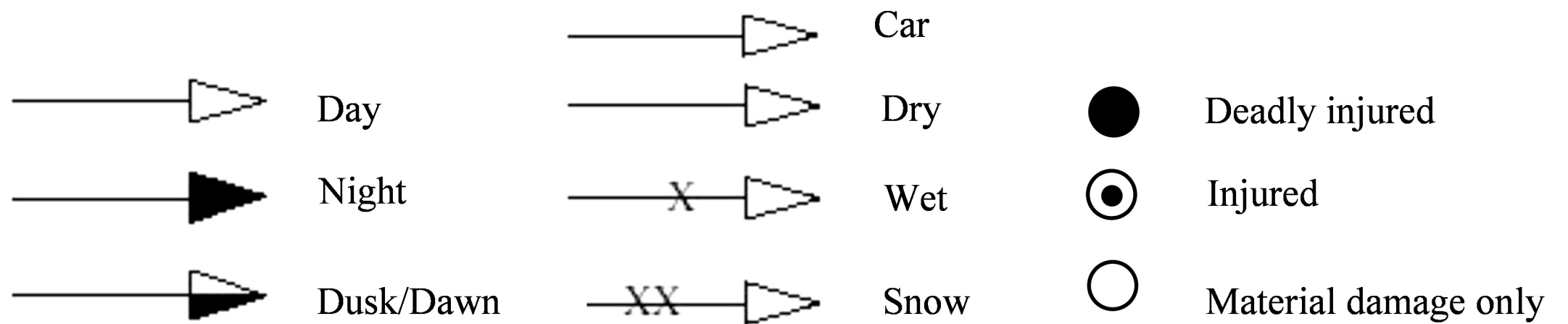


Figure A1 Collision diagram of a roundabout location (Local police department, 2013)

Table A1 Roundabout segments

Roundabout segment	Description
Entry lane	
Segment 1	20-100 meters off the roundabout. Oncoming traffic, queues associated with congestion.
Segment 2	20 meters before the roundabout until the yield markings. Includes pedestrian and cyclist crossings, if present.
Circulatory road	
Segment 3	Location on the entry path of the circulatory road situated beyond the yield markings of the entrance lane.
Segment 4	Continuation of segment 3. Location on the circular part of the roundabout near the central island. Includes the (truck) apron, if present.
Segment 5	Location on the circulatory road situated 10 meters beyond the entry lane and 10 meters before exit lane of the roundabout.
Segment 6	Location on the circular part perpendicular to the exit lane and before the curved exit path of the roundabout.
Exit lane	
Segment 7	20 meters beyond the circulating part of the roundabout. Includes pedestrian and cyclist crossings, if present.
Segment 8	20-100 meters off the roundabout. Leaving traffic.
Bypass	
Segment 9*	The beginning of the bypass, if present
Segment 10*	The middle section of the bypass which includes pedestrian and cyclist crossings, if present.
Segment 11*	The end section of the bypass, if present.

*These segments are optional and are only relevant when the roundabout is characterised by a bypass. The definitions of the segments are based on the geometric design features of roundabouts discussed in Rodegerdts et al. (2010).

Table A2 Distribution of roundabout crashes by roundabout segment and crash severity

Roundabout segment	Total crashes	Property damage only crashes	Injury crashes	Slightly injured*	Severely injured*	Fatally injured*
All segments	399 (100)					
Segment 1	65 (16)	48	17	17	0	0
Segment 2	52 (13)	31	21	19	2	0
Segment 3	75 (19)	48	27	25	2	0
Segment 4	83 (21)	45	38	32	5	1
Segment 5	32 (8)	28	4	4	0	0
Segment 6	53 (13)	33	20	18	1	1
Segment 7	27 (7)	14	13	13	0	0
Segment 8	8 (2)	7	1	1	0	0
Segment 9	0	0	0	0	0	0
Segment 10	4 (1)	3	1	1	0	0
Segment 11	0	0	0	0	0	0

Values between () represent percent values of the column total

* The severity of the injury crashes is determined by the injury severity of the road user who endured the most serious injury during the crash (Carpentier and Nuyttens 2013):

- Fatally injured: every person involved in a crash and died at the scene or before hospitalization or within 30 days after the crash;
- Severely injured: every person involved in a crash and whose condition is so severe that hospitalization for more than 24 hours is required;
- Slightly injured: every person who gets injured in a crash and for whom the definitions of fatally and severely injured is not applicable.

Table A3 Roundabout crash types by crash location

Crash type ^a	Crashes	X ²	p ^b
All crash types	399 (100)		
Run-off-road	43 (11)		
Segment 2	10 (23)	1.836	0.175
Segment 3	1 (2)	8.556	0.003
Segment 4	5 (12)	2.576	0.109
Segment 5	5 (12)	0.850	0.369
Segment 6	5 (12)	0.115	0.735
Segment 7	10 (23)	20.769	<0.001
Segment 8	6 (14)	35.018	<0.001
Segment 10	1 (2)	1.599	0.290
Collision with central island	79 (20)		
Segment 4	78 (99)	357.636	<0.001
Segment 5	1 (1)	6.092	0.014
Wrong-way	4 (1)		
Segment 2	1 (25)	0.511	0.429
Segment 5	2 (50)	9.653	0.034
Segment 7	1 (25)	2.129	0.245
Rear-end	115 (29)		
Segment 1	61 (53)	160.036	<0.001
Segment 2	27 (23)	15.554	<0.001
Segment 3	3 (3)	27.739	<0.001
Segment 5	15 (13)	5.527	0.019
Segment 6	5 (4)	11.199	0.001
Segment 8	2 (2)	0.058	1.000
Segment 10	2 (2)	2.110	0.201
Loss-of-control	41 (10)		
Segment 1	3 (7)	2.881	0.090
Segment 2	3 (7)	1.437	0.231
Segment 3	6 (14)	0.626	0.429
Segment 4	1 (2)	9.846	0.002
Segment 5	9 (21)	11.441	0.003
Segment 6	14 (33)	16.383	<0.001
Segment 7	6 (14)	4.206	0.052
Entering-circulating	54 (13)		
Segment 3	51 (96)	240.062	<0.001
Segment 6	2 (4)	4.798	0.028
Vulnerable road user	50 (13)		
Segment 2	9 (18)	1.244	0.368
Segment 3	14 (28)	3.172	0.075
Segment 6	17 (34)	21.299	0.000
Segment 7	10 (20)	15.866	0.001
Sideswipe	13 (3)		
Segment 1	1 (8)	0.729	0.703
Segment 2	2 (15)	0.066	0.681
Segment 6	10 (77)	47.248	0.000

Values between () represent percent values of the column total Values between () represent percent values of the column total regarding the segment distribution within each crash type

X²-test: each crash type is per segment compared to the combined average of all other segments

^a Not every crash type occurred in each segment

^b p ≤ 0.05 (significant at 95% CI)

The p-value of the overrepresented crash types is highlighted in bold

Table A4 Logistic regression results for crash severity on subject level

	Model 1			Model 2		
	Parameter	Odds ratio	Significance	Parameter	Odds ratio	Significance
Intercept	0.3844		0.3683°	0.0732		0.9850°
Crash type (ref. sideswipe)						
Run-off-road	0.3125	1.37	0.5146°			
Collision with central island	1.7761	5.91	<0.0001***			
Wrong-way	-0.0727	0.93	0.9605°			
Rear-end	0.4517	1.57	0.1299°			
Loss-of-control	-0.3726	0.69	0.3870°			
Entering-circulating	-0.3095	0.73	0.4230°			
Vulnerable road user	0.9282	2.53	0.0877*			
Road user (ref. pedestrian)						
Car	-2.0880	0.12	<0.0001***	-1.6908	0.18	<0.0001***
Moped rider	1.2506	3.49	0.0352**	1.3799	3.98	0.0216**
Cyclist	2.3382	10.36	<0.0001***	2.2573	9.56	<0.0001***
Motorcyclist	0.4044	1.50	0.6372°	0.3356	1.40	0.6854°
Truck	-3.7178	0.02	<0.0001***	-3.2773	0.04	<0.0001***
Roundabout (ref. single-lane)						
Double-lane	0.4209	1.52	0.0009***	0.4712	1.60	0.0007***
Segment (ref. segment 10)						
Segment 1				0.5726	1.77	0.0838*
Segment 2				0.4855	1.63	0.1546°
Segment 3				-0.3671	0.69	0.3065°
Segment 4				1.8308	6.24	<0.0001***
Segment 5				-1.5987	0.20	0.0273**
Segment 6				-0.6332	0.53	0.0996*
Segment 7				0.1404	1.15	0.7717°
Segment 8				-0.1871	0.83	0.8309°
Summary statistics						
Observations			636			636
Observed nr. of injured			156			156
Proportion of injured			0.25			0.25
Hosmer and Lemeshow test ^a			X ² = 7.57 (df= 6, p=0.27)			X ² =1.67 (df=6, p=0.94)

^a The Hosmer and Lemeshow goodness-of-fit test indicates a good fit for both models.

Odds ratio values that are significant at p ≤ 0.05 are highlighted in bold.

*** p≤0.01 (significant at 99% CI); ** p≤0.05 (significant at 95% CI); * p≤0.10 (significant at 90% CI); ° p>0.10 (not significant at 90% CI)

Due to convergence problems the variables ‘crash type’ and ‘segment’ could not be inserted in one model.

Table A5 Distribution of cyclists' and mopeds' crashes according to type of cycle facility

Cycle facilities	Total number of crashes	Crashes (only cyclists and mopeds)	χ^2	p^a
All cycle facilities	399	46		
Mixed traffic	21 (5)			
Cyclists and mopeds		3 (6)	2.572	0.109
Cycle lanes within roundabout	131 (33)		36.913	<0.001
Cyclists and mopeds		36 (79)		
Separated cycle paths	138 (35)		12.585	<0.001
Cyclists and mopeds		6 (13)		
Grade separated cycle paths	109 (27)		23.103	<0.001
Cyclists and mopeds		1 (2)		

Values between () represent percentages of the column total

χ^2 -test: the crash number for each cycle facility is compared to the combined average crash number of all types of cycle facilities

^a $p \leq 0.05$ (significant at 95% CI)

The p-value of the overrepresented crashes is highlighted in bold

Table A6 Distribution of cyclists' and mopeds' crashes according to type of cycle facility and roundabout segment

Cycle facilities	Total number of crashes ^a	Crashes (only cyclists and mopeds)	χ^2	p^b
Mixed traffic	21	3		
Segment 2	3 (14)	0	0.010	1.000
Segment 3	9 (42)	2 (67)	0.397	0.611
Segment 6	2 (9)	1 (33)	0.485	0.650
Segment 7	0	0	0.000	1.000
Cycle lanes within roundabout	131	36		
Segment 2	7 (5)	5 (14)	1.427	0.245
Segment 3	26 (20)	10 (28)	0.003	1.000
Segment 6	17 (13)	16 (44)	6.250	0.012
Segment 7	7 (5)	5 (14)	3.001	0.118
Separate cycle paths	138	6		
Segment 2	9 (7)	2 (33)	2.454	0.144
Segment 3	2 (1)	1 (17)	1.135	0.414
Segment 6	4 (3)	0	4.906	0.039
Segment 7	4 (3)	3 (50)	5.375	0.041
Grade separated cycle paths	109	1		
Segment 2	18 (17)	0	0.224	1.000
Segment 3	13 (12)	1 (100)	2.624	0.280
Segment 6	27 (25)	0	0.526	1.000
Segment 7	2 (2)	0	0.255	1.000

Values between () represent percentages of the column total

^a Only the crashes that occurred in these 4 segments are mentioned in this column

^b $p \leq 0.05$ (significant at 95% CI)

χ^2 -test: the crash number for each segment is per type of cycle facility compared to the combined average crash number of all other segments

The p-value of the overrepresented crashes is highlighted in bold

Table A7 Logistic regression results for type of involved road user on subject level

	Model 1			Model 2		
	Parameter	Odds ratio	Significance	Parameter	Odds ratio	Significance
Intercept	2.7292		<0.0001***	3.1485		<0.0001***
Crash type (ref. sideswipe)						
Run-off-road	0.3466	1.41	0.6658°			
Collision with central island	0.4309	1.54	0.4541°			
Wrong-way	-0.5320	0.59	0.7192°			
Rear-end	1.1895	3.29	0.0236**			
Loss-of-control	0.4572	1.58	0.4819°			
Entering-circulating	-0.3639	0.70	0.4190°			
Vulnerable road user	-2.7696	0.06	<0.0001***			
Roundabout (ref. single-lane)						
Double-lane	0.8899	2.44	0.0003***	1.1289	3.09	<0.0001***
Segment (ref. segment 10)						
Segment 1				1.9229	6.84	0.0025***
Segment 2				-0.6826	0.51	0.0955*
Segment 3				-0.6400	0.53	0.0718*
Segment 4				0.7287	2.07	0.0034***
Segment 5				0.6035	1.83	0.3539°
Segment 6				-1.3129	0.27	0.0008***
Segment 7				-1.2588	0.28	0.0028***
Segment 8				0.2608	1.30	0.8566°
Summary statistics						
Observations			636			636
Observed nr. of motorized ^a			568			568
Proportion of motorized			0.89			0.89
Hosmer and Lemeshow test ^b			$\chi^2 = 2.59$ (df= 6, p=0.86)			$\chi^2 = 1.19$ (df=6, p=0.98)

^a The motorized category contains cars and trucks while the vulnerable road user category consists of pedestrians, cyclists, motorcyclists and moped riders.

^b The Hosmer and Lemeshow goodness-of-fit test indicates a good fit for both models.

Odds ratio values that are significant at $p \leq 0.05$ are highlighted in bold.

*** $p \leq 0.01$ (significant at 99% CI); ** $p \leq 0.05$ (significant at 95% CI); * $p \leq 0.10$ (significant at 90% CI); ° $p > 0.10$ (not significant at 90% CI)

Due to convergence problems the variables 'crash type' and 'segment' could not be inserted in one model.