Parking

Category: **Other**

Other Relevant Topics:

▸ Children (Pedestrians)

▸ Teenagers (Pedestrians)

▸ Adults (Pedestrians)

▸ Older (Pedestrians)

▸ Safe Route Planning (Pedestrians)

▸ Pedestrians (Roads)

▸ Laws and Regulations (Compliance and the Law)

Keywords:

**On-street parking,
Off-street parking,
Footway parking**

About the Road Safety Observatory

The Road Safety Observatory aims to provide free and easy access to independent road safety research and information for anyone working in road safety and for members of the public. It provides summaries and reviews of research on a wide range of road safety issues, along with links to original road safety research reports.

The Road Safety Observatory was created as consultations with relevant parties uncovered a strong demand for easier access to road safety research and information in a format that can be understood by both the public and professionals. This is important for identifying the casualty reduction benefits of different interventions, covering engineering programmes on infrastructure and vehicles, educational material, enforcement and the development of new policy measures.

The Road Safety Observatory was designed and developed by an Independent Programme Board consisting of key road safety organisations, including:

▶ Department for Transport

▶ The Royal Society for the Prevention of Accidents (RoSPA)

▶ Road Safety GB

▶ Parliamentary Advisory Council for Transport Safety (PACTS)

▶ RoadSafe

▶ RAC Foundation

By bringing together many of the key road safety governmental and non-governmental organisations, the Observatory hopes to provide one coherent view of key road safety evidence.

The Observatory originally existed as a standalone website, but is now an information hub on the RoSPA website which we hope makes it easy for anyone to access comprehensive reviews of road safety topics.

All of the research reviews produced for the original Road Safety Observatory were submitted to an Evidence Review Panel (which was independent of the programme Board), which reviewed and approved all the research material before it was published to ensure that the Key Facts, Summaries and Research Findings truly reflected the messages in underlying research, including where there may have been contradictions. The Panel also ensured that the papers were free from bias and independent of Government policies or the policies of the individual organisations on the Programme Board.

The Programme Board is not liable for the content of these reviews. The reviews are intended to be free from bias and independent of Government policies and the policies of the individual organisations on the Programme Board. Therefore, they may not always represent the views of all the individual organisations that comprise the Programme Board.

Please be aware that the Road Safety Observatory is not currently being updated; the research and information you will read throughout this paper has not been updated since 2017. If you have any enquiries about the Road Safety Observatory or road safety in general, please contact **help@rospa.com** or call **0121 248 2000**.

How do I use this paper?

This paper consists of an extensive evidence review of key research and information around a key road safety topic. The paper is split into sections to make it easy to find the level of detail you require. The sections are as follows:

Key Facts	A small number of bullet points providing the key facts about the topic, extracted from the findings of the full research review.
Summary	A short discussion of the key aspects of the topic to be aware of, research findings from the review, and how any pertinent issues can be tackled.
Methodology	A description of how the review was put together, including the dates during which the research was compiled, the search terms used to find relevant research papers, and the selection criteria used.
Key Statistics	A range of the most important figures surrounding the topic.
Research Findings	A large number of summaries of key research findings, split into relevant subtopics.
References	A list of all the research reports on which the review has been based. It includes the title, author(s), date, methodology, objectives and key findings of each report, plus a hyperlink to the report itself on its external website.

The programme board would like to extend its warm thanks and appreciation to the many people who contributed to the development of the project, including the individuals and organisations who participated in the initial consultations in 2010.

Key facts

- The term 'parking' can be used to describe:
  - The infrastructure provided for the storage of vehicles whether on or off-street; and,
  - Parking as an activity forming part of the overall process of car travel.

  (Palmer and Ferris, 2010)

- Of the 252,500 vehicles involved in reported Road Traffic Incidents (RTIs) in 2016, 10,056 of these were parked vehicles (4 per cent).

  (RRCGB, DfT, 2017)

- On-street parking can introduce a road safety problem, particularly if traffic speeds are above 20mph and there are few places for pedestrians to cross with adequate visibility.

  (Palmer and Ferris, 2010)

- On-street parking is associated with increased RTI risk compared to roads of the same category without on-street parking.

  (Edquist et al, 2012)

Summary

Parking refers either to the act of parking a vehicle or the facilities provided for parking regardless of whether these are on-street or off-street.

It is important to understand pedestrian and driver safety when designing car parks. Guidance is provided for designers by the British Parking Association. However, it is recognised that many local highways authorities maintain their own standards.

On-street parking is abundant in urban and suburban areas, even when driveway parking is available. Chaotic on-street parking and footway parking can cause many problems for both drivers and pedestrians, especially those using pushchairs, wheelchairs and those who are visually impaired.

Footway parking can be discouraged using a number of physical measures such as raised kerbs and bollards, but it is also important to consider how these engineering measures will affect pedestrian and other footway users.

Initiatives educating drivers that footway parking is not acceptable have also been successfully used. Leaflets are left on the offending vehicles outlining the reasons why footway parking is dangerous and outlining the fines that can be incurred.

Parking on 'School Keep Clear' zig-zag markings is also a widespread problem. Oxfordshire County Council and Medway Council have introduced schemes aimed at parents. These programmes have included banners, posters, and roadside activities aimed at discouraging illegal parking.

Research related to parking and road safety is far from extensive. Research conducted has been related to on-street parking and its effects on road traffic incidents (RTIs). These effects relate to pedestrians crossing between parked cars and the narrowing of lanes for drivers. Most research suggests that as parking density increases, RTI risk increases for all road users.

Methodology

This synthesis was compiled during November - December 2012.

Note

This review includes statistics from Reported Road Casualties Great Britain 2011, which were the latest available data when the review was written. In December 2017, statistics from Reported Road Casualties Great Britain were updated to Reported Road Casualties Great Britain 2016.

A detailed description of the methodology used to produce this review is provided in the Methodology section of the Observatory website at http://www.roadsafetyobservatory.com/Introduction/Methods

The steps taken to produce this synthesis are outlined below:

- **Identification of relevant research** – searches were carried out on pre-defined research (and data) repositories. As part of the initial search some additional information sources were also consulted, which included http://www.ingentaconnect.com and various project archives. Search terms used to identify relevant papers included but were not limited to:
  - o 'Parking';
  - o 'Safety';
  - o 'On-street parking';
  - o 'Off-street parking'; and,
  - o 'Illegal parking'.

  A total of 14 pieces of potentially relevant research were identified.

- **Initial review of research** – primarily involved sorting the research items based on key criteria, to ensure the most relevant and effective items went forward for inclusion in this synthesis. Key criteria included:

  - o Relevance – whether the research makes a valuable contribution to this synthesis and is relevant to parking.
  - o Provenance – whether the research is relevant to drivers, road safety policies or road safety professionals in the UK. If the research did not originate in the UK the author and expert reviewer have applied a sense check to ensure that findings are potentially relevant and transferable to the UK.
  - o Age – priority is given to the most up to date titles in the event of over-lap or contradiction.
  - o Effectiveness – whether the research credibly proves (or disproves) the effectiveness of a particular parking initiatives or intervention.

Following the initial review, 11 pieces of research were taken forward to form the basis for this synthesis, 9 of which were published in the UK.

- **Detailed review of research** – key facts, figures and findings were extracted from the identified research to highlight pertinent road safety issues and interventions.

- **Compilation of Synthesis** – the output of the detailed review was analysed for commonality and a synthesis written in the agreed format. Note that the entire process from identifying research to compiling the synthesis was conducted in a time bound manner.

- **Review** – the draft synthesis was subjected to extensive review by a subject matter expert, proof reader and an independent Evidence Review Panel.

Please note that legislation has not been referred to in this synthesis as it is assumed that practitioners would be aware of any associated requirements. However, if an understanding of related parking legislation is required then reference should be made to the Road Traffic Regulation Act 1984. Part IV of the Act (sections 32 to 63) contains legislation covering:

- Provision of off-street parking, and parking on roads without pavement
- Control of off-street parking
- Parking on highways for payment
- Provision of parking places by parish or community councils
- Special parking provisions
- Parking attendants

Key statistics

- Of the 252,500 vehicles involved in reported Road Traffic Incidents (RTIs) in 2016, 10,056 of these were parked vehicles (4 per cent).

(RRCGB, DfT, 2017)

- In 16 per cent of RTIs involving pedestrian casualties in 2011, the pedestrian had 'pedestrian crossing road masked by stationary or parked vehicles' reported as a contributory factor. The equivalent figure for uninjured pedestrians was 14 per cent.

- In 2011, 'Pedestrian crossing road masked by stationary or parked vehicle' was the 4th most frequently reported contributory factor for reported RTIs involving pedestrians.

- In 2011, of all 118,403 RTIs attended by a police officer and in which a contributory factor was recorded, 'vision affected by stationary or parked vehicle(s)' was a contributory factor in 3,943 accidents (3 per cent).

(Kilbey et al, 2012)

Note

More recent statistics are available in December 2017, statistics from Reported Road Casualties Great Britain were updated to Reported Road Casualties Great Britain 2016..

Research findings

Summaries of key findings from several research reports are given below. Further details of the studies reviewed, including methodology and findings, and links to the reports are given in the References section.

- The term 'parking' can be used to describe:
    - The infrastructure provided for the storage of vehicles whether on or off-street; and
    - Parking as an activity forming part of the overall process of car travel.

- The various types of parking include:
    - Private off-street parking;
    - Public off-street parking (short stay, long-stay, contract);
    - Controlled on-street parking; and,
    - Uncontrolled on-street parking.

- Destinations may be categorised in a variety of ways:
    - General town centres (including Park & Ride and controlled (paid) on-street parking);
    - Railway stations;
    - Shopping centres;
    - Workplaces - Private Non-Residential (PNR) parking;
    - Stadia; and
    - Airports.

(Palmer and Ferris, 2010)

On-street parking

On-street parking is common in urban and suburban areas, even where driveway parking is available. Parked cars may obstruct the view of the road ahead, making it more difficult to see other road users, including crossing pedestrians. Most of the research discussed in this section suggests that on-street parking may be correlated with increased RTI risk for all road users. However it is not easy to quantify this as there are many factors that contribute towards RTI risk.

- Accommodating parked vehicles is a key function of most streets, particularly in residential areas. Whilst the greatest demand is for parking cars, there is also a need to consider the parking of cycles, motorcycles and, in some circumstances, service vehicles.

- The way cars are parked is a key factor for many issues, such as visual quality, street activity, interaction between residents and safety.

- A failure to properly consider this issue is likely to lead to inappropriate parking behaviour, resulting in poor and unsafe conditions for pedestrians.

- On-street parking can introduce a road safety problem, particularly if traffic speeds are above 20mph and there are few places for pedestrians to cross with adequate visibