ANALYSING PEDESTRIAN AND VEHICLE INTERACTION AT COURTESY CROSSINGS

Giovanni Di Guardo

Transport Planning Associates (TPA)

Prof. Peter Jones

University College London (UCL)

ABSTRACT

Courtesy crossings are elements of the highway, typically provided in more shared street environments, highlighted with coloured surfacing, marked stripes, a raised carriageway and/or narrowing of the road. Whilst not providing a formal pedestrian crossing, they invite pedestrians to cross in a specific place and drivers to let them cross the road safely, out of courtesy.

The Chartered Institution of Highways and Transportation and the Department for Transport have recently sought more evidence on such schemes; one of the objectives of this study was to fill this gap.

The study has analysed 1,369 observations of pedestrians crossing the road at 12 Sites across the UK, including some ‘shared space’ schemes (such as Bexleyheath, Felixstowe, Poynton, Preston and Swindon). Multilinear regression models have been developed both at aggregate and disaggregate levels, relating courtesy behaviour to 34 explanatory variables. In addition, a before-after analysis testing the effect of the introduction of marked stripes at one site has also been undertaken.

This paper presents the results of the models, comments on the statistical significance of factors such as traffic and pedestrian volumes and composition and site infrastructure characteristics; and provide recommendations on how to design courtesy crossings.

The presence of stripes had the most significant impact on driver`s courtesy behaviour; it was also observed that the legal requirement to give way to pedestrians at a controlled zebra crossing only affects the pedestrian delay at the crossing. Other relevant design features positively affecting courtesy include the presence of ramps and visual narrowings of the road. On the other hand, where traffic flows include significant numbers of heavy goods vehicles and buses, then vehicles are less likely to give way to pedestrians.

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1 INTRODUCTION

Most research studies and guidelines focus on the planning, design and installation of controlled crossings, either in the form of a zebra or a signalised crossing. Not enough guidance is currently provided on informal, uncontrolled crossings, particularly for those defined as “courtesy crossings”.

Courtesy crossings are elements of the highway, typically provided in more shared street environments, with “*no statutory requirement for drivers to give way to pedestrians, but many do out of courtesy”* (DfT, LTN 1/11). They are typically highlighted with coloured or textured surfacing, marked stripes, raised carriageway or narrowing of the road, which, whilst not representing formal pedestrian crossings, invite pedestrians to cross in a specific place and drivers to let them cross the road safely. Courtesy crossings must take into account the comfort and safety of all road users but especially pedestrians, given that the car driver is under no obligation to stop and give priority to the pedestrian.

This study looks in more detail at different types of courtesy crossing and their relative effectiveness in influencing driver/pedestrian interaction, in favour of the latter.

1.1 Background

Research on pedestrian crossings has traditionally concentrated on theories of the gap acceptance (Kadali et al, 2012), route choice, accident prediction, driver`s braking behaviour, speed reduction and vehicle delay at signalised and unsignalised crossings. There are three categories of factors affecting the operation of pedestrian crossings:

> *“1. behavioural factors – response time, age, disability;*
>
> *2. traffic factors – traffic volume, speed of road users, traffic density, acceptable gaps, level of service (LOS), conflict situations;*
>
> *3. road factors – pedestrian crossing geometry, road and pedestrian facility capacity, visibility of pedestrians and vehicles”*
>
> (Gumińska, 2016).

The influence of levels of pedestrian and traffic volumes on the operation of the crossings has been identified as a key factor in most studies and included in some UK guidelines, sometimes in its squared form.

More recently, another field of the research has been the introduction of some generally unobserved factors into predictive models, such as "*behavioural routines and patterns, human factors like perceptions, attitudes and preferences".* It was concluded that *"these factors have additional explanatory power over road and traffic factors of pedestrian behaviour"* (Papadimitriou et al., 2016).

1.2 UK Guidance

In the UK, Local Transport Notes 1/95 and 2/95 are the two DfT documents that set out, respectively, a general method of assessment to be used when providing at-grade pedestrian crossings and more detailed guidance on each type of crossing, when planning, designing and installing them.

Until recently, in the UK, the DfT LTN 1/11 – now withdrawn – has provided the most comprehensive guidance on the principles behind 'shared space', including the provision of courtesy crossings. A number of studies have been conducted on 'shared space', including before–after and traffic conflict studies (Dong, 2012; Schönauer et al., 2012; Horrell, 2014); while they identified some key elements affecting crossing behaviour, they also recommended further research.

The Chartered Institution of Highways and Transportation (CIHT) published in January 2018 a new professional guidance relating to areas of so-called Shared Space: *Creating better streets: Inclusive and accessible places. Reviewing shared space*.

Based on the analysis of 11 schemes across the country, the CIHT guidance recommends general principles and good practice. It "*found the term 'shared space' to be unhelpful, as it is vague and tends to be associated with several preconceived ideas"* (CIHT, 2018). Instead it proposes three new design approaches to replace it, as summarised in Table 1.1.

With regards to courtesy crossings, the new guidance concludes that:

> *"Courtesy crossings fit well with the aim of encouraging road users, particularly drivers, to engage with their surroundings rather than simply following traffic rules, which tends to reduce traffic speed. There is a need for more research in this area.*
>
> *At some courtesy crossings, a high proportion of drivers have been observed to give way to pedestrians whereas others have been less successful. The use of speed reduction measures, conspicuous treatments, locating crossings on junction entries and exits, changes in level and median strips all appear to*

encourage greater driver courtesy. Further research into the relationship between these and other design features and driver courtesy is needed. This research should also identify whether and to what extent the willingness of drivers to give way depends on the characteristics of the person(s) wishing to cross". (CIHT, 2018)

Table 1.1 CIHT definitions

Approach	Description	Examples
Pedestrian prioritised streets	Streets where pedestrians feel that they can move freely anywhere and where drivers should feel they are a guest. Under current legislation, this does not give formal priority to pedestrians	Elwick Square Exhibition Road Holbein Place Leonard Circus
Informal streets	Streets where formal traffic controls (signs, markings and signals) are absent or reduced. There is a footway and carriageway, but the differentiation between them is typically less than in a conventional street	Fountain Place Gosford Street Kimbrose Triangle Fishergate Hamilton Road
Enhanced streets	Streets where the public realm has been improved and restrictions on pedestrian movement (e.g., guardrail) have been removed but conventional traffic controls largely remain	Walworth Road Shenley Road

The need of research on courtesy crossings is confirmed by the latest CIHT guidance (2018) which includes the following recommendation:

"Recommendation 10

Government should undertake research into courtesy crossings, focusing on the relationship between various design features, context, user types, levels of driver courtesy and their relationship with formal crossings."

1.3 Study Objectives and Approach

Designing courtesy crossings lacks a strong empirical basis.

This study seeks to fill the gap in literature with a view to:

1. Understand what are the elements of courtesy crossings that encourage driver`s courtesy;
2. Derive conclusions and provide design recommendations.

To achieve the above, this study:

1. Develops statistical relationships between the courtesy behaviour and the infrastructure and traffic characteristics at the crossing; and
2. Undertakes a before-after analysis at one courtesy crossing.

2 METHODOLOGY

This study undertakes an analysis of pedestrian - vehicle interaction at a number of selected pedestrian crossings across the UK. They include controlled (zebra) and uncontrolled (courtesy) crossings, both at junctions and links, and also comprise a variety of the distinguishing features of courtesy crossings identified in the literature (e.g. colour treatment, different surfaces, marked stripes, ramps and vertical deflection).

Features potentially influencing driver behaviour were analysed and compared against the observed courtesy behaviour at the crossing, as captured by video cameras.

2.1 Site selection

This study comprised 12 urban Sites, a mix of controlled and uncontrolled crossings, located within or outside road junctions (i.e. within links), and within and outside shared space schemes. Video footage was obtained from Phil Jones [1] and Chris Oakley[2], which has enabled this study to be undertaken. The Sites are listed in Table 2.1, and between them cover a wide range of traffic and pedestrian volumes.

Table 2.1 List of Sites

Site		Location	Type of crossing	Range of Traffic (vph)	Range of Peds (pph)
1	Arnsberg Way / Mayplace Road West	Bexleyheath, Greater London	Courtesy, Junction	424-980	44-59
2	Albion Road / Broadway	Bexleyheath, Greater London	Courtesy, Junction	634-648	106-124
3	Promenade, The Blackpool Tower	Blackpool, Lancashire	Zebra, Link	1,392	453
4	Shenley Road	Borehamwood, Hertfordshire	Courtesy, Junction	654	453

Site		Location	Type of crossing	Range of Traffic (vph)	Range of Peds (pph)
5	Gosford Street / Cox Street / Whitefriars Street	Coventry, West Midlands	Courtesy, Junction	325-401	39-139
6	Hamilton Rd / Cobbold Road	Felixstowe, Suffolk	Courtesy, Junction	198	267-303
7	Kimbrose Triangle (Commercial Road)	Gloucester, Gloucestershire	Courtesy, Junction	690-796	230-332
8	King Ed Rd / A50 / A5033	Knutsford, Cheshire	Zebra, Junction	784-931	8-400
9	Fountain Place / Park Lane	Poynton, Cheshire	Courtesy, Junction	902-1,360	24-89
10	Park Lane / Bulkeley Road	Poynton, Cheshire	Courtesy, Junction	652-822	5-55
11	Fishergate	Preston, Lancashire	Courtesy and Zebra, Link	94-390	149-290
12	Regent Circus / Crombey Street	Swindon, Wiltshire	Courtesy, Link	318-540	94-206

Note - traffic and pedestrian flows counted from the survey videos and converted in hourly volumes and indicate the range of observed flows at one site when all individual crossings and both directions (as appropriate) are considered

2.2 Measurement of vehicle/pedestrian interactions

When a pedestrian (or a group of pedestrians) attempts to cross a road, two main situations present themselves; either the carriageway is clear and there is No potential pedestrian/vehicle interaction (**NI**), or there is a pedestrian/vehicle interaction (**I**). Clearly:

% NI + **% I** = 100%

The main focus of this study is on the "With Interaction" (**I**) situations, where three possible outcomes might occur (Table 2.2).

Table 2.2 Outcomes of crossing 'With Interaction' with vehicles and corresponding aggregate measures

Outcome	Description	Aggregate Measure
Courtesy	The pedestrian crosses in the presence of vehicles and the first vehicle approaching the crossing gives way to the pedestrian; if there are more vehicles (for example, with multiple traffic lanes or two-way traffic), all drivers give way to the pedestrian	**% C**
Some Courtesy	The pedestrian crosses in the presence of cars and at least one vehicle does not give way but then one vehicle does	**% SC**
No Courtesy	At least one vehicle does not give way to the pedestrian; the pedestrian waits and then crosses when the carriageway is free of vehicles	**% NC**

As can be seen, the Courtesy Rate **% C** is calculated as a percentage of the number of crossings 'With Interaction', thus excluding those crossings made without approaching vehicles or in between stationary vehicles. This also applies to **% SC** and **% NC**, and therefore the following applies:

% C + **% SC** + **% NC** = 100% **I**

We can finally define **% SDC** (Table 2.3), "Some Degree of Courtesy", the percent of cases 'With Interaction' where the pedestrian crosses in the presence of a vehicle giving way (but not necessarily the first one, i.e. including cases where preceding drivers had not stopped).

Table 2.3 Some Degree of Courtesy: definition and aggregate parameter

Outcome	Description	Aggregate Parameter
Some Degree of Courtesy	The pedestrian crosses in the presence of vehicles giving way (but not necessarily the first one approaching the crossing)	**% SDC = % C + % SC**

2.3 Video survey analysis

Video surveys of 21 individual selected crossings, totalling around 9 hours 30 minutes of footage, were reviewed to gain an understanding of the proportion of drivers giving way at the crossing in the presence of a pedestrian (or group of pedestrians) at the edge of the carriageway or approaching the crossing. The details of the survey sites and periods are listed in **Appendix A**.

With the aim to calculate the percentages described in Table 2.2, each "event" (i.e. a pedestrian or a group of pedestrians crossing the road at the identified crossing points), was identified, labelled with a unique alphanumeric code and categorised.

A detailed breakdown into approximately 20 categories covered all possible combinations of courtesy behaviour when all directions of travel and category of vehicles are considered (e.g. one vehicle giving way while one in an adjacent lane or travelling in the opposite direction does not, pedestrians waiting for a gap while multiple vehicles not stopping, oncoming vehicle in one direction followed by another vehicle etc.).

2.4 Multiple Linear Regression

To achieve its main objective, this study undertook statistical analysis of the level and type of courtesy behaviour as a function of the site infrastructure and traffic and pedestrian characteristics; to this effect, a series of Multiple Linear Regression (MLR) models were developed. Potential correlations between explanatory variables were checked and any with a correlation greater than 0.70 were removed. Standard measures of model performance were estimated and examined, including the *coefficient of determination* r^2, an *adjusted* r^2, appropriateness of sign, size and relative size of the coefficients. The explanatory variables which were not statistically significant, indicated by a P-value greater than 0.10 at a 90% confidence level, were discarded and the model recalculated until all the remaining variables were significant.

2.5 Types of models and variables

In this research study, the analysis was undertaken at two levels:

1. Aggregate level: using the average values for each crossing;
2. Disaggregate level: considers each individual observation.

Two dependent variables measuring the degree of courtesy were related to the set of explanatory variables:

1. "Courtesy" Rate, **% C**; and
2. "Some Degree of Courtesy" Rate, **% SDC**; indirectly, this also provided insights into the "No Courtesy" Rate, **% NC.**

An extensive number of explanatory variables was tested in the model, ranging from traffic and pedestrian volumes and characteristics, to geometric features of the crossing and/or the road. Table 2.4 provides a list of symbols and descriptions.

Table 2.4 Explanatory Variables

Symbol	Description	Aggr. Models	Disaggr. Models
% HGV	% HGV / Buses	x	x
1WT	One-way traffic	x	x
APC	Average Pedestrians per Crossing	x	
CAW	Carriageway Apparent Width	x	x
Ch	Child		x
CL	Crossing Length	x	x
CT	Colour Treatment	x	x
CW	Crossing Width	x	x
D-J	Distance from nearest junction	x	x
F	Female		x
FoV	Vehicle is Followed by another Vehicle		x
GW	Distance from give way	x	x
HGV	Vehicle is an HGV		x
KH	Kerb Height	x	x
KW	Kerbed refuge Width	x	x
LOT	Lanes of Oncoming Traffic	x	x
M	Male		x
Med	Crossing from Median	x	x
PPC	Pedestrians Per Crossing		x
PPH	Pedestrians Per Hour	x	x
R	Ramps	x	x
RKA	Relevant Kerbside Activity	x	x
SC	Stripes on Crossing	x	x
Sen	Senior		x
SL	Speed Limit	x	x
TCL	Total Crossing Length	x	x
V2	VPH squared	x	x
VA	Visibility Angle	x	x
VN	Visual Narrowing	x	x
VPH	Vehicles Per Hour	x	x
W	Weekend	x	x
wBL	with Buggie / Luggage		x

Symbol	Description	Aggr. Models	Disaggr. Models
WCS	Wheelchair, walking Stick		x
ZC	Controlled (Zebra) Crossing	x	x

2.6 Before-After study

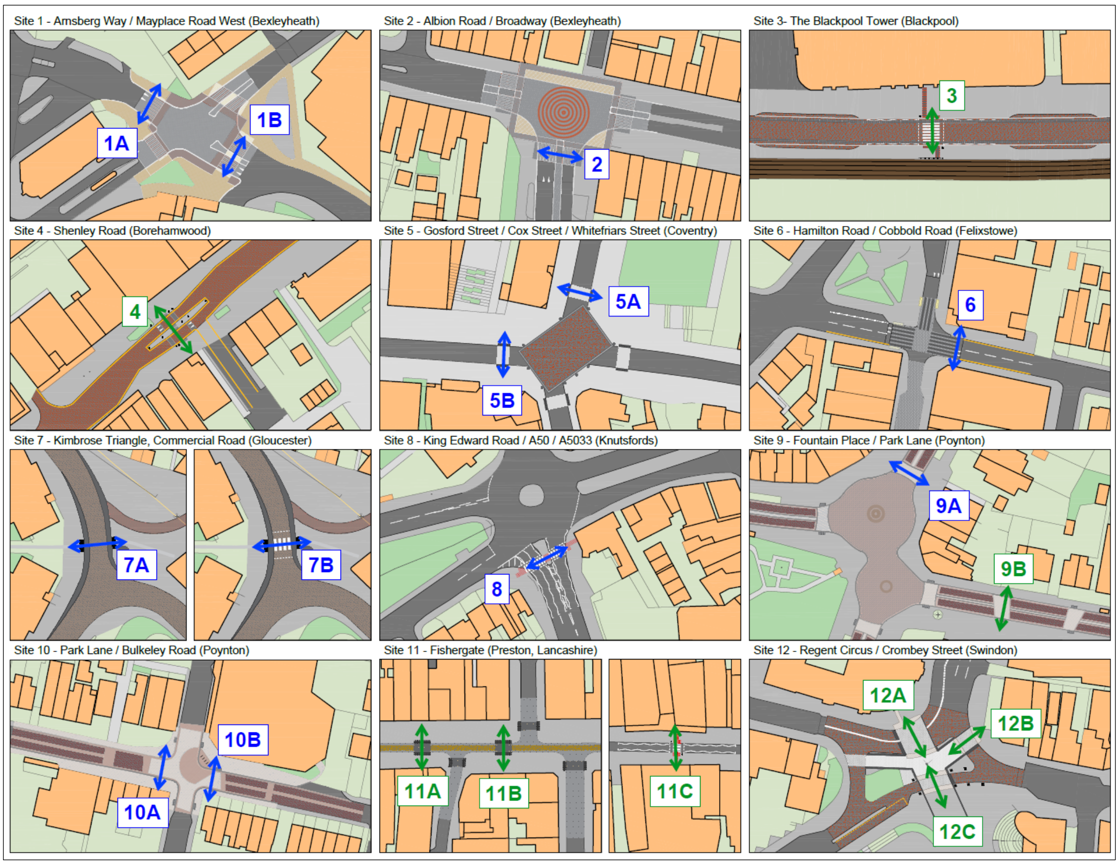
As will be explained in greater detail in the next section, at one of the sites it was possible to examine the effects of a change in layout and treatment, as video surveys were available for both before and after situations.

A before-after analysis will therefore be presented, examining any differences in courtesy behaviour at the crossing.

3 CASE STUDY: SITE CHARACTERISTICS

3.1 Type of crossings

As already noted, 12 Sites are used in this analysis. In total, they comprise 20 individual Crossings (21, considering that one appears twice, under two different layouts); an overview is provided in Figure 3.1 with more detail in **Appendix B**.



Note: Blue arrows = Junction, Green arrows = Link

Figure 3.1 Site overview plans

Table 3.1 lists the 21 crossings and their main features, highlighting whether they:

- are located within a Junction or a Link;
- are Controlled (Zebra) or Courtesy Crossings; and
- feature stripes, raised tables and ramps, colour treatment and / or visual narrowing.

Table 3.1 Distinguishing features of the 22 crossings

Site		Crossing	Junction (J) - Link (L)	Controlled (Zebra)	Stripes	Ramps	Colour treatment	Visual narrowing
1	Arnsberg Way / Mayplace Road West (Bexleyheath)	**1A**	J		x	x	x	
		1B	J		x	x	x	

Site		Crossing	Junction (J) - Link (L)	Controlled (Zebra)	Stripes	Ramps	Colour treatment	Visual narrowing
2	Albion Road (Bexleyheath)	**2**	J		x	x	x	
3	The Blackpool Tower	**3**	L	x	x			x
4	Shenley Road (Borehamwood)	**4**	L[3]			x		
5	Gosford St / Cox St / Whitefriars St (Coventry)	**5A**	J				x	
		5B	J				x	
6	Hamilton Rd (Felixstowe)	**6**	J		x	x	x	
7	Kimbrose Triangle, Commercial Rd (Gloucester)	**7A**	J					x
		7B	J		x			x
8	King Ed Rd (Knutsford)	**8**	J	x	x			
9	Fountain Place / Park Lane (Poynton)	**9A**	J				x	x
		9B	L				x	x
10	Park Lane / Bulkeley Rd (Poynton)	**10A**	J				x	x
		10B	J				x	x
11	Fishergate (Preston)	**11A**	L[4]				x	x
		11B	L				x	x
		11C	L	x				
12	Regent Circus / Crombey Street (Swindon)	**12A[5]**	L			x	x	
		12B	L			x	x	
		12C	L			x	x	

Courtesy behaviour at each of the crossings was analysed in detail with a view to gaining an understanding of the influence of the various explanatory variables on behaviour, as listed in Table 2.4 and elaborated in **Appendix C**.

4 ANALYSIS

4.1 Courtesy Rates

First, the percentages of "No Interaction" (**NI**), "Courtesy" (**C**) and "Some Degree of Courtesy" (**SDC**) were calculated.

Courtesy rates varied quite significantly across the Sites, ranging from 0% (for example at the crossings in Coventry) up to 100% (for example some individual crossings in Bexleyheath or Swindon).

An example of the results of the aggregate analysis at one site is reproduced in Figure 4.1 below.

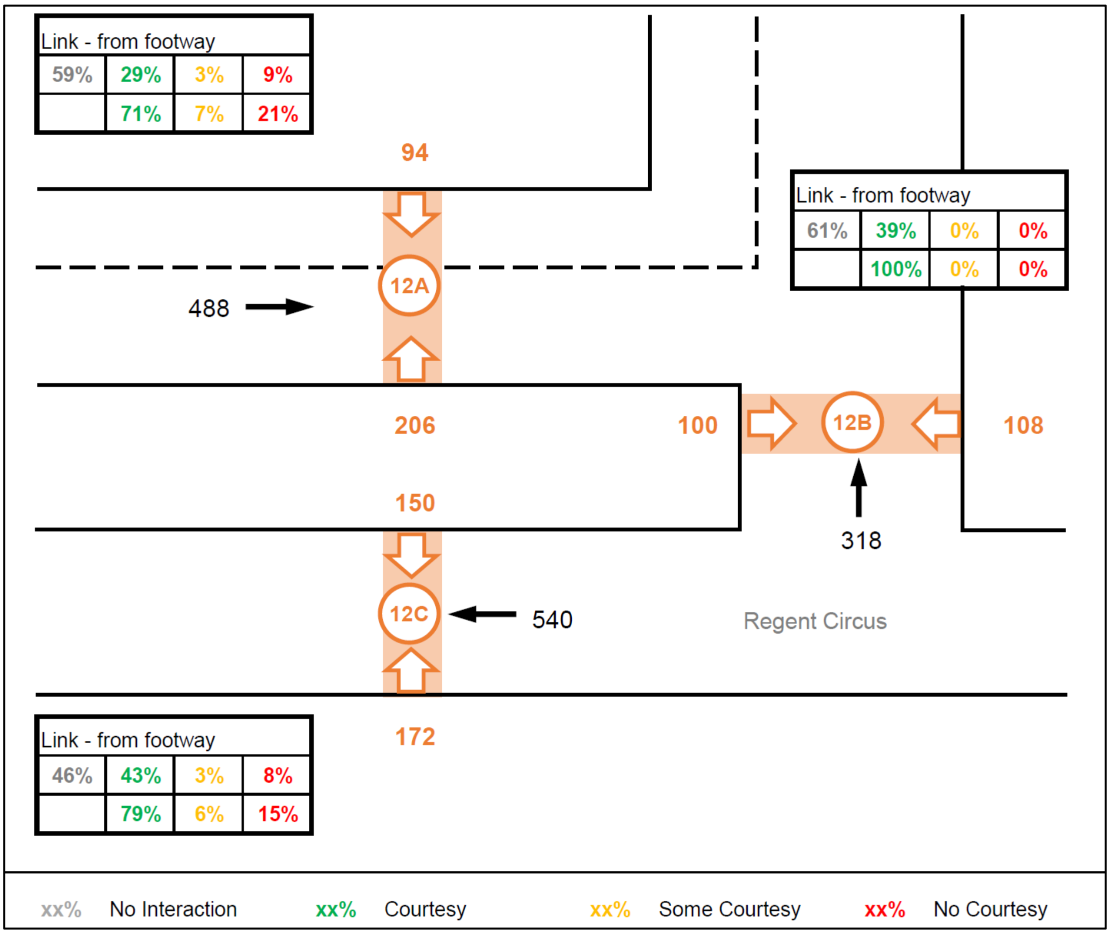


Figure 4.1 Analysis of pedestrian/vehicle interaction at Site 12

4.2 Influence of Traffic Volumes on Courtesy Behaviour

No Interaction

The percentage of events where the pedestrian (or group of pedestrians) crossed the road in the absence of cars ("No Interaction", **% NI**) was first calculated. As would be expected and as illustrated at Figure 4.2, this percentage decreases as the volumes of vehicles increase, as, intuitively, it becomes more difficult to find gaps between vehicles when the traffic volumes increase. A strong inverse linear relationship, with a very high R^2, is identified.

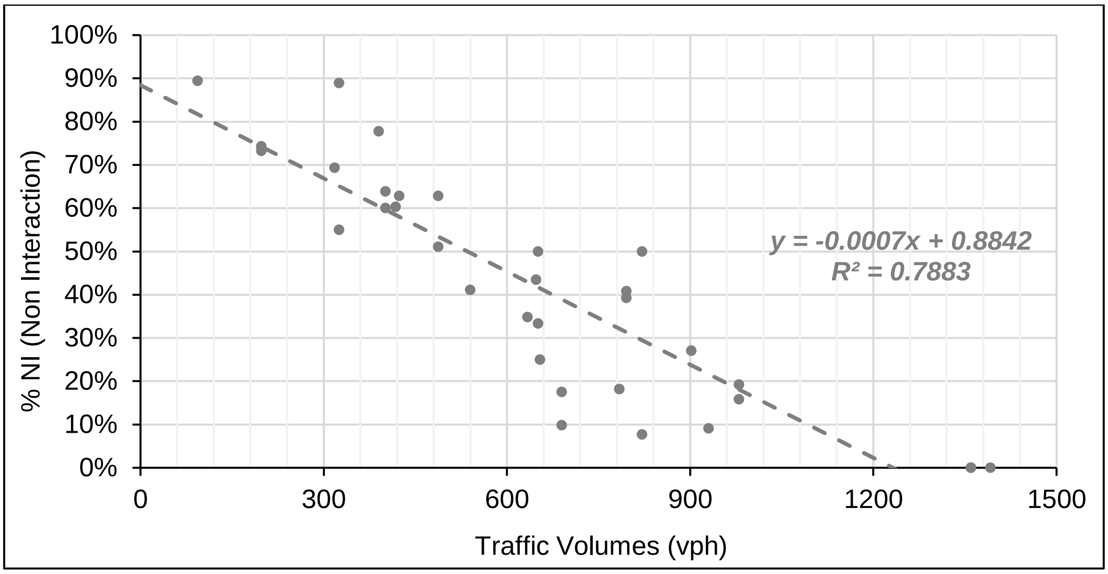


Figure 4.2 % Crossing with No Interaction against traffic volumes

Based on the equation shown in *Figure 4.2*, it can be concluded that the probability to be able to cross the road without encountering vehicles decreases by 7% for every extra 100 (hourly) vehicles within the road.

Courtesy and Some Degree of Courtesy

The relationship between courtesy and traffic volumes was also studied for **% C** and **% SDC**; the scatter plots are illustrated in Figure 4.3 and Figure 4.4, from which it can be seen that there does not appear to be any strong relationship between the Courtesy behaviour and the traffic volumes – even when a distinction is made between crossings at junctions or on links (Figure 4.5). This will be investigated further with the MLR models below.

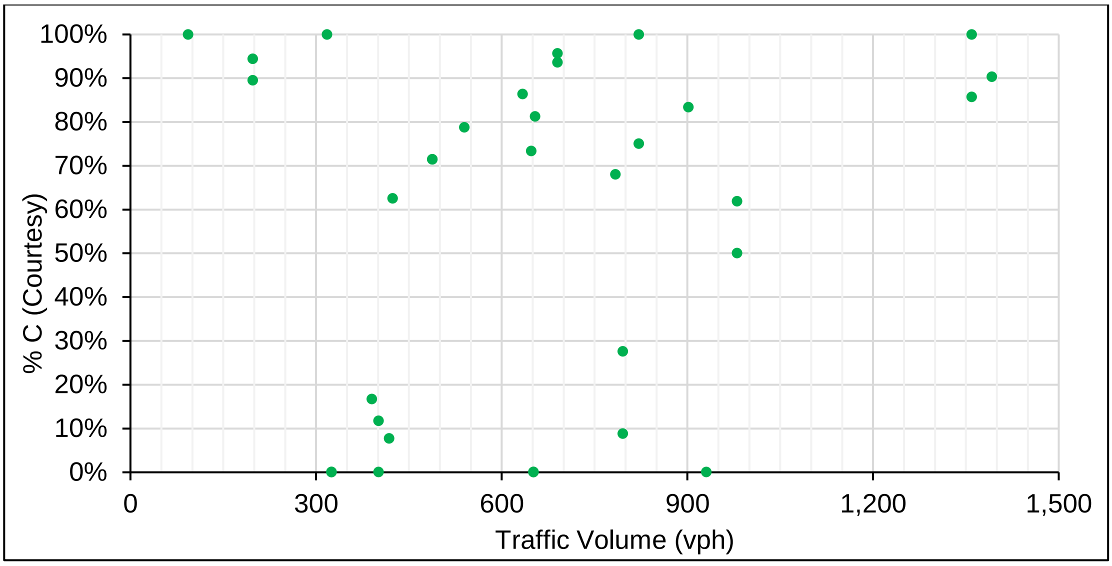


Figure 4.3 % C (Courtesy) against Traffic Volumes

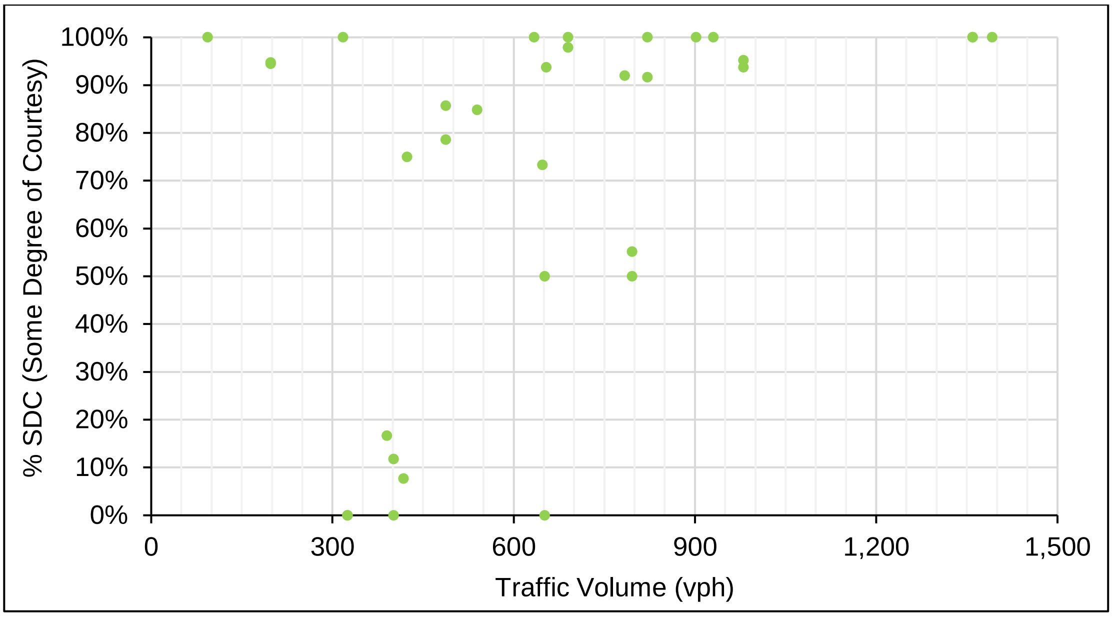
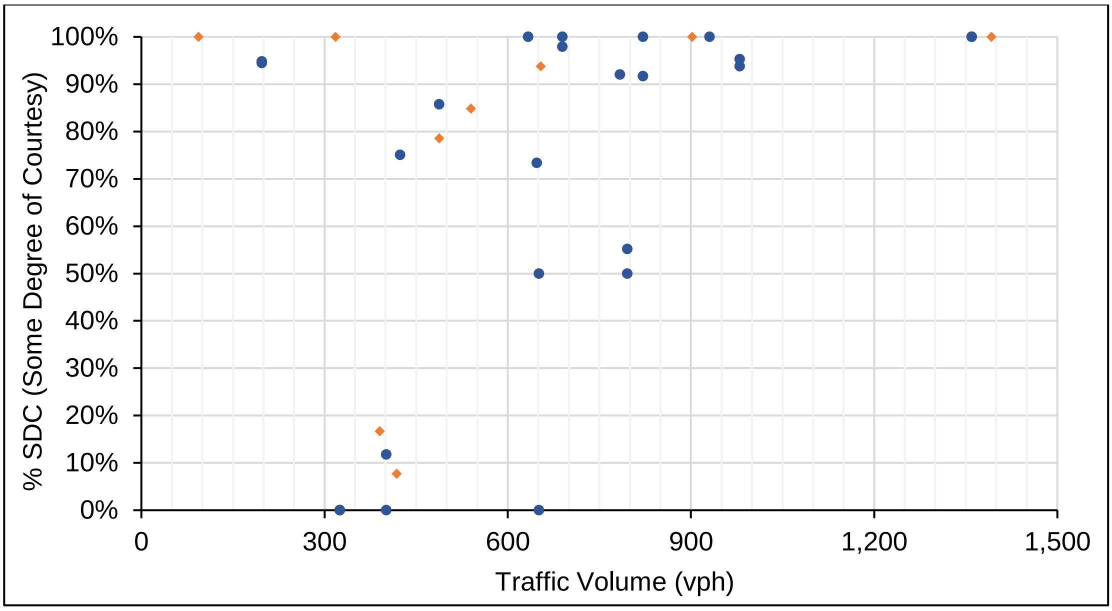


Figure 4.4 % SDC (Some Degree of Courtesy) against Traffic Volumes



Blue (circle) = Junctions; Orange (diamond) = Links

Figure 4.5 % SDC by Traffic Volumes, for Sites at Junctions and Links distinguished

4.3 Influence of the explanatory variables on Courtesy behaviour

The correlation of each of the explanatory variables, when considered individually, with both Courtesy (**% C**) and Some Degree of Courtesy (**% SDC**) was next analysed.

The results are shown in Table 4.1 and in Table 4.2, for the aggregate and the disaggregate analysis, respectively. Correlations greater than ±20% are highlighted.

Table 4.1 Correlation with each explanatory variable – Aggregate level

Explanatory Variable		% C	% SDC
VPH	Vehicles per Hour	0.13	0.31
V2	Squared Vehicles per Hour	0.16	0.32
% HGV	% HGV / Buses	-0.40	-0.47
PPH	Pedestrians Per Hour	0.24	0.21
APC	Average Pedestrians per Crossing	0.09	0.15
W	Weekend	0.22	0.25
Med	Crossing from Median	0.26	0.26
D-J	Distance from nearest Junction	0.17	0.15
1WT	One Way Traffic	0.31	0.24
KW	Kerbed median Width	0.33	0.32
ZC	Controlled (Zebra) Crossing	0.24	0.23
SC	Stripes on Crossing	0.54	0.52
CT	Colour treatment at the crossing	-0.26	-0.30
VN	Visual Narrowing	-0.16	-0.11
SL	Speed Limit	0.02	0.02
R	Ramps	0.43	0.48
CL	Crossing Length	0.00	0.11

Explanatory Variable		% C	% SDC
TCL	Total Crossing Length	0.31	0.35
CAW	Carriageway Apparent Width	-0.02	0.10
CW	Crossing Width	0.09	0.04
KH	Kerb Height	0.32	0.28
VA	Visibility Angle	-0.23	-0.16
LOT	Number of Lanes of Oncoming Traffic	-0.39	-0.33
RKA	Relevant Kerbside Activity	0.27	0.21
GW	Distance from give way	0.13	0.11

Table 4.2 Correlation with each explanatory variable – Disaggregate level

Explanatory Variable		C	SDC
M	Male	0.06	0.05
F	Female	0.07	0.08
Ch	Child	0.05	0.09
Sen	Senior	-0.04	-0.01
wBL	With Buggie / Luggage	-0.01	0.05
WCS	Wheelchair, walking Stick	-0.05	-0.05
HGV	HGV / Bus	-0.10	-0.04
FoV	Vehicle is Followed by another Vehicle	0.17	0.27
VPH	Vehicles per Hour	0.07	0.17
V2	Squared Vehicles per Hour	0.10	0.17
%HGV	% HGV / Buses	-0.17	-0.20
PPH	Pedestrians Per Hour	0.21	0.21
PPC	Pedestrians Per Crossing	0.14	0.14
W	Weekend	0.08	0.14
Med	Crossing from Median	0.12	0.12
D-J	Distance from nearest Junction	0.07	0.01
1WT	One Way Traffic	0.07	0.04
KW	Kerbed median Width	0.08	0.10
ZC	Controlled (Zebra) Crossing	0.15	0.20
SC	Stripes on Crossing	0.38	0.42
CT	Colour treatment at the crossing	-0.17	-0.24
VN	Visual Narrowing	-0.11	-0.12
SL	Speed Limit	-0.19	-0.21
R	Ramps	0.15	0.18
CL	Crossing Length	0.07	0.15
TCL	Total Crossing Length	0.16	0.24
CAW	Carriageway Apparent Width	0.13	0.24
CW	Crossing Width	0.08	0.02
KH	Kerb Height	0.08	0.08
VA	Visibility Angle	-0.05	0.01
LOT	Number of Lanes of Oncoming Traffic	-0.12	-0.05
RKA	Relevant Kerbside Activity	0.15	0.09

GW	Distance from give way	-0.01	-0.08

A brief review of the coefficients shown at Table 4.1 and Table 4.2 has shown that, when the variables are considered individually:

- At the aggregate level, a much greater number of variables are correlated;
- At the disaggregate level of analysis, **C** appears to be correlated with only two variables, out of the 33, when the ±20% threshold is chosen; **SDC** with 8;
- At the disaggregate level, traffic volumes and the characteristics of the pedestrians (gender, age, disability, etc) do not appear to be statistically significant in influencing courtesy behaviour;
- In both cases, the presence of stripes appears to be the factor with the greatest (positive) influence, followed by the percentage of HGVs (negative), but the latter only at an aggregate level.

4.4 MLR Models: Aggregate level

Models were developed at an aggregate level, i.e. considering the averages of the Courtesy behaviour (both **% C** and **% SDC**) at each crossing, distinguished in Inbound/Outbound and from Footway/Median. Crossings with less than 10 observations were discarded from the analysis.

Courtesy

The results of the model are summarised at Table 4.3.

Table 4.3 Aggregate % C MLR model results

Adjusted R Square				0.817
Standard Error				0.139
Observations				36
Significance F				1.1E-08
Variable		***Coefficients***	***Standard Error***	***P-value***
Intercept		0.146	0.157	0.362
V2	Vehicles Per Hour Squared	-4.8E-07	0.000	0.001
% HGV	% HGV / Buses	-2.368	0.588	0.000
PPH	Pedestrians Per Hour	-0.001	0.000	0.049
D-J	Distance from nearest junction	0.016	0.002	0.000
1WT	One-way traffic	-0.323	0.086	0.001

ZC	Zebra Crossing	0.391	0.215	0.081
SC	Stripes on Crossing	0.706	0.093	0.000
VN	Visual Narrowing	0.449	0.108	0.000
R	Ramps	0.186	0.108	0.098
KH	Kerb Height	0.041	0.017	0.020

The aggregate model, with very high goodness of fit and relatively low standard error, has revealed that:

- Courtesy increases in the presence of controlled crossings, stripes, vertical deflections (ramps) and visual narrowings of the carriageway;
- The presence of marked stripes (SC), regardless of being a formal zebra or informal crossing, is the strongest influence on courtesy behaviour;
- Courtesy decreases with traffic volumes and in the presence of HGVs and buses;
- Courtesy decreases where the carriageway is one-way traffic;
- Courtesy increases with the distance from a road junction.

Some Degree of Courtesy

When the model is re-calculated with **SDC**, the results at Table 4.4 are obtained.

Table 4.4 Aggregate % SDC MLR model results

Adjusted R Square				0.916
Standard Error				0.097
Observations				36
Significance F				1.4E-11
Variable		***Coefficients***	***Standard Error***	***P-value***
Intercept		-0.999	0.213	0.000
V2	Vehicles Per Hour Squared	-2.45E-07	7.25E-08	0.003
% HGV	% HGV / Buses	-1.573	0.415	0.001
PPH	Pedestrians Per Hour	-0.001	0.000	0.011
D-J	Distance from nearest Junction	0.032	0.005	0.000
KW	Kerbed Refuge Width	-0.107	0.033	0.004
SC	Stripes on Crossing	0.700	0.079	0.000
VN	Visual Narrowing	1.073	0.123	0.000
R	Ramps	0.343	0.096	0.002
CAW	Carriageway Apparent Width	0.084	0.026	0.004
KH	Kerb Height	0.118	0.015	0.000

RKA	Relevant Kerbside Activity	-0.184	0.060	0.006
GW	Distance from Give Way	-0.014	0.004	0.001

The regression shows a stronger goodness of fit and a high statistical significance of the parameters, showing that:

- The same considerations apply as to **C** for the effect of traffic, HGVs, distance from junction, stripes, visual narrowing, ramps and kerb height apply;
- ZC (zebra crossing) is not significant in this case;
- The median width decreases the level of courtesy; suggesting that in the presence of a narrower kerbed median some drivers are more likely to give way to the pedestrian and (eventually, if not the first vehicle) show a higher level of courtesy.

Conclusions for the Aggregate models

Overall, the aggregate models have revealed that:

- Several variables appeared in both the % C and % SDC models and with the same sign: Volumes of traffic (-), %HGV (-), Pedestrians Per Hour (-), Distance from junction (+), Stripes (+), Visual Narrowing (+), Ramps (+), Kerb Height (+);
- Whether the crossing is controlled (ZC) appears to affect only **% C**;
- Notably, the probability of drivers giving way increases by 70% in the presence of stripes;
- Ramps, visual narrowings and kerb heights increase courtesy too, but with a different relative weight for **% C** and **% SDC**.

4.5 MLR Models: Disaggregate level

MLR models were also developed with disaggregate level data, i.e. with each of the individual observations. Out of the 1,369 total observations, only the 765 (56%) "With Interactions" were kept, accounting for 1,530 (62%) out of the 2,476 recorded individual pedestrian movements – in the other cases there was no vehicle/pedestrian interaction.

Courtesy

The results of the model are summarised below.

Table 4.5 Disaggregate C MLR model results

Adjusted R Square				0.338
Standard Error				0.389
Observations				765
Significance F				8.0E-63
Variable		***Coefficients***	***Standard Error***	***P-value***
Intercept		0.270	0.055	0.000
F	Female	0.073	0.030	0.016
HGV	Vehicle is an HGV	-0.174	0.072	0.016
FoV	Vehicle is followed by another vehicle	0.159	0.032	0.000
%HGV	% HGV / Buses	-2.589	0.350	0.000
PPH	Pedestrians Per Hour	-0.001	0.000	0.000
PPC	Pedestrians Per Crossing	0.023	0.010	0.022
W	Weekend	-0.419	0.080	0.000
D-J	Distance from nearest Junction	0.008	0.001	0.000
1WT	One-way Traffic	0.224	0.044	0.000
KW	Kerbed Refuge Width	-0.105	0.021	0.000
SC	Stripes on Crossing	0.853	0.065	0.000

The model, with a moderately good statistical significance, has revealed that:

- Drivers tend to give way more often to females; all other categories of pedestrians (such as males, children, senior, wheelchairs, walking sticks, luggage, etc.) did not prove to be statistically significant;
- HGVs and buses show less courtesy less than other vehicles;
- Levels of traffic volumes are not statistically significant;
- If a vehicle is followed by (at least) another one, there is a higher probability that the driver will concede courtesy;
- In general, higher pedestrian volumes decrease the likelihood of drivers giving way; while, a greater number of pedestrians attempting to cross at the same time increases the likelihood that a vehicle stops;
- The weekend appears to have a negative impact on courtesy behaviour;
- Crossings distant from a junction experience greater courtesy;
- Crossing only one direction of traffic increases the probability of drivers giving way;
- The presence of stripes increases courtesy behaviour;

- All the other ‘shared space’ features (visual narrowing, colour treatment, ramps) were not significant
- Whether the crossing was controlled (zebra) was not statistically significant; this stresses the fact that it is the presence of stripes itself, regardless of being part of a controlled crossing, is what influences driver`s behaviour.

Some Degree of Courtesy

When the model is re-calculated with **SDC**, the results in Table 4.4 are obtained.

Table 4.6 Disaggregate SDC MLR model results

Adjusted R Square				0.432
Standard Error				0.319
Observations				765
Significance F				3.5E-87
Variable		***Coefficients***	***Standard Error***	***P-value***
Intercept		-0.271	0.099	0.006
F	Female	0.084	0.024	0.000
FoV	Vehicle is followed by another Vehicle	0.217	0.025	0.000
V2	Vehicles Per Hour squared	1.64E-07	0.000	0.000
% HGV	% HGV / Buses	-1.546	0.321	0.000
W	Weekend	-0.349	0.048	0.000
1WT	One-way Traffic	0.384	0.058	0.000
SC	Stripes on Crossing	0.473	0.036	0.000
R	Ramps	0.342	0.039	0.000
CL	Crossing Length	0.051	0.009	0.000
TCL	Total Crossing Length	-0.040	0.007	0.000
CAW	Carriageway Apparent Width	0.061	0.016	0.000

This model as expected has a higher goodness of fit and has revealed, unsurprisingly, very similar results to those for the Courtesy levels (Table 4.5), but:

- Now traffic volume is statistically significant; in the presence of more traffic, it becomes more likely that a driver gives way to a pedestrian; this can be explained as with more traffic the probability that at least one vehicle, eventually, will give way (which is the definition of SDC) increases;
- The presence of ramps is now significant and affects positively the courtesy behaviour;

- The crossing apparent width (i.e. taking into account marked narrowings, where present) and physical width both affect positively the courtesy level;
- The total crossing width (including the median, where present) negatively affects courtesy behaviour.

4.6 Before / after study

Kimbrose Triangle, Gloucester (Site 7) experienced extensive changes in road layout, with a view to enhance the public realm and the pedestrian experience; after the implementation of an initial scheme, stripes were later added on the carriageway, resembling the appearance of the surface markings of a zebra crossing.

Two sets of video surveys were available at this Site, before (Figure 4.6) and after (Figure 4.7) the addition of the stripes.

Figure 4.6 Site 7 – Before the introduction of the stripes (2014)

Figure 4.7 Site 7 – After the introduction of the stripes (2015)

The aggregate analysis has revealed an average Courtesy Rate **% C** of 17.5% (and **% SDC** = 52.4%), before and **% C** of 94.6% (with **% SDC** = 98.9%) after the introduction of the stripes. Table 4.7 provides more details on the aggregate values of some key parameters.

Table 4.7 Statistical significance of the parameters

	Before: No Stripes (August 2014)	**After: With Stripes (February 2015)**	**Likely effect of the change in magnitude of the variable, on increasing or decreasing courtesy, between August 2014 and February 2015**
Pedestrians per crossing	2.4	1.9	Lower group size expected to increase courtesy
Male	68%	75%	Not statistically significant
Female	70%	53%	Drop expected to decrease courtesy
Child	15.9%	2.2%	Not statistically significant
Senior	17.5%	2.2%	Not statistically significant
Buggie / shopping / luggage / bike / with dog	7.9%	4.3%	Not statistically significant
Wheelchair / Stick	4.8%	0.0%	Not statistically significant
Followed by another vehicle	36.5%	96.8%	Expected to increase courtesy
Vehicles per Hour	796	691	Lower vehicle flow expected to decrease courtesy
% HGV / Buses	3.3%	2.4%	Lower % expected to increase courtesy
Pedestrians Per Hour	233	339	Higher pedestrian flow expected to decrease courtesy
C (Courtesy)	**17.5%**	**94.6%**	
SDC (Some Degree of Courtesy)	**52.4%**	**98.9%**	

Comparing user profiles ‘before’ and ‘after’ the introduction of stripes, we see many fewer ‘discretionary’-type users and more ‘essential’ users, which seems to be associated with the different weather conditions in August vs February – the latter deterring women, children, elderly people, etc. so that average group size is smaller too. It seems intuitively very unlikely that the introduction of stripes would have had this effect on user profiles. Traffic volumes are also slightly lower, reflecting an expected seasonal effect. But, overall pedestrian volumes are nearly 50% higher, which would seem to be due to the more clearly demarcated crossing.

At the bottom of the table it can be seen that courtesy increased very significantly after the introduction of the stripes – with courtesy (C) up sharply, from 17.5% to 94.6%. Based on the model results, half of the observed changes in usage patterns would have been expected to decrease courtesy – so the increase is not primarily due to these factors. The explanation seems to be due to the introduction of stripes – which is consistent with the cross-sectional modelling findings.

4.7 Discussion

The analysis has revealed some common trends in the four MLR models and the before-after study, enabling the conclusions summarised in Table 4.8 to be drawn.

Table 4.8 Statistical significance of the parameters

Parameters	Conclusions
Pedestrian characteristics	Out of all the variables (gender, age, luggage, wheelchair, disabled), the presence of females at the crossing was the only statistically significant one, positively affecting drivers` courtesy
Traffic Volumes	No clear relationships were identified when looking at the scatter plots (Figure 4.3 and Figure 4.4) and the MLR models have revealed contrasting conclusions on their effects. Also, it appears that the fact that the driver is followed by another vehicle affects positively the courtesy level.
HGV / Buses	Significant in every model, they decrease the probability of courtesy behaviour; the disaggregate models confirm this
Pedestrian Volumes	The number of pedestrians (per hour) reduces the likelihood that the driver would give way; conversely, the number of pedestrians waiting at any one time appears to increase it
Weekend	Significant in two models, courtesy levels fall at weekends
Zebra	The lawful obligation of the driver to let the pedestrian cross (zebra) affects the likelihood that the first driver stops; eventually, following drivers would then give stop regardless
Speed Limit	This was not significant in any of the models; observed speeds would have been preferable, but could not be directly measured and was probably captured in the models by other variables (carriageway widths, visual narrowings, ramps etc.)

Parameters	Conclusions
Stripes	This is the variable that appears to be affecting (positively) driver`s courtesy behaviour the most; further confirmed by the before-after standalone study
Crossing one-way traffic	Contrasting results; some +, some -, some non-significant
Distance from Junction	Significant in three models, all positive
“Shared Space” other distinguishing features	Visual Narrowing = Significant in two models, both + Colour Treatment = Not significant in any models Kerb Height = Significant in two models, both + Kerbed median Width = Significant in two models, both – Ramps = Significant in three models, all +

5 CONCLUSION AND FINAL REMARKS

5.1 Conclusions

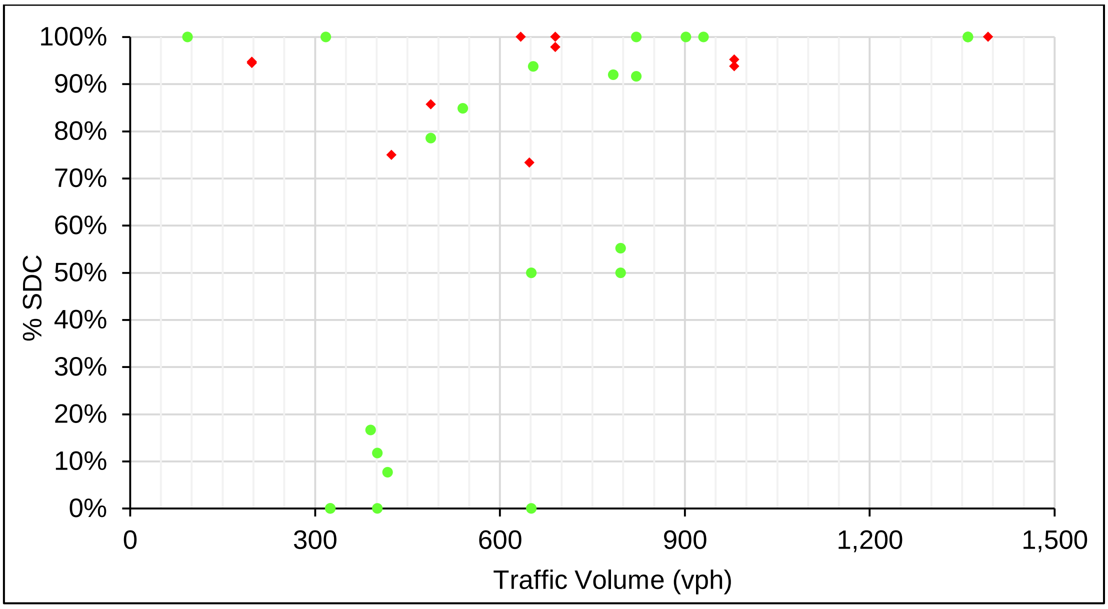
This study has provided an overview of the existing literature and has found very little that has been produced in terms of quantitative analysis of driver/pedestrian interaction at courtesy crossings.

The multilinear regression models developed in this study, at both aggregate and disaggregate levels, relating the courtesy behaviour to 34 explanatory variables, have shown various degrees of goodness of fit, from reasonable to excellent.

Little evidence has been found to draw conclusions on the effect of traffic volumes; higher percentages of heavy goods vehicles and buses, however, have been found to result in lower courtesy rates. Also, the likelihood that a pedestrian would cross the road in the presence of oncoming vehicles has been found to decrease by 7%, for every additional 100 vehicles on the road.

The influence of stripes is the most evident feature affecting driver`s courtesy behaviour; it largely explains the high courtesy rates at Bexleyheath, Felixstowe, Gloucester (the layout with the added stripes, indeed), and, as expected, the three controlled crossings. The obligation to give way to pedestrians at a zebra crossing only increases the likelihood of the first oncoming vehicle give way; it does not appear to impact the likelihood that a subsequent vehicle would stop; in other words, it affects only the length of pedestrian delay at the crossing.

The influence of the presence of stripes can be seen in Figure 5.1. This differentiation between crossings with and without stripes brings some clarity to the Figure 4.4, which showed no clear relationships between **% SDC** and traffic volumes. Now we can see that all the sites with stripes have **% SDC** courtesy rates of over 70%



Red (diamond) = with Stripes

Figure 5.1 % SDC (Some Degree of Courtesy) against Traffic Volumes, with Sites with Stripes highlighted

Other relevant design features positively affecting courtesy, though with less statistical evidence, are the presence of ramps (Bexleyheath, Borehamwood, Felixstowe, Poynton, Swindon) and visual narrowings (Poynton, Gloucester) of the road. Colour treatment did not produce statistically significant results.

Overall, this study has provided a method to understand the factors affecting courtesy levels at courtesy crossings – in response to Recommendation 10 of the recent CIHT (2018) guidance.

This study recommends that future design guidance on courtesy crossings encourages stripes, vertical deflections (such as ramps) and features to visually narrow the carriageway, with the stripes being the most important feature, to encourage driver`s courtesy. Particular care should be taken on the provision of crossings at roads with high percentages of heavy goods vehicles and/or buses. Courtesy crossings some distance from junctions are more effective too.

5.2 Limitations and recommendations for further research

With some conclusions being more tentative than others, it is recommended that this study be extended to cover a larger number of crossings; while 21 crossings at 12 sites, 9.5 hours of videos and 1,369 observations are considered sufficient to draw some initial conclusions, a bigger sample is recommended before major changes in crossing design guidance are enacted.

There is also a need to relate the observed accident records to types of crossing and courtesy behaviour.

Being outside of its scope and the available data, this study has not analysed the effect of different crossing types on some vulnerable users, such as those with mobility, visual or other physical impairment. It is recommended that the research is extended to include this central aspect of courtesy crossings.

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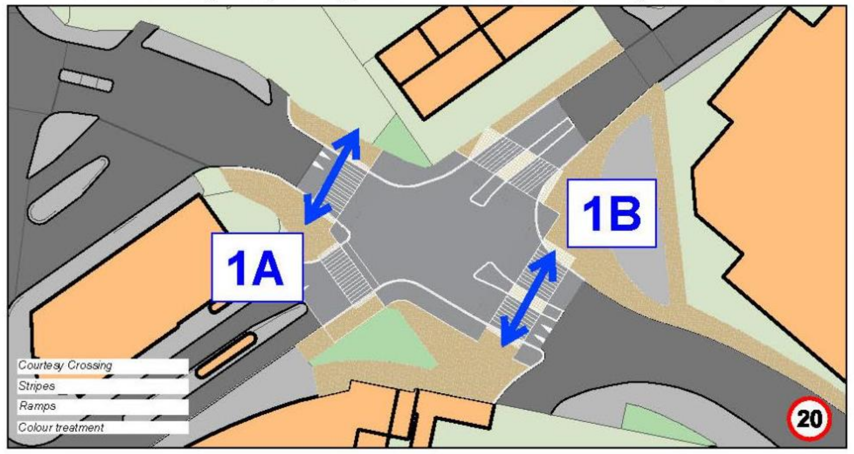
APPENDIX A

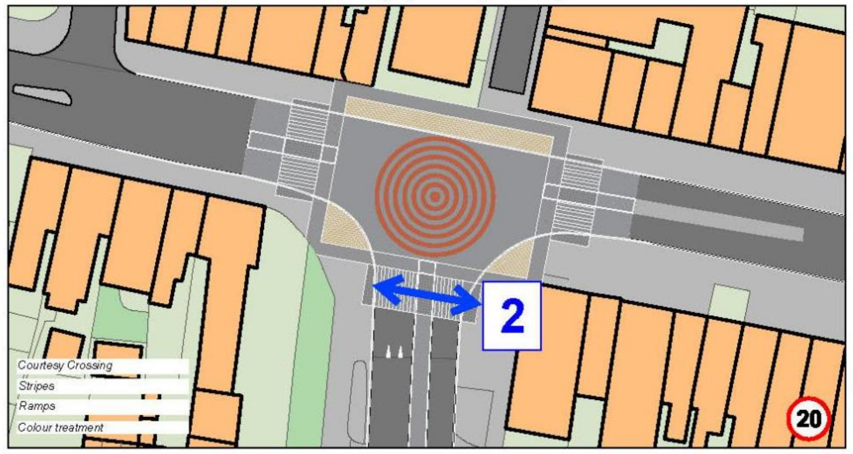
Site		Crossing	Day		Time	Duration
1	Arnsberg Way / Mayplace Road West (Bexleyheath)	**1A**	Sat	30/08/14	11:08	32:26
		1B	Sat	30/08/14	11:38	30:00
2	Albion Road / Broadway (Bexleyheath)	**2**	Sat	30/08/14	14:16	30:00
3	Promenade, The Blackpool Tower (Blackpool)	**3**	Tue	21/07/15	N/A	28:37
4	Shenley Road (Borehamwood)	**4**	Fri	19/09/14	17:20	26:08
5	Gosford Street / Cox Street / Whitefriars Street (Coventry)	**5A**	Thu	28/08/14	14:54	32:17
		5B	Thu	28/08/14	14:54	32:17
6	Hamilton Rd / Cobbold Rd (Felixstowe)	**6**	Wed	01/04/15	10:21	25:10
7	Kimbrose Triangle, Commercial Rd (Gloucester)	**7A**	Wed	27/08/14	11:01	30:00
		7B	Tue	10/02/15	N/A	18:05
8	King Ed Rd / A50 / A5033 (Knutsford)	**8**	Fri	09/10/09	N/A	15:09
9	Fountain Place / Park Lane (Poynton)	**9A**	Fri	05/09/14	16:00	25:01
		9B	Fri	05/09/14	14:49	28:56
10	Park Lane / Bulkeley Road (Poynton)	**10A**	Fri	05/09/14	15:26	27:14
		10B	Fri	05/09/14	N/A	25:14
11	Fishergate (Preston)	**11A**	Wed	20/08/14	11:15	28:42
		11B	Wed	20/08/14	10:26	17:22
		11C	Wed	20/08/14	10:54	14:05
12	Regent Circus / Crombey Street (Swindon)	**12A**	Tue	24/03/15	09:12	30:00
		12B	Tue	24/03/15	09:12	30:00
		12C	Tue	24/03/15	09:12	30:00

APPENDIX B

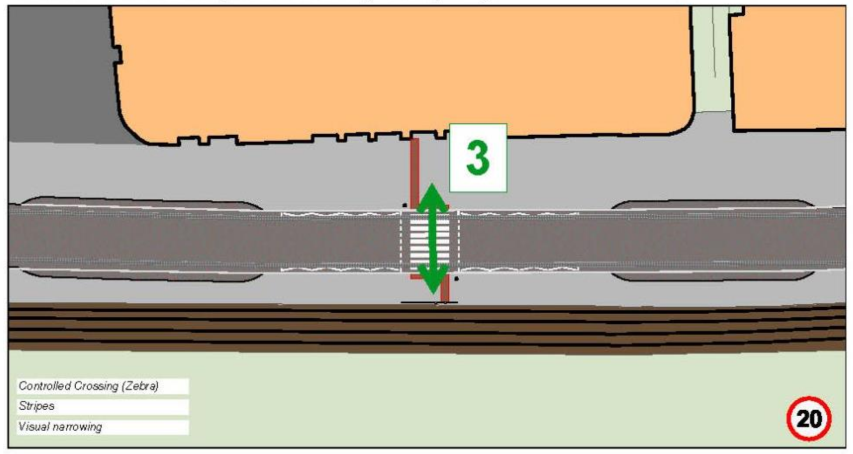
Site 1 - Arnsberg Way / Mayplace Road West (Bexleyheath)



Site 2 - Albion Road / Broadway (Bexleyheath)

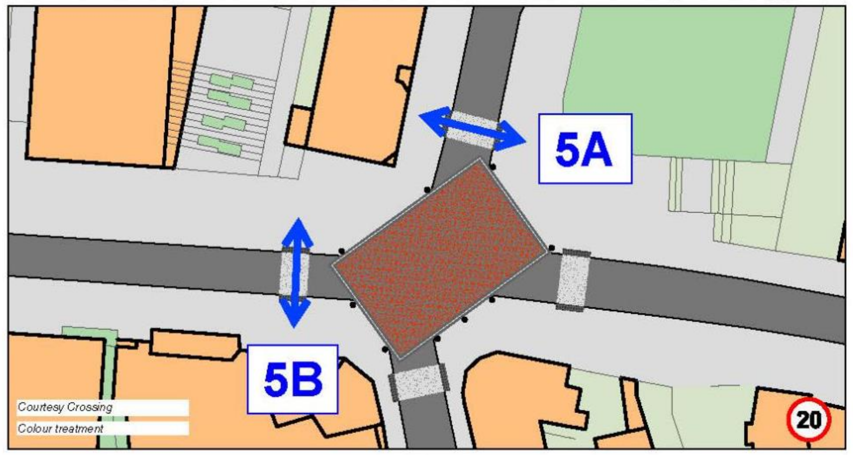


Site 3- The Blackpool Tower (Blackpool)

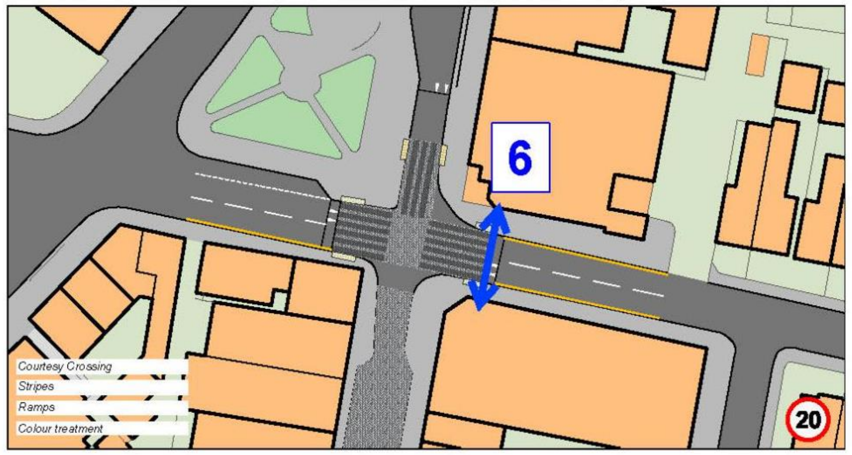


Site 4 - Shenley Road (Borehamwood)

