Inclusive design at bus stops with cycle tracks: Literature review

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This literature review has been produced as part of the Living Streets project 'Inclusive Design at Bus Stops and Continuous Footways'. This project is funded by the Scottish Road Research Board, Transport Scotland and Department for Transport.

Author
Emma Pearce, Living Streets

Annex A author
Rachel Lee, Living Streets

Editing/reviewing
Robert Weetman (Living Streets)
David Spaven (External editorial support)
Alisha Pathania & Emma Koprena (Transport for All)

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Abstract

Bus stop bypasses (or 'floating bus stops') and boarders[1] have been developed to improve safety and amenity for people cycling through the vicinity of bus stops. These two designs have been installed across the UK, but there is a vast difference in how these designs have been implemented on site.

This literature review was produced as an early stage in a two-year research project, titled 'Inclusive Design at Bus Stops and Continuous Footways', during which Living Streets is investigating problems of inclusion (a) where bypasses and boarders are provided at bus stops (including identification of the conditions under which such interventions can be installed without significant negative impact on pedestrian amenity and inclusive access), and (b) at continuous footways. This review will help to frame the scope of the larger project, establishing key issues, current knowledge, and gaps in knowledge.

We reviewed, at a national and local level, formal design guidance that includes bus stop interventions. The review found that bypasses are generally preferred by government bodies, with boarders completely omitted from many documents, however some documents suggest that boarders may be the safer option. The literature review confirms that there is some inconsistency in use of terminology and definition, and also in how the infrastructure is intended to work.

There are a significant number of factors to consider in the choice and use of bus stop bypasses and boarders, some of which have onward implications for the design of the infrastructure. While there is generally overall consistency in basic appearance for the designs, there is variation in smaller details, notably the type and number of pedestrian crossings of the cycle track; design and definition of the bypass cycle track; use of signage and markings; and some critical dimensions such as width of island and footway. Guidance documents call for involvement of stakeholders in the design and implementation of bus stops, but this may open up scope for further variation to design, on a very localised basis. Greater clarity is needed on how to adapt standard designs for different street conditions, with clearer guidance on when this infrastructure may not be appropriate for use.

We reviewed several published studies into bypasses and a number of published position statements from stakeholder groups representing disabled people. This confirmed that there is uncertainty from both people walking and cycling over how to use the facilities, though there appears to be a general sense that both groups

[1] NB: This literature review was written at an early stage in the research. In the final report we adopt two new terms to avoid confusion over the term 'boarder'. See 'Addendum' note on page 27.

act differently at defined crossing points to how they act in the rest of the bus stop area. There is a lack of published research into boarders, but we are aware that Transport for Greater Manchester and Transport for London are currently undertaking research in this area.

We discovered significant concerns around inclusion and accessibility related to this infrastructure, particularly at boarders, which are considered by some stakeholders to be completely unacceptable and unable to be safely implemented. The challenge for designers is to move beyond relying on, somewhat, ambiguous visual communication to create infrastructure which can clearly communicate priority and dictate the appropriate behaviour from both people walking and cycling.

The findings of the literature review suggest that there is a need for both guidance and legislation to be more specific and consistent in addressing bus stop bypasses and boarders.

The major issue left unresolved by the literature is that of how users are expected to act and who, if anyone, has priority – people walking or those who are cycling? There is no consistency across the literature in either who, in theory, *should* have priority, who *does* have it in reality, and *where* in the bus stop area does this apply? This is somewhat addressed by the recent updates to the Highway Code however there is also the question of how to enforce and signal this prioritisation. The lack of clarity is identified as a point of significant concern in multiple studies and by stakeholder groups, with a strong preference for pedestrians being given clear legal and signalled priority at crossing points. Various approaches to signalling and even enforcing priorities have been suggested, but many of these appear to be untested so their effectiveness is unknown. The question of how to signal 'priority' is one of the key issues that should be addressed through future stages of this study.

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Abbreviations and acronyms

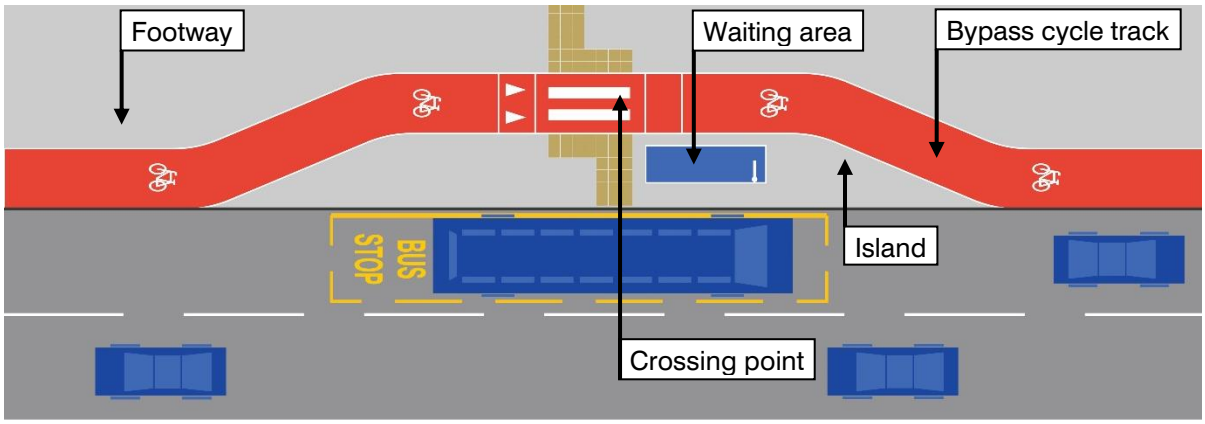
AECOM	(not abbreviated) AECOM, a design and engineering consultancy
CbD	Cycling by Design (Transport Scotland, 2021)
CD 195	Design Manual for Roads and Bridges: CD 195 Designing for cycle traffic
DfT	Department for Transport
GMCA	Greater Manchester Combined Authority
LCDS	London Cycling Design Standards (Transport for London, 2014)
LTN 1/20	Local Transport Note 1/20: Cycle Infrastructure Design (Department for Transport, 2020)
MACS	Mobility and Access Committee for Scotland
NFBUK	National Federation of the Blind of the UK
RNIB	Royal National Institute of Blind People
TfGM	Transport for Greater Manchester
TfL	Transport for London
TfWM	Transport for the West Midlands
TRI	Transport Research Institute, Edinburgh Napier University
TRL	(not abbreviated) TRL, a transport research consultancy
TSRGD 2016	Traffic Signs Regulations and General Directions 2016
Wales Active Travel Act Guidance	Active Travel Act Guidance 2021 (Welsh Government, 2021)

Working definitions and language

For the purposes of this document, we will refer to:

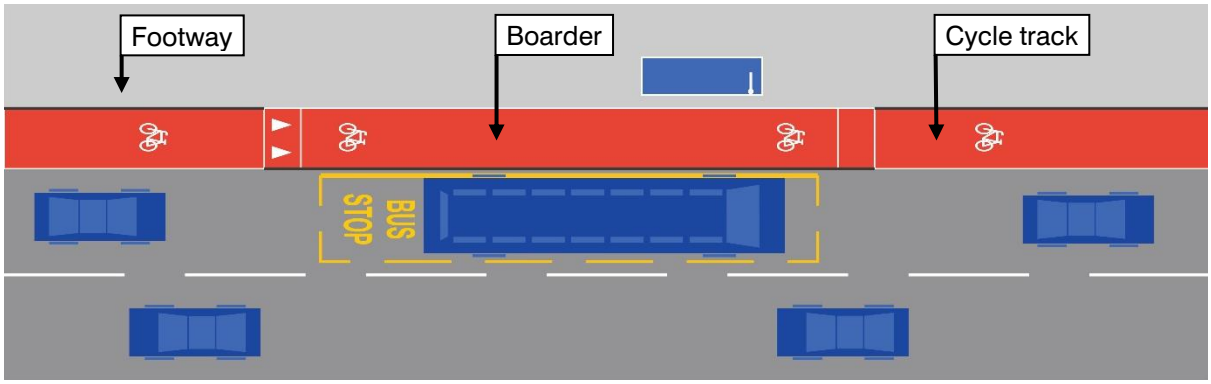
A **bus stop bypass** (also known as a 'floating bus stop' or 'island bus stop'), which is an infrastructure design where a cycle track is routed behind a bus stop waiting/ boarding area. The waiting area is separated from the main footway by the cycle track. For conciseness, the shortened term 'bypass' will be used throughout this document (see illustrations on pages 20 and 21.)

Figure 1 **Bus stop bypass (uni-directional) – typical design**



A **bus stop boarder**[2], which is an infrastructure design where a cycle track continues through the bus stop area between the footway and carriageway. The cycle track is raised onto a platform at footway level in the vicinity of the bus stop.

Figure 2 **Bus stop boarder without buffer – typical design layout**



[2] NB: This literature review was written at an early stage in the research. In the final report we adopt two new terms to avoid confusion over the term 'boarder'. See 'Addendum' note on page 27.

The bus passenger waiting area lies within the footway and passengers cross the cycle track to board the bus. There may be a narrow buffer zone provided between the carriageway and cycle track. For conciseness, the shortened term ‘boarder’ will be used throughout this document (see illustrations on page 22.)

We will also refer to the following infrastructure terms:

- *Bus stop area:* The full area around a bus stop including waiting and boarding areas, any bus layby, and the extent of any changes to the cycle route.
- *Waiting area:* The area at a bus stop where passengers will wait for the bus. This may include a shelter and other facilities.
- *Boarding area:* The specific area at a bus stop where passengers will leave the footway to board and alight the bus. In some circumstances, the waiting area and boarding area may be contiguous.

In this document, the terms below have the following meanings:

- *Pedestrian:* For the purposes of this study, the word ‘pedestrian’ refers not just to people walking, but those using wheeled mobility aids.
- *Passenger:* A person who is using a bus service at the bus stop.
- *Cyclists:* A person using any type of cycle including standard two-wheeled and non-standard or adapted cycles.
- *Wheeling:* The use of a wheeled mobility aid such as a mobility scooter or wheelchair.
- *Active travel:* A term used to refer to walking, cycling and other physically active modes of transport, particularly for everyday journeys.
- *Footway*: An area for pedestrians adjacent to and associated with a carriageway - commonly called ‘the pavement’.
- *Carriageway*: The area of a road or street intended for motor vehicle use.
- *Cycle lane:* Cycle lanes are part of the carriageway but are marked for use by bicycle.
- *Cycle trac*k: Cycle tracks have a clear separation both from carriageway and footway and may be described as a ‘off-carriageway’ route.
- *At-grade*: This refers to moving from one part of the street to another, or from the street to a vehicle) without stepping upwards or downwards. This is particularly important for people with mobility impairments.
- *Chicane:* A sharp double bend created on a carriageway or cycle track to slow vehicular or cycle traffic for safety.

The terms ‘pedestrian’, ‘cyclist’ and ‘driver’ are used sporadically as simple shorthand to refer to people walking, cycling and driving in the vicinity of the bus stop, and are not intended to imply specific behaviours or mind-set.

1 Introduction

Bus stop bypasses and boarders are infrastructure designs that allow people cycling to pass through the vicinity of a bus stop without the need to interact with vehicles on the carriageway. These measures are primarily introduced for the safety of people cycling but there are concerns that this may come at the expense of safety and comfort for pedestrians, and particularly for some disabled people. The study will investigate how bus stop bypasses and boarders can be designed to ensure they provide amenity for people cycling while not compromising accessibility and inclusivity for pedestrians.

This literature review has been produced as an early stage in a two-year research project 'Inclusive Design at Bus Stops and Continuous Footway', undertaken by Living Streets. This project is funded by Transport Scotland and the Department for Transport, to investigate issues of inclusion at both continuous footways and where cycle tracks are provided through bus stops. The review aims to help frame the scope of the larger project, establishing key issues and current knowledge, and gaps in knowledge.

This literature review focuses on cycling at bus stops, through installation of bypasses and boarders. It summarises and comments on the themes covered in the current design guidance and published research studies relating to bus stop bypasses and boarders to establish a context and baseline for the primary research stage of the project. It explores the scope of design guidance, the factors considered in research studies, and the findings of those studies.

In introducing this work, Chapter 2 describes the scope of the literature review and outlines the key sources studied.

The main content of the document is then structured as follows:

- Chapter 3 discusses the meaning of the terms 'bypass' and 'boarder', establishing that there is some inconsistency in their use. It identifies the working definitions for this study.
- Chapter 4 explores the design goals behind the use of bypasses and boarders, looking at who they are intended to benefit, who is intended to have priority, and what the conditions for their installation are.
- Chapters 5 and 6 explore the design of the physical features within a bypass or boarder, identifying where there is agreement or variation within the published design guidance.

- Chapter 7 explores the implications for inclusion and accessibility that result from the installation of bypasses and boarders.
- Chapter 8 discusses the legislation that governs actions and relationships on UK highways and explores the wider policies that drive design choices.
- Chapter 9 provides a discussion of the findings of this literature review and identifies the implications for the wider Living Streets project 'Inclusive Design at Bus Stops and Continuous Footways'.

Appendices are provided, giving a summary of the sources discussed in the review.

Annex A is an additional literature review addressing broader issues of inclusion and accessibility in street design as applicable to both this report and the sister document on continuous footways.

Diagrams are used throughout this document to represent typical layouts for bus stop bypasses and boarders, as used in guidance documents. Details may vary by guidance source or at real-world examples. The cycle track/lane is typically shown in red to identify the route for cyclists – this is for illustrative purposes only and does not imply that the track will be coloured as such. Diagrams are not to scale.

(NB: This document was published in May 2023 but the literature review was undertaken at the start of the related Living Streets project – it may omit reference to any literature produced after Summer 2022)

2 Scope of literature review

This chapter clarifies the scope of the literature review, including an overview of the key types of literature studied.

The review has been produced as the first stage of the 'Inclusive Design at Bus Stops and Continuous Footways' study, helping to frame the scope of the larger project, establishing key issues and current knowledge and gaps in knowledge around these. The review will allow the research project to be targeted to explore gaps in current knowledge and potentially compare the effectiveness of different design treatments.

The review focuses on interventions to allow cycle tracks at bus stops. A second literature review has been produced alongside this, concentrating on continuous footways. Parallel to the two infrastructure-specific reviews is a third literature review looking more broadly at issues of inclusion and behaviour change. This is attached as Annex A.

Evidence was sought particularly on the following questions:

- What outcomes are being sought where bus stop bypasses and boarders are provided? Where does the provision of this infrastructure sit in the context set by wider policy?
- Does current design guidance, and the wider structure of rules and legislation in Britain, support or hinder the delivery of successful bus stop interventions?
- How do issues of inclusion sit in this context? How extensive are the issues and who is affected?
- What evidence is there that bus stop interventions succeed or fail to deliver the intended outcomes, and does this effect how inclusive a street is?
- What factors might affect this?

2.1 Methodology

The methodology sought to ensure that the review of literature was comprehensive and provided a well-rounded perspective on the issues with sufficient evidence to allow us to answer the research questions.

Some of the literature reviewed was already known to the authors of this review. A search of literature was undertaken in Autumn 2021 and further literature was selected through several channels:

- Several design guidance documents were found either by searching directly on local government websites or through search engines with terms including “street design guidance” and “cycling design guidance”.

- Many studies were sourced through online search engines and Google Scholar using terms including “bus stop bypass”, “bus stop boarder”, “floating bus stop”, “island bus stop”. Additional searches of those terms were made with keywords (and their variants) including “inclusive”, “accessibility”, “disability”, “study” and “research”.

- Additional sources were found in the references and footnotes of other documents. One study was found via a reference in an online media article.

2.2 Types of literature studied

As part of this review, the following types of literature were studied:

- Design guidance for cycle infrastructure, active travel infrastructure and street design published at a national or local government level.
- Key published studies of the use, safety and effectiveness of bus stop bypasses and boarders.
- Other publications which are known to have an established role in guiding designs for urban streets, or in regulating the behaviour of road users including:
- Third-party design guidance and commentary.
- Published formal and informal commentary from stakeholders, including Position Statements.

An overview of the key documents is provided below.

DESIGN GUIDANCE AND STANDARDS

This chapter outlines the key national and local guidance and standards of relevance to the design of bus stop bypasses and boarders. The details of these documents are discussed further throughout this literature review and summaries are provided in Appendix 1. Design guidance.

The literature includes guidance aimed at street design, guidance concerned with active travel infrastructure, and guidance that specifically focus on cycle

infrastructure. The focus and intent of the documents may affect their approach to modal conflict, and the extent to which cycling is prioritised through these spaces.

National guidance, legislation and standards

National government bodies have recently published design guidance for cycle infrastructure which includes reference to bus stop design. These should be read in parallel with the national legislation, rules and standards for use and design of highways, including the Highway Code and Traffic Signs Regulations and General Directions 2016, but it is clear that legislation of behaviour does not consistently correlate directly with how people will behave in reality.

Table 1 National guidance and standards sources

Author	Guidance document	Date
Department for Transport	Local Transport Note 1/20 Cycle Infrastructure Design (LTN 1/20)	2020
Transport Scotland	Cycling by Design 2021	2021
Welsh Government	Active Travel Act Guidance	2021
Highways England	Design Manual for Roads and Bridges. Road Layout Design. CD 195: Designing for cycle traffic	2021

The guidance in LTN 1/20 and Cycling by Design should be interpreted based on the key principle in both documents that cycles must be treated as vehicles, not as pedestrians. Additionally, the two documents, reference a requirement for accessible and inclusive cycle infrastructure [1] [2]. Similarly, the Welsh Active Travel Act Guidance notes that walking and cycling are different and have distinct needs, but groups them at the top of the 'sustainable transport hierarchy' [3].

Inclusive Mobility, updated in December 2021, is the Department for Transport's guide to best practice on access to inclusive pedestrian and transport infrastructure. It makes a brief reference to bus stop bypasses [4].

Local guidance

Several local authorities have taken the initiative by producing their own design guidance for cycling infrastructure, some of which includes bus stop interventions. A search of existing published guidance was performed, and those documents including relevant guidance are identified below.

Many of these documents pre-date LTN 1/20 and/or Cycling by Design 2021 and should be read with this in mind.

Table 2 Local guidance sources

Author	Guidance document	Date
Transport for London	London Cycling Design Standards	2016
Transport for London	Accessible Bus Stop Design Guidance	2017
Transport for London	Guidance Note: Pedestrian crossings at Bus Stop Bypasses	2018
City of Edinburgh Council	Edinburgh Street Design Guidance: Part C – Detailed Design Manual	2017
Greater Manchester Combined Authority and Transport for Greater Manchester	Greater Manchester Interim Active Travel Design Guide	2021
Transport for the West Midlands	West Midlands Cycle Design Guidance	2017
Camden Council	Shared Use Bus Boarders: Context and design considerations	
Leicester City Council	Leicester Street Design Guide	2020

KEY UK STUDIES

Several studies have been undertaken in the past decade, looking at safety of bus stop bypasses and the effectiveness of design variables in a UK context. These primarily focus on bus stop bypasses with little work done to-date to look into boarders. Further information on the studies is provided in Appendix ii Key UK studies.

It should be noted that the studies pre-date most of the current design guidance, and that the design of the infrastructure studied may not align with current standards, which will therefore limit the extent to which conclusions can be drawn about the safety and functionality of new infrastructure.

Table 3 Key study sources

Author	Study name	Date
Sustrans	Cambridgeshire 'floating bus stops' interaction analysis	2015
Greater Manchester Combined Authority	Oxford Road Trial Bus Stop Evaluation Report	2016
Brighton & Hove City Council	Lewes Road: Interim Post-Construction Monitoring Report	2016
AECOM	Leith Walk cycling infrastructure analysis: Summary of key findings	2018
Transport Research Institute, Edinburgh Napier University	Analysis of cyclist-pedestrian interactions at a floating bus stop site in Edinburgh, United Kingdom	2018
P. Barham for TRL	Accessible Public Realm: Updating Guidance and Further Research [CPR2714]	2020
I. York and S. Tong for TRL	Off-street trials of a bus stop bypass - An assessment of user perceptions, safety, capacity and accessibility [PPR730]	2014
S. Greenshields, S. Chowdhury, P. Jones and S. Davidson for TRL	Various London bus stop bypass studies [PPR855, PPR854, and PPR853]	2018
Transport for London	New cycle infrastructure on London's streets: Summary report of on-street trials	2018

Transport for Greater Manchester and Transport for London are both currently undertaking research into bus stop boarders, with a view to identifying if and how boarders can be safely implemented without compromise to inclusivity and accessibility for pedestrians. Once published, this research will expand knowledge in this area significantly.

OTHER PUBLICATIONS

Several other publications specifically consider bus stop bypasses and boarders and are of relevance to this literature review, including third-party design guidance and commentary from advocacy groups.

Table 4 Other publications reviewed

Author	Guidance document	Date
Wheels for Wellbeing	A Guide to Inclusive Cycling	2020
John Parkin	Designing for Cycle Traffic: International principles and practice	2018
RNIB	Seeing streets differently: How changes to our streets and vehicles are affecting the lives of blind and partially sighted people	2021
RNIB	RNIB's response to DfT's "Review of The Highway Code to improve road safety for cyclists, pedestrians and horse riders"	
RNIB	Policy Position Statement: Access to bus stops (bus stop bypasses and bus stop boarders)	2021
RNIB Scotland	Royal National Institute of Blind People (RNIB) Scotland Response to the City of Edinburgh Council Consultation Meadows to George Street: Concept Design Consultation	2019
Aluko-olokun and Marsh for Guide Dogs	Making the built environment inclusive - guidance on ensuring regeneration schemes are accessible for people with sight loss	2021
Sustrans	Temporary active travel facilities – draft factsheet	2021
Waltham Forest Cycling Campaign	Bus boarders, islands & bypasses	
S. Jensen for Trafitec ApS	Bicycle Tracks and Lanes: A Before-After Study	2007
S. Jensen for Trafitec ApS	Udformning af busstoppesteder på supercykelsti-rute Hjallesevej-Odensevej-	2020

Author	Guidance document	Date
	Svendborgvej [translated as “Design of bus stops on the superbike path route Hjallesevej-Odensevej-Svendborgvej”]	
British Columbia Human Rights Tribunal	Reasons for Decision: Belusic obo Canadian Federation of the Blind v. City of Victoria and another (No. 4), 2020 BCHRT 197	2020

3 Terminology and key concepts

This chapter looks at ways in which bus stop bypasses and boarders have been defined in the literature and sets out the definitions to be used by this study.

Through this literature review, clear answers to the following questions were sought:

- How much consistency is there in the literature over the definition of the terms ‘bypass’ and ‘boarder’?
- How much deviation is there from our working definitions?
- What other titles and terms are used to describe designs which might meet our working definition?

At present, this infrastructure is not specifically referenced in legislation, meaning that there is no legally defined terminology or definition.

The reviewed literature is generally consistent in the basic definitions used for both bypasses and boarders, but there is much variance in details. Additionally, several sources use specific nuances in their definitions that could affect how both designers and stakeholders respond to the interventions. The review established that our study should include designs described with terms such as ‘floating bus stop’, ‘island bus stop’, and ‘shared use bus boarder’.

The ‘Inclusive Design at Bus Stops and Continuous Footways’ study is primarily concerned with bus stop bypasses rather than boarders as these are the preferred bus stop type of the primary funder, Transport Scotland and are included in the 2021 update to Cycling by Design. There is, however, an overlap in how these interventions have been implemented in the past, with some schemes adopting a hybrid bus stop type combining elements of typical bypass and boarder designs, such as a chicane layout with clear island but where waiting is accommodated on the footway or waiting accommodated on a very narrow island.

As existing guidance typically makes clear distinctions between the two infrastructure type, they will be treated as distinct in this study, but the characteristics of both types will be explored to provide further context when reviewing real-world examples.

3.1 Definitions currently in use

BUS STOP BYPASS

There is general consistency in the definition of bus stop bypass (generic layout shown in Figure 7, p26). Cycling by Design simply states “bus stop bypasses provide an island between the cycle track and the road” [2]. Similarly, Local Transport Note 1/20 (LTN 1/20) defines the infrastructure thus: “with a bus stop bypass, a cycle track is taken around the rear of the stop […]” [1]. TfL states “a segregated cycle lane or track continues through the bus stop area behind the shelter, thereby creating an island for bus passengers boarding and alighting at the stop” [5].

There is more variation in type of cycle route referred to. While some sources, including the Wales Active Travel guidance [3] and TfL [8], note that bypasses can be used as part of off-carriageway (cycle track) routes, TRL’s definition notes use with on-carriageway routes only [6].

In the majority of definitions, the waiting area is described as on the island. Using the terminology ‘floating bus stop’, Edinburgh Street Design Guidance defines two bypass designs: bus shelter on island and bus shelter on footway. While the first follows the typical bypass arrangement with waiting on the island, the second places the shelter on the footway, creating a bypass-boarder hybrid that allows use in locations with more limited space.

DMRB CD 195 does not use the term ‘bypass’ but states that “Cycle tracks shall be designed so that passengers disembarking from buses do not step down directly on to a cycle track” and “Where a route with cycle lanes has bus stops with space available at the back, the cycle lane should be changed to a cycle track and routed behind the bus stop” essentially alluding to a bypass [7].

While ‘bus stop bypass’ or simply ‘bypass’ is the most common term, this design is also referred to as ‘island bus stops’ (in the Wales Active Travel guidance [3]) and as ‘floating bus stops’ (including by City of Edinburgh Council [8] and Brighton and Hove City Council [9]).

The term ‘floating bus stop’ is occasionally used to refer to situations where a road, usually a minor/ service road, passes between the bus stop island and the footway. This definition is not used in this study. Campaign group Waltham Forest Cycling Campaign refer to “bus stop islands” which are somewhat of a hybrid between standard bypass and boarder designs, with the chicane and island of a bypass (albeit smaller) but with the waiting area accommodated at the back of the footway [10]. Their report also does not use ‘bypass’ to refer to bus stop types like that

named “DE501 Bus Stop: Cycle Lane Bypass” in the Wales Active Travel Act Guidance which refers to an on-carriageway facility [3].

The use of the term ‘bypass’ should not be confused with cycle bypasses installed to either allow cyclists to bypass traffic calming features or to allow cycle-only movements at a junction.

BUS STOP BOARDER

Typical definition

There is one basic design typology in use in the UK that seems widely to be called a ‘bus stop boarder’. This describes an arrangement where the cycle track is brought up to a footway-level platform where it effectively continues through the bus stop area, with passengers invited to cross the track to board/alight from the bus. This arrangement is used in LTN 1/20 and the Wales Active Travel guidance (‘bus boarder’) and is known as a ‘shared use bus boarder’ in the Camden guidance (generic layout shown in Figure 9, p28).

LTN 1/20 defines boarders as where “cyclists are brought up onto a footway-level cycle track which passes between the footway and the edge of the carriageway” [1]. The Wales Active Travel guidance has a similar definition: “A bus boarder in line with the cycle lane/track will bring cyclists up to footway level within a shared use area enabling them to continue across the bus boarder when it is clear or to cycle past pedestrians waiting at the bus stop” [3]. The Edinburgh guidance states that “a bus boarder like footway extension can be created in line with the segregated cycle track, raised at footway level. The shelter is located on the footway edge whilst boarding/alighting takes place on the bus boarder/ cycleway section” [8].

Bus stop boarders are included in fewer guidance documents and studies than bypasses, potentially due to the perception of lower safety and increased confusion for boarding and alighting passengers.

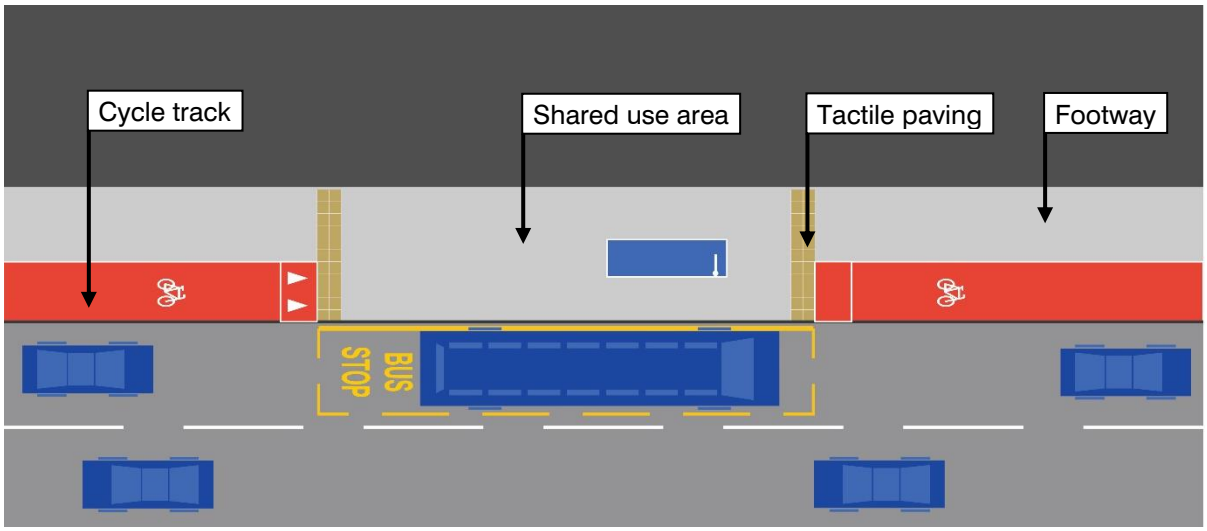
Alternative usage for the term ‘boarder’

There are further typologies that have been associated with the term ‘boarder’ but are used less widely and consistently in the UK. These definitions will not be used within this report unless otherwise stated.

Cycling by Design

Cycling by Design shows a design called ‘cycle track at bus boarder’ where the cycle track is terminated either side of the bus stop. The stop sits within a shared use area (discussed further in section 4.1). This arrangement is shown as an additional option in the Wales Active Travel guidance (‘shared use’) and has been used for many years in the absence of design guidance for bypass and boarder designs.

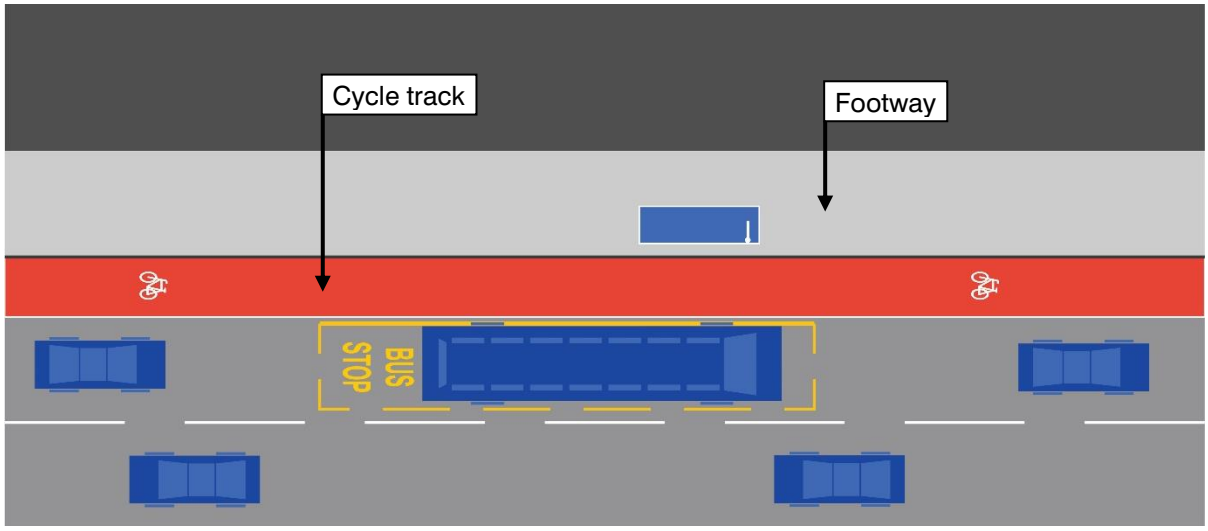
Figure 3 **'Cycle track at bus boarder' from Cycling by Design [2]**



Continuous kerbside track

The term 'boarder' has been used to refer to situations (common in Denmark) where a cycle track continues past a bus stop parallel to the kerb and at a constant level (called a 'Kantstensopstilling' or 'kerb layout' in some Danish research [11]). There may be no changes to the design of the track or footway, to indicate that this is a bus stop, other than with a flag and/or shelter, and nothing to indicate special rules or priorities. Pedestrians must cross the cycle track to board and alight from the bus. There are some examples of this type of design in use in the UK but they differ from the boarder designs included in key guidance documents.

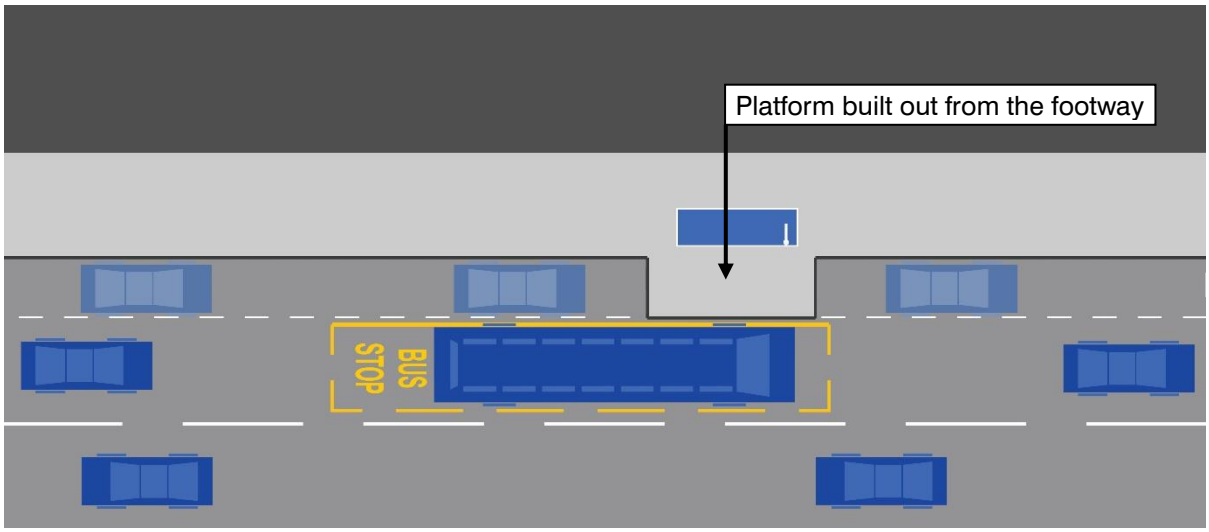
Figure 4 **Continued kerbside track**



Horizontally-projecting boarder platform

The term 'boarder' is also often used at locations without cycle tracks or lanes to refer to the provision of a platform projecting horizontally outwards (kerb build-out) from the footway to provide level access onto buses and avoiding need for buses to deviate from the main carriageway for boarding.

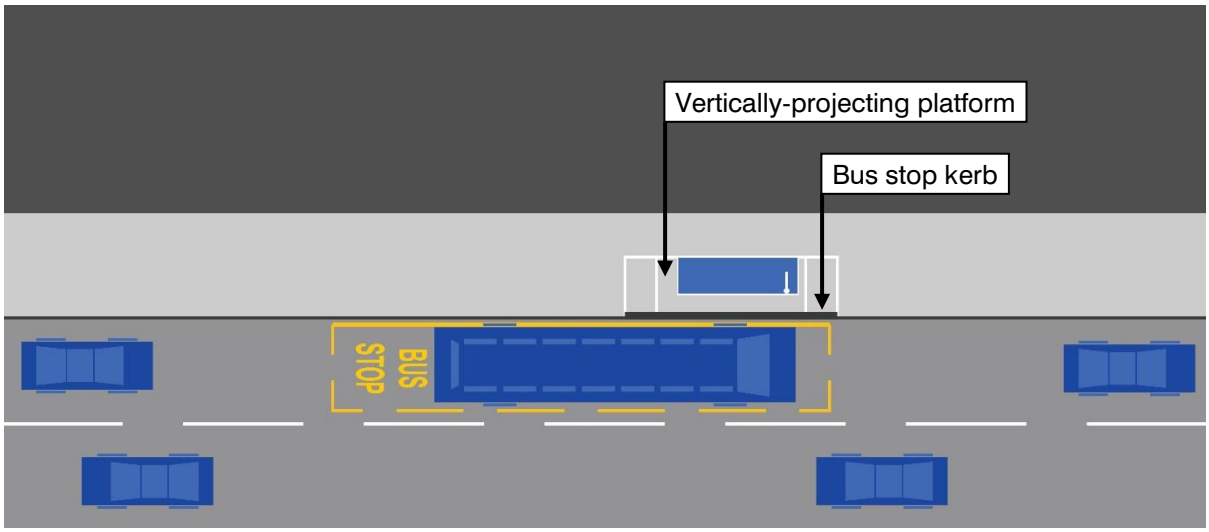
Figure 5 **Horizontally-projecting boarder platform**



Vertically-projecting boarder platform

The term 'boarder' is also often used at locations without cycle tracks or lanes to refer to the creation of a platform around the bus stop where the footway is raised to the height of a bus stop kerb. This is similar in design to some tram stops and provides level access onto buses.

Figure 6 **Vertically-projecting boarder platform**



3.2 Working definitions used in this document

This review established that there appeared to be inconsistency in terminology around bus stop bypasses and boarders, and also around design details. Consequently, as an initial step, a working definition of these key terms was established.

BUS STOP BYPASS

This document uses the term “bus stop bypass” or “bypass” to refer to an infrastructure design where a cycle track is routed around the rear of the bus stop waiting / boarding area (including bus stop flag and shelter). The waiting / boarding area becomes an ‘island’ separated from the rest of the footway by the cycle track. There may be marked pedestrian crossing points across the cycle track.

The key characteristics typically shared by bus stop bypasses are:

- Passengers cross the cycle track to access the island from the main footway.
- Passengers wait on the island to board the bus and alight back onto the island.

Figure 7 and Figure 8 represent typical layouts for bus stop bypasses, as used in guidance documents. It should be noted that in Figure 8 the ‘island’ extends well outside the bus stop area (there is little relationship between the one-way/two-way short island/long island characteristics).

Figure 7 Bus stop bypass (uni-directional, short island) – typical design layout

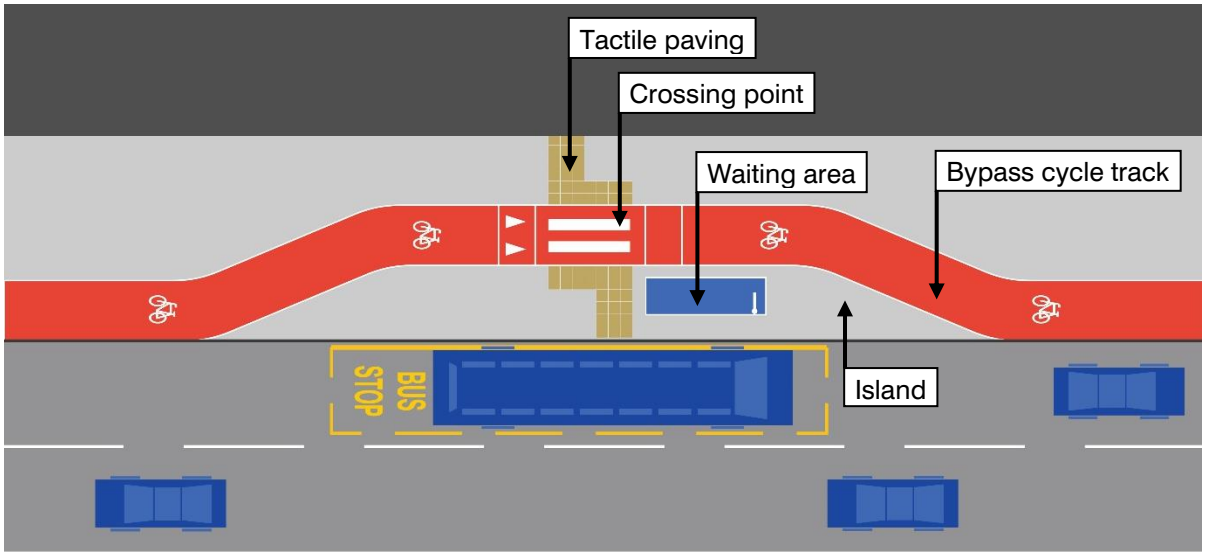
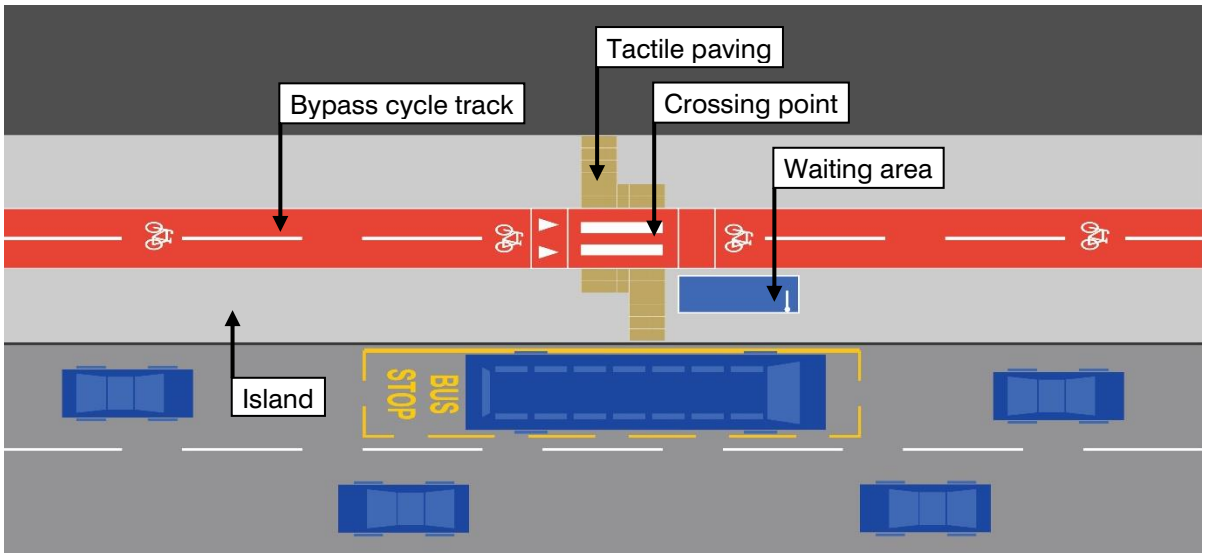


Figure 8 **Bus stop bypass (bi-directional, long island) – typical design layout**



BUS STOP BOARDER

This document uses the term “bus stop boarder” or “boarder” to refer to interventions where a cycle track continues through the bus stop area between the footway and carriageway, staying parallel to the kerb. The waiting area lies within the main footway. The cycle track is raised up to footway level on a platform in the vicinity of the bus stop to allow level boarding for passengers. This boarder area is effectively an area of shared space for people walking and cycling, however passengers stay on the outside edge of the cycle track, only crossing it when the bus arrives.

There may be a narrow buffer zone provided between the carriageway and cycle track. There may be marked pedestrian crossing points across the cycle track, often aligned with where the bus will pull up.

The key characteristics typically shared by bus stop bypasses are:

- Passengers wait at a stop located at the front of the footway.
- Passengers cross the cycle track only when they need to board / alight from the bus.

Figure 9 and Figure 10 represent typical layouts for bus stop boarders, as used in guidance documents. Details may vary by guidance source. (The cycle track is shown in red in diagrams for illustrative purposes only.)

Figure 9 **Bus stop boarder without buffer – typical design layout**

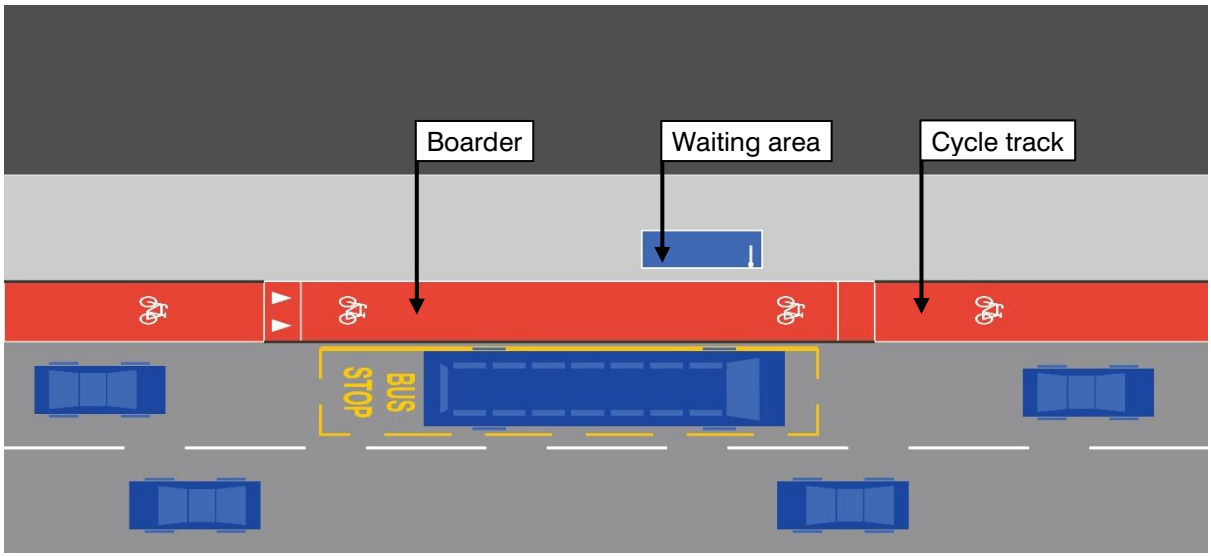
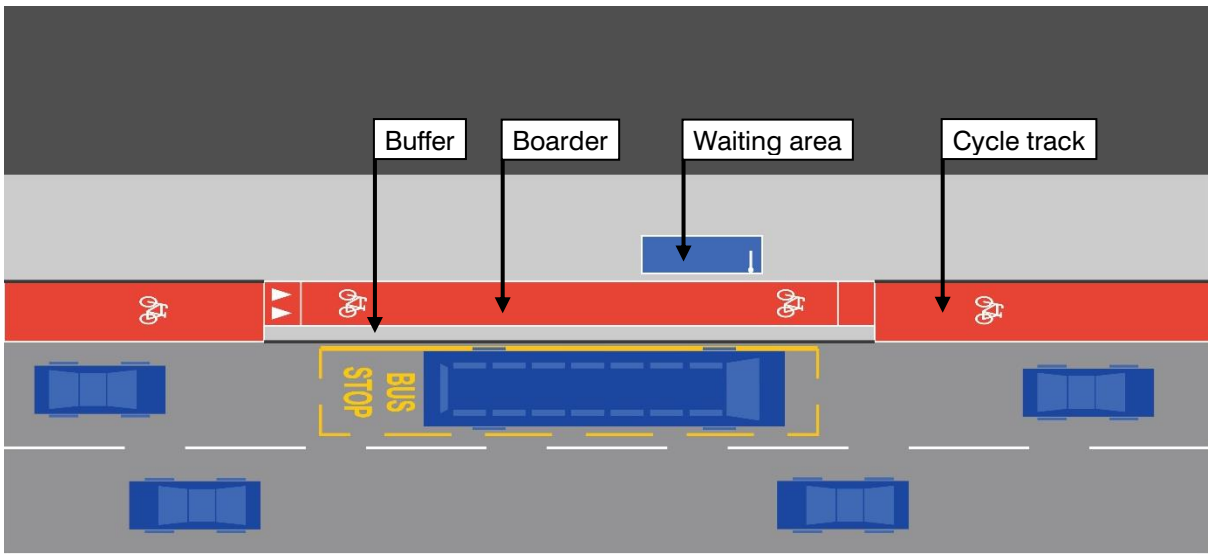


Figure 10 **Bus stop boarder with buffer - typical design layout**



Addendum, May 2023: This literature review was written at an early stage in the research. In the final report we adopt two new terms to avoid confusion over the term 'boarder'. These are "shared platform boarder" – to refer to the design shown in Figure 9 and Figure 10 (above) – and "continued kerbside track" – to refer to the design shown in Figure 4 (page 25).

Our expectation is that the wider adoption of these terms would make the key differences between these two basic designs clearer, and would also make clear the difference between these and the designs shown in Figure 5 and Figure 6 (page 26), which are not associated with a cycle track at all.

The clear naming of the different designs makes it easier to name and/or describe hybrid designs (which are common).

4 Design goals

The chapter addresses the key questions behind the design and implementation of bus stop bypasses and boarders:

- *Who are bus stop bypasses and boarders for?* – why are they used and who are they intended to benefit, including the question of 'who may be disadvantaged?'
- *Who has priority?* – how does the infrastructure tell us people walking and cycling should act? Should pedestrians yield to oncoming cyclists or vice-versa?
- *What are the usage considerations?* – when might a bus stop cycle intervention not be appropriate?

4.1 Who are bus stop bypasses and boarders for?

Improvements to active travel infrastructure are being rolled out across the country, encouraged by changes at national and local policy level, often aligned to sustainability agendas. Programmes such as English Local Cycling and Walking Infrastructure Plans and the Active Travel Network Maps in Wales are encouraging local authorities to develop plans for the improvement of active travel infrastructure in existing urban areas, and, combined with the recent pressure to improve cycling facilities as part of the Covid-19 social distancing response, are likely to lead to a significant increase in the points of interaction between cycle routes and bus routes.

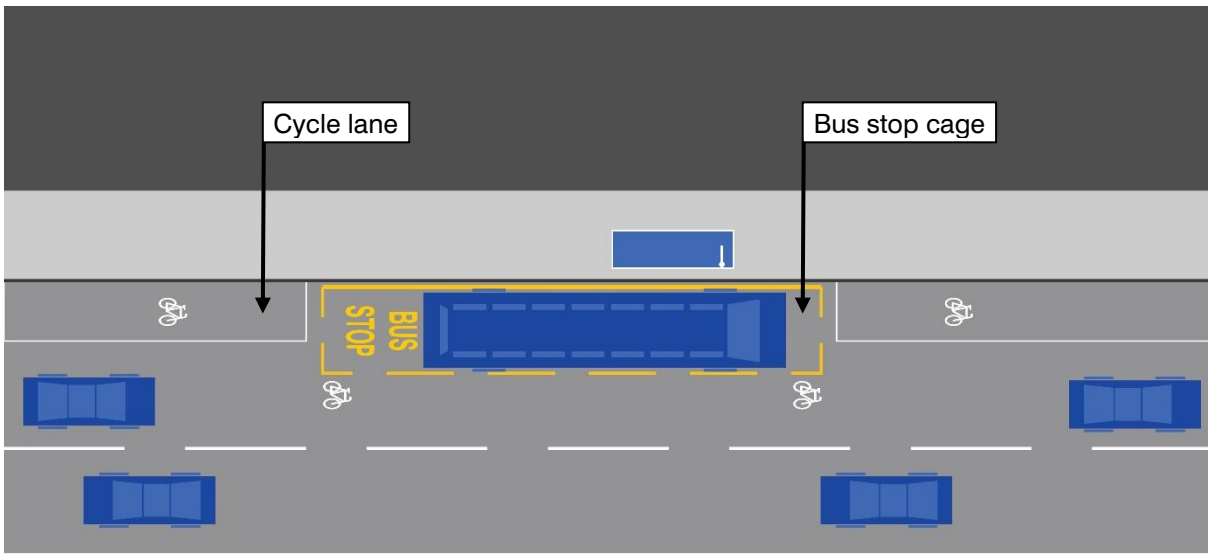
Bypasses and boarders are designed primarily to assist people cycling at bus stops. They allow people cycling to continue their journey, pass stationary buses and avoid conflict with buses and other vehicles on the carriageway. Depending on the design, they may also reduce conflict with pedestrians when compared to some of the design approached previously adopted. These types of infrastructure are relatively common in other parts of Europe, notably the Netherlands and Denmark.

At a standard bus stop (one without bus stop bypass or boarder), a bus will typically pull up to the footway kerb to allow passengers to board/alight at-grade. Prior to the development of bypasses and boarders, two designs have typically been used:

On-carriageway cycle routes
These are terminated upon reaching the bus stop cage, and restarted beyond the stop, with people cycling forced to either wait behind stationary buses or pull out

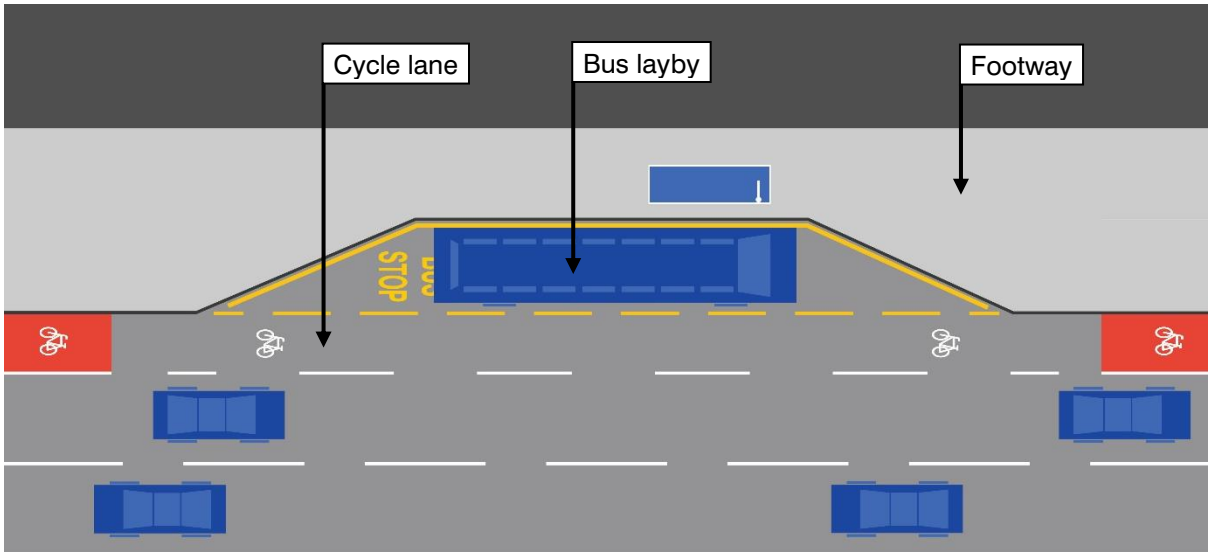
into the carriageway to pass, forcing them to mix with vehicular traffic. The cycle lane cannot be continued along the kerbside as buses would be unable to pull up to the kerb to allow passengers to board at-grade with the footway. An example is shown in Figure 11.

Figure 11 On-carriageway cycle route



Where the bus pulls into a layby the cycle lane may be continued parallel to the main carriageway, though there are several disadvantages. It requires a large amount of space, the bus can be delayed by waiting to re-join the traffic, and cyclists are at risk of being hit by manoeuvring buses. An example is shown in Figure 12.

Figure 12 On-carriage cycle route with layby



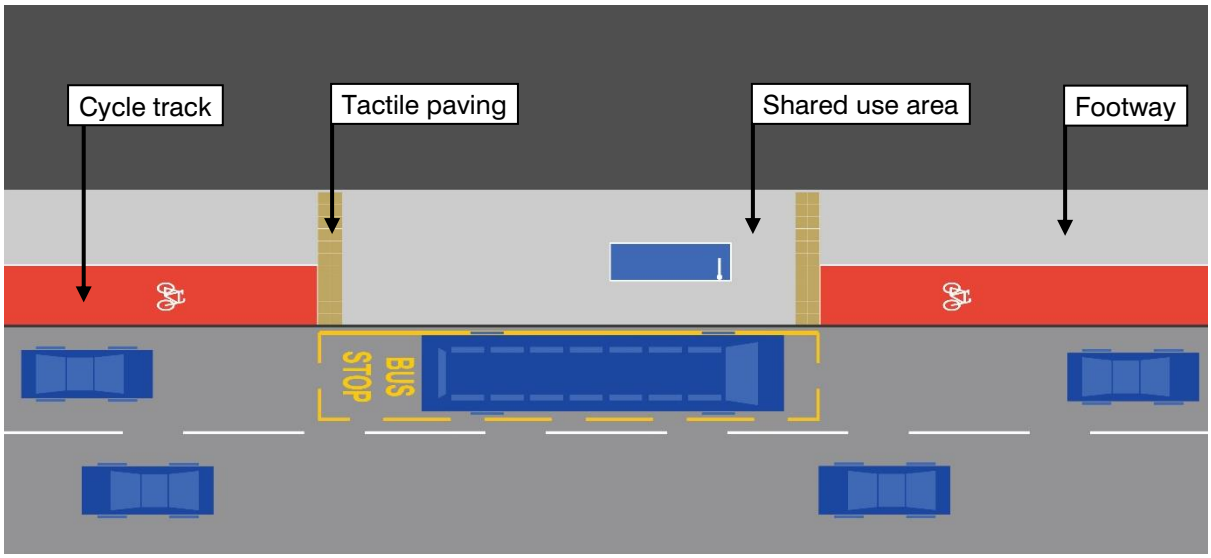
Off-carriageway cycle routes

The cycle track terminates at the bus stop area with cyclists continuing into a shared use area, with the cycle track re-starting beyond the bus stop. Shared use areas are

disliked by many pedestrians, as they can be difficult to navigate and involve a high level of unpredictability of pedestrian and cyclist movements due to the lack of clear route to follow. This design also lacks a clear waiting space for pedestrians – cyclists may pass around the front or back of the shelter. An example is shown in Figure 13.

This design is included in Cycling by Design as "cycle track at bus boarder" which states they should only be used on one-way tracks at bus stops with low service frequency [2].

Figure 13 Off-carriageway cycle route – shared use area



Choice of language used in definitions may inadvertently influence how a bypass is implemented and what the expectations for users are. This potentially frames whether bus stop bypasses and boarders are seen as a convenience for people cycling (potentially at the expense of pedestrians) or as a necessary safety feature to prevent cyclist conflict with buses and other vehicles.

Bus stop bypass

Bus stop bypasses are becoming increasingly common as part of long-term cycling improvement schemes. They are generally considered preferable over boarders but can be more difficult to install as they have a larger footprint and require more changes to the street layout.

Most guidance places an emphasis on use of bypasses to improve the safety of cyclists, avoiding conflict without need to pass stationary buses and potentially come into conflict with vehicles and buses pulling out from the stop. LTN 1/20 comments that "cyclists […] need a means of passing stationary buses and trams without having to come into conflict with faster vehicles on the carriageway" [1]. The Wales Active Travel guidance identifies the purpose as providing both 'safety' and 'comfort' for cyclists passing stationary buses [3] – this is an important change from

the 2014 guidance where the primary emphasis was on enabling people cycling to "maintain momentum and minimise delay" [12]. Similarly, Parkin notes that "the advantage of this arrangement is that cycle traffic does not have to perform a sometimes-difficult overtaking manoeuvre when there is a bus at a stop" [13]. Brighton and Hove Council states "the design is also intended to make cyclists feel safer and encourage those who may be less experienced or confident" [9]. The Greater Manchester Interim Design Guide notes the additional role of bus stop interventions in avoiding broader shared space around bus stops [14].

Somewhat in contrast, RNIB has referred to giving people cycling "an alternative way to overtake a bus that has pulled up at the stop, where the cyclist can choose to depart from the carriageway and follow a cycle track that loops over the pavement and around the back of the bus-stop" [15], placing an emphasis on choice and convenience rather than safety.

Reporting on the Oxford Road trials, TfGM noted that bypasses are "intended to allow cyclists to safely pass busy bus stops, separate from the main carriageway, encouraging more cyclists to use this key route". Despite the focus on cycle amenity, the study found that pedestrians rated the bus stop as easier to use than people cycling, and 5% of people cycling felt that the lane put both cyclists and pedestrians at risk [16].

TfL found that around 90% of people cycling chose to use the bypass rather than the main carriageway, although in these locations they were already approaching the bypass on off-carriageway cycle tracks mostly protected by a kerb [17]. If unable to re-join the carriageway, some more confident cyclists may feel disadvantaged by the infrastructure. TRL's study found most cyclists would be unlikely to use the bypass if a bus was not at the stop and would be unlikely to use it if there was little traffic on the carriageway (assuming an on-carriageway cycle route approaching the bypass) [6].

Bus stop boarder

Bus stop boarders have been used in some form for several years but have become particularly common since 2020 as part of active travel works associated with Covid-19 recovery schemes. Boarders offer advantages over bypasses as they can be installed more simply and easily within an existing street layout.

The Wales Active Travel guidance states that boarders enable people cycling "to continue across the bus boarder when it is clear or to cycle past pedestrians waiting at the bus stop", maintaining "route continuity" and eliminating "risk of conflict with buses". It also notes that the boarder provides step-free access for bus users [3].

LTN 1/20 notes that these arrangements are "not common" [14]. Similarly, Greater Manchester Combined Authority (GMCA) comments that this is "how the majority of bus stops are designed in Denmark, but it is uncommon in the UK currently", concluding that these interventions are not recommended for installation in Greater Manchester until the conclusion of TfGM's trials [14].

WHO MAY BE DISADVANTAGED?

The main group that may be disadvantaged by this infrastructure is pedestrians, including those boarding/alighting from buses and those passing along the street. Bus stop bypasses and boarders introduce a point of interaction between people walking and cycling which does not exist at a standard bus stop and add to the cognitive load[3] already faced by people moving down any street. Compared to most vehicles, people cycling are very quiet as they move and may be more difficult for pedestrians to detect, either while actively checking or passively, while engaged in other activities.

The literature suggests that disabled people can be amongst the most disadvantaged by these pieces of infrastructure. The Leicester Street Design Guide notes that disability groups have raised concerns about bypasses and that the council will "design to mitigate any potential disproportionate disadvantage to people with disabilities. We are considering options to increase the accessibility of bus stop bypasses and considering how we ensure that we promote sustainable modes of travel" [18].

Bus stop bypasses introduce a risk for bus passengers when they approach or leave the bus stop waiting areas, while eliminating conflict with people cycling immediately when boarding or alighting. There is potential conflict for other pedestrians who may inadvertently stray into the cycle track. A Danish study by Trafitec found that installation of cycle tracks on some of the busiest streets (for people walking and cycling) in Copenhagen resulted in a significant increase in incidents involving people cycling and boarding/alighting pedestrians at bus stops[4], rising from five incidents to 73. Prior to the installation, there was no formal off-carriageway provision for people cycling, who had to use the carriageway; this could explain the low level of interactions at the point of boarding [19].

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[3] *'Cognitive load'* refers to the amount of information that the brain's working memory can hold and manage at once. Having a large amount of information to deal with at once, such as in a busy street environment, can increase the cognitive load and make it difficult to consider other information about risks and threats.

[4] The study does not specify which design of bus stop has been studied. The city of Copenhagen includes typical boarder designs along with some hybrid designs that have a long narrow island or buffer. It should be noted that many bus stops in the city have a very simple design without contrasting surfaces and with little signage for either pedestrians or cyclists.

In contrast, boarders primarily concentrate potential conflict at the same moment of boarding or alighting from a bus. Responding to a study by TRL, Strathclyde Partnership for Transport commented that a boarder "would increase the risk of injury to passengers, particularly when they feel a sense of urgency in boarding or alighting from the bus, and so might be less likely to be aware of an approaching cyclist" [20]. There is potential for further conflict on the remainder of the boarder area, from pedestrians either following desire lines to the boarding point, or inadvertently straying onto the boarder. Edinburgh's guidance considers that "in cases where regular overspill of pedestrians onto the cycleway appears likely, the benefits of providing a protected cycleway must be balanced with the disadvantages of conflict at a floating bus stop" [8].

The majority of design guidance considers that bypasses are the preferable design option. The Waltham Forest Cycling Campaign express first preference for bus stop bypasses, followed by "bus stop islands" (a third bus stop type that lies between a bypass and a boarder with buffer area) and finally bus stop boarders, commenting that they are concerned about risk of conflict [10]. However, there are a couple of outliers with a preference for boarders. GMCA commented that boarders manage the potential conflict and severance better than bypasses [14] and TfGM has subsequently begun a study into safety and design of boarders. Parkin comments that boarders are "much more straightforward" than bypasses and "easier for partially-sighted people to navigate", with pedestrians taking priority when boarding and alighting, and cyclists passing along with ease at other times [13].

In an on-street study, TRL found that over 90% of people cycling passed through bypasses without interaction with pedestrians and the large majority of those interactions were of a low level [17]. TRL's off-street study found that the vast majority (98%) of interactions between people walking and cycling were minor with only 1% involving a participant changing direction and typically occurring at the dedicated crossing point. While people cycling reacted most strongly in nearly all lower-level interactions, serious interactions tended to require pedestrians to take action to yield to people cycling [6].

In TRL's video behaviour analysis, the factors judged to be important in higher-level interactions between people walking and cycling were pedestrian inattentiveness; local features that constrained pedestrian movements or reduced inter-visibility; crowding; and lack of space for manoeuvring [17].

Inclusivity is covered further in Chapter 6 Implications for inclusion.

4.2 Who has priority?

The key issue for design of bus stop bypasses and boarders, particularly at crossings but also along the wider bus stop area, is the issue of user priority – does anyone have absolute defined priority? Who must stop for who, people walking or people cycling? How is it indicated and where does it apply to – at the crossing point or in the whole cycle track? How are people walking and cycling expected to act?

There was general agreement in the literature (amongst those stakeholders questioned) that pedestrians should have clear priority expressed through legislation and the design of the infrastructure. Many stakeholders wanted this 'priority' to extend to cyclists being required to stop for pedestrians waiting to cross, rather than being limited to those already crossing. As noted in Annex A, the relationship between road users is not necessarily fixed and could be negotiated and influenced by social context. However, the challenge for designers is to move beyond the ambiguity of visual communication to create infrastructure which can communicate the desired priority and dictate the appropriate road user behaviour.

This issue has developed further since the 2022 update to the Highway Code, which established a 'hierarchy of users' (Rule H1) placing a responsibility on people cycling to reduce danger to pedestrians and noting that some people "may have impaired sight, hearing or mobility". Rule H2 emphasises that "You MUST give way to pedestrians on a zebra crossing, and to pedestrians and cyclists on a parallel crossing (see Rule 195)", indicating that this is a legal requirement, with additional advisory wording stating that pedestrians have priority when on a zebra crossing and that "you should give way to pedestrians waiting to cross a zebra crossing". The Highway Code changes are discussed further in Chapter 8. All the studies and reports referenced in this literature review date from before these legislative changes so should be read with this in mind. There remains a need for waiting pedestrians to feel confident in their ability to start to cross and establish their priority.

In Denmark, issues of priority and yielding at bus stops are clear. The national traffic act, *Færdselsloven*, (Chapter 2, Section 27, point 4) [21] states that at bus stops where passengers board or alight the bus onto an area not specifically designed for them (i.e. a boarder), people cycling must yield and, if necessary, stop for pedestrians. Where pedestrians are crossing a cycle track, as at bypasses, they do not have priority and should use a crossing if provided (Chapter 3, Section 10, Points 1-5) but cyclists approaching a uncontrolled pedestrian crossing must be alert and adjust their speed so there is no danger or inconvenience to people who

are crossing or about to cross, and must yield at a signalised crossing when instructed to do so (Chapter 4, Section 27, Points 6 and 7).

Bus stop bypasses

Design guidance shows a range of perspectives on priority, perhaps based on their age relative to the emerging (and now adopted) Highway Code changes. Cycling by Design is clear that "pedestrians should have priority over cycle users" [2]. The West Midlands guidance muddies the water slightly by stating "cyclists are usually expected to give way to pedestrians" [22] and other guidance avoids mentioning this issue entirely. RNIB has noted that the Highway Code review hierarchy puts pedestrians above people cycling but that there is no mention of priority at bus stop interventions, further noting that many blind and partially sighted people are unable to rely on their own ability to see cyclists approaching in order to safely negotiate this priority issue [23]. Strathclyde Partnership for Transport has commented in a TRL study that designs should "alert cyclists to the fact that bus passengers have priority at the junction" [20].

Meanwhile, TRL's off-street trial found that a greater proportion of people, both walking and cycling, assumed there was pedestrian priority at a crossing compared to along the remainder of the bypass cycle track. However, most cyclists felt they had priority in the bypass cycle track – a view not shared by most pedestrians. The proportion of pedestrians feeling they should have priority was double that of what they experienced on-site [6]. Based on a bypass design with a zebra crossing, TfL noted that people cycling should be "encouraged to act courteously, slowing down on the approach to a crossing and giving way as necessary" – the raised table (ramp) crossing is cited as a way of reducing cyclist speed [5].

TfGM's trial found that lack of clarity on priority was the major issue at the bypass, with pedestrians causing confusion by crossing the cycle lane at any point. Only 51% of people cycling and 71% of bus users were satisfied that priority was clear. Stakeholders suggested that signage is needed to indicate who has priority at crossings and elsewhere [16].

Bus stop boarders

Although this may depend on the specific designs used, bus stop boarders can intentionally introduce a space which feels to be shared, being equally for both cycling and pedestrians. It is this element of ambiguity that some stakeholders, including RNIB, object to (this is covered further in Chapter 7 Implications for inclusion) [15]. Camden Council's design guide states that "the priority user in this short section of raised paving changes depending on whether a bus is present or not", with the boarder acting as shared space and people cycling expected to look out for people getting off the bus, based on the Highway Code. Furthermore, Camden Council states that "the design of the [boarder] must convey this change in

priority, to allow both sets of users to understand when to give way, and when to take priority", however, there is no specific guidance on how to achieve this [24].

LTN 1/20 and the Wales Active Travel guidance comments make similar comments about a need for good intervisibility between people walking and cycling, to minimise potential for conflict. The bus stop must also be apparent to people cycling to allow them to adjust their behaviour and speed accordingly [1] [3].

Priority is discussed further in Chapters 5 and 6, with specific regard to crossing point design and additional aids.

4.3 What are the usage considerations?

Bus stops sit as part of their environs, not as a stand-alone feature. Several design guides list considerations of whether a bus stop bypass or boarder is appropriate at a given location, including:

- Activities occurring in the vicinity of the bus stop.
- Volumes of people walking and cycling past the bus stop, numbers using the bus stop, and volumes of traffic on the carriageway.
- Physical space available for the bus stop bypass /boarder.
- The type of cycle route passing the bus stop (on-/ off-carriageway and direction of travel).
- Gradient along the cycle route.

BUS STOP BYPASSES

The Wales Active Travel Act Guidance considers that "the suitability of [bus stop bypasses] is dependent on the available space, bus frequency and passenger volume and the number of pedestrians using the footway" [3]. Similarly, Strathclyde Partnership for Transport has identified four conditions that determine the extent of risk of conflict between people walking and cycling: passenger flows; cycle flows; number of bus services using the stop; and whether the cycle track is uni- or bi-directional [20].

Modal traffic flows and urban environment

In TRL's off-street trials, pedestrians felt that increases to cycle or pedestrian flows adversely affected their safety, and that they may be put off using the bus service under higher cycle-flow scenarios, due to a perception of lower safety. Changes to pedestrian and cycle flows had different impacts on cycle time and crossing behaviour depending on the type of crossing point used [6].

AECOM and TRI's studies concluded that overcrowding contributed to pedestrians walking in the cycle track, and thus to interactions, with some pedestrians perhaps

not aware that they had stepped into a cycle lane due to crowds present. The studies considered that being part of a larger group may also increase pedestrian confidence and reduce their propensity to check for people cycling [25] [26].

Edinburgh's guidance cautions use where there may be regular overspill of pedestrians into the cycleway, but concludes that 'floating bus stops' are the preferred option for locations with high passenger numbers [8].

Cycling by Design notes that bypasses may not be appropriate in locations likely to generate a high number of bus users, including in the immediate vicinity of schools and public facilities, instead recommending that conflict is 'designed out' or addressed at a network planning level, avoiding having both bus and cycle routes on the same street. It notes that the alternative bus stop types could be used where bus frequency is low (and therefore people cycling are unlikely to be affected on the carriageway), or where there are very high numbers of bus passengers with low cycle user numbers [2]. Edinburgh's guidance notes that 'careful consideration' should be given at locations close to land uses with larger than normal numbers of vulnerable users (e.g. schools, sheltered housing) [8]. In Cambridge, Sustrans found that more interactions occurred during PM peak when school students were overcrowding the bus stop, with many straying into the cycle lane [27][5].

TRL's video analysis found that neither 'congestion' on the cycle track or presence of a bus at the bus stop altered cyclists' route choice (whether to use the bypass or continue on the carriageway). The study also found that cyclists' speed was not correlated to the level of interaction with pedestrians. TRL found that some sites had more higher-level interactions between people walking and cycling than others, hypothesising that this was related to more pedestrians loitering or walking near the cycle track [17].

GMCA's guidance includes a low-end threshold, using a standard bus stop where traffic flows are 'sufficiently low' to share the carriageway [14]. TfWM suggest an alternative for quiet roads with cycle lanes where people cycling can stay on-carriageway and only use the bypass if a bus is present [22].

At present, the majority of studies of bypasses have looked at relatively busy urban environments in London, Manchester and Edinburgh; the Brighton study is an outlier, looking at stops along a road which, while busy for traffic, has less built development and footfall immediately in the vicinity of the bus stops and may have lower cyclist flows (this figure is not stated in the report). It is unclear whether this different urban environment could have an impact on how people use and

[5] In these locations, the cycle track is coloured red to contrast with the footway. The crossing matches the footway and is marked with a zebra.

understand the stops and whether the regular presence of people cycling is important in signalling presence of the cycle track.

Operation of the bus stop could have an impact on the likelihood of interactions between people walking and cycling. A Danish study by Trafitec noted considered that it was important for the bus to be able to stop and start from the bus stop quickly and easily to minimise time when people cycling may be interacting with passengers. It noted that including chicanes (with four changes of direction) resulted in a very marginal increase of travel time for each cyclist of 0.8 seconds, though it extrapolated this across a longer time period, resulting in an additional 800 seconds of potential interaction time per day (for a route with 1000 people cycling past per day) or approx. 80 hours per year [11].

A factor not addressed by the literature is whether low frequency of bus service could impact on pedestrian behaviours on approach to the stop. It could be theorised that pedestrians are more likely to rush for the bus or take more direct routes at locations where service frequency is low and thus wait times between buses are longer. Relatedly, it could be theorised that this could be associated with a lower level of attention paid to their surroundings, including the cycle track, and with an increase of pedestrians displaying unexpected behaviours.

Adjacent bus stops

There is little advice on what to do in circumstances where there are multiple bus stops close together: should multiple stops be linked with a single bypass island? Cycling by Design refers to either creating isolated bypasses at single bus stops or the potential to link stops to crossing locations or other amenities within a single island [2]. Presumably, this could include linking multiple nearby bus stops. TfGM's Oxford Road study included a continuous bypass serving two adjacent stops with crossing points at either end, and a third crossing located between the stops [16].

Physical space requirements

There is little discussion in the literature of the physical space required to accommodate a bypass. While advised widths may be given for the island, footway and cycle track, this is clearly a wider space than is available in most streets and there is little discussion on how a bypass could be accommodated. Camden Council note that "the minimum width requirements […] means this design can rarely be implemented in a London street context" [24]; in the template diagram, space is gained by narrowing the cycle track and footway space.

Cycling by Design does, however, provide advice on how to deal with this: "This layout will require additional space to accommodate the bus stop island, cycle track and footway. It is desirable to reallocate space from the road carriageway rather than the footway when providing bus stop bypasses". This approach requires a

much more widespread change to space allocation along the full street [2]. Both Cycling by Design[6] and the Edinburgh guidance provide alternative bus stop types noted for use where there is insufficient space for a bypass.

On- and off-carriageway routes

As previously noted, bypasses are shown as part of both on- and off-carriageway cycle routes. The Wales Active Travel guidance allows for all eventualities by noting these features can be used "in conjunction with cycle lanes, cycle lanes with light separation, stepped cycle tracks and separated off-carriageway tracks" [3]. Similarly, TfL's definition allows for both lane and track routes [5].

In contrast, TRL has defined bypasses as involving "a cycle lane being taken away from the carriageway and behind a bus stop" [6], not specifically including for routes that were already off-carriageway. LTN 1/20 also specifically refers to "removing cyclists from the carriageway", potentially implying they were previously using a cycle lane [1]. Cycling by Design provides guidance on transitioning from cycle lane to track, with a minimum of 10m inward transition and 20m outward beyond the bus cage [2].

It seems reasonable to conclude that the type of route may have implications for design at the bus stop, particularly delineation of the track, however none of the literature discusses how this may influence either cyclist or pedestrian behaviours.

Uni- and bi-directional tracks

Much of the guidance assumes a uni-directional cycle track and shows only one scenario, though Cycling by Design includes designs for both uni- and bi-directional tracks; these layouts are notably different, with the bi-directional route lacking a chicane and including an extended, continuous island to improve visibility and orientation at crossing points. The Edinburgh guidance considers that bypasses are the most suitable bus stop type for bi-directional routes but notes that inter-visibility of people walking and cycling should be carefully considered [8].

TRL's on-street study noted that more people cycling changed behaviour on (compact and chicaned) uni-directional sites than at (wider, straight) bi-directional sites, but the bi-directional sites had the lowest numbers of interactions [6] – exactly which of the variables caused this behaviour is unclear. In the off-street trials, pedestrians were more likely to use crossings where people cycling were approaching from behind them [6].

[6] Cycling by Design identifies four design options: Bus stop bypass (with island or continuous island); Cycle track at bus boarder; Cycle lane across inset bus box; Cycle lane across in-line bus box. [2]

AECOM's study at Leith Walk found that relative direction of travel between people walking and cycling (on a uni-directional track) had an impact on frequency and severity of interactions, with rates being higher when both users were travelling in the same direction.

Route gradient

Cycling by Design identifies steep downhill gradients as unsuitable sites for bypasses though the Edinburgh guidance considers them to perform better than boarders and shared use scenarios on downhill gradients [8]. AECOM's study found that people cycling were less likely to use the downhill track (46% to 69%) compared to the uphill cycle track (67-80%) concluding that there was a lower speed difference between vehicles and people cycling, and that those cycling would not need to regulate their speed to avoid conflict with pedestrians. [25]

BUS STOP BOARDERS

The majority of guidance considers that bypasses are the preferable design option, with boarders typically given as an option in locations where there is insufficient width for a bypass [3] [24]. Camden Council notes that boarders "do not take any space away from the existing footway, but instead 'borrow' space from the existing carriageway" [24]. Published guidance shows boarders which extend for the length of the bus stop cage, however some built schemes have a smaller footprint, similar in width to the shelter footprint.

Both Welsh Government and LTN 1/20 advise that boarders are best suited to stops with less frequent services and lower passenger and pedestrian volumes [3].

The Wales Active Travel guidance considers that this design can be considered in conjunction with cycle lanes, light separation or one-way stepped cycle tracks [3].

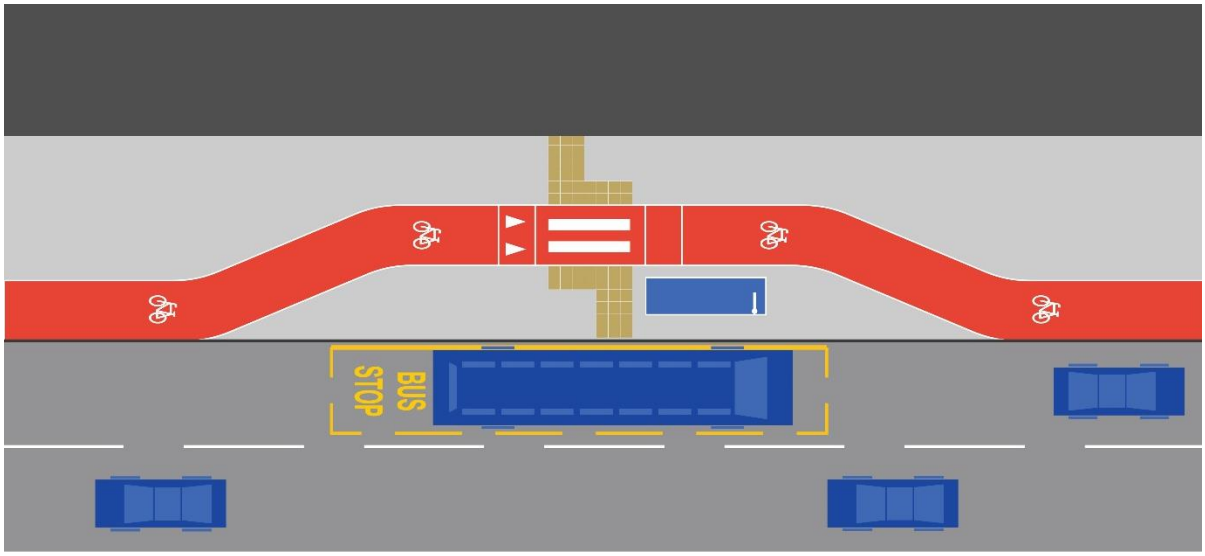
The Waltham Forest Cycling Campaign comment that boarders are "particularly unsatisfactory for stops with larger numbers of bus passengers embarking or alighting a particular bus, or with high pedestrian volumes along narrower footways, due to waiting users blocking the cycle track, or passing pedestrians overflowing onto the track." [10].

5 Physical design features and factors – bus stop bypass

This chapter looks at the design of physical features created as part of the bus stop bypass. It compares the standards set out in a range of design guidance literature and includes relevant design commentary from studies.

The literature review highlights a significant range in the design of bus stops. In many cases the design guidance is not explicit about the rationale behind individual design features and criteria, meaning this can only be inferred.

Figure 14 Bus stop bypass - typical design



A range of design features are included in design guidance or have been investigated through research studies. Some guidance explicitly comments on these features in relation to bus stop bypasses, while for others it can be assumed that the principles set in relation to the wider cycle network will apply, for example, minimum cycle track widths or differentiation of pedestrian and cycle spaces. These variables can be categorised as:

- Footway width and design
- Island design
- Cycle track design
- Crossing features
- Control and priority measures.

Sustrans note that “Temporary proposals should aim to achieve a layout that is intuitive and easily understood by all users, especially those with mobility and/or

visual impairments" [28]. This same principle can be applied to permanent schemes also.

None of the design guidance shows a layout where the bus pulls into a layby / bay although there are many examples where this approach has been used in combination with a bypass.

CONSISTENCY AND CONSULTATION

Both the TfL Accessible Bus Stop Design Guidance [5] and TRL's studies [29] [30] note that there is a need for greater consistency in design, with TfL allowing for location-specific dimensions and other design details. The Wales Active Travel guidance goes further in classifying bypasses ('island bus stops') as "Standard details: Details that are well understood and should be applied as shown unless there are particular reasons for local variation", however it does note that "the drawings and images are illustrative and will not cover all circumstances" and should be applied to fit local context [3].

Typically, the published design guidance notes a desired outcome but does not outline a range of appropriate options or exemptions for achieving these goals. TfL's guidance note goes further than most by commenting that "although it is accepted that site-specific constraints may require different solutions, the principle of legibility should continue to guide the adaptations that designers make to the standard layout". A series of allowable exemptions are outlined [16].

A number of sources, including Cycling by Design [2], TfL [5] and LTN 1/20 [1], note a need for early engagement with potential users, particularly disabled people who report significant concerns about this infrastructure. There is potential that engagement could lead to deviation from standardised designs, compromising consistency and familiarity - this would need to be carefully managed to avoid confusion for users. TfL emphasises the need for a Road Safety Audit [5] for any designed facility.

5.1 Footway

While most guidance does not explicitly state that the footway should continue behind the bus stop area, some documents state minimum footway widths.

Table 5 Bypass footway width

Guidance document	Spatial requirement: Footway width
Cycling by Design 2021	Defined in general guidance. Desirable minimum width: 2.0m Absolute minimum width: 1.5m
LTN 1/20	2-3m behind the bus stop
Edinburgh Street Design Guidance	Low pedestrian flow: 2m High pedestrian flow: 3m+ Both with an additional distance of shelter width plus 0.5m required if the shelter is positioned on the footway.
TfL Accessible Bus Stop Design Guidance	Minimum pedestrian level of service while noting a need for wider footways near cashpoints
Camden Council guidance	Minimum footway width of ~2.5m

5.2 Island design

Dimensions

The basic layout of the bus stop area is one of the key features covered by existing guidelines. TRL hypothesise that island width could influence how people use the area and cross [6]. TfL note that wider islands may be required "where significant bus passenger activity is observed" [5].

Following stakeholder feedback, a bypass in Cambridge was amended to increase the island from 1.5m to 2m width [20]. The TfGM study used a 3m wide island – 7% of bus user were dissatisfied with the width. In an off-street study, TRL looked at the maximum and effective pedestrian capacity of bus stop islands, with a formula for these calculations. The study also looked at queuing behaviours, noting that formalised queuing broke down after around 33 passengers [6].

While width of island is specified in many guides (see Table 6 Bypass island design), length is not stated. Some diagrams (including Cycling by Design, LTN 1/20 and Wales guidance) show a bypass where the whole island including chicanes is approximately the length of the bus box, while for others (including TfL, Edinburgh and Camden guidance) the bus box is more akin to the length of the

area excluding the chicanes. This difference affects a) how close the chicanes are to each other and to the crossing point and b) how quickly in succession a cyclist will have to deal with these features. It is unclear if this affects safety and useability for people walking and cycling.

Table 6 Bypass island design

Guidance document	Spatial requirement: Island width
Cycling by Design 2021	'Desirable boarding area': 2m x 2m with an additional 0.5m between the boarding area/ shelter and cycle track. Min. 1.3m between shelter and carriageway to allow for circulation
Wales Active Travel Act Guidance	Desirable minimum width: 2.0m Absolute minimum width: 1.0m
Edinburgh Street Design Guidance	*If shelter on island:* Shelter width + 0.5m setback to the front and rear. Min 2.2m with cantilevered bus shelter. *If shelter on footway:* desirable minimum 2m, absolute minimum 1.5m.
LTN 1/20	Minimum 2.5m wide
TfL Accessible Bus Stop Design Guidance	Minimum 2.5m wide
Camden Council guidance	Minimum 2.5m wide

Island layout and visibility

TfL's guidance makes explicit reference to the positioning of the bus stop flag, with the crossing point shown upstream of the flag and the shelter downstream, as per typical boarding on the TfL network[7] [5]. In contrast, Cycling by Design shows a "desirable boarding area" upstream of the flag and downstream of shelter [2], with the upstream crossing providing access to the boarding area without needing to pass the shelter. Other guidance does not define locations for boarding areas or

[7] On the TfL network, the bus pulls up with the rear of the front doors aligned with the flag. Passengers typically wait and board the bus downstream of the flag (on the left of the flag as when approaching the bus), and alight upstream. In other locations, buses typically may up in line with, or beyond, the downstream end of the shelter.

flags, potentially leading to user conflicts or difficulty for wheelchair and pushchair users to navigate past a shelter to move between crossing and boarding point.

Location and design of the bus stop infrastructure and other street furniture is an important consideration to ensure manoeuvring space for all users and good inter-visibility between users, specifically cyclists and bus passengers but also visibility for cyclists re-joining the main carriageway and passengers looking out for the bus [5] [20]. LTN 1/20 notes that "good intervisibility is required between pedestrians […] and cyclists. This minimises the potential for conflict and the stop should be apparent to cyclists, who will need to be able to adjust their behaviour and speed, particularly when a bus is at the stop" [1]. The Edinburgh guidance notes the specific need for good inter-visibility on bi-directional routes, noting a need to consider the design and placement of shelters and the use of advertising on end panels [8]. Guidance literature does not comment on the design or orientation of bus shelters, although this may be covered in supplementary guidance. It is known from existing real-world examples that this can vary but it is not clear if this could affect how people walking and cycling interact[8].