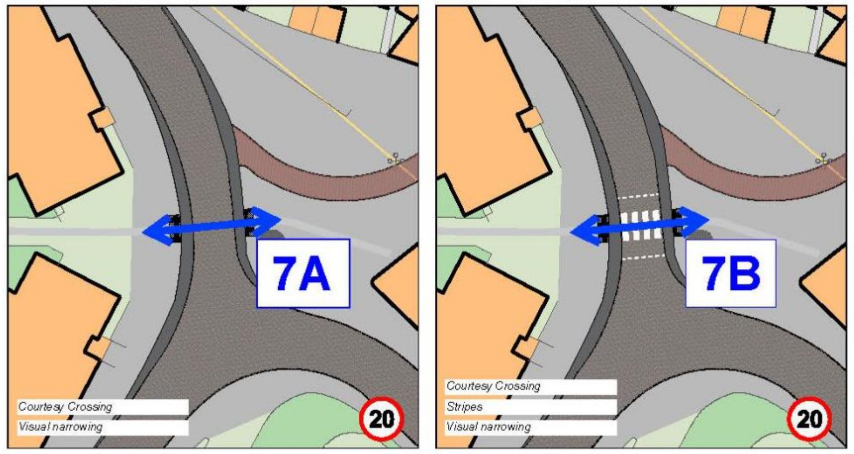
Site 5 - Gosford Street / Cox Street / Whitefriars Street (Coventry)



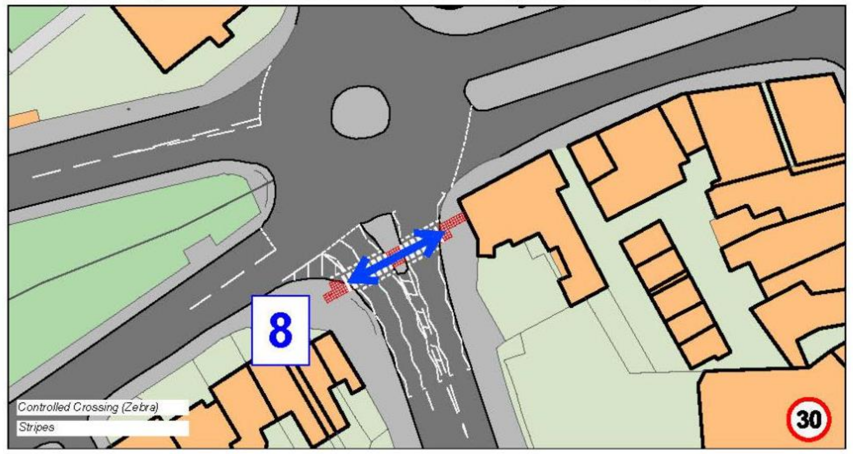
Site 6 - Hamilton Road / Cobbold Road (Felixstowe)



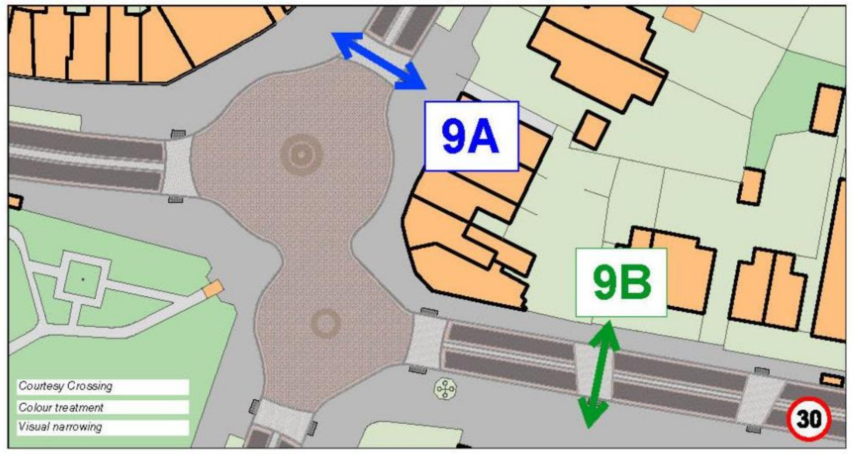
Site 7 - Kimbrose Triangle, Commercial Road (Gloucester)



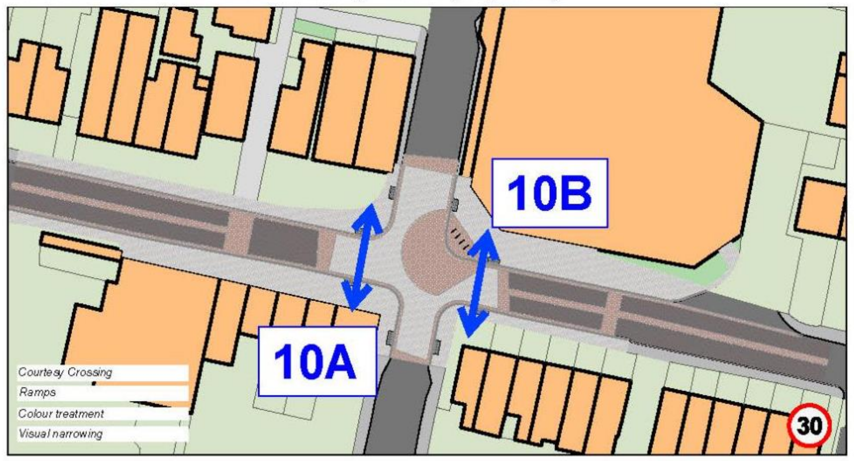
Site 8 - King Edward Road / A50 / A5033 (Knutsfords)



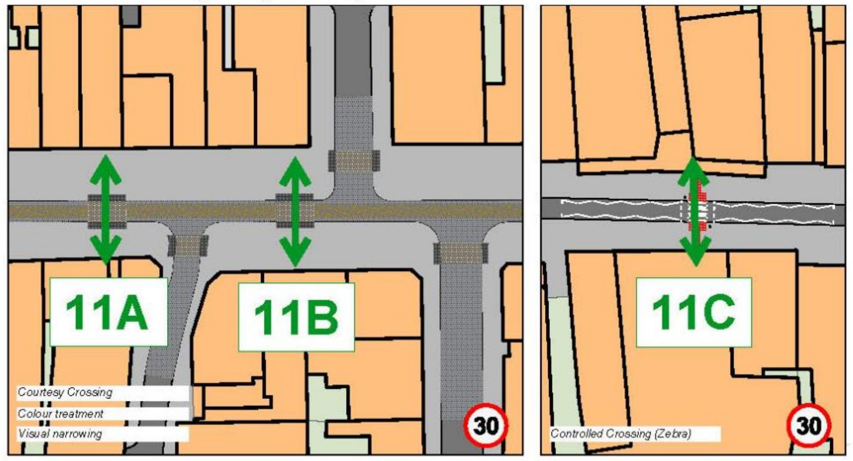
Site 9 - Fountain Place / Park Lane (Poynton)



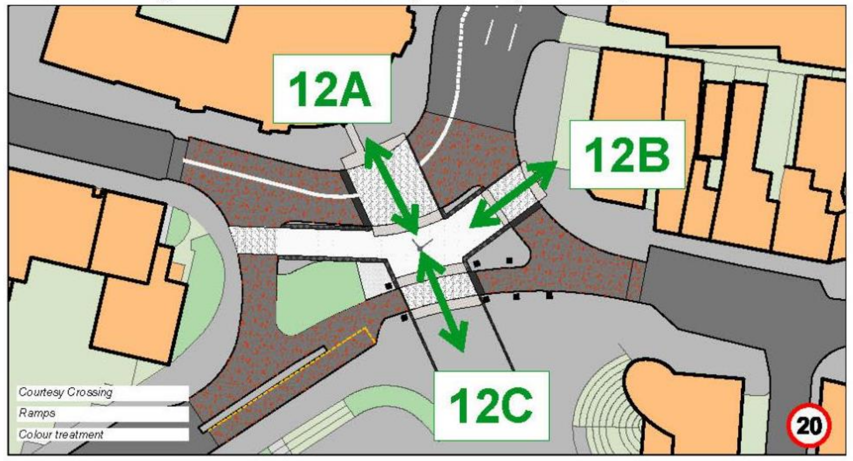
Site 10 - Park Lane / Bulkeley Road (Poynton)



Site 11 - Fishergate (Preston)



Site 12 - Regent Circus / Crombey Street (Swindon)



APPENDIX C

				Observations	No interaction	Courtesy	Some courtesy	No Courtesy	Courtesy	Some Degree of Courtesy	No Courtesy	Vehicles per Hour	Squared Vehicles per Hour	% HGV / Buses	Pedestrians Per Hour	Pedestrian Per Crossing	Weekend	Crossing from Median	Distance from (centre of) nearest junction	One way traffic	Kerbed median, width (m)	Formal Crossing (0 / 1)	Stripes on crossing (0 / 1)	Colour treatment at the crossing	Visual Narrowing	Speed Limit	Ramps (0 / 1)	Crossing Length (m)	Total Crossing Length (m)	Carriageway apparent width (m)	Crossing Width (m)	Kerb height (cm)	Visibility Angle	Number of lanes of oncoming traffic	Relevant kerbside activity	Distance from give way (m)
					NI				C	SDC	NC	VPH	V2	%HGV	PPH	APC	W	Med	D-J	1WT	KW	ZC	SC	CT	VN	SL	R	CL	TCL	CAW	CW	KH	VA	LOT	RKA	GW
1A	Inbound	Footway	1A - Inbound - Footway	26	19%	50%	27%	4%	62%	95%	5%	980	961,327	4.3%	59	1.2	1	0	11	0	0.0	0	1	1	0	20	1	8.0	8.0	8.0	4.4	3	183	4	0	3.6
1A	Outbound	Footway	1A - Outbound - Footway	19	16%	42%	37%	5%	50%	94%	6%	980	961,327	10.5%	46	1.3	1	0	11	0	0.0	0	1	1	0	20	1	8.0	8.0	8.0	4.4	3	258	4	0	7.6
1B	Inbound	Footway	1B - Inbound - Footway	19	58%	26%	5%	11%	63%	75%	25%	424	179,776	5.2%	44	1.2	1	0	15	1	1.8	0	1	1	0	20	1	5.1	13.2	5.1	5.5	3	69	1	0	6.0
1B	Inbound	Median	1B - Inbound - Median	16	81%	19%	0%	0%	100%	100%	0%	424	179,776	5.2%	48	1.5	1	1	15	1	1.8	0	1	1	0	20	1	5.1	13.2	5.1	5.5	3	96	1	0	6.0
1B	Outbound	Footway	1B - Outbound - Footway	16	56%	31%	6%	6%	71%	86%	14%	488	238,144	7.4%	48	1.5	1	0	15	1	1.8	0	1	1	0	20	1	6.3	13.2	6.3	5.5	3	165	3	0	4.9
1B	Outbound	Median	1B - Outbound - Median	19	68%	26%	0%	5%	83%	83%	17%	488	238,144	7.4%	44	1.2	1	1	15	1	1.8	0	1	1	0	20	1	6.3	13.2	6.3	5.5	3	103	3	0	4.9
2	Inbound	Footway	2 - Inbound - Footway	36	39%	53%	8%	0%	86%	100%	0%	634	401,956	1.6%	124	1.7	1	0	11	1	2.5	0	1	0	0	20	1	6.2	13.5	6.2	5.9	6	75	2	1	2.0
2	Inbound	Median	2 - Inbound - Median	33	30%	67%	3%	0%	96%	100%	0%	634	401,956	1.6%	106	1.6	1	1	11	1	2.5	0	1	0	0	20	1	6.2	13.5	6.2	5.9	6	89	2	1	2.0
2	Outbound	Footway	2 - Outbound - Footway	33	55%	33%	0%	12%	73%	73%	27%	648	419,904	0.6%	106	1.6	1	0	11	1	2.5	0	1	0	0	20	1	4.8	13.5	4.8	5.9	6	138	2	1	2.0
2	Outbound	Median	2 - Outbound - Median	36	33%	44%	8%	14%	67%	79%	21%	648	419,904	0.6%	124	1.7	1	1	11	1	2.5	0	1	0	0	20	1	4.8	13.5	4.8	5.9	6	114	2	1	2.0
3	Link	Footway	3 - Link - Footway	62	0%	90%	10%	0%	90%	100%	0%	1,392	1,938,209	7.7%	453	3.5	0	0	50	0	0.0	1	1	0	1	20	0	9.2	9.2	6.4	5.6	1	157	1	1	50
4	Link	Footway	4 - Link - Footway	30	47%	43%	7%	3%	81%	94%	6%	654	428,157	3.0%	99	1.4	0	0	50	1	2.2	0	0	0	0	30	1	3.85	9.9	3.85	2.4	9	82	1	1	50.0
4	Link	Median	4 - Link - Median	30	30%	50%	13%	7%	71%	90%	10%	654	428,157	3.0%	99	1.4	0	1	50	1	2.2	0	0	0	0	30	1	3.85	9.9	3.85	2.4	9	180	1	1	50.0
5A	Inbound	Footway	5A - Inbound - Footway	15	60%	0%	0%	40%	0%	0%	100%	401	161,159	10.8%	39	1.4	0	0	16	0	0.0	0	0	1	0	20	0	6.9	6.9	6.9	4.0	3	189	4	0	3.4
5A	Outbound	Footway	5A - Outbound - Footway	47	64%	4%	0%	32%	12%	12%	88%	401	161,159	3.8%	143	1.6	0	0	16	0	0.0	0	0	1	0	20	0	6.9	6.9	6.9	4.0	3	183	4	0	3.4
5B	Inbound	Footway	5B - Inbound - Footway	20	55%	0%	0%	45%	0%	0%	100%	325	105,784	23.2%	54	1.5	0	0	21	0	0.0	0	0	1	0	20	0	6.3	6.3	6.3	4.0	3	182	4	0	5.5
5B	Outbound	Footway	5B - Outbound - Footway	18	89%	0%	0%	11%	0%	0%	100%	325	105,784	27.6%	46	1.4	0	0	21	0	0.0	0	0	1	0	20	0	6.3	6.3	6.3	4.0	3	192	4	0	5.5
6	Inbound	Footway	6 - Inbound - Footway	71	73%	24%	1%	1%	89%	95%	5%	198	39,157	2.4%	267	1.6	0	0	8	0	0.0	0	1	1	0	20	1	7.2	7.2	7.2	3.0	6	158	3	1	6.7
6	Outbound	Footway	6 - Outbound - Footway	70	74%	24%	0%	1%	94%	94%	6%	198	39,157	2.4%	303	1.8	0	0	8	0	0.0	0	1	1	0	20	0	7.2	7.2	7.2	3.0	6	224	3	1	6.7
7A	Inbound	Footway	7A - Inbound - Footway	56	39%	5%	25%	30%	9%	50%	50%	796	633,616	2.8%	236	2.1	0	0	12	0	0.0	0	0	0	1	20	0	9.5	9.5	6.2	4.0	0	175	3	0	7.3
7A	Outbound	Footway	7A - Outbound - Footway	49	41%	16%	16%	27%	28%	55%	45%	796	633,616	3.8%	230	2.3	0	0	12	0	0.0	0	0	0	1	20	0	9.5	9.5	6.2	4.0	0	186	3	0	7.3
7B	Inbound	Footway	7B - Inbound - Footway	57	18%	77%	4%	2%	94%	98%	2%	690	476,291	3.7%	345	1.8	0	0	12	0	0.0	0	1	0	1	20	0	9.5	9.5	6.2	4.0	0	175	3	0	7.3
7B	Outbound	Footway	7B - Outbound - Footway	51	10%	86%	4%	0%	96%	100%	0%	690	476,291	1.0%	332	2.0	0	0	12	0	0.0	0	1	0	1	20	0	9.5	9.5	6.2	4.0	0	186	3	0	7.3
8	Inbound	Footway	8 - Inbound - Footway	32	22%	53%	19%	6%	68%	92%	8%	784	614,904	4.5%	400	3.2	0	0	10	1	2.4	1	1	0	0	30	0	7.1	15.5	7.1	2.4	12	91	2	0	5.0
8	Inbound	Median	8 - Inbound - Median	1	0%	100%	0%	0%	100%	100%	0%	784	614,904	4.5%	8	2.0	0	1	10	1	2.4	1	1	0	0	30	0	7.1	15.5	7.1	2.4	12	80	2	0	5.0
8	Outbound	Footway	8 - Outbound - Footway	1	0%	0%	100%	0%	0%	100%	0%	931	866,190	4.3%	8	2.0	0	0	10	1	2.4	1	1	0	0	30	0	6	15.5	6	2.4	12	136	3	0	4.7
8	Outbound	Median	8 - Outbound - Median	32	9%	75%	9%	6%	83%	93%	7%	931	866,190	4.3%	400	3.2	0	1	10	1	2.4	1	1	0	0	30	0	6	15.5	6	2.4	12	100	3	0	4.7
9A	Inbound	Footway	9A - Inbound - Footway	8	38%	63%	0%	0%	100%	100%	0%	1,360	1,849,310	4.9%	31	1.6	0	0	17	0	1.2	0	0	1	1	30	1	8.1	8.1	5.6	4.1	3	85	1	0	3.5
9A	Outbound	Footway	9A - Outbound - Footway	8	13%	75%	13%	0%	86%	100%	0%	1,360	1,849,310	2.9%	24	1.3	0	0	17	0	1.2	0	0	1	1	30	0	8.1	8.1	5.6	4.1	3	127	2	0	3.5
9B	Link	Footway	9B - Link - Footway	37	84%	14%	3%	0%	83%	100%	0%	902	813,737	1.6%	89	1.2	0	0	38	0	0.9	0	0	1	1	30	0	7.4	7.4	4.6	5.3	3	168	2	0	50
10A	Inbound	Footway	10A - Inbound - Footway	4	75%	25%	0%	0%	100%	100%	0%	822	675,334	1.0%	11	1.3	0	0	8	0	0.0	0	0	1	1	30	1	6.3	6.3	4.6	2.0	3	248	4	1	3.5
10A	Outbound	Footway	10A - Outbound - Footway	13	8%	69%	15%	8%	75%	92%	8%	822	675,334	1.1%	55	1.9	0	0	8	0	0.0	0	0	1	1	30	1	6.3	6.3	4.6	2.0	3	198	4	1	3.5
10B	Inbound	Footway	10B - Inbound - Footway	2	50%	0%	0%	50%	0%	0%	100%	652	424,477	0.9%	5	1.0	0	0	9	0	0.0	0	0	1	1	30	1	6.3	6.3	4.6	1.0	3	230	4	1	3.5
10B	Outbound	Footway	10B - Outbound - Footway	6	33%	0%	33%	33%	0%	50%	50%	652	424,477	0.0%	19	1.3	0	0	9	0	0.0	0	0	1	1	30	1	6.3	6.3	4.6	1.0	3	242	4	1	3.5
11A	Link	Footway	11A - Link - Footway	68	81%	1%	0%	18%	8%	8%	92%	418	174,823	9.5%	270	1.9	0	0	25	1	0.0	0	0	1	1	30	0	3.0	3.0	2.0	5.5	4	86	1	1	50
11B	Link	Footway	11B - Link - Footway	27	78%	4%	0%	19%	17%	17%	83%	390	152,415	14.2%	149	1.6	0	0	25	1	0.0	0	0	1	1	30	0	3.0	3.0	2.0	5.5	4	86	1	1	50
11C	Link	Footway	11C - Link - Footway	38	89%	11%	0%	0%	100%	100%	0%	94	8,785	31.8%	290	1.8	0	0	50	1	0.0	1	1	0	0	30	0	3.1	3.1	3.1	2.4	9	86	1	1	50
12A	Link	Footway	12A - Link - Footway	34	59%	29%	3%	9%	71%	79%	21%	488	238,144	2.9%	94	1.4	0	0	50	1	0.0	0	0	1	0	20	1	10.1	10.1	3.8	10.2	6	112	2	1	50
12A	Link	Median	12A - Link - Median	60	47%	37%	5%	12%	69%	78%	22%	488	238,144	2.9%	206	1.7	0	1	50	1	0.0	0	0	1	0	20	1	10.1	10.1	3.8	10.2	6	52	2	1	50
12B	Link	Footway	12B - Link - Footway	36	61%	39%	0%	0%	100%	100%	0%	318	101,124	4.4%	108	1.5	0	0	50	1	0.0	0	0	1	0	20	1	5.3	5.3	5.3	6.0	6	105	1	1	50
12B	Link	Median	12B - Link - Median	26	81%	12%	8%	0%	60%	100%	0%	318	101,124	4.4%	100	1.9	0	1	50	1	0.0	0	0	1	0	20	1	5.3	5.3	5.3	6.0	6	59	1	1	50
12C	Link	Footway	12C - Link - Footway	61	46%	43%	3%	8%	79%	85%	15%	540	291,600	0.7%	172	1.4	0	0	50	1	0.0	0	0	1	0	20	1	3.5	3.5	3.5	10.2	6	109	1	1	50
12C	Link	Median	12C - Link - Median	46	35%	50%	4%	11%	77%	83%	17%	540	291,600	0.7%	150	1.6	0	1	50	1	0.0	0	0	1	0	20	1	3.5	3.5	3.5	10.2	6	59	1	1	50

Notes

[1] *Phil Jones Associates*
[2] *Crowd Dynamics International Limited*
[3] *classified as Links, despite the presence of side roads, due to the lack of appreciable turning flows at the junctions*
[4] *same as Site 4; both 11A and 11B*
[5] *classified as Links, despite the fact that it could be argued that they are within a Junction; however, the one-way system at all the Links of the junction makes the three crossings more comparable to those at a Link, rather than a Junction*