Cycling by Design identifies visibility zones for cyclists approaching crossings and notes that "care is needed to ensure that street furniture, bus stop advertising panels or other objects do not obstruct this visibility" [2]. The feedback from TRL's accompanied visits was that there is a need for a reduction in clutter that blocks sightlines and makes it harder for all users to locate the stop [29]. TfGM's study found that pedestrians liked the ability to move freely while people cycling appreciated some barriers to control pedestrian movement. The study concluded that street furniture could be positioned to deter pedestrians from inadvertently walking into the carriageway off the island. Guardrailing was felt to be potentially hazardous as it could trap pedestrians in the bypass track [16].

Looking at a range of bus stop designs including one that resembles a bypass/boarder hybrid[9], a Danish study by Trafitec identified that a small number of accidents recorded had occurred when people cycling had stopped or braked for boarding/alighting passengers and were hit from behind by other cyclists. Potentially, this risk can be lessened if people cycling have greater visibility of the crossing area and are more aware of when people cycling ahead of them may stop. The study comments that street furniture should be placed at least 0.5m back from the kerb and 0.3m from the cycle path [11].

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[8] Design could include length/width of shelter, enclosed shelter with offset entry/exit versus open-sided shelter, number of sides, advertising panels, seating, and orientation towards/away from the kerb.

[9] "Fremrykket stoppested med busperron og langstrakt midterhelle" – translated by Google Translate as "Advanced stop with bus platform and elongated center slab".

Following accompanied visits to the sites with disabled people, TRL found a variety of preferences related to physical feature. Wheelchair users were sometimes constrained in their manoeuvrability by the size of the bus stop island or were hindered by tactile paving, with some fear of dropping into the cycle track from the kerb. Blind and partially sighted people found difficulties understanding the layout and finding the bus stop flag [29].

5.3 Cycle track at bypass

Track width and geometry

Width of track is a basic dimension identified in most guidance, with some providing basic dimensions while others provide more nuance to allow for different usage situations. None of the literature reviewed discussed maximum widths.

Cycling by Design 2021 notes that "the cycle track width should desirably be maintained at the same width as the approaching cycle track or lane, but may be reduced locally to absolute minimum widths throughout the bus stop bypass if the approaching width is greater" [2]. Wheels for Wellbeing [31] and TfL [5] both note the importance of considering wider and heavier cycles when determining cycle track design.

TfGM's study noted a need to prevent road traffic from stopping or parking in front of the entry to the bypass [16] – this issue will only affect certain types of cycle infrastructure.

Stated minimum widths are listed in Table 7 - where widths are not explicitly noted at bypasses but are defined in the wider principles, these are marked with an asterisk.

Table 7 Bypass cycle track width

Guidance document	Spatial requirement: Cycle track width
Cycling by Design 2021	*Uni-directional routes:* < 300 cycles per hour: min. 2m >300 cycles per hour: min. 2.5m *Bi-directional routes:* < 300 cycles per hour: min. 3m > 300 cycles per hour: min. 4m
Local Transport Note 1/20	Desirable minimum; absolute minimum: *Uni-directional routes:* < 200 cycles per hour: 2m; 1.5m 200-800 cycles per hour: 2.2m; 2m > 800 cycles per hour: 2.5m; 2m *Bi-directional routes:* < 200 cycles per hour: 3m; 2.5m 200-800 cycles per hour: 3m; 2.5m > 800 cycles per hour: 4m; 3m
Wales Active Travel Act Guidance	Desirable minimum: 2m. Absolute minimum: 1.5m
Edinburgh Street Design Guidance	*Uni-directional routes:* Desirable minimum: 1.5m. Absolute minimum: 1.2m *Bi-directional routes:* Desirable minimum: 2.5m. Absolute minimum: 2m
TfL Accessible Bus Stop Design Guidance	Minimum width: 1.5m
Camden Council guidance	Minimum width: 1.5m
Leicester Street Design Guide	Desirable minimum: 2m. Absolute minimum: 1.5m

Chicane

Current design guidance tends to show layouts with a chicane in the cycle track: cyclist approach the bypass on a cycle track immediately adjacent to the kerb (either on- or off-carriageway), which then diverts away from the kerb, continues

parallel to the kerb behind the waiting area, and returns back to the kerbside. This chicane creates space for the waiting and boarding 'island' without affecting the layout of the street either side.

LTN 1/20 (repeated in the GMCA guidance), the Wales Active Travel guidance and Leicester's guidance state minimum entry and exit tapers of 1:10, though the diagrams look considerable tighter than this. Edinburgh's guidance states a minimum taper of 1:3, while Camden's guidance has a 6m long taper and TfL has 5-10m long taper (both measured parallel to the kerb not in the direction of travel). The uni-directional layout in Cycling by Design 2021 has more curved chicanes [2]; this is an evolution of the layout in the previous guidance which had a continuous arc around the whole bus stop area [32]. The bi-directional layout does not have a chicane but resembles the basic layout used by the bi-directional bypasses in the TRL studies (Blackfriars sites) [17].

Wheels for Wellbeing notes that tight corner radii may have an impact on use by non-standard cycles [31]. TRL note that effectiveness of the bypass could vary with different angles of entry and exit to the bus stop area but did not test this as part of the off-street study – the study used a 10m long taper [6].

Delineation and differentiation of cycle track

Delineation of the track marks it out as a space that is different from the footway and may have different priorities and risks. There is a need for both visual distinction and physical detection and could include other more ethereal characteristics that help to mark a space out as something different. Parkin comments that "a solution where the impression that cycle traffic and pedestrians are sharing the space is far less effective for cycle traffic than a solution where the cycle track and footway are clearly delineated" [13]. Although delineation is an important issue along the full cycle track, including areas well away from bus stops, it is more important at bus stops so that people are aware of the existence of the track when moving towards or away from the carriageway.

There is a clear preference for well-defined cycle tracks. LTN 1/20 notes that "cycle tracks and footways should be designed to be perceived as wholly separate facilities, even if they are at the same level and alongside one" [1]. Sustrans' factsheet for temporary active travel features notes that "Signs, markings and materials should be carefully considered to ensure visual clarity between pedestrian only, pedestrian priority and cycle routes and assist in reinforcing ideal operation/behaviours" [28].

Across the literature, several methods of delineation are identified, though typically, the guidance either does not specifically comment on differentiation at the bus stop area or shows a bypass cycle track design that continues the appearance and form

of the track away from the bus stop area, and it can be assumed that any general guidance on delineation applies. LTN 1/20 notes that the use of contrasting materials, in colour and texture, is useful to highlight the track [1], while TfL similarly note that "Visual contrast, ideally 50 per cent difference" should be provided between the crossing and footway with the cycle track [5]. The Edinburgh guidance considers it appropriate to continue the contrasting appearance (red-chipped asphalt) of the rest of the cycleway [8].

LTN 1/20 and the Wales Active Travel guidance use level differentiation (implied by inclusion of a ramp at the crossing) but are not specific about kerb height, kerb type or general visual appearance[10] [3]. LTN 1/20 shows a similar arrangement and notes that the use of contrasting materials, in colour and texture, is useful to highlight the track [1]. Referring to cycle tracks in general, Cycling by Design notes the role of tonal contrast in assisting partially sighted pedestrians to navigate spaces [2]

Delineation is a clear issue for many disabled people, with height difference between cycle track and footway considered to be an important factor. RNIB and Guide Dogs comment that full kerbs are required to allow blind and partially-sighted people and guide dogs to detect the cycle track [20] [33], with RNIB noting that bus stop bypasses are "often installed without detectable kerbs or accessible crossing facilities" [34]. Cycling by Design notes that the track should be at a lower level than the footway and island, "with a level difference of at least 60mm" [2], while TfL states either a 50mm level difference or use of a raised delineator strip (TSRGD diagram 1049.1) [35]. Wheels for Wellbeing note that kerbs need to be chamfered so they are 'forgiving' for all cycle types [31].

TfGM's study found that cyclists, bus users and pedestrians were generally in agreement (over 91% of each group) that segregation was "positive and effective" and the cycle track was clearly marked - these trial bus stops had a kerb edge and cycle track that visually contrasted with the footway. The kerb edge and recessed bypass lane were felt to improve awareness of the cycle track. The installed green LEDs were noted as a positive measure to improve visibility and stakeholders supported amending the design to include red LEDs at crossings [16].

Unlike most guidance and study locations, the Leith Walk bypasses[11] studied by AECOM have cycle tracks at footway-level, marked by a single row of corduroy paving either side. AECOM's study found that pedestrians were using the cycle track of an extension of the pavement and that, particularly at times of overcrowding, some alighting passengers may not be aware they were stepping

[10] The Guidance does not require colour or tonal contrast for other cycle lanes and tracks, apart from at side road junctions due to highlight an area of potential conflict with vehicles.

[11] These have since been replaced as part of a bigger scheme.

into a cycle track [25]; this finding was supported by TRL's off-street trials [6]. AECOM considered that this could be lessened by increasing pedestrians' awareness of the bus stop design and introducing various measures to make the cycle track more visible.

Speed calming measures

Multiple sources refer to cycle slowing measures to aid passenger crossing and improve safety. TfL note that any physical slowing measures need to be designed to accommodate non-standard cycles [5]. Guidance from TfL and Cycling by Design refers to 'encouraging' people cycling to slow on approach to the crossing, while others, including disability charities, take a more direct approach, referring to a need for measures to enforce slowing and/or stopping [20]. This can be achieved by cycle track narrowing, both visually, through use of hatched markings (as noted by Cycling by Design [2]) and physically (as noted by several sources including TfL [5] and Cycling by Design [2]). Sustrans also note a role for visual narrowing to control speeds without reducing effective width [28].

Ramped crossing areas are typically included in guidance to cause slowing by vertical deflection (and provide a level crossing point) [3]. Ramps are suggested as an option by Guide Dogs [33]. Other deflection measures ('speed bumps') are not included, however TfL includes sinusoidal speed humps and P2W speed deterrent humps in its general standards [36].

Rumble strips are noted as potential measures in TfL's LCDS [36], Cycling by Design [2] and the TfGM study [16]. Several documents including Cycling by Design and the Edinburgh guidance include 'SLOW' ground markings on the cycle track [2] [8].

A Danish study by Trafitec found that chicanes in the cycle track resulted in slightly longer journey times for people cycling but this was very marginal. Each change in direction equated to a slowing by 2km/h on a 10m stretch, an additional 0.2 seconds, so a typical bypass with four turns would extend journey times by only 0.8 seconds [11]. There was no mention in the literature of chicanes being installed specifically to slow cyclists.

5.4 Crossing features

While pedestrians will naturally follow desire lines, the complex environment of a bypass suggests a need for some level of consistency of crossing point. All the guidance and studies reviewed assume the provision of some form of crossing point, from simple dropped kerbs to a formal Zebra crossing. Parkin notes that "the risks associated with conflict between pedestrians and cyclists are minimised if it is

clear where pedestrians are expected to cross the cycle track which should be treated as though it were a carriageway" [13] though Rule H2 of the updated Highway Code notes that "pedestrians may use any part of the road and use cycle tracks as well as the pavement" [37] allowing them to choose where to cross. There remains a need for waiting pedestrians to feel confident in their ability to start to cross and establish their priority, and a need for physical infrastructure to assist with this.

Most guidance shows a single crossing point located in the centre of the bypass track while TfL note that long bypasses with high usage may need multiple crossing points [5]; it could be inferred that a single crossing is typically included to reduce interruption to cycle movement and potentially improve adherence to the 'rules' of the bypass. Cycling by Design includes, as standard, two crossing points at each bypass, located on the chamfered edges of the island to meet pedestrian desire lines [2]. The Edinburgh guidance notes that crossings should be on desire lines, but places these perpendicular to the footway, along the back edge of the island. The diagram shows multiple crossings and two shelters but there no guidance in the text on how many should be used [8]. As yet, none of the studies have compared safety and effectiveness of two crossing points versus one.

A basic consideration is "the ability of anyone with a visual, hearing, mobility or cognitive impairment to find the crossing point and to reach the island and then find the bus stop from the island" [5]. Tactile paving is included in all guidance, with addition of a tail across the footway. TRL found that Blind and partially sighted people and wheelchair users were more likely than non-disabled pedestrians to use the designated crossing [6], with around half of disabled participants using the designated crossing point every time, particularly wheelchair users and those with sight loss [17].

While provision of a crossing point is a positive aspect, the design and clarity is critical. MACS has noted that "crossing a cycle lane using a designated crossing could also be a frightening experience for a wheelchair user, if it is perceived that an approaching cyclist is unlikely to stop" [20].

TfGM's Oxford Road study found that between 1% and 4% of pedestrians were definitely not looking when crossing the cycle path, and between 1% and 11% used the cycle path as a pavement (the cycle track was at footway level through the bus stop area). At a location with three crossing points, with zebra markings on the central crossing, 60% of pedestrians used any of the crossings, with 25% using the zebra [16]. The Edinburgh guidance includes markings on each side of the crossing points to advise pedestrians which way cyclists are travelling [8].

Appearance

All design guides show tactile paving at crossing points, most also including a tactile tail – TfL states that it is only acceptable to exclude a tail at a zebra crossing if it would not lead a pedestrian into an ambiguous situation [35].

The design guidance literature does not include much commentary on the basic appearance of crossing points, although the accompanying diagrams do suggest how the crossings should be treated. Several documents, including Cycling by Design, TfL and Camden Council guidance, show a crossing that contrasts with the cycle track (and typically also contrasting with the footway), while other sources, including LTN 1/20, the Wales Active Travel guidance and the Edinburgh guidance, show a crossing that continues the appearance of the cycle track.

Zebra crossing

TSRGD 2016 makes provision for zebra crossings placed across cycle tracks, with the same legal status as standard designs used on carriageways, allowing for narrower stripes and does not require provision of Belisha beacons [38]. These designs, known as 'mini-zebras' (with striped marking but no Belisha beacon), are included within the majority of guidance including Cycling by Design, LTN 1/20 and CD 195 – they were not included in TfL's Accessible Bus Stop Design Guidance but feature in the later guidance note. TfL note that these variant zebra crossings can help achieve greater priority for bus passengers, particularly in high flow areas [5]. Mini-zebras are an option in the Edinburgh guidance (though featured on the example diagram), with additional guidance to install a 'formal zebra crossing' in areas with large numbers of pedestrians and/or vulnerable pedestrians [8].

TfL's note requires that the crossing should, as standard, be aligned with the position of the rear doors of a bus, but if this cannot be achieved then it is preferable to include a courtesy crossing in the standard location rather than relocating the crossing [35].

TRL's on- and off-street studies have found a generally positive response to zebra crossings compared to unmarked crossings, noting that zebra crossings:

- Encouraged pedestrians to use the crossing [30] [17], particularly if cyclists were approaching from behind or if there was also a ramp [6].
- Encouraged alighting bus passengers to use the crossing [6].
- Increased the proportion of cyclists giving way at the crossing [17].

- Made crossing points more easily identifiable for both cyclists and pedestrians, including those with disabilities [6] [30][12]. The high contrast and tactile tail were important advantages of zebra crossings for blind and partially-sighted pedestrians [29].
- Improved perceptions of safety and comfort for pedestrians with and without disabilities [6] [30] [29].
- Improved understanding of priority [6].
- Increased perception of pedestrian priority at the crossing point, for both pedestrians[13] and cyclists [6] [30].
- Increased perception of pedestrian priority away from the crossing. However, this belief was more marked for pedestrians than for cyclists [6] and the on-street trials found that overall, both groups still assumed cyclist priority away from the crossing [30].
- Increased the proportion of cyclists giving way to pedestrians but also increased the proportion of pedestrians giving way to cyclists [17].
- Made it easier to see other users [6].
- Reduced interactions between people walking and cycling in an off-street trial [6] although showed a 15% increase in an on-street study [17].
- Reduced serious interactions between people walking and cycling [6] [17].
- Reduced avoidance actions by pedestrians and increased "controlled action" moves by cyclists [6].
- Reduced the impact of increasing cyclist flows [6].
- Reduced the level of confusion about using the crossing [30].
- Changed the way that cyclists rode through the bypass area, including an increase in cyclists commenting that they actively slow down or look out for pedestrians [30].
- Either did not impact cyclist speed [17] or had a small delay to cyclists [6].

[12] Impact was greater in the off-street trials and at the Blackfriars Road sites.

[13] In off-street trials, over 80% assumed pedestrian priority at crossings with a zebra, compared to 15% at sites without [6]. The on-street trials found a larger increase in perception of pedestrian priority at the Blackfriars sites – straight, bi-directional cycle track [30].

The functionality of a zebra crossing on a bypass should be seen in the context of zebra crossings on the wider road network as any general uncertainty about priority is not exclusive to their use at bypasses and boarders. Further context is provided by the Highway Code rules, which give pedestrians greater priority at zebra crossings than they have elsewhere. With a change to the rules giving clarity on priority and stopping requirements, behaviours could change without needing changes to the infrastructure, although the 2021 consultation suggested that many respondents already believed that it was necessary to stop for waiting pedestrians [39]. Potentially, the non-standard appearance and use of zebra crossings at bypasses could affect how they are approached by users of all modes and whether people believe them to as 'official' as a standard carriageway zebra crossing.

There were some stakeholder concerns expressed in TfGM's study that pedestrians could "misinterpret the zebra crossing and believe it to apply to the main carriageway", leading to a recommendation that a physical barrier could be used to prevent pedestrians from entering the road but without limiting space on the island.

Belisha beacons

In TRL's study, the addition of Belisha beacons to Zebra crossings made no significant difference to user perceptions (people stating they used or noticed the crossings) [30], though video analysis suggested a statistically significant increase in pedestrian use of the crossing [17]. There was an increase in cyclists assuming pedestrian priority when beacons were used. Based on TRL's London studies, TfL concluded that zebras should be implemented at new and proposed bypasses on the TfL road network but that Belisha beacons were not required by default [40]. The TfL guidance note allows use of Belishas at the designer's discretion in situations of poor lighting or compromised visibility [35].

Footway-level versus cycle track-level crossings

Pedestrians require a level surface to cross between the footway and island; this can be provided by dropped kerb (crossing at cycle-track level) or a raised table (crossing at footway-level). TfL [5], LTN 1/20 [1]and the Wales Active Travel guidance [3] prefer a raised/ramped crossing, with the Edinburgh guidance noting the advantages for emphasising pedestrian priority and encouraging a reduction in cycle speeds [8]. Cycling by Design allows for both bus stop types and states that choice of crossing type should be determined through user group engagement [2].

TfL state that the raised table should be local to the crossing point but may extend further and should be delineated from the footway if this occurs. It sets minimum widths (in direction of cyclist travel) of 3.65m for a uni-directional route and 4.90m for bi-directional [35].

TRL's off-street study found that crossing level had less impact than the type of crossing (unmarked or zebra crossing). The key findings were:

- Mobility-impaired participants preferred a footway-level crossing.
- Blind and partially-sighted participants preferred a cycleway-level crossing as the dropped kerb gave extra confirmation of the location of the crossing point.
- Participants without a disability had a marginal preference for a cycleway-level crossing.
- There was a marginal increase in interactions with a ramped crossing.
- There was a slight reduction in serious interactions with a ramped crossing.
- Ramped crossings reduced the effect of increasing pedestrian flows.
- There was generally a slightly lower safety rating for footway-level crossings if there was no zebra.

Following stakeholder feedback, a bypass in Cambridge was amended to raise crossing points to footway level, also surfacing them to match the footway and reinforce pedestrian priority [20].

Effect of pedestrian and cyclist flows

TRL hypothesised that the likelihood of pedestrians diverting off their desire line to a crossing is based on several factors, including:

- The extent of ownership they feel over the cycle track, with an expectation that higher pedestrian numbers could increase sense of ownership; and
- The ease of crossing between cyclists, with the expectation that higher cycle flows would result in fewer opportunities to cross.

An increase in cycle flows led to an increase in pedestrians using the crossing if cyclists were approaching from behind, but the effect of flows was less significant if they approached from the front. There was also a usage increase for those alighting from the bus when cycle flows increased. Increase in pedestrian flows only decreased usage of the crossing in a no ramp/no zebra scenario [6].

5.5 Control and priority measures

Signage and markings

Sustrans' factsheet for temporary active travel features notes that "Messaging to cyclists […] should be clearly understandable, within the context that travelling at speed alters a person's ability to process what they see and recognise" [28].

Multiple design guides, including Wales Active Travel guidance, Cycling by Design, TfL and LTN 1/20 show the cycle symbol markings as part of the scheme, complementing any physical differentiation, but do not state requirements for positioning or frequency. The various guidance reviewed does not currently include post-mounted signage for pedestrians or cyclists at bypasses.

AECOM [25] and TfL [5] refer to potential to include road markings and signage, while RNIB and Guide Dogs state a need for warning markings and signage to instruct cyclists to yield to pedestrians at the crossing and reduce speed through the bypass area [15] [33].

Following TfGM's study, the suggested general arrangement for a bypass was amended to include awareness-raising signage and lane markings for both people walking and cycling: bollard mounted signage ('give way to pedestrians' and 'look for cycles'), 'SLOW' markings at the entrance to the bypass lane, a painted give way at the crossing [16] – these signage features are not currently listed in the interim Greater Manchester design guide.

Crossing signals

RNIB's survey has highlighted that many blind and partially sighted people rely on signalised crossings to cross cycle tracks [34]. Cycling by Design comment that signal-controlled crossings could be used in circumstances with high cycle traffic speed and flow [2]. LTN 1/20 comments that "Pedestrian crossing points should be controlled if cycle traffic speed and flow are high" but it is unclear if this refers to the mini-zebra crossing or another type of controlled crossing [1]. Stakeholders in TfGM's study suggested a need for signal-controlled crossings at the middle crossing point to aid Blind and partially sighted people [16].

A recent human rights ruling in British Columbia, Canada [41], found that the bus stop bypass design used on the Pandora Bikeway discriminated against blind people as it did not provide a safe crossing to access the bus. A comparison was made to the Wharf Street Bikeway which uses "a flashing yellow light with an audible signal, activated by a pedestrian wishing to cross to the Floating Stop via a Stop Crossing" [41]. The audible signal notifies the pedestrian that the signal is activated while the light notifies the approaching cyclist that they are required to yield to the pedestrian.

The tribunal concluded that including these signals on the Pandora Bikeway was a "reasonable accommodation" but noted that it is not a full answer and does not mean that the City should not implement any future technologies to "fully guarantee protection for blind people". The alternative technological solutions suggested by the Complainant (including installing "a railway style crossarm to stop traffic on the Bikeway", "Automated bicycle detection to alert vision impaired persons bicycles have stopped" [41]) were not considered reasonable or viable options at this time.

At present there appears to be no signal technology in use in the UK that provides the same service to all users – that being an installation that provides no stop or go no signal to either party except for when the signal is activated, and an instruction given to cyclists to yield to pedestrians. Standard traffic signals show a green light to one party at a time, while zebra crossings do not make it clear to cyclists that there is a waiting pedestrian who specifically requires signal support to cross.

Other physical measures

In addition to the signage, markings, speed control measures and zebra crossings already discussed, stakeholders in published studies have highlighted a range of potential additional aids to provide either warnings or instructions to pedestrians or cyclists. While existing measures are typically 'analogue' and static, the measures include a range of interactive features and are primarily untested on bypasses.

Both Guide Dogs [33] and RNIB [15] [42] have commented that crossing points should include auxiliary aids such as audible and tactile beacons that indicate when it is safe to cross, before stepping out, however, Guide Dogs Scotland have noted that the navigation aids used by many blind and partially-sighted people may make it difficult to hear auditory warnings and well as warnings from approaching cyclists [20].

During TRL's stakeholder workshops, suggestions for improving crossing safety included red lights to alert cyclists to waiting pedestrians, gates across the cycle path, and bypass speed-control measures [20]. TRL noted that a trial is planned for Manchester Oxford Road to use cameras and sensors to alert blind and partially-sighted people, via a rotating cone, of approaching cyclists [20].

Wheels for Wellbeing advocates a balanced approach with technical solutions at crossings to alert cyclists to crossing pedestrians while informing pedestrians when it is safe to cross. This includes a design suggestion with LED strips and motion detectors for cyclists and pressure sensors in the tactile paving with vibration and audible warnings to pedestrians [31]. Similarly, the Sustrans guidance for temporary facilities notes a potential role for coloured reflectors to help convey that the cycle route is approaching and crossing a pedestrian priority zone (white to green to amber then red) [28].

Bollards were added to a bypass in Cambridge on the approach to the crossing point to aid navigation for blind and partially sighted people while giving the impression of a 'gateway' for pedestrians [20]; this approach is also referenced in Cycling by Design [2].

Non-physical and behaviour change measures

TfL has concluded that, due to a lack of compliance at zebra crossings, non-physical measures are required to manage give way issues at bypasses, with options including audio announcements on approaching buses [40]; this approach shared by both Cycling by Design and RNIB and included in the update to Inclusive Mobility [2] [15] [4].

TfL's report also mentions "behaviour change activities to encourage cyclists to give way at Zebra crossings" but does not elaborate further on what these are or how they could be achieved [40].

TRL's engagement with disabled people concluded that there is a need for a range of awareness-building and training:

- For disabled people to learn how to use bypasses;
- For cyclists to improve awareness of bypasses and the needs of disabled people;
- For bus drivers to ensure they consider the needs of disabled people and stop at convenient places [29].

TfL's bus stop design guidance also mentions potential for targeted publicity and messaging [5].

Policy measures

In response to DfT's Highway Code review, RNIB commented that there should be explicit mention of bus stop bypasses and boarders, giving stronger priority to pedestrians crossing and waiting to cross in locations with and without zebra crossings [23]. This change may require significant publicity in order to ensure that all parties are aware of changes to their obligations, however legislative change is unlikely to guarantee compliance on its own.

5.6 Summary of design features

Design features set in the design guidance are summarised in Table 8 Summary of bypass design features, demonstrating the variance in design. Where features are not explicitly noted at bypasses but are defined in the wider principles (i.e. general cycle track design), these are marked with an asterisk.

Table 8 Summary of bypass design features

	No. crossings	Crossing type	Crossing height	Chicane taper	Track - physical delineation	Track - visual delineation	Crossing - visual delineation
Cycling by Design 2021	2	Mini-Zebra or signal	Ramped	R15 inside, R20 outside	*Min. 60mm	*Tonal contrast	Contrast with cycle track
Local Transport Note 1/20	1	Mini-Zebra (or controlled)	Ramped	Min. 1:10 tapers	Carriageway level	Colour / texture contrast	Matching cycle track
Wales Active Travel Act Guidance	1	Mini-Zebra	Ramped	Min. 1:10 tapers	Below footway level (varies)	*No requirement	Matching cycle track
Edinburgh Street Design Guidance	1+	Mini-Zebra or uncontrolled	Ramped	Min. 1:3 tapers	*Intermediate level track: 25-50mm. Carriageway level track: 75-100mm	Red-chipped asphalt or other visually distinct material	Matching cycle track
TfL Accessible Bus Stop Design Guidance / Guidance note	1	Mini-Zebra	Ramped	5-10m taper**	Min. 50mm or raised delineator strip	50% visual contrast	Contrast with cycle track
Greater Manchester Design Guide	1	Mini-Zebra	Ramped	Min. 1:10 tapers	Carriageway level	Colour / texture contrast	As LTN 1/20 (Matching cycle track)
West Midlands Cycle Design Guidance	Not stated	Not stated	Ramped	Not stated	Not stated	Not stated	Not stated
Camden Council guidance note	1	Mini-Zebra	Ramped	6m taper**	Not stated	Not stated	Contrast with cycle track

* Features not explicitly noted at bypasses but defined in the general cycle track design.

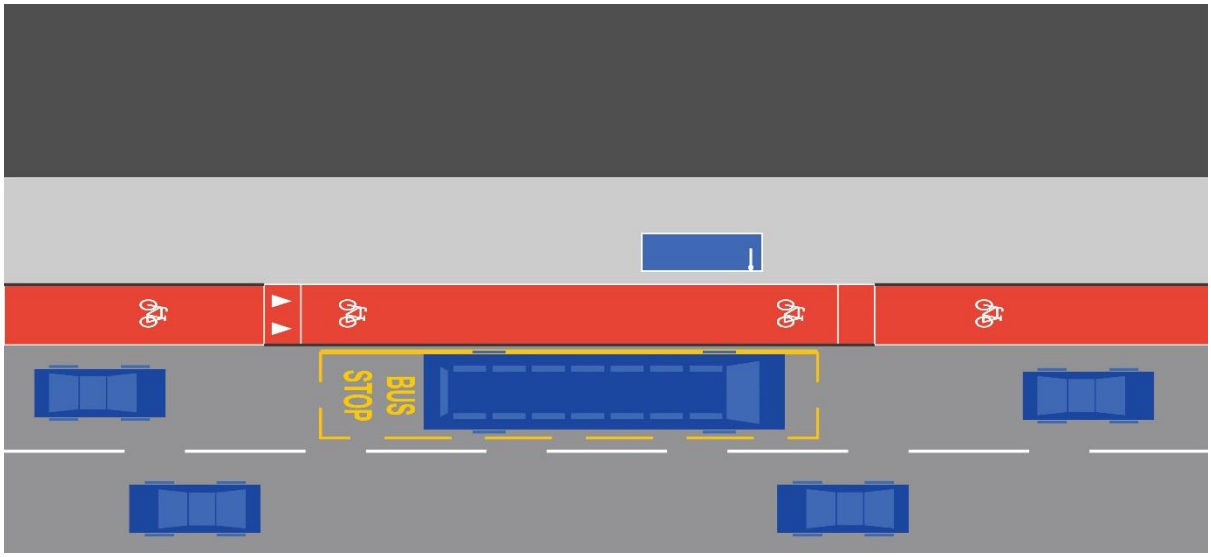
** Measured parallel to the kerb.

6 Physical design features and factors – bus stop boarder

Following from the previous chapter, this chapter looks at the design of physical features created as part of the bus stop boarder. It uses ‘boarder’ to refer to the type of design shown in LTN 1/20, where the cycle track continues parallel to the carriageway but is raised up to footway level to provide a level boarding platform. It does not refer to the type of infrastructure called “Cycle track at bus boarder” shown in Cycling by Design.

Boarders are currently included in a much narrower range of literature than bypasses but are used by many local authorities, either as a strict ‘boarder’ design, or more of a bypass-boarder hybrid.

Figure 15 Bus stop boarder - typical design



As with bypasses, there is a broad range of physical variables for how to implement a boarder at a given location: These variables can be categorised as:

- Boarder design
- Buffer area design
- Waiting area design
- Footway width.

There is less design guidance on many of these issues compared to bypasses, but a strong focus on the requirement for stakeholder consultation.

CONSISTENCY AND CONSULTATION

As with bypasses, LTN 1/20 notes that early consultation with "relevant interested parties" should be undertaken. Camden Council's template design is intended to provide enough consistency to allow for allow for monitoring and evaluation of bus boarders. The guide notes that Stage 3 Road Safety Audits will be conducted at each site to highlight any post-construction issues and necessary design changes [24]. The Wales Active Travel guidance includes boarders as a "Standard detail" but as with bypasses, these are subject to local context [3].

6.1 Boarder design

Dimensions

Camden Council sets a minimum overall width of 2m to cater for adapted cycles, with 0.75m marked as a "passenger landing zone", (akin to a buffer) and states that this visual narrowing will encourage slower speeds when a bus is not present [24]. Guidance does not state a length for the boarder platform although this can be judged from the accompanying diagrams. A longer platform would increase the area in which you might expect interactions between people walking and cycling, but this is not covered by the literature.

Table 9 Boarder dimensions

Guidance document	Boarder width	Boarder length
Wales Active Travel Act Guidance	Desirable minimum width: 2.0m Absolute minimum width: 1.5m	Diagram shows flat top area and ramps as length of bus cage.
Edinburgh Street Design Guidance	Minimum 1.5m.	Diagram shows flat top area as length of bus cage.
Camden Council guidance note	Minimum width 2m, with 0.75m width to be marked as a "passenger loading zone.	Diagram shows flat top area as length of bus cage.

Ramps

Ramps are included in the guidance to, variously, reduce cycle speeds [3] and provide an at-grade boarding/alighting point for passengers. All sources show, as standard, a boarder that is at footway level for the full length of bus stop cage [3]. Interestingly, reviewing existing constructed boarders across the UK, several are considerably shorter than the bus stop cage and include platform that is little wider

than the marked mini-zebra. The Wales Active Travel guidance notes that "where the difference between levels is small a short ramp may be appropriate" [3]. Parkin comments that minimising the effect of vertical deflection is important for cycle traffic [13].

Differentiation from footway

LTN 1/20 notes that "the use of contrasting materials for the footway and cycle track, both in colour and texture, is useful to highlight the difference between the two, to both pedestrians and cyclists". In the diagram, the boarder has an appearance that contrasts with the footway and continues the appearance of the cycle lane/track [1]; this approach is also shown in the Wales Active Travel guidance [3]. If the boarder is intended to act as a 'shared space', this approach may not signal a change of priority to cyclists.

The Edinburgh guidance takes an alternative approach, with the diagram showing a boarder that appears to be an extension of the footway and contrasts with the rest of the cycle track and a note that "careful consideration should be given to cycleway material, in particular use of blocks to denote pedestrian priority" [8]. With this bus stop type, the boarder looks much more akin to the type of 'boarder' installed at locations without cycle tracks to assist pedestrians to board the bus.

The Camden guidance includes contrasting corduroy paving along the full length of the footway-level platform to aid blind and partially-sighted pedestrians [24].

Markings and signage

Multiple sources include use of the cycle symbol (Diag. 1057) at regular intervals along the cycle track either side of the boarder – unlike bypasses, these are explicitly labelled on the diagrams. LTN 1/20, the Wales Active Travel guidance, and the Edinburgh guidance include post-mounted signage to warn pedestrians to look both ways before crossing the cycle track (diag. 963.1) [1] [3]. The Edinburgh guidance also allows for an optional "advisory courtesy sign" for cyclists on approach to the boarder [8].

The Camden Council guidance includes give way markings at the point where the cycle track narrows to create a buffer area for pedestrians. The Camden guidance also includes 'Slow' markings for cyclists on approach to the boarder [24] – these are shown by Welsh Government in the 'shared use' arrangement but not for standard boarders [3].

Crossing point

In contrast to the guidance for bypasses, there are typically no features to define crossing points at bus stop boarders. The Edinburgh guidance is unusual in showing a mini-zebra, here positioned in line with the upstream end of the bus

shelter [8]. Reviewing existing constructed boarders across the UK, many do include a mini-zebra.

6.2 Buffer area

A key variable for bus boarders is the provision or absence of a buffer area – LTN 1/20 notes that one can be provided if space permits and recommends this should have a width of 1.5m to 2.0m and a contrasting appearance [1]. The Camden guidance, focusing on temporary and quick roll-out schemes, identifies a "passenger landing zone" within the boarder, marked by hatched white line markings [24]. Although not identified on the diagram, the Edinburgh guidance includes a 0.5m buffer [8].

A Danish study identified that inclusion of a platform between cycle path and bus reduced the accident rate, from 40 accidents to 28 [11]. The resulting bus stop design is somewhat of a hybrid between bus boarder with buffer area and bypass[i].

6.3 Waiting area

Camden Council's guidance notes that the bus stop flag (with timetable) should be positioned on the footway to negate need for pedestrians to enter the boarder until the bus arrives [24]. The Wales Active Travel guidance notes that "bus shelters and flags should be placed at the back of the bus boarder", within the retained footway [3]. LTN 1/20 and Welsh Government show the bus shelter positioned immediately behind the boarder rather than at the back of the footway [3] [1].

[i] "Fremrykket stoppested med busperron og langstrakt midterhelle" – translated by Google Translate as "Advanced stop with bus platform and elongated center slab"

6.4 Footway width

Table 10 Boarder footway width

Guidance document	Spatial requirement: Footway width
Wales Active Travel Act Guidance	Desirable minimum width: 3.0m Absolute minimum width: 3.0m
Edinburgh Street Design Guidance	Low pedestrian volumes: Desirable minimum width: 1.5m Absolute minimum width: 0.9m High pedestrian volumes: Desirable minimum width: 3.0m Absolute minimum width: 2.5m
Local Transport Note 1/20	Minimum 2-3m of footway behind the bus stop

While not explicitly stating that the footway should continue behind the bus stop area, the Wales Active Travel guidance comments that sufficient space should be provided behind the boarder to minimise passengers standing in the line of the cycle track [3]. The Camden Council guidance does not state any dimensions but shows a shelter positioned with a very narrow footway to the rear [24].

In addition to the "clear footway zone behind/in front of bus shelter", the Edinburgh guidance includes a 0.5m clearance between cycle track and shelter and 0.2m for a cantilever shelter in the footway width between shelters. It also includes an option to locate the shelter 0.5m from the building line [8].

6.5 Summary of design features

Design features set in the design guidance are summarised below.

Table 11 Summary of boarder design features

	No. crossings	Crossing type	Buffer area	Differentiation of track
Local Transport Note 1/20	None	N/A	If space permits	Shown continuing cycle track appearance

Wales Active Travel Act Guidance	None	N/A	N/A	Shown continuing cycle track appearance
Edinburgh Street Design Guidance	1	Mini-Zebra	0.5m buffer	Shown as extension of footway
Camden Council guidance note	None	N/A	Hatched markings	Corduroy paving along footway edge

7 Implications for inclusion

This chapter discusses how bus stop bypasses and boarders may affect accessibility and inclusion for pedestrians. It includes an overview of comments from stakeholders and advocacy groups about this infrastructure and a summary of the inclusivity-specific findings of published studies. Annex A provides a more in-depth review of inclusivity issues.

7.1 Design guidance

Inclusive Mobility, published in January 2022, is the Department for Transport's guide to best practice on access to pedestrian and transport infrastructure, describing "features that need to be considered in the provision of an inclusive environment and issues related to disabling barriers, the use of technology, maintenance, awareness of the needs of disabled people, and engagement." Section 9.7 includes a reference to bus stop bypasses, noting that LTN 1/20 provides guidance on these and that "it is essential that the needs of pedestrians are taken into account, particularly disabled people." It comments that "it would be helpful" if buses included on-board announcements on the presence of bypass or boarders at stops. [4]

7.2 Inclusion and accessibility considerations

The ability to move through our streets can affected by several factors, which can mean the infrastructure's design comes into conflict with individual needs. According to the 2011 Census (data for England and Wales):

- 21% of the population was aged under 18, with nearly 10% aged under 8 years [43]. 17% of under 18s live in households with no access to a vehicle [44];
- 17% of the population was aged over 65 [43]. 29% of people aged over 65 live in households with no access to a vehicle, rising to 51% for those over 80 [44];
- 9% of the population self-reported as having a long-term health problem or disability that limited their day-to-day activities 'a lot' with a further 9% limited 'a little'. This figure does not include people who have experienced short-term health problems or disabilities that may be equally limiting [45].

Around 39% of people with long-term health problems or disabilities[i] live in households with no vehicle, compared to 16% of those without a disability [46]. Even in households with a vehicle, this may not be available to all individuals to use for all journeys, and there are many, including children and Blind and partially sighted people who would be refused a driving licence on medical grounds. As a result, a significant proportion of the population is reliant on public transport and active travel [42].

While passage along any street involves numerous hazards and risks, of which cycle routes are but one, any additional features will add to the cognitive load faced by pedestrians. Bus stop bypasses and boarders can be seen as intrusions into the footway – a space provided for the safety, comfort and amenity of pedestrians and which many would expect to be a safe space free from moving hazards. The existence of varying guidance and standards across the country could further compromise ability to use this infrastructure.

Similar to how much of our streetscape is designed, the design of bus stop bypasses and boarders typically assumes several factors relating to people's ability to safely move to and from a bus stop:

- Ability to identify navigation routes between the footway and bus stop.
- Ability to establish the presence of cyclists, their speed and the level of risk faced by starting to cross.
- Ability to be seen by people cycling.
- Ability to physically move through the bus stop area, from the footway to the bus stop and onto the bus.

It could also be considered that designs assume that pedestrians have the ability to use eye contact to establish an understanding with people cycling. While individuals will be able to rely on each of these factors to differing degrees, the Social Model of Disability considers that it is the street environment that is the limiting factor, not a person's individual characteristics. This means streets should be designed to avoid creating barriers that affect the movement of all pedestrians, including those with Protected Characteristics.

Bus stop cycle intervention design needs to consider how these factors can be addressed and mitigated as far as possible. Chapters 5 and 6 discuss the use of design features intended to improve safety for pedestrians, including those which are focused on inclusive access such as tactile paving and ensuring sufficient turning space for wheelchairs.

[i] Individuals in England and Wales who reported their day-to-day activities are "limited a lot" by long-term health problems or disabilities, compared to those who said their activities were "not limited".

Sustrans has listed features to assist people with mobility impairments and partially sighted people at temporary infrastructure: signage, markings and materials to delineate spaces; give-way and crossing markings to regulate priority; tactile surfaces at crossings; prominent bus stop signs; coloured reflectors and suitable lighting [28].

At present, studies focus on bypasses rather than boarders, meaning there is limited formalised understanding of how boarders function for inclusive access. Both bus stop types introduce areas of potential conflict between people walking and cycling. Bypasses include some form of pedestrian crossing which could be viewed as part of the same issue as the behaviour of road users at carriageway pedestrian crossings.

Boarders are seen by some as introducing areas shared equally between cyclists and pedestrians, although designs vary considerably. LTN 1/20 states that "cyclists must be physically separated from pedestrians and should not share space with pedestrians" including at junctions and highway crossings [1] with Cycling by Design also having a "presumption against" shared facilities.

Annex A includes a wider perspective on inclusion and accessibility problems in the street environment. This material has been placed in an annex as it includes themes that cut across both strands of research in this project, bus stop interventions and continuous footways, and looks at the wider context for inclusion in street design. The study of road users in Israeli cities demonstrated that the relationship between road users is not fixed and instead is negotiable and influenced by social context. This could have important implications for how much we consider that users could adjust their behaviour around bus stops, particularly where they encounter others who are visibly more vulnerable than they are. Annex A also refers to being lost in thought or daydreaming as part of the pleasure of walking, with this interrupted by interaction with complex environments and other road users.

7.3 Feedback from stakeholder and advocacy groups

The issues and concerns raised by accessibility groups broadly align with those raised more widely in the literature, though concerns are heightened due to a reduced ability to detect or avoid related hazards.

Following review of potential new topics for inclusion in accessible public realm guidance, TRL concluded it is likely that bus stop bypasses can be designed to be safe and inclusive and should be included in revised guidance, particularly as they provide benefits for cycle safety [20]. As part of the study, TRL consulted with a

range of stakeholder and advocacy groups concerned with inclusivity and accessibility:

- RNIB has serious concerns about safety at bus stop bypasses and boarders, noting that blind and partially sighted people may rely on public transport and thus need to be able to safely access and board buses. They consider that bypasses cause confusion for all user groups with a lack of clarity over markings and priorities, and lack of warning for alighting passengers.

- Guide Dogs Scotland has noted that blind and partially-sighted people need to know where it is safe to walk, in order to reduce anxiety and confusion that could discourage them from using the streets.

- Aside from difficulty detecting a cycle track, there is concern from Age Scotland that these designs could cause confusion for people with dementia due to lack of clarity as to what the demarcation means and where is safe for pedestrians [20].

In both their response to the Highway Code review and Seeing Streets Differently report, RNIB noted that TRL's study identified the factors judged to be important in higher-level interactions between people walking and cycling, including pedestrian inattentiveness and reduced inter-visibility; RNIB consider that this highlights a significant issue for blind and partially-sighted people who may not be able to rely on sight to detect approaching cyclists [23] [34]. There is a clear statement in RNIB's 2021 position statement that "There must be no further construction of bus stop bypasses / floating bus stops or bus stop boarders until a comprehensive investigation has been conducted into accessibility and safety issues, and new planning and construction guidance". They comment on the lack of crossing facilities on many bypasses and object to the shared use areas at boarders [15].

Guide Dogs has noted many of the same issues as other organisations, commenting that one of the problems is "The indiscriminate designs of bus stop bypasses and boarders", also citing cycle speed and difficulty detecting the track and crossings as being problems [33].

Campaign group the National Federation of the Blind of the UK (NFBUK) has expressed concern about the installation of boarders in Enfield, commenting that "they do not provide a safe, accessible method to board or exit a bus for blind, partially sighted, disabled, vulnerable or indeed for any passenger". NFBUK further comments that "there is no signage, nor road markings, currently in place to indicate that cyclists should actually give way." There is concern that there is no evidence to support claims of safety and that the roll-out does not acknowledge the different legislative context in the countries where they are more prevalent, and

comments that “NFBUK understands that Denmark has now started to remove these designs because of the conflict and collisions they create between cyclists and pedestrians” [48].

One respondent to TRL’s study, a regular walking stick user and occasional wheelchair or scooter user, commented that they find buses difficult to use and frequently hail a taxi from the pavement but find that cycle lanes/tracks can make this significantly harder and can make routes longer. This shows that there are some pedestrians for whom any cycle route is a barrier, with bus stops representing just one difficult scenario [20].

While many inclusivity campaign groups express concern about bus stop bypasses and boarders, inclusive cycling charity Wheels for Wellbeing has been openly supportive of the creation of (properly planned) bus stop bypasses and the role they play in protecting and encouraging disabled people who use a cycle as a mobility aid [31].

7.4 Accompanied visit studies

TRL’s accompanied visits to bypass sites with disabled people found that experiences of the infrastructure varied. Participants had mixed experiences crossing to the footway, largely dependent on their impairment type and on where the bus stopped in relation to the crossing point.

The most impacted group were blind or partially sighted people who had difficulties understanding the layout or instructing their guide dog. This was also the group who felt the least confident crossing the cycle track, with some participants commenting that external factors affected their understanding of the situation, including noise from a nearby construction site. The tactile paving and zebra markings were noted as a positive factor, however some participants had difficulty finding the tactile paving when the bus stopped away from the crossing, and others felt the at-grade crossing made detection more difficult. Wheelchair users also had problems with manoeuvring about the island or past tactile paving.

When asked about their experiences of using the facility:

- Blind and partially sighted participants: 25% found the uncontrolled crossing ‘easy’ or ‘very easy’ to use when crossing from island to footway, compared to 50% using sites with a zebra crossing.
- Deaf or hard of hearing participants: 60% found the uncontrolled crossing easy to use when crossing from island to footway, compared to 100% using sites with a zebra crossing.

- Participants with learning disabilities or mobility impairment: 100% found the uncontrolled crossing ‘very easy’ to use when crossing from island to footway, but fewer of both groups found the zebra crossing ‘very easy’.

Participants were asked *“Was this any different to the experience you might expect at ordinary bus stops?”,* with 79% commenting that it was not. When asked “How safe or unsafe did you feel while crossing the cycle track to reach the bus stop?”, over 80% of participants with mobility impairments or learning disabilities felt safe or very safe with both crossing types. For deaf or hard of hearing participants, this was 40% at uncontrolled crossings and over 80% at zebra crossings, and for blind and partially sighted people this figure was 20% feeling safe and none feeling very safe at uncontrolled crossings; this rose to 30% safe and 35% very safe at zebra crossings. While 35% felt unsafe or very unsafe at uncontrolled crossings, this fell to under 20% at a zebra crossing. Inability to detect if a cyclist was approaching was a significant barrier to safety and confidence for these participants.

Interpreting the feedback from the visits second-hand, via TRL’s reports, the user experiences would appear to not be as negative as the feedback from the stakeholder groups would suggest. This was based on a sample size of 36 participants who were aware that they were visiting sites that had this infrastructure installed, but were not guided through the site. There were however strongly negative individual responses: "Any bus stop which is on an island is not safe for people with disabilities. It doesn’t protect the rights of disabled people to access the environment safely." [29]

7.5 Engagement in design

As previously noted, numerous design guides include a requirement to consult and engage with stakeholders early on as part of the design process to ensure that the bus stop is as accessible and inclusive as possible. RNIB Scotland comment that the organisation is “keen to engage with cycle advocates, planners, designers and engineers to discuss and identify solutions to the current design issues” [42]. Inclusive Mobility emphasises the importance of early engagement with relevant interested parties when considering use of a bypass [4].

8 Legislation, rules and policies driving design choices

This chapter provides a review of literature on legislation and highway usage rules, alongside wider street design guidance, to set the context in which bus stop bypasses and boarders are designed and operate.

Section 8.1 discusses legislation and rules relevant to bus stop bypasses and boarders, including on priorities and obligations.

Section 8.2 highlights that the use of bus stop bypasses and boarders is not explicitly covered in wider policy and guidance that seeks to ensure that streets are well designed for pedestrians and that they create a sense of place.

8.1 The Highway Code

The Highway Code, updated in January 2022 [37] identifies, in an accessible format, the legal requirements and other rules for use of roads in England, Scotland and Wales. The Highway Code includes legal requirements (for which disobeying means committing a criminal offence) and advisory rules that "may be used in evidence in any court proceedings under the Traffic Acts". The Introduction clarifies that the "aim of The Highway Code is to promote safety on the road, whilst also supporting a healthy, sustainable and efficient transport system."

Rule H1 was introduced to outline the 'hierarchy of users' and states:

> *It is important that ALL road users are aware of The Highway Code, are considerate to other road users and understand their responsibility for the safety of others.*
>
> *Everyone suffers when road collisions occur, whether they are physically injured or not. But those in charge of vehicles that can cause the greatest harm in the event of a collision bear the greatest responsibility to take care and reduce the danger they pose to others. […]*
>
> *Cyclists, horse riders and drivers of horse drawn vehicles likewise have a responsibility to reduce danger to pedestrians.*

None of this detracts from the responsibility of ALL road users, including pedestrians, cyclists and horse riders, to have regard for their own and other road users' safety.

Always remember that the people you encounter may have impaired sight, hearing or mobility and that this may not be obvious.

Rule H2 further clarifies priorities relating to people walking and cycling, stating:

[…] You MUST give way to pedestrians on a zebra crossing, and to pedestrians and cyclists on a parallel crossing (see Rule 195).

Pedestrians have priority when on a zebra crossing, on a parallel crossing or at light controlled crossings when they have a green signal.

You should give way to pedestrians waiting to cross a zebra crossing, and to pedestrians and cyclists waiting to cross a parallel crossing.

[…] Cyclists should give way to pedestrians on shared use cycle tracks and to horse riders on bridleways.

[…] Pedestrians may use any part of the road and use cycle tracks as well as the pavement, unless there are signs prohibiting pedestrians.

These principles of hierarchy, priority and zebra crossing use are repeated across several other rules. At present there is no explicit reference to bus stop bypasses and boarders in the rules, however these principles about user priority and pedestrian crossings apply. The reference to 'shared use cycle tracks' could apply to bus stop boarders where there is an area of shared space.

Amongst the 'rules for cyclists' is Rule 69; by making it clear that people cycling must obey all traffic signs, this puts a legal requirement on them to obey the rules relating to zebra crossings and other pedestrian crossing types.

*Rule 69 You **MUST** obey all traffic signs and traffic light signals.*

Under the rules for 'using the road' is Rule 195:

*Rule 195 **Zebra crossings.** As you approach a zebra crossing*

- look out for pedestrians waiting to cross and be ready to slow down or stop to let them cross
- you should give way to pedestrians waiting to cross
- you MUST give way when a pedestrian has moved onto a crossing

- […]
- be aware of pedestrians approaching from the side of the crossing.

This instructs people cycling (and other road users) to look out for pedestrians and be ready to stop, but stops short of legally requiring them to give way unless the pedestrian has started to cross. There are instructions to pedestrians that are relevant here:

> *Rule 18* ***At all crossings.*** *When using any type of crossing you should*
>
> - always check that the traffic has stopped before you start to cross or push a pram onto a crossing.
> - always cross between the studs or over the zebra markings. Do not cross at the side of the crossing or on the zig-zag lines, as it can be dangerous.
>
> *You* **MUST NOT** *loiter on any type of crossing.*
>
> *Rule 19* ***Zebra crossings.*** *Give traffic plenty of time to see you and to stop before you start to cross. Vehicles will need more time when the road is slippery. Wait until traffic has stopped from both directions or the road is clear before crossing. Remember that traffic does not have to stop until someone has moved onto the crossing. Drivers and riders should give way to pedestrians waiting to cross and MUST give way to pedestrians on a zebra crossing (see Rule H2). Keep looking both ways, and listening, in case a driver or rider has not seen you and attempts to overtake a vehicle that has stopped.*

These rules instruct pedestrians to take care and to use crossings as designed and clarify that pedestrians do not have priority at a zebra crossing until they have started to cross. Rule 32 is specifically relevant to this study:

> *Rule 32* ***Buses.*** *[…] Watch out for cyclists when you are getting off. […]*

Several other rules provide additional instructions to people cycling and are relevant to bus stops. Under 'general rules, techniques and advice for all drivers and riders':

> *Rule 146 Adapt your driving to the appropriate type and condition of road you are on. In particular […]*
>
> - be prepared to stop at traffic control systems, road works, pedestrian crossings or traffic lights as necessary.

- try to anticipate what pedestrians and cyclists might do. If pedestrians, particularly children, are looking the other way, they may step out into the road without seeing you.

Rule 147 ***Be considerate.*** *Be careful of and considerate towards all types of road users, especially those requiring extra care (see Rule 204). […]*

- try to be understanding if other road users cause problems; they may be inexperienced or not know the area well.
- be patient; remember that anyone can make a mistake.

Rule 206 ***Drive carefully and slowly*** *when*

- in crowded shopping streets, Home Zones and Quiet Lanes (see Rule 218) or residential areas
- driving past bus and tram stops; pedestrians may emerge suddenly into the road. […]

8.2 Street design guidance

Design guidance that explicitly deals with bus stop bypasses and cycle boarders has been discussed earlier in this literature review, but this sits in a broader context of guidance for the design of streets and public realm. Two key documents that consider street design at a national level are:

- Manual for Streets (2007) and Manual for Streets 2 (2010) [England and Wales]
- Designing Streets (2010) [Scotland].

Manual for Streets

Manual for Streets provides technical guidance for the design of roads and streets outside the trunk road network. When published, it marked a change in design approach in England and Wales, from one that was fundamentally highway-focused to one that places a high priority on people and promotes the needs of active travel users. It recommends that the design of a scheme should follow a user hierarchy which puts pedestrians above people cycling, who are above public transport users and other motor traffic – this is echoed in Manual for Streets 2. It is unclear at which point a 'pedestrian' becomes a 'public transport user' or how this may relate to pedestrians' need to cross a cycle track to reach a bus or bus stop.

Manual for Streets references the Disability Discrimination Act 2005 [i] and notes the requirement to eliminate unlawful discrimination, promote quality of opportunity and

[i] Manual for Streets was published prior to the Equality Act 2010.

encourage participation in public life by disabled people. There is no explicit mention of bus stop bypasses and cycle boarders though it notes that “routes to bus stops must be accessible by disabled people” and that “Footways at bus stops should be wide enough for waiting passengers while still allowing for pedestrian movement along the footway” [49].

Manual for Streets is currently under review and may provide additional guidance specifically on these themes.

Designing Streets

Designing Streets is “the first policy document in Scotland on street design” and it describes itself as marking “the Scottish Government’s commitment to move away from processes which tend to result in streets with a poor sense of place and to change the emphasis of policy requirements to raise the quality of design in urban and rural development.” It specifies that “information on principles, layout and street geometry which is not consistent with Designing Streets should be revised [and] Designing Streets should be adopted by all Scottish local authorities or should provide the basis for local and site-specific policy and guidance.”

As with Manual for Streets, Designing Streets puts pedestrians at the top of the user hierarchy and states that street design should be inclusive; “Streets should be designed, not only to allow for walking, but to actively encourage it to take place”. Much of the content is of a similar nature and tone to that in Manual for Streets and there is a similar lack of content on managing pedestrian and cycle conflicts [50].

9 Discussion of findings

The literature review has explored a wide range of publications looking at studies of existing infrastructure and guidance for development of new infrastructure. This has identified areas that have been well researched and others where further research and study would be worthwhile.

9.1 Key findings

This literature review has established that there are areas of consistency and variance across the published literature. These are summarised below:

- *Terminology and rationale*: While there is some consistency in the use of terminology and definition of the infrastructure, there is more variation in descriptions of how the infrastructure is used and who it benefits. Whether this has an influence on how the infrastructure is designed or used is unknown.

- *User priorities:* There is an inconsistency around user priorities (pedestrians or cyclists) at bus stops: who *should* we be prioritising versus who *does* already have priority. There is also inconsistency in where people feel this prioritisation applies and how this is signalled on site by the bus stop design. This lack of clarity is felt to be responsible for a large number of the arguments against bus stop bypasses and boarders and hesitancy from more vulnerable pedestrians. The recent changes to the Highway Code add additional clarity around this issue and bolster pedestrian priority but do not go as far as to legally require people cycling to stop to allow pedestrians to cross at zebra crossings.

- *Preferred bus stop type:* Bypasses are preferred over boarders by the majority of sources, with some guidance only including bypass designs. Some stakeholders have expressed views that boarders could not be made satisfactorily safe for all pedestrians.

- *Implications for inclusive access:* There are strong concerns around how bus stop bypasses and boarders compromise inclusivity and access to public transport for disabled people. Of particular concern are inability to detect the presence of the cycle track, inability to find the crossing point and inability to detect approaching cyclists or establish eye contact.

- *Design of the bus stop:* Basic footprint and principles in the design of bypasses and boarders is broadly consistent across the literature, however, Cycling by Design uses a bypass layout which deviates from the norm, with two crossing points rather than one. There is greater variation in the smaller details including the design of crossing point and basic dimensions of the island, footway and cycleway. Whilst variance could be expected as part of real-world design and installation to adapt to different urban conditions greater consistency could be expected across the guidance without, perhaps, arbitrary variation by guidance geography.

- *Use of zebra crossings:* Studies have concluded that, compared to uncontrolled crossings, mini-zebra crossings are generally a positive addition to bypasses, associated with improvements in clarity, safety and behaviours.

A growing quantity of street design literature includes bus stop bypasses, although boarders lag behind for inclusion in both design guidance and studies. There is still a relatively small number of studies, looking at off-road tests alongside infrastructure in London, Edinburgh, Brighton and Manchester. There is also a limited range of variables assessed by the bypass studies, with the focus primarily on crossing design.

The literature raises a number a suggested features that could improve awareness and adherence to priorities, including warning and control measures for people cycling, but to-date many of these have not been tested and it is unclear how feasible these proposals are.

9.2 SWOT analysis of bypasses and boarders

BUS STOP BYPASSES

This section summarises the findings of the literature review based on what can be inferred about the strengths and weaknesses of the bus stop bypass design, opportunities for improvement and threats to further roll-out of the design.

Strengths

Existence of national and local design guidance

Bypasses are included in several design guides at national and local levels, including the key documents LTN 1/20, Cycling by Design and the Wales Active Travel guidance. This provides designers with a level of confidence that they are acceptable infrastructure and giving some key design factors. However, this could lead to over-confidence in their appropriateness and the level to which they have been researched and tested.

Safety and amenity for people cycling (protection from vehicles)
The major strength of the bus stop bypass relates to their key purpose: improving safety and convenience for people cycling past bus stops and stationary buses. People cycling are kept away from buses and other vehicles on the carriageway and can either divert onto or continue an off-carriageway route.

Simplified interactions at boarding/alighting time
The bypass arrangement allows passengers to board and alight the bus without interaction with people cycling. The boarding and crossing arrangements are kept separate, allowing passengers to focus on one activity at a time, whereas the two activities are concurrent in a boarder scenario. However, studies have typically not studied a comparison between the two arrangements.

Weaknesses

Lack of clarity of priority at crossing
The literature review has highlighted that there remains a lack of clarity over who has priority at the island crossing point and who should yield. While addition of zebra markings does appear to help shift the balance towards pedestrian priority, there is still ambiguity and a difference in response from people walking and cycling. It is unclear what factors are causing this lack of clarity. This issue is somewhat superseded by the changes to the Highway Code.

Lack of clarity of priority on bypass cycle track
Similarly, there is a lack of clarity on priority in the remainder of the bypass cycle track. A zebra crossing appears to increase the sense of pedestrian priority on the remainder of the bypass track, but this again is not definitive.

Spatial requirements
A bus stop bypass requires a significant footprint, both in width and length, often much wider than the combined space available between footway and cycle facilities. As a result, there are many locations where there is insufficient space to achieve the minimum design standards. While Cycling by Design does suggest that additional space can be gained by reallocation from the carriageway, there is no further guidance on how this can be achieved.

Unsuitable on downhill sections
Bypasses may be unsuitable for locations where they are approached on a steep downhill gradient, due to the faster cycle speeds that may occur.

Opportunities for improvement

Clarify priorities
There is a need and opportunity to clarify priorities at crossings and the wider bus stop area, particularly as this appears to be the area of most concern for inclusivity.

This may come through signage and markings, materials or other controls on the site, and could be reinforced through further legislative changes.

Threats to further roll-out

Challenge by accessibility groups

There is currently significant concern and opposition to bus stop bypasses from groups representing disabled people. Guidance typically recommends that such groups are included in design development but it seems clear that they are the most disadvantaged by this infrastructure.

Pedestrian and cycle flows

Some studies and guidance suggest that bus stop bypasses may be unsuitable where pedestrian, cycle or passenger flows are particularly high.

Lack of space – lack of ability to reclaim carriageway space

In many locations it will be difficult, if not impossible, to reclaim sufficient space to install a bus stop bypass. In others, it may require significant amendments to streetspace allocation and the way the whole street functions.

BUS STOP BOARDERS

Bus stop boarders appear to be more contentious than bypasses, seen as either unavoidably dangerous or potentially the safer design choice. Due to a lack of studies, it is more difficult to assess the merits of a bus boarder, however a subjective assessment has been made below.

Strengths

Existence of national and local design guidance

Although less favoured than bypasses, boarders are included in several design guides at national and local levels, providing designers with a level of confidence that they are acceptable infrastructure and giving some key design factors. However, this could lead to over-confidence in their appropriateness and the level to which they have been researched and tested.

Safety and amenity for people cycling (protection from vehicles)

As with bypasses, a key strength of bus stop boarders is the improved safety and convenience for people cycling past bus stops and stationary buses.

Spatial requirements

Bus stop boarders have a smaller footprint than a bypass, making them more straightforward to install on many streets and reducing the need to reconfigure the street and carriageway space. This has particular benefits for temporary schemes and fast roll-out, including as part of Covid-19 active travel improvements.

Weaknesses

Lack of clarity of priority on boarder

The designs included in existing guidance do not include features that clarify priorities on the boarder area, though designs typically continue the appearance of the cycle track. In contrast, Danish highway rules are clear that people cycling should yield to pedestrians crossing this type of infrastructure. This issue is somewhat superseded by the changes to the Highway Code.

Potential confusion for bus passengers

People alighting from the bus may not be aware that they are stepping into a shared used zone, with particular risk for disabled people. The inclusion of a buffer zone may improve safety and comfort however this has not been surveyed at present.

Opportunities for improvement

Clarify priorities

There is a need and opportunity to clarify priorities. As with bypasses, this may come through signage and markings, materials or other controls on the site, and could be reinforced through further legislative changes.

Threats to further roll-out

Lack of published studies

At present, no published studies were identified that investigate the safety and amenity of bus stop boarders. This means that their use could be difficult to justify, particularly if there are concerns from stakeholders around accessibility and inclusion. The current research by Transport for Greater Manchester and Transport for London will be of significant value.

Challenge by accessibility groups

At present, RNIB has stated strong objections to the concept of bus boarders, considering that they present unavoidable risk to pedestrians. Although several guides recommend involving accessibility groups in design development, it may be impossible to amend the design sufficiently to address these concerns.

9.3 Consequences for Living Streets research

This review has been conducted as part of a project to investigate how bus stop bypasses and boarders can be introduced in a way which allows increased safety and amenity for people cycling, supporting cycling for everyday use, without compromising how inclusive our streets are.

The weaknesses and threats outlined suggest there are several gaps in existing knowledge and design practice that could be explored and tested through the primary research stage of the project.

Clarification and indication of priority

Probably the most significant and most commonly-cited issue is the lack of clarity over which users have priority. This is clearly a complex issue affected by factors beyond the physical design of the infrastructure. Further consideration and research into this issue is needed to address the well-founded concerns of many stakeholders. Although the Highway Code update clarifies a number of the issues raised, there is a question over how well known and understood these changes are. With some of the rules falling short of being legal requirements, there remains a need for the physical infrastructure to help guide and inform all users.

Alongside more familiar and 'analogue' signage and markings, the literature review highlighted several safety and priority measures that appear relatively innovative and may be untested for this use. There could be opportunities to work with design teams and stakeholder groups to test their impact on pedestrian and cyclist behaviours. The outcome would be an enhanced understanding of how effective these measures are, and which should be recommended for use in what circumstances.

Adaptation to different street conditions

Given the large footprint of the standard bypass designs, it is clear that it will not be feasible to use them in many circumstances. We know there are numerous variant and hybrid designs in use across the country and there is an opportunity to explore how these standard designs have been adapted to different physical and use conditions and assess what impact this has on their safety and functionality. This could include varying conditions including narrow streets, bi-directional routes, busy cycle routes, or bus stops with high passenger use. The outcome of this area of study could include guidance on how to adapt standard designs for compromised sites, allowing for a wider roll-out. This greater consistency of design would give all users, particularly disabled people and other vulnerable users, greater confidence in using the facilities.

Testing varying combinations of elements

The published studies have focused mainly on the effects of varied crossing design, mostly addressing height of crossing (footway or cycleway level), presence or absence of a zebra crossing, and use of Belisha beacons. Other studies have looked at the effectiveness of a single design without having other designs to compare against. As a result, many of the design factors have not been studied in

detail and it has not been possible to undertake a multiple regression[i]. This study has potential to explore a wider variety of design elements and their implications and could be particularly valuable if participant perception studies form a part of the research.

9.4 Wider consequences

This review identifies a need to improve guidance to remove inconsistency and provide all users with greater confidence in how to use these facilities. Clearly people, walking or cycling, will travel across the country and could encounter these facilities in different areas but need sufficient consistency of design to allow them to confidently navigate through streets and use the infrastructure.

The review has identified that while Danish highway legislation is clear about give-way responsibilities at bus stop boarders (it should be noted that the design of Danish bus stop boarders can differ from the typical designs found in UK guidance), this is not the case in the UK, with an absence of reference to this infrastructure in key legislation including the Highway Code. The inclusion of bypasses and boarders in national and local guidance will inevitably encourage their use, but further finesse of the designs and guidance is needed before further roll-out can be actioned in confidence.

[i] Multiple regression is a statistical technique used to measure the degree to which multiple variables have an impact on the outcome of another variable. It can be used to compare designs at different locations where more than one factor varies, such as cycle track width or island design.

Appendix 1. Design guidance

National guidance and standards

Cycling by Design 2021 (Transport Scotland, 2021)

Cycling by Design provides guidance to all those designing and developing cycling infrastructure in Scotland. The 2021 update has significantly increased the level of detail on improving safety for people cycling at bus stops by including two off-carriageway design options, with a preference for bus stop bypasses. Where there is insufficient space for a bypass, there is a 'cycle track at bus boarder' design, which is notably different to most other boarder designs.

Figure 16 "Bus stop bypass (with island)" [Figure 3.22] [2]

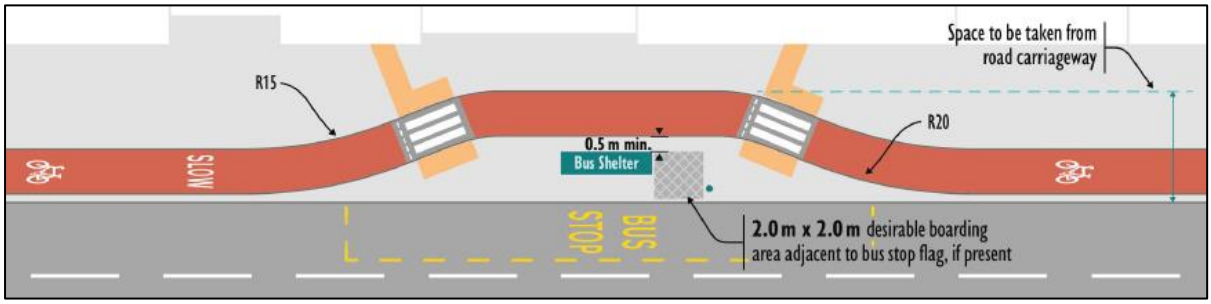
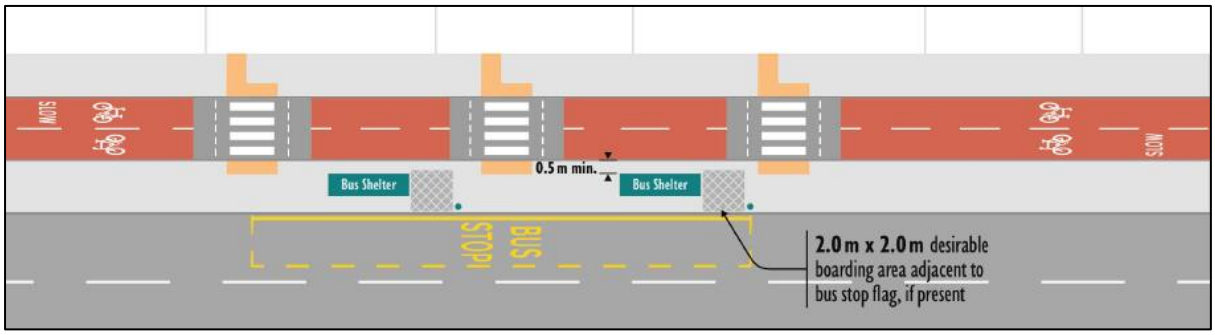


Figure 17 "Bus stop bypass (continuous island)" [Figure 3.23] [2]



Local Transport Note 1/20 Cycle Infrastructure Design (Department for Transport, 2020)

LTN 1/20 provides guidance and good practice for cycle infrastructure design in England and Northern Ireland. The guidance covers cycling at bus and tram stops, with options for bypass and boarder arrangements. Shared used facilities should be used as a last resort "if well-designed and implemented" and "designers should be realistic about cyclists wanting to make adequate progress".

Figure 18 "Bus stop bypass layout" [Figure 6.30] [1]

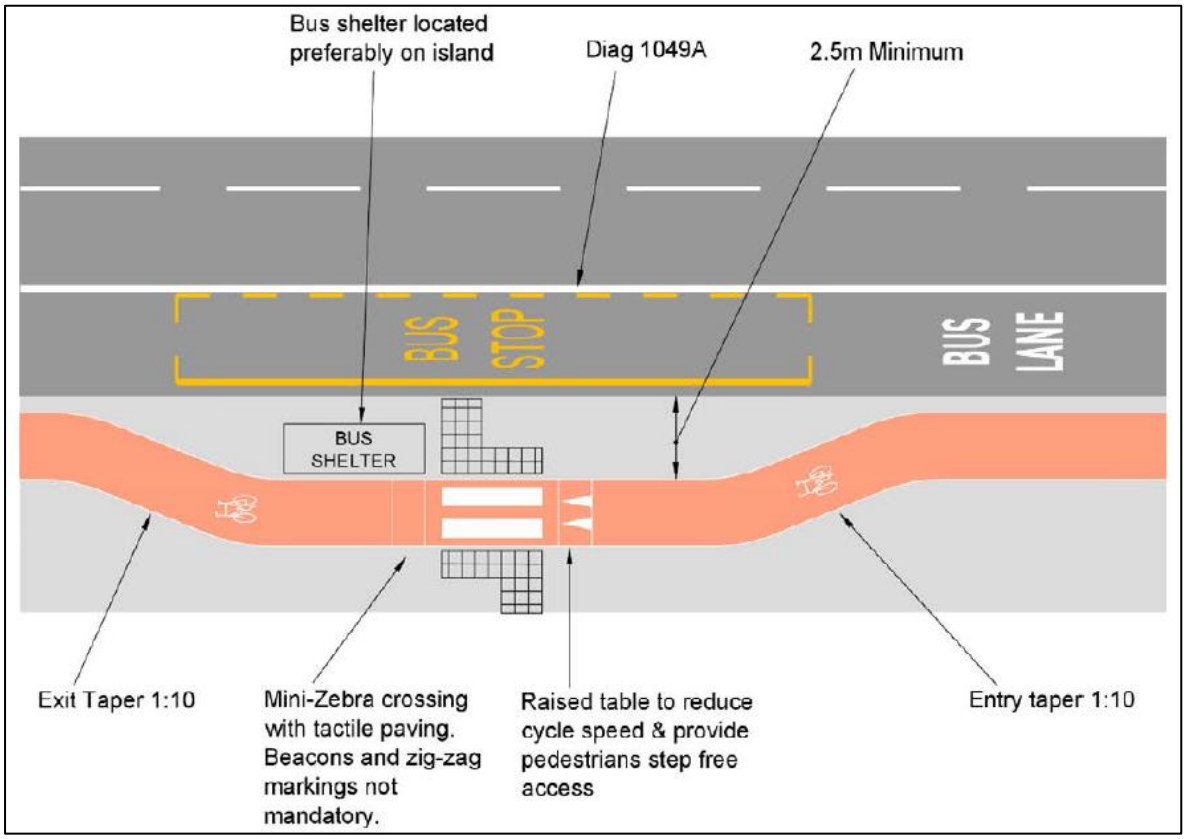
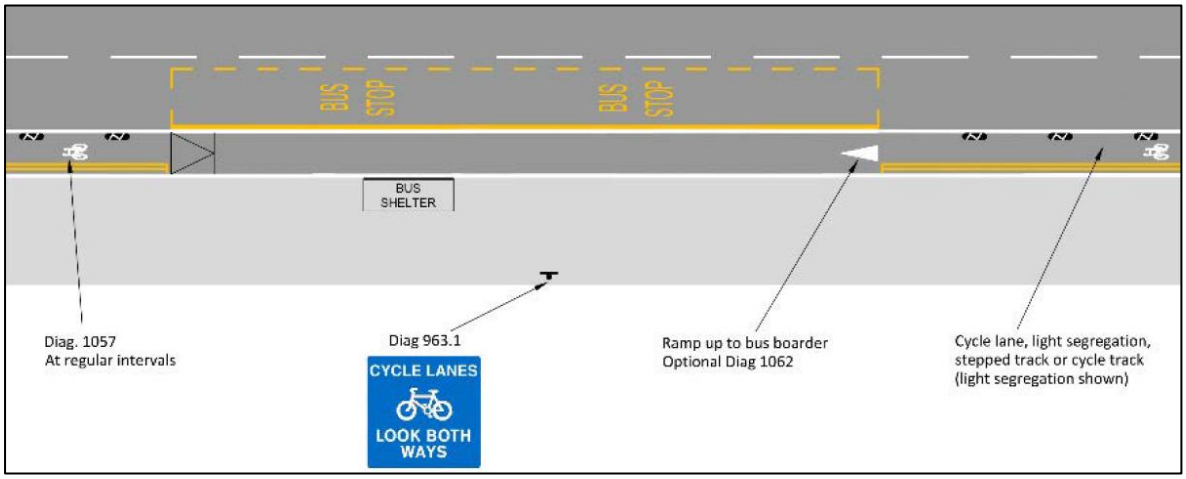


Figure 19 "Bus stop boarder layout" [Figure 6.32] [1]



Active Travel Act Guidance (Welsh Government, 2021)

The document provides guidance under the Active Travel (Wales) Act 2013 for planning, designing and maintaining active travel routes and related facilities in Wales. Compliance with the guidance will be required to secure Welsh Government funding for future schemes. The guidance includes one scenario for on-carriageway cycle facilities at bus stops, and three off carriageway arrangements: 'island bus stops' (bus stop bypasses), bus boarders, and a 'shared use' design.

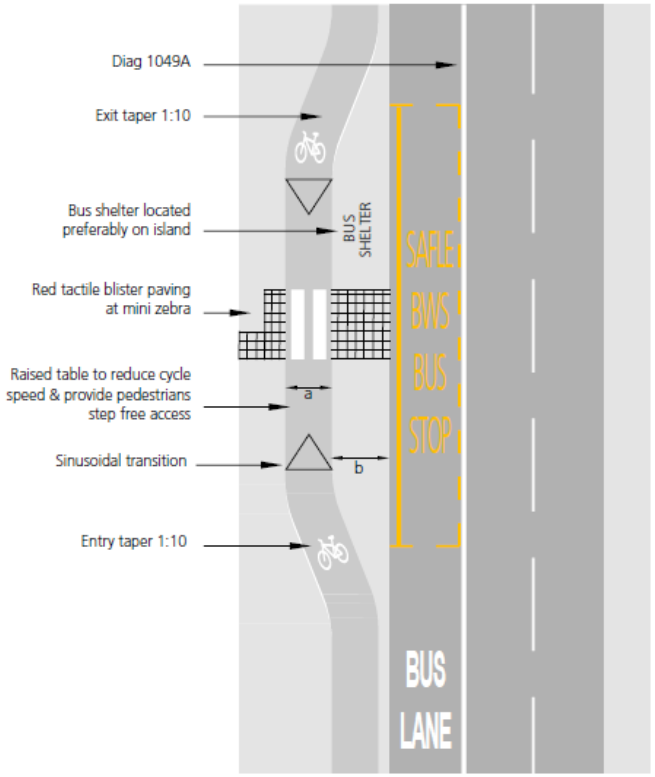


Figure 20 "DE502 Bus stop: island bus stop" [3]

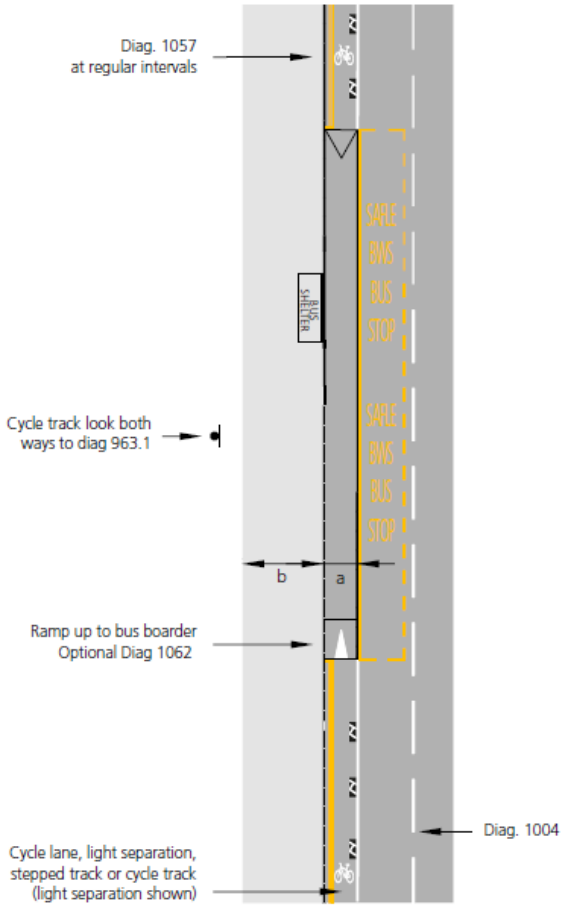


Figure 21 "DE503 Bus stop: bus boarder" [3]

Inclusive Mobility: A Guide to Best Practice on Access to Pedestrian and Transport Infrastructure (Department for Transport, 2021)

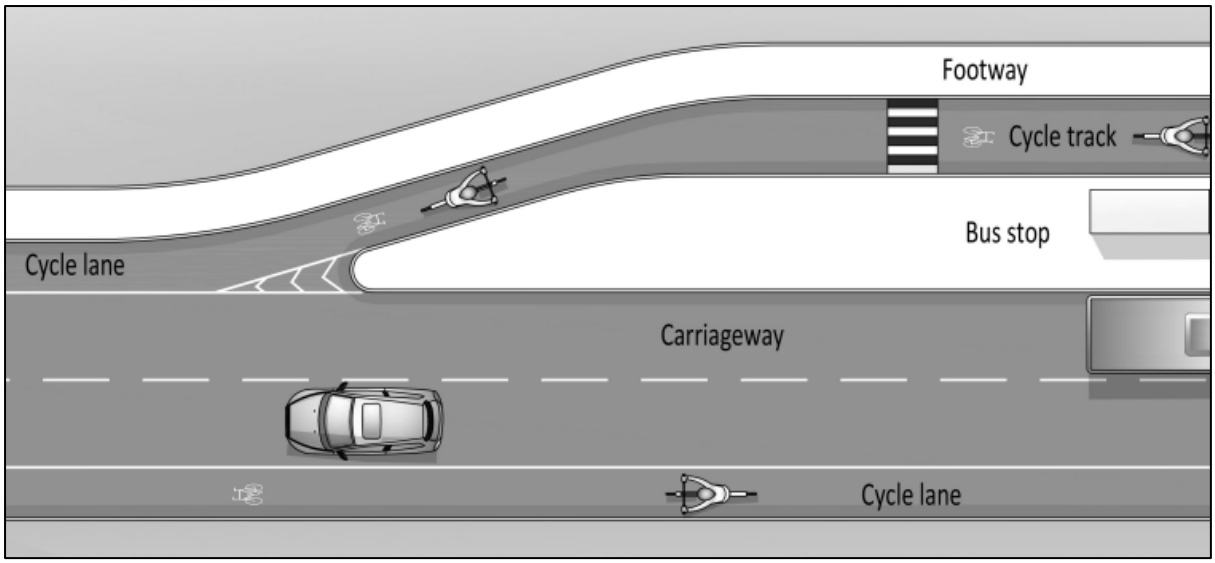
Inclusive Mobility, updated in December 2021, is the Department for Transport's guide to best practice on access to inclusive access in pedestrian and transport infrastructure. It includes a brief mention of bus stop bypasses.

Design Manual for Roads and Bridges. Road Layout Design. CD 195: Designing for cycle traffic (Highways England, 2021)

This document provides requirements and advice relevant to the UK motorway and trunk road network for the design of infrastructure for cycle traffic. It instructs cyclists should be routed behind the bus stop (a bypass) and the design should mean that

disembarking passengers do not step directly onto the cycle track. A zebra or mini-zebra crossing can be provided. No critical dimension are given.

Figure 22 "Zebra crossing across a cycle track at a bus stop" (Figure E/3.15N3) [7]



National legislation

The Traffic Signs Regulations and General Directions 2016 (TSRGD) and Traffic Signs Manual (various)

TSRGD prescribes the designs and conditions of use for traffic signs, road markings, traffic signals, and crossings that can lawfully be used and enforced in England, Scotland and Wales. The Traffic Signs Manual provides further assistance on compliance with the regulations. The regulations and guidance make provision for a special type of zebra crossing for use on cycle tracks, with reduced size and option for omission of Belisha beacons.

The Highway Code (Department for Transport, updated January 2022)

The Highway Code identifies the legal requirements and other rules for use of roads in England, Scotland and Wales. It covers a wide range of factors and considerations that will affect how people move around streets using various modes. Rule H1 has been introduced to outline the 'hierarchy of users' while Rule H2 clarifies priorities and give way requirements, including the legal requirement that "You MUST give way to pedestrians on a zebra crossing", and instructs but does not have a legally enforceable obligation to stop to let pedestrians cross.

Local guidance

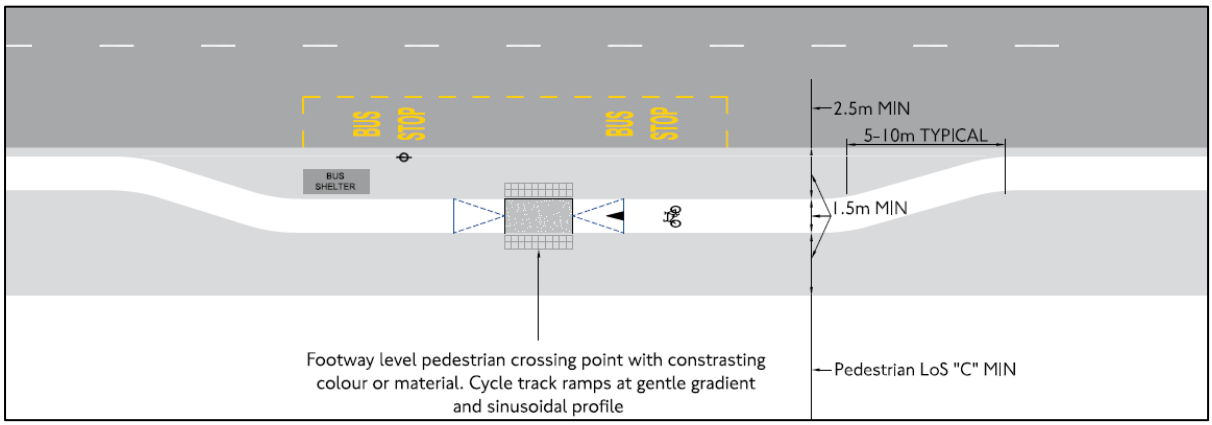
London Cycling Design Standards (Transport for London, 2016)

The London Cycling Design Standards (LCDS) sets out Transport for London's (TfL) requirements and guidance for the design of cycle-friendly streets and spaces, including integration with bus stops.

Accessible Bus Stop Design Guidance (Transport for London, 2017)

The Accessible Bus Stop Design Guidance sets out TfL's requirements and guidance for the design of accessible bus stop environments and forms one part of the Streetscape Toolkit. It includes guidance for bypasses and on-carriageway routing around the bus stop cage but does not include boarders (n.b. use of the term 'boarders' in the guidance refers to kerb build-outs to help passengers to board and alight the bus). This guidance post-dates the LCDS so has been used as the primary reference for TfL's standpoint in this study.

Figure 23 **"Indicative bus stop bypass layout" [Figure 23] [5]**



Guidance Note: Pedestrian crossings at Bus Stop Bypasses (Transport for London, 2018)

The note supplements the guidance provided in the LCDS and Accessible Bus Stop Design Guidance to recommend that a Zebra crossing on a raised table should be provided at bus stop bypasses and establish 'standard layouts' for uni- and bi-directional routes.

Figure 24 "One-way cycle track" [Figure 2.2] [35]

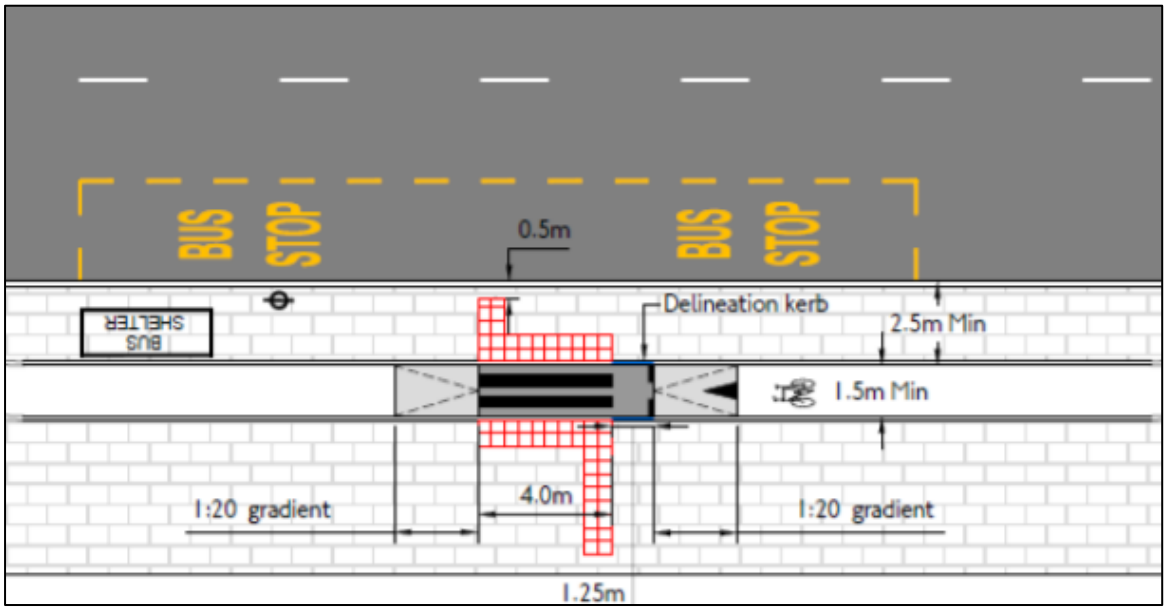
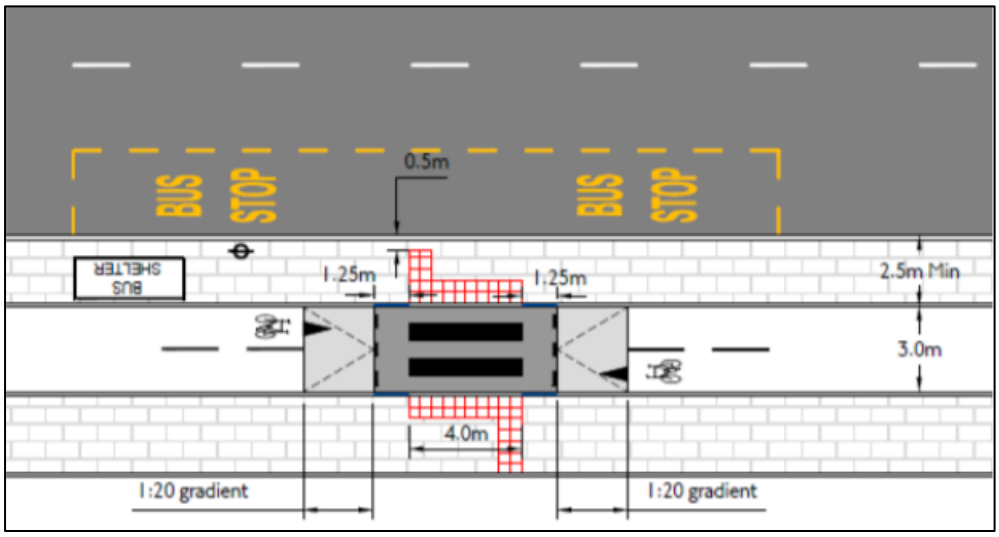


Figure 25 "Two-way cycle track" [Figure 2.3] [35]



Edinburgh Street Design Guidance: Part C – Detailed Design Manual (City of Edinburgh Council, 2017)

This guidance outlines several options for integration of cycle facilities at bus stops: 'floating bus stop with shelter located on island' (akin to a typical 'bus stop bypass'), 'floating bus stop with shelter located on footway' (a hybrid between a bypass and boarder), 'cycle track through bus boarder' (akin to a typical bus stop boarder) and 'shared use footway' (with a shared use area across the whole bus stop area). It outlines key advantages, disadvantages and design considerations for each bus stop type and considers suitability for different conditions.

Figure 26 "Floating Bus Stops - Bus shelter located on island" [8]

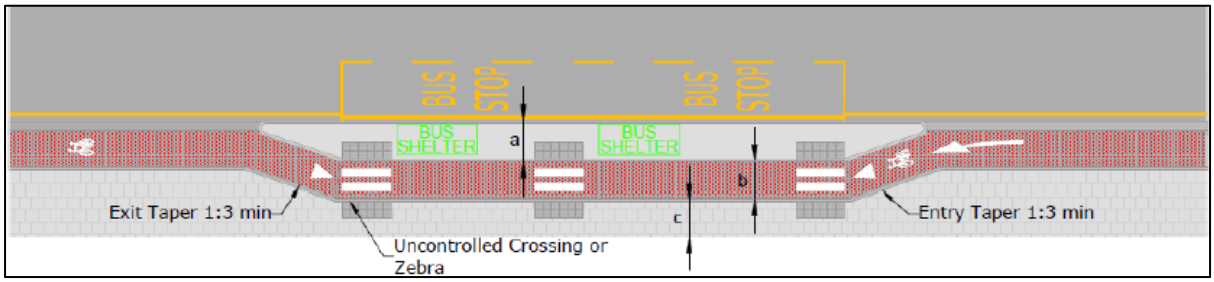


Figure 27 "Floating Bus Stops - Bus shelter located on footway [8]"

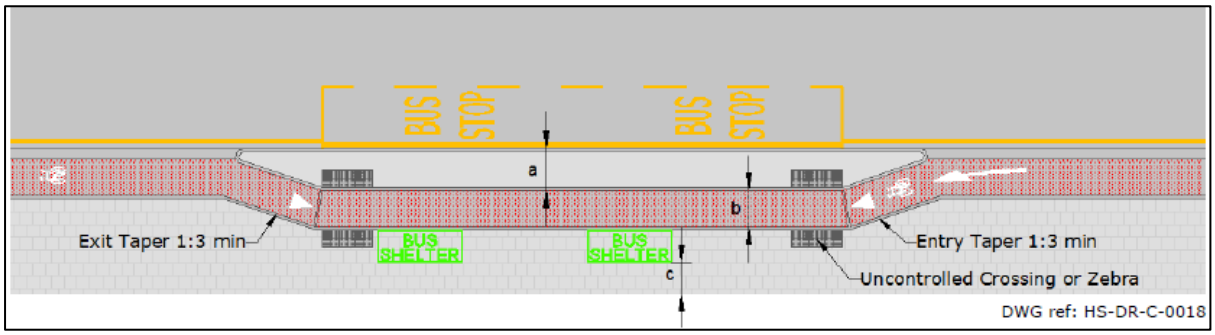
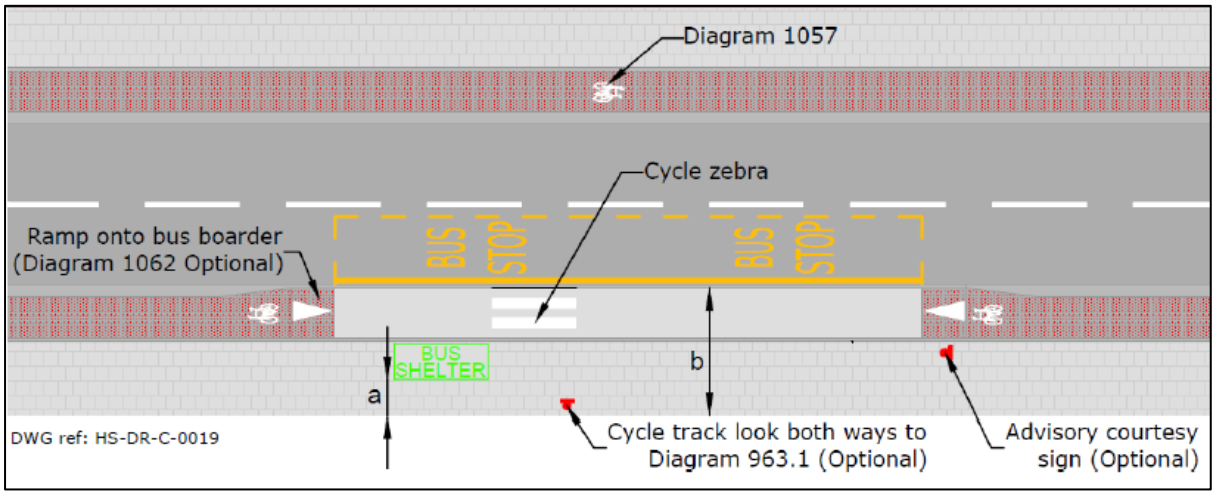


Figure 28 "Bus Boarder - Cycle track through bus boarder" [8]



Greater Manchester Interim Active Travel Design Guide (Greater Manchester Combined Authority and Transport for Greater Manchester, 2021)

Greater Manchester Combined Authority produced the guide to provide interim guidance for the design of schemes on the Bee Network and other active travel schemes. The guide uses the designs for bypasses and boarders from LTN 1/20, while providing additional local criteria and considerations for usage and implementation.

West Midlands Cycle Design Guidance (Transport for the West Midlands, 2017)

This design guidance provides a 'good practice' guide to design of cycle facilities within the West Midlands, including a brief reference to cycle tracks at bus stops.

The guide is intended to summarise national guidance but as it pre-dates LTN 1/20, should be considered with caution.

Shared Use Bus Boarders: Context and design considerations (Camden Council)
Camden Council produced interim guidance for the safe accommodation of cycling at bus stops, with a focus on boarders. The guide is intended to set out design considerations as part of the Covid-19 response and notes that the basic design may differ from what may be put into a permanent scheme. Template designs are shown for bypass and 'shared use bus boarder' interventions, with the intention that implemented schemes will be monitored and evaluated during the 6–18-month experimental period.

Figure 29: "Template for cycle bypass, where footway or road space is generous" [Fig.1] [24]

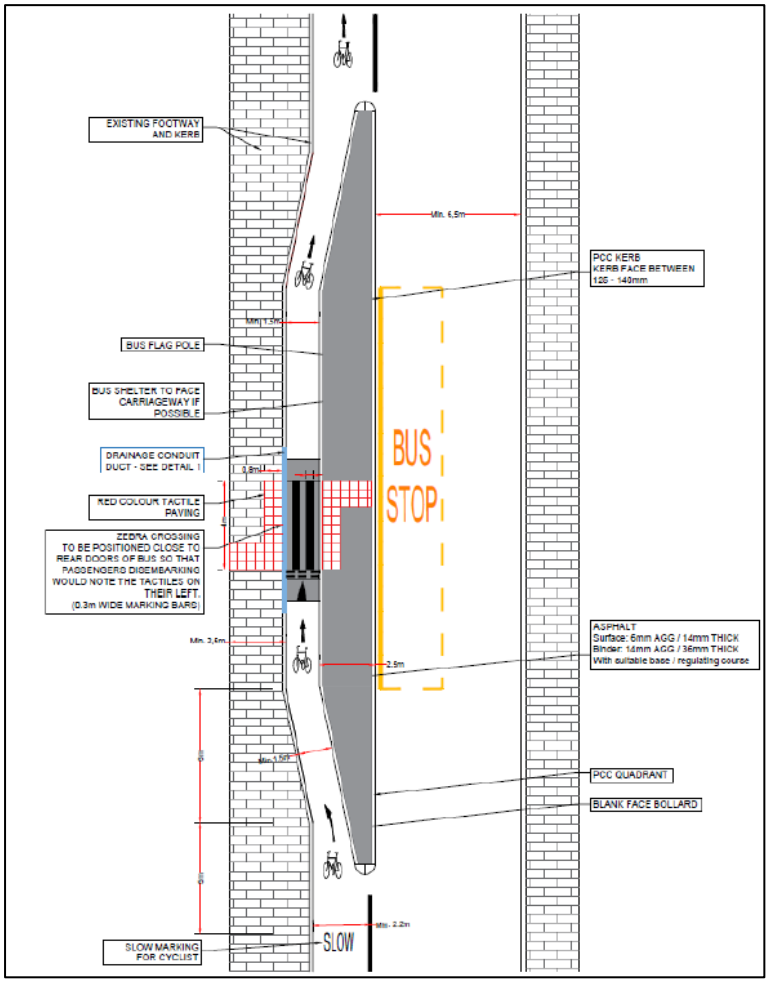
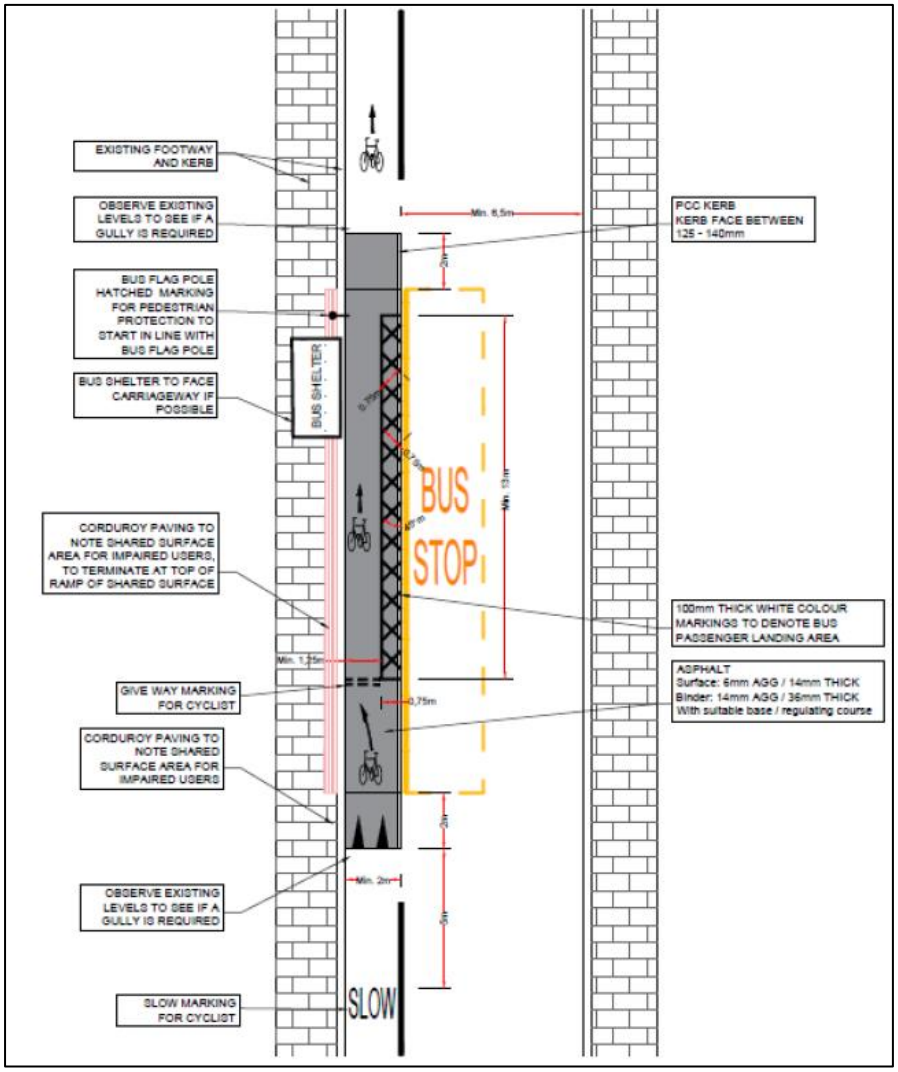


Figure 30: "Shared Use Bus Boarder, where footway widths are tighter" [Fig.2] [24]



Leicester Street Design Guide (Leicester City Council, 2020)

Leicester City Council has produced a design guide for future changes to the city's streets and roads to continue the current process of favouring walking and cycling. The guide includes mention of bus stop bypasses but limited specific design guidance beyond cycle track width and notes that "Designs must meet the principles as set out in the main Leicester Street Design Guide."

Appendix 2. Key UK studies

Cambridgeshire 'floating bus stops' interaction analysis (Sustrans, 2015)
In their analysis of two bus stop bypasses in Cambridge, Sustrans found that, using an interaction scoring system, all interactions between people cycling and other road users were given a low score, which is "generally considered safe and normal behaviour", though it was concluded that "it does appear that pedestrians are making more adjustments at these sites than cyclists" [27].

Oxford Road Trial Bus Stop Evaluation Report (Transport for Greater Manchester, 2016)
Transport for Greater Manchester developed a trial bus stop design[i] to test through surveys, video analysis and site visits. The study raised key issues that it considered require further investigation: who has priority; separation and interaction issues; and speed of people cycling [14]. Over a 19-hour period, there were 35 minor and 18 major 'conflicts', with conflict more frequent at busy times. Positively, there were no 'contact events' during either this or a longer observation period (24-hour, seven-day period) although two cyclists reported having been in a collision. Over 90% of surveyed bus users stated that they would be happy to use the stop again, with 77% confidence level from people cycling. 6% of people cycling and 2% of bus users found the bypass difficult to use.

Lewes Road: Interim Post-Construction Monitoring Report (Brighton & Hove City Council, 2016)
Brighton and Hove City Council monitored the success of a series of interventions at Lewes Road, including creation of several bus stop bypasses. The study considered that the bus stops have been successful with over 84% user satisfaction levels with regards to both ease of use and safety. There were no accidents recorded in the vicinity of the bus stops. Compared to bypass designs seen in other studies and guidance, these bypasses are relatively simple with dropped kerbs, no marked crossing, and no contrasting surface on the cycle track.

Off-street trials of a bus stop bypass - An assessment of user perceptions, safety, capacity and accessibility [PPR730] (York and Tong for TRL, 2014)
A bus stop bypass was built on TRL's test track to facilitate three trials: one involving cyclists and pedestrians using the bypass under different flow conditions; a second conducted with people who had a range of disabilities (including sight, hearing and mobility issues); and a third looking at capacity of the island. The studies considered the design of crossing points, with scenarios with/without a zebra crossing and using dropped kerbs versus a ramped table crossing. Movement and

[i] The trial bus stop had a kerb edge and cycle track that contrasted with the footway. The track is marked with green LEDs and set 75mm lower. The bypass serves two stops and includes two uncontrolled crossings and a zebra crossing with Belisha between the stops.

interaction were observed, and participants were asked to provide feedback on their perceptions of the bypass. The vast majority (98%) of interactions between people walking and cycling were minor with only 1% involving a participant changing direction and typically occurring at the dedicated crossing point.

As the study looks at an off-street scenario rather than a real-world example, this may affect how participants acted and could impair its applicability.

London bus stop bypass studies [PPR855, PPR854, and PPR853][i] (Various for TRL, 2018)
TRL has undertaken parallel studies looking at safety and ease of crossing at bus stop bypasses through video analysis, accompanied visits with disabled people, and a user survey. The studies looked at six bus stop bypasses in London with varying physical characteristics, including both uni-directional and bi-directional cycle tracks and bypasses with uncontrolled crossing and zebra crossing configurations[ii].

Accessible Public Realm: Updating Guidance and Further Research (Barham for TRL, 2020)
TRL led a research project for Department of Transport to inform proposed updates to existing Government guidance documents on inclusive street design. Specifically relevant to this study, a literature review and stakeholder workshops were undertaken to consider potential new themes for addition to *Inclusive Mobility*, including bus stop bypasses. A broad conclusion was that bypasses should be included but that guidance should reflect concerns about their impact on people with impaired mobility while acknowledging the benefits to people cycling, including disabled cyclists and those using cycles as a mobility aid.

New cycle infrastructure on London's streets: Summary report of on-street trials (TfL 2018)
The report summarises TfL's findings from assessments on the impact of new cycle infrastructure on London's streets. It draws on several related studies by TRL, including the 2018 London bypass studies, and sets out TfL's conclusions. It refers specifically to crossings at bypasses and concludes that zebras should be implemented at new and proposed bypasses on the Transport for London road network.

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[i] Study references: Greenshields and Davidson, PPR855: Pedestrians and cyclists survey [30]; Greenshields, Chowdhury and Jones, PPR854: Analysis of pedestrian and cyclist behaviour via video [17]; and Greenshields and Davidson, PPR853: Accompanied visits of people with disabilities to Bus Stop Bypasses [29].

[ii] Stratford and Whitechapel sites: uni-directional cycle track with chicane; one zebra crossing including a Belisha beacon. Blackfriars sites: straight bi-directional cycle track; one zebra crossing including a Belisha beacon.

Leith Walk cycling infrastructure analysis: Summary of key findings (AECOM, 2018)
AECOM were commissioned by the City of Edinburgh Council to assess the operation and safety of three new bus stop bypasses on Leith Walk (since replaced as part of a bigger scheme), visiting the site in November 2017, May 2018 and November 2018. The study found relatively low numbers of interactions between people walking and cycling, with the vast majority involving either a precautionary or controlled action and no collisions or very near misses. There was a significant decreasing trend of people cycling giving way to pedestrians, falling from 69% in 2017 to 48% in May 2018 and 31% by November 2018.

More interactions, and more higher-severity interactions, were found when people walking and cycling were travelling in the same direction. Additionally, 40% of interactions were due to activity related to the bus stop. Between 40% and 60% of passing pedestrians entered the cycle track, often to pass slower walkers, although this had decreased to around 20% by the end of the study, suggesting familiarity with the layout. There was an increase in interactions over time however this corresponded with a temporary narrowing of the pavement which could have affected pedestrian movements, and there was a downward trend between the first two survey periods.

The study concluded that "Two of the main causes of interactions between non-motorised users were found to be pedestrians walking on the cycle track and overcrowding of the pavement". The report recommends that design measures are used to increase pedestrians' awareness of the design of the bypass, including signage, markings, colour contrasts and level changes. This could be coupled with local information campaigns or information at the bus stop.

Analysis of cyclist-pedestrian interactions at a floating bus stop site in Edinburgh, United Kingdom (Transport Research Institute at Edinburgh Napier University, 2018)
As part of AECOM's study, the Transport Research Institute undertook a more detailed behaviour on the northbound stop. Concurring with the larger AECOM work, the study concluded that there are more interactions when people walking and cycling are not facing each other. The interactions in this case are also of higher severity. The main causes of interactions were found to be pedestrians walking on the cycle track (75%), pedestrians crossing the cycle lane (16%) and pedestrians waiting or standing in the cycle lane (10%). The report recommends changes to increase pedestrian awareness while also increasing alertness of people cycling and encouraging slower speeds.

Commenting on the AECOM and TRI studies, David Hunter of Not for Profit Planning has noted that the studies did not establish whether interactions were more likely between certain groups of people walking and cycling, did not assess the impacts on disabled people and did not assess user perceptions, noting that his could be an

important dimension to the study. Hunter further notes TRI's figures imply an interaction rate of over 5000 'controlled actions' and 150 'near misses' at a single stop in a year. [51]

Appendix 3. Other publications and references

A Guide to Inclusive Cycling (Wheels for Wellbeing, 2020)
Wheels for Wellbeing, an inclusive cycling charity, has produced guidance on the basic principles of inclusive cycling. The guide includes discussion of the problems and potential solutions regarding bus stop bypasses, concluding that, planned properly, bypasses are a positive feature, but may require further study and the addition of technical solutions to alter users to potential conflicts.

Designing for Cycle Traffic: International principles and practice (Parkin, J, 2018)
This book compares and evaluates international principles and design approaches to cycle traffic provision, set within a wide context of public realm design and planning. It includes a short discussion of the usage of bypasses and boarders and some key design principles.

Consultation outcome - Government response to the review of The Highway Code (Department of Transport, Updated 30 July 2021)
During 2020, UK Government consulted on proposed changes to improve safety for vulnerable road users, with the results and proposed amendments published in July 2021. One proposed change concerns the wording for zebra crossings to include parallel crossings and makes it more explicit that drivers, motorcyclists, horse riders and people cycling should give way to pedestrians waiting to cross, while not going as far as making it a legal requirement. Over 95% of respondents agreed with the proposal, although many believed this was already the norm. Others had concerns that pedestrians may assume it is safe to cross and not check first and that there needed to be clarification that pedestrians have duty of care for their own safety.

RNIB's response to DfT's "Review of The Highway Code to improve road safety for cyclists, pedestrians and horse riders" (RNIB, 2020)
RNIB has published a response to the proposed review of the Highway Code, in which it expresses support for the proposed 'hierarchy of road users' which puts pedestrians at the top. It notes that no explicit mention is made of priority at bus stop bypasses and boarders and that clarity is critical as many blind and partially-sighted people cannot rely on inter-visibility or attentiveness to allow them to safely navigate the spaces.

Royal National Institute of Blind People (RNIB) Scotland Response to the City of Edinburgh Council Consultation Meadows to George Street: Concept Design Consultation, (RNIB Scotland, 2019)
RNIB Scotland responded to proposals to transform parts of Edinburgh City Centre, which includes installation of a cycle route and corresponding bus stop bypasses.

RNIB Scotland comment that access to public transport is particularly important for many disabled people. Bypasses must provide a formal crossing facility that gives legal right of way to any pedestrian needing to cross the cycle track, with full tactile paving and auxiliary aids such as an audible and tactile beacon which indicates when it is safe to cross. Warning markings and signage should be installed to instruct people cycling to stop when pedestrians are near or on the formal crossing, along with notices to reduce speed marked at regular intervals on the bypass. Full kerbs of a minimum 60mm are also required.

Policy Position Statement: Access to bus stops (bus stop bypasses and bus stop boarders) (RNIB, 2021)
RNIB has published a position statement clarifying the organisation's views on bus stop infrastructure and the impacts on blind and partially sighted people. It notes that RNIB objects to their use and is calling for a halt to their further roll-out, citing issues with the creation of areas of shared space at boarders and lack of provision of safe crossing points on bypasses.

Seeing streets differently: How changes to our streets and vehicles are affecting the lives of blind and partially sighted people (RNIB, 2021)
RNIB has published the results of a survey of blind and partially sighted people who were asked about their experience of walking journeys and what makes these easier or more difficult. This includes discussion of bus stop bypasses and related infrastructure and design choices, and their implications for inclusive access.

Making the built environment inclusive - guidance on ensuring regeneration schemes are accessible for people with sight loss (Aluko-olokun and Marsh for Guide Dogs, 2021)
Guide Dogs has published a design guide to assist designers and local authorities to create places that are inclusive of people with sight loss. There is a specific section on "Floating Bus Stops, Bus Stop Bypasses and Bus Boarders" which addresses the key issues and provides a list of design features required including audible aids and tactile paving at crossing points, signage to instruct cyclists to stop for pedestrians, instructions to cyclists to slow down, full kerb upstands, and guidance paving leading to crossing points.

Temporary active travel facilities – draft factsheet (Sustrans, 2021)
Although the Sustrans factsheet specifically refers to temporary facilities put in as part of a Covid-19 response, it includes some important considerations for permanent facilities, particularly with regard to inclusivity, accessibility and minimising risk of conflict.

Bicycle Tracks and Lanes: a Before-After Study (Jensen, S for Trafitec ApS, 2007)
Trafitec, a Denmark-based private research-based advisory centre, undertook a study of the implications for accident rates of installing cycle lanes and tracks on

some of Copenhagen's busiest streets. It found that installation of cycle tracks resulted in a significant increase in incidents involving cyclists and boarding/alighting pedestrians at bus stops, rising from five incidents to 73. The study notes that installation of cycle infrastructure could encourage people to cycle in those streets who otherwise would not, increasing the numbers of people cycling and the likelihood of an incident, regardless of who may be at fault.

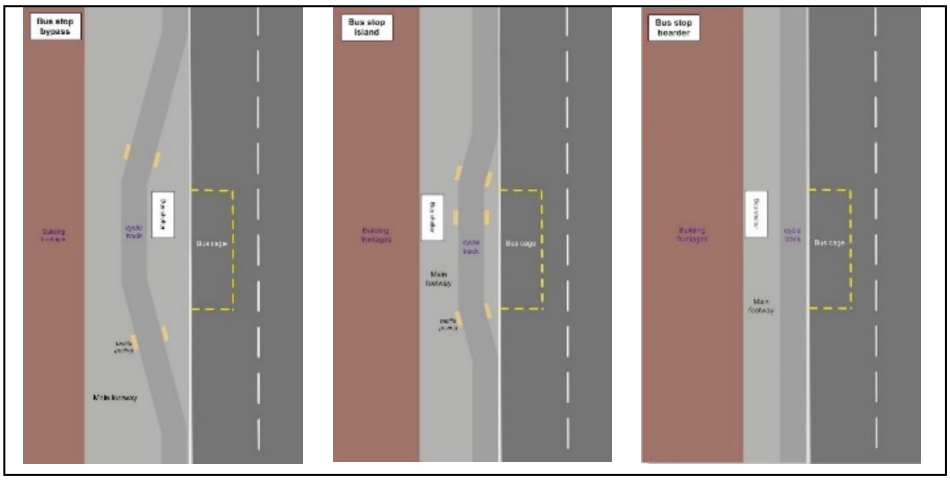
The study also refers to "expected" incident levels which is not an expectation of the safety of the cycle infrastructure but instead is based on estimates of future incidents if no cycle infrastructure was installed - calculated based on existing data adjusted for changes in traffic flow, crash trends and 'regression to the mean'.

Udformning af busstoppesteder på supercykelsti-rute Hjallesevej-Odensevej-Svendborgvej (Jensen, S for Trafitec ApS, 2020)
[Translated as: Design of bus stops on the superbike path route Hjallesevej-Odensevej-Svendborgvej].

Trafitec were commissioned by Odense Municipality to develop proposals for a new design of bus stop on the upcoming 'superbike route' Hjallesevej-Odensevej-Svendborgvej. The study looked at 24 stops along the route and identified suggestions for their design, ensuring they allowed for a cycle track of at least 2.5m width along both sides of the street. The study looked at implications for bus movement and movement of other vehicles, alongside consideration of people walking and cycling.

Bus boarders, islands & bypasses (Waltham Forest Cycling Campaign)
Local campaign group, Waltham Forest Cycling Campaign produced a short webpage outlining their preferred bus stop types for accommodating cycling at bus stops. First preference is a standard bypass, with second preference to a 'bus stop island' and third preference to a boarder without buffer zone.

Figure 31 **Bus stop bypass, bus stop island and bus stop boarder diagrams [10]**



Belusic obo Canadian Federation of the Blind v. City of Victoria and another (No. 4), 2020 BCHRT 197[i] (British Columbia Human Rights Tribunal, 2020)

A recent human rights ruling in British Columbia, Canada, found that the bus stop bypass design used on the Pandora Bikeway discriminated against blind people as it did not provide a safe crossing to access the bus. A comparison was made to the Wharf Street Bikeway which uses:

> *"a flashing yellow light with an audible signal, activated by a pedestrian wishing to cross to the Floating Stop via a Stop Crossing. Activation starts the flashing yellow light signal and audibly communicates that it has been activated. On the evidence the audible flashing light notifies the blind pedestrian the signal is activated. It notifies any approaching cyclist or user that the pedestrian intends to enter the Stop Crosswalk and that they are required to yield when the pedestrian does so – a very different scenario than depicted in the evidence of witnesses for the Complainant or in the video. " [41].*

The case concluded "I find that the pedestrian activated audible flashing yellow is a reasonable accommodation of the issue raised by this complaint at this point in time" but noted "However, the use of the audible flashing light is not a full answer either. It satisfies the [bona fide reasonable justification] requirements at this point in time but does not mean the City should not implement technologies that would provide fully guaranteed protection for blind pedestrians if such solutions become available in the future and would not result in undue hardship to the City" [41].

The tribunal ruled that alternative technological solutions suggested by the Complainant (including installing "a railway style crossarm to stop traffic on the Bikeway", "Automated bicycle detection to alert vision impaired persons bicycles have stopped") would create "undue hardship for the City or are not proven technology for the purposes for which they are being advanced" [41].

[i] Indexed as: Belusic obo Canadian Federation of the Blind v. City of Victoria and another (No. 4), 2020 BCHRT 197 IN THE MATTER OF THE HUMAN RIGHTS CODE, RSBC 1996, c. 210 (as amended) AND IN THE MATTER of a complaint before the British Columbia Human Rights Tribunal.

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Annex A: Literature review of wider inclusion issues

A.1 Overview

Around 1 in 5 of the UK population (over 14 million people) report having a disability that limits their daily activities[1]. Disability is defined in the Equality Act 2010 as 'a long-term limiting mental or physical health condition, that has a substantial negative effect on your ability to do normal daily activities that has lasted, or is expected to last, more than 12 months'[2]. Impairments include chronic health conditions (e.g. diabetes and cancer), physical disability (e.g. mobility and dexterity), mental health (e.g. depression and anxiety) and sensory impairments (e.g. hearing and vision).

Disability becomes more prevalent with age: 8% of children are disabled, compared to 19% of working age adults and 44% of adults over State Pension age[3]. Mobility is the most common impairment affecting just over half of all disabled people[4]. Physical inactivity is more common for people with a disability or long-term health condition (41%) than those without (20%) and the more impairments an individual has, the less active they are: 49% of those with three or more impairments are inactive (physical activity includes sport, exercise, brisk walking and cycling)[5]. Not all impairments are visible or obvious to other people. Table A1 shows how people with learning difficulties or speech impairments are the most inactive group.

Focusing specifically on walking, disabled people are less likely to think of replacing short car journeys with walking[6].

> *"People experiencing difficulties with personal care (e.g. getting dressed; taking a bath or shower) and those with physical coordination problems (e.g. balance) appear to be most likely never to use public transport or to walk or cycle for short journeys. They are followed by people with mobility issues, loss of manual dexterity and incontinence."*[7]

This underlines the importance of creating inclusive built environments, because incorporating physical activity into daily life through active travel is an effective way of helping to maintain good health.

Physical activity is particularly important for disabled people to "not only… promote health and prevent disease but also to reduce the number of secondary conditions that can result from an initial disability'[8]. Secondary conditions have been defined as preventable physical, mental, and social disorders resulting directly or indirectly from an initial disabling condition[9]. These could include chronic muscle pain or contractions, falls or other injuries, arthritis, cardiovascular disease, pressure ulcers, feeling isolated or depressed, obesity or sleeping poorly[10].

Table A-1 - Proportion of adults 40 to 60 who are inactive by limiting disability or illness[i].

Impairment	% Inactive
No disability or illness	**16.7%**
Limiting disability or illness (any)	**33.4%**
Speech	47.1%
Learning	45.3%
Memory	41.7%
Mobility	41.2%
Behavioural	40.1%
Vision	39.4%
Dexterity	38.8%
Hearing	37.9%
Chronic health condition	37.9%
Long term pain	37.9%
Mental health	36.7%
Breathing	32.8%

A.2 Physical barriers

There is a lack of published peer reviewed evidence relating to the disabling impact of the built environment on people living with a broad spectrum of physical, sensory, intellectual or behavioural impairments[11]. Some studies have, for example, focused on the need for accurate data for transport modelling on walking speeds and minimum amount of space needed for people with different mobility impairments to reach their desired speeds[12], and the crossing behaviour of people with impairments at unsignalised crossings[13]. However, there is 'grey literature'[ii] exploring this topic – see box 1 – and campaign groups representing blind and partially sighted people (in particular) in the UK and elsewhere, have addressed a range of issues, such as the problems caused by advertising boards cluttering

[i] Analysis of previously unpublished data from Sport England's Active Lives survey, to look specifically at brisk walking levels and physical inactivity in people aged between 40 and 60 in England in 2015 to 2016. Physical inactivity levels in adults aged 40 to 60 in England 2015 to 2016 - GOV.UK (www.gov.uk)

[ii] 'Grey literature' refers to materials and research produced by organisations outside of the standard commercial or academic publishing and distribution channels, including reports, government documents and working papers.

streets[14], the removal of kerbs to create level 'shared surfaces'[15] and continuous footways[16].

With an ageing population, a topic which *has* elicited attention in public health and transport/urban design spheres is the physical impact of the built environment on the functional mobility – and disability – of older people. For example, the Inclusive Design for Getting Outdoors (I'DGO) project involved over 4,350 participants in two key phases over a ten-year period (2003-2103), with a team drawn from research centres in the Universities of Edinburgh, Heriot-Watt, Salford and Warwick. It has published over thirty papers covering issues, such as: dementia friendly outdoor environments[17]; the effects of tactile paving on older adults' gait when crossing the street[18]; 'outdoor environments, activity and wellbeing'[19], and; the design of lifetime neighbourhoods[20]. Researchers found, for example, that cycling on pavements, obstructions from cars parked on pavements and the absence of street design elements, such as adequate seating and smooth pavements may influence an older person's decision to go out[21].

Box 1: Overcoming barriers to walking for disabled people[22]

Focus groups conducted by Living Streets with disabled people with a range of learning, mobility and visual impairments found that the most common physical barrier to walking identified by the participants was crossing the road. Crossings connect pedestrian routes, they intersect with vehicular traffic and are the point at which pedestrians are most vulnerable walking. Having enough time to cross, not finding a safe place to cross the road, signalised crossings that do not work, the Puffin design with a low-level green man and the absence of dropped kerbs were all mentioned.

Participants preferred wide, level, smooth, uncluttered and well-maintained pavements. The condition of the pavement had a direct impact on individual's confidence walking outdoors. Uneven surfaces were associated with the fear of falling; worry was expressed by the need to constantly look down and check footing, reducing the pleasure in walking. This was offset by the attraction of fully accessible environments, such as indoor shopping centres.

Obstructions, in particular advertising boards, wheelie bins and parked cars, were commonly encountered and made walking difficult. Like problems crossing the road, obstructions on the pavement could put pedestrians at risk (e.g. by having to step onto the carriageway to go past a parked car). The experience of wheelchair-using participants was that obstructions could prevent moving until an obstruction is moved. The expectation that there would be obstructions could be enough to prevent a disabled person going out.

Conflict between different road users emerged as both a physical and social barrier. Cyclists and the use of mobility scooters on the pavement were an annoyance because they can be hard to hear and move fast. This is a problem for many disabled (and older) people and deaf people in particular. Participants felt that safer roads (e.g. lower speed limits) could help to overcome this barrier by making cyclists more prepared to use them, as would raising awareness of disabled people's extra need for more considerate behaviour (e.g. slowing down and stopping to let disabled pedestrians pass) particularly those with non-visible impairments such as dementia and hearing loss.

Adaptations to make the pedestrian environment more accessible can also be problematic. For example, tactile paving helps blind and partially sighted people to navigate, but is a trip-hazard for others – for example stroke survivors who have problems lifting their feet. Similarly, the lack of colour contrast in seemingly accessible places can create hazards only a partially sighted person can see. This demonstrates the need to consider the accessibility of pedestrian environment from a pan-impairment perspective.

Providing comfort facilities can improve walking conditions and enable people with limiting conditions to make every day walking journeys. Benches offer places to rest for people who tire easily and could encourage disabled people to walk more. Similarly, the availability of accessible public toilets can encourage or limit walking opportunities. Participants noted that even where toilet facilities are present and advertised as accessible, they may be locked or not large enough for their purpose.

A.3 Spatial (time/cost) barriers

Consideration needs to be given to the 'door-to-door' journey and the links between buildings, streets, and public transport services[23]. People with different mobility and accessibility needs are more at risk of 'community severance'[i], consequently, an inclusive, accessible outdoor environment is one that allows a disabled person to travel from their home to any chosen destination without risk or worry[24].

The need to devise adaptive strategies (e.g. planning routes or going more slowly) to cope with both physical and organisational barriers (e.g. arranging for assistance

i A term coined by Donald Appleyard in 1972 when he compared peoples' movements living on quiet or busy streets and demonstrated that heavily trafficked streets reduce interactions between neighbours living across the road as well as on the same side of the street. Appleyard, D., Lintell, M. (1972). 'The Environmental Quality of City Streets', Journal of the American Institute of Planners, JAIP, vol. 38, no.2, p 84- 101

on journeys involving public transport) costs more and takes more time and effort for disabled people[25]. Journey planning scenarios, ease-of-access to information about different transport modes and service facilities, as well as photos illustrating potential physical barriers are all useful[26]. On average, overall journey times by public transport can be 80% higher for disabled people compared to individuals without constraint[27]. Journey times may be reduced substantially through accessible design of public transport vehicles (e.g. low floor access buses), facilities (e.g. slip resistant platforms), terminals and interchanges[28].

A.4 Social barriers

Disabled people are more likely to be on a low income, out of work or have low educational qualifications; they also face a disproportionate likelihood of living in a deprived area[29]. People from lower socio-economic groups are more likely to live in areas that do not support walking and cycling, but in turn are more likely to need to walk and cycle for transport and to access employment[30]. Boarded up windows, graffiti and rubbish, all hallmarks of deprived neighbourhoods, can act as daily reminders of social exclusion[31]. This not only acts as a deterrent to walking it can also impact people's ability to participate fully within society – research based on data from the Chicago Community Adult Health Study (2001 to 2003) showed that people with underlying difficulties with mobility living in areas where the streets were in poor condition were 60% less likely to vote[32].

People with impairments (including seeing, hearing, communication and walking impairments) who are living in deprived areas are just as likely to fear crime as to feel excluded. Recorded incidents of disability hate crimes have risen; data shows that in the three years ending March 2018 there were an estimated 52,000 incidents of disability-motivated hate crime against adults (16 and over) in England and Wales per year[33]. Fear and a lack of company may also be a significant influence on people's motivation to exercise and walk outside[34].

Studies looking at motivators and barriers to physical activity identify poor health, fear and negative experiences, lack of company, and an unsuitable environment as the issues mentioned more often by those with severely limited mobility than by those with less mobility limitation[35] [36]. Similarly, in a German study the second most cited reason for not being active was lack of company – leading the authors to highlight that efforts to promote physical activity should emphasise its wider benefits for socialising, enjoyment, relaxation and physical and mental well-being[37]. In contrast, when comparing autistic and neurotypical children, living in a perceived 'safe' neighbourhood has a greater influence on participation in physical activity than access to play facilities and community support[38].

Excluding the voices of disabled people (adults and children) from discussions about active travel is another form of social barrier. For example, children's experiences of disability are largely missing from literature on children's active school travel and independent mobility, as is the relationship between disability and other social factors (e.g. ethnicity and deprivation)[39]. Disability should be viewed alongside other factors, such as age, gender or ethnicity[40].

A.5 Environmental barriers

Sound and soundscapes have received little attention in the design of urban spaces, for which vision is the primary sense. However, there is a growing field of sound inclusive design and the idea of acoustic comfort for all[41]. Such an approach recognises the diversity of people's hearing experiences and highlights, for instance, the need to provide visual and auditory information for people with hearing loss, auditory navigation cues for people with sight loss and support for neurodivergent people (e.g. mapping soundscapes and quiet spaces) for whom hypersensitivity to sound can cause distress and physical discomfort[42].

A.6 Needs of blind and partially sighted people

There are more than 325,500 registered blind and partially sighted people in the UK, 29% use no mobility aid at all, 43% use a cane (equivalent to about 140,000 people) and 7.5% use a guide dog[i] (there are currently 4800 working guide dog partnerships in the UK[ii]). The UK Equality Act (2010) places a duty of care on public bodies to eliminate discrimination and advance equality of opportunity for all[43]. In the context of this discussion, that means enabling safe and independent access for blind and partially sighted people to familiar streets and street infrastructure, and just as importantly, to unfamiliar spaces[44].

The introduction of 'shared spaces' in the late 2000s brought attention to the specific the needs of blind and partially sighted people. Broadly characterised by minimal use of traffic signs and other traffic management related street furniture and the removal of kerbs to create level surfaces, this new infrastructure blurred the division between the carriageway and the footway:

> *"In the absence of rules, predictability and certainty, drivers have to rely on cultural signals and informal social protocols. Speeds reduce, eye*

[i] Pers. Comm. From Zoe Courteney at the RNIB, in reference to the My Voice Survey (2015).
[ii] See What is it like to have visual impairment? - Civil Service (blog.gov.uk)

contact becomes the norm, and the driver becomes a part of her or his social surroundings and context."[45]

The intention of this design approach was to reduce the dominance of motorised vehicles and increase a sense of place. However, as noted in Government guidance, 'for pedestrians to fully share the space, relatively low motor traffic flows and speeds are usually necessary'[46]. David Bates, an engineer who lost his sight aged 60, set out his strategy for crossing a shared space:

"As there is no [kerb] from which to establish a precise direction of travel, it is necessary to start with one's back touching the wall of a building, and to then walk slowly forward, scanning one's cane in the usual way while walking slowly into the path of approaching traffic. Some drivers can get very annoyed at pedestrians, who step out in front of them without looking, but ***it is important for a blind person not to look to the left or right, as an approaching driver may think he has been seen and that the pedestrian will then automatically stop for him****. It is also essential to walk slowly to give drivers time to see the pedestrian and to stop or to swerve in order to avoid an accident."* [47]

Of course, eye contact cannot become the norm for people who have little or no useful sight. In addition to missing cues from drivers (or people cycling), Bates observed that blind people could inadvertently give the wrong message to other road users. Reliance on visual communication may also prove challenging when children are present or for neurodivergent[i] people[48].

Blind and partially sighted pedestrians rely on their other senses – touch, smell and hearing – to navigate streets safely[49]. Tactile clues are felt through the cane and their feet; a long cane user will follow either the building line or the kerb line. Smells (e.g. a coffee shop or a florist) may help to identify premises. The sounds of traffic (e.g. listening to decide if it's safe to cross the road), of controlled crossings, from building frontages (e.g. shop music) and from tapping the cane against different surfaces are perhaps most important of all for safe orientation. Without vision, electric vehicles (including e-scooters and e-bikes) and bicycles are frightening because they approach rapidly and relatively silently (although 'Acoustic Vehicle Alerting Systems' are now provided on cars, activated when these travel at under 12mph). Guide dogs are taught to stop at kerbs, find doors and frequently visited locations, but the responsibility for route finding rests with the person and this requires clues for navigation[50]. For people with some residual sight, colour contrasts

[i] This includes the diagnosis of Autism Spectrum Disorders, Attention Deficit Hyperactivity Disorder, Specific Learning Disorder, Motor Difficulties, Communication Disorders and Intellectual Disabilities.

(e.g. yellow and white lines against a darker surface) provide extra information and guidance.

Many blind and partially sighted people navigate routes they have been trained to use[51]; this may not be the most direct route, but the route where conflicts are minimised or avoided. Conflict may be interpreted as problematic interactions with other (non-pedestrian) road users. Pedestrian comfort, when viewed from the perspective of partially sighted people, prioritises security and safety – in particular, the presence of crossings with auditory signals[52]. Signalised crossings offer clear protection and safe passage between safe pedestrian spaces. Key design elements[53] that blind and partially sighted people say they need include:

- Segregated pedestrian only spaces (footways usually)
- Safe crossings (signalised – not based on visual cues)
- Routes free from obstacles
- Route continuity and coherence (navigation and connection to public transport)

Like the 'shared space' design concept, bus stop bypasses (installed to benefit cyclists) and continuous footways (primarily installed to benefit pedestrians) introduce risk and uncertainty for blind and partially sighted people where they are forced to interact with (but cannot communicate with) people who are driving or cycling through the same space. Contrary to the spirit of the Public Sector Equality Duty, this creates an additional barrier to their participation in society. The challenge for designers is to move beyond the ambiguity of visual communication to create infrastructure which can communicate pedestrian priority and dictate the appropriate road user behaviour.

A.7 How changes to street infrastructure influence pedestrian behaviour

Research on behalf of the IConnect consortium demonstrated that improvement of walking and cycling environments – and improving safety from traffic – is a necessary condition for promoting more active travel[5455]. Residents in Southampton, Cardiff and Kenilworth living with 5 km of new walking and cycling infrastructure were sent questionnaires at the time of the intervention in 2010 and two years later in 2012. The questionnaire assessed residents' perceptions of their walking and cycling environment, their use of the new infrastructure and their walking and cycling behaviours. The results showed that those who lived near and used the new infrastructure reported improvements in their perceptions of the walking and cycling environment and of safety.

Similarly, the magnitude of the effect of the 'mini Holland' (low traffic neighbourhood) interventions in three outer London boroughs on walking and cycling levels depended upon people's proximity to new infrastructure[56]. A shift in travel behaviour could also take time to appear.

Street design mediates how people use the space to walk, wheel, cycle or drive and changes to street layouts can be used to enforce or influence a desired change in road user behaviour. For example, the installation of 'raised crosswalks' (informal courtesy crossings where drivers are not legally required to stop) with preceding speed humps on busy arterial roads in Israel slowed drivers down and increased the yielding behaviour of vehicles to pedestrians[57]. Evidence shows that slower vehicle speeds increase give-way behaviour[58] – as does the introduction of familiar zebra stripes on courtesy crossings; before and after video survey counts showed that yielding behaviour at Kimbrose Triangle in Gloucester increased from 41.6% to 99.4% after the addition of stripes[59]. The latter study which examined design elements influencing driver behaviour at 20 courtesy crossings in England also found that yield rates were consistently higher where there were shops and services along the footway. The road humps enforced slower speeds and addition of the stripes influenced driver behaviour.

Pedestrian behaviour can be influenced too. In 2002, a new type of pedestrian waiting countdown timer was tested at signalised pedestrian crossings in Dublin[60]. The aim of the experiment was to reduce the number of people crossing the road before the green man phase. The countdown timers increased the accuracy of pedestrians' expectation of how long they would have to wait and had a significant effect on reducing the number of pedestrians crossing during the red man phase. Before the timers were installed 65% of pedestrians started to cross during the green man and amber phases but this rose to 76% after the timers were installed. This study also showed greater willingness to comply with crossing during the green man phase among female pedestrians.

Designing roads for the primary purpose of accommodating vehicle journeys not only discourages walking and cycling because of the traffic – it also encourages driver behaviour contrary to the advice given in the Highway Code. For example, Rule 170 states that drivers should:

> *"take extra care at junctions… you should watch out for cyclists, motorcyclists, powered wheelchairs/mobility scooters and pedestrians as they are not always easy to see… [and] watch out for pedestrians crossing a road into which you are turning. If they have started to cross they have priority, so give way"*

However, wide splays at side road junctions enable drivers to turn or exit without having to slow down significantly or stop. Participants in a study designed to understand attitudes to priorities at side road junctions overwhelmingly agreed that lack of consistency between design and regulations – and the lack of compliance with regulations was not acceptable[61]. Participants were representative across age, ability (including people with visual and mobility impairments) and gender.

A.8 Why social context is very important

Almost twenty years ago pedestrian behaviour was observed at two busy intersections in neighbouring Israeli cities of Bnei-Brak and Ramat-Gan[62]. Both cities were of a similar size – which is where the demographic similarity ended. The Ultra-orthodox population of Bnei-Brak lived according to rabbinical law. Of Bnei-Brak's 140,000 residents only 23,000 were salaried employees and only 38% of households had a private vehicle (compared to 88% in the general population) – and its pedestrians were notorious for their 'unsafe behaviour'. The authors' observations focused on five pedestrian behaviours or perceived 'violations': running a red-light, crossing where there is no crosswalk, walking along the road, failing to check for traffic prior to crossing, and (not) taking a child's hand when crossing. The findings showed that males committed significantly more violations than females, and the younger the individual, the more frequently s/he committed a violation. However, irrespective of their age, pedestrians in the orthodox environment committed violations about three times more frequently than those in the secular environment.

The authors attributed a strong connection between the belief in the supremacy of other laws (i.e. religious laws) over state laws, and a readiness to violate the law. The most interesting feature of this case is that although Bnei-Brak residents committed three times as many on-road violations as residents in other cities, it was not reflected in their road injury statistics. Drivers in the city had adjusted their behaviour in response to the risk-taking road habits of Bnei-Brak pedestrians. This demonstrates that the relationship between road users is not fixed. Instead, it is negotiable and influenced by social context.

Negotiation between road users is primarily achieved through visual communication. This includes, but is not limited, to the exchange of eye contact. Several organisations have focused research on the interactions between pedestrians and drivers. Researchers in San Diego filmed a variety of roadways and intersections (junctions), each with a different road configuration, geometry and traffic control type, ranging from highly controlled four-way signalised controls to completely uncontrolled middle of the street locations[63]. Stationary recordings and mounted 'dash cams' or wearable cameras offered multiple perspectives on the

street scene. Three vehicle patterns were observed repeatedly during the video analysis: advancing, slowing early and stopping short. Here too, there is a link to the social context. They observed that:

> *"When drivers did not stop significantly short of a crosswalk, pedestrians often demonstrated discomfort, showing [that]* ***stopping short is a social norm within the road user community****… Our observations of real-world human road user behavior in urban intersections indicate that movement in context is a central method of communication for coordination among drivers and pedestrians. The observed movement patterns gain meaning when seen within the context of road geometry, current road activity, and culture."*

These examples from Israel and the United States show that road user behaviour is contingent both on the road layout and on social expectations. Social expectations are not fixed and, therefore, could be influenced alongside the design and introduction of new infrastructure, such as continuous footway and bus stop bypasses.

Unfortunately, there is limited research available on pedestrian interactions with other road users at either type of location. A rare study from New Zealand has used video footage to categorise 'interactional adaptation' between people cycling and pedestrians at bus stop bypasses[64]. Interactions were based on looks and 'non-looks', the latter was divided into two categories of 'doing oblivious' (the 'non-glance' whereby the pedestrian purposefully avoids looking and by inference ceding priority to the cyclist) and 'being oblivious' (the pedestrian was focused entirely on something else e.g. talking to someone or unloading a vehicle). In both these situations the onus was on the cyclist to pay more attention to act reasonably and responsibly.

The act of 'being oblivious' is not limited to pedestrians. Road safety literature[65] highlights distraction as a major risk factor for traffic collisions, cyclists can 'glaze' when cycling in urban areas[66] and pedestrians may also elicit 'inattentional blindness'[67] arising from a variety of stimuli such as a busy street, crowds, roadside signage, or emergency vehicles. People's very familiarity with the streets they are driving, wheeling or walking on 'can lead to an inwardly focused reverie, a kind of detached experience where we may look into the distance, or at nothing in particular'[68]. Being lost in thought or daydreaming can be part of the pleasure of walking, so that a pedestrian may hardly notice their surroundings at all. In contrast, having to pay attention (e.g. when interacting with people cycling or driving) can threaten and interrupt the inner life of the pedestrian, reducing some of the quality of the walking experience[69].

So, improving the quality of the walking experience is just as important as improving the quality of the walking environment to encourage people to walk/wheel more. The same logic applies equally to cycling (or driving). Unfortunately, limited road space and the priority given to motor vehicles mean that increasingly people who travel actively are expected to share the same spaces. Japan was an early adopter of shared use paths for walking and cycling following a change in traffic regulations in 1978[70]. In the late 1990s an observational study of a shared use pavement carried out in the city of Fukuoka in Kyusyu province noted that:

> *"If densities of pedestrians and bicycles are low, pedestrian cyclist conflicts are infrequent. As these densities increase, potential conflicts among road space users become more frequent. As a result, cyclists are forced to travel on shared road space at low speeds. Pedestrians are also required to be vigilant to take evasive action to avoid collision by passing bicycles."*

The aim of this study was to evaluate the optimal spacing 'between users in passing' to reduce pedestrian perceptions of risk'. The authors showed that while bicycle speeds declined as pedestrian densities increased, the perceived risk did not decline as bicycle speeds reduced. Pedestrian's perceptions of collision risk were dependent on their physical abilities. Older people and primary school children were more apprehensive of bicycles on the shared footpath compared to young fit adults. A much more recent study has shown that even if there are no observable conflicts occurring, people walking and cycling may still experience unwanted frustrations resulting from sharing a path with one another[71].

As shared use paths and spaces have proliferated across the globe, so too has the literature examining the challenging relationship between people walking and cycling[72] [73]. While there is scope to influence people's behaviour and expectations, the fundamental differences in characteristics of people walking and cycling (e.g. mass and speed of people cycling or unpredictable change of direction of pedestrians) give rise to conflict and reduce the quality of the walking or cycling experience. Visual communication through movement and looking (or not looking) is the primary means of negotiating priority when pedestrians, cyclists and drivers are brought into contact with one another. This brings a unique set of challenges for blind and partially sighted people.

A.9 Policy landscape

ENGLAND

In 2015, the Government's Sports Strategy 'A Sporting Future: a New Strategy for an Inactive Nation' set out 'a particular focus on getting disabled people active'[74]. This reflected the position taken by Government that physical activity guidelines can and should apply equally to disabled children, young people, adults and older adults once adjustments are made for individual physical and mental capabilities[75]. The Cycling and Walking Investment Strategy, which established the preparation of Local Cycling and Walking Infrastructure Plans makes a commitment to create 'better integrated routes for those with disabilities or health conditions'[76]. This is supported by evidence based public health guidance, for example, NICE guidelines on walking and cycling (PH41) note that promotional programmes should '…include information that people with impairments will require, such as where dropped kerbs are located, the location and design of barriers at access points to cycle paths, and where public transport links and disabled toilets can be found'[77].

In 2018, the Government published 'The Inclusive Transport Strategy' which effectively 'paused' any new 'shared space' schemes – where features such as kerbs, road surface markings, designated crossing places and traffic signs are removed – because this excludes blind and partially sighted people[78]. Creating active environments, including the wider built environment is one of the key objectives of Sport England's 10-year strategy 'Uniting the Movement'[79]

Evidence based guidance is supported by statutory obligations. For example, the National Planning Policy Framework (2019) promotes healthy communities (Section 8)[80] and planning practice guidance on Healthy Safe Communities states that "Local planning authorities should ensure that health and wellbeing… are considered in local and neighbourhood plans and in planning decision making"[81]. Under the Equality Act (EqA 2010) local authorities have a Public Sector Equality Duty which requires them to 'advance equality of opportunity' and 'remove or minimise disadvantages suffered', for example, through poor quality public realm by people who share protected characteristics, such as ageing and disability.

SCOTLAND

The Scottish Government's 'A Fairer Scotland for Disabled People' in (2016) promised to 'remove barriers and improve access to housing and transport'[82]. With its focus on helping disabled people to influence transport decisions, improving access to public transport and disabled parking, the strategy misses the opportunity to address active travel. Nevertheless, the Active Scotland Delivery Plan (2018) commits to improving 'active infrastructure' (outcome 4) by putting walking and cycling at the heart of transport planning[83]. Scotland's National Transport Strategy

(2019) notes the link between physical inactivity and health (physical inactivity contributes to over 2,500 premature deaths in Scotland each year) and aims to 'make sure that public transport and active travel options are the preferred choice for people making short journeys'[84].

WALES

Wales is the only country in the UK to have a duty on local authorities and the Welsh Government to improve infrastructure and significantly increase levels of walking and cycling. The Active Travel (Wales) Act came into effect in 2013[85]. Its associated Design Guidance is comprehensive in its approach to disabled people and other protected characteristics under the EqA (2010). It notes the importance of actively involving disabled people in the design and delivery of transport services such as the provision or improvement of pedestrian routes and cycle routes[86]. The revised guidance (consulted on in 2020) notes that 'it makes strategic sense to ensure our environments are accessible to all people. A route that is accessible for disabled people is usually more comfortable and convenient for all, such as older people and those accompanied by young children'[87].

NORTHERN IRELAND

Northern Ireland's Department for Infrastructure is responsible for active travel. The Department is in the process of preparing guidance on the design of walking infrastructure which will be based on existing UK guidance including the Welsh Active Travel Act Design Guidance and the Manual for Streets[88].

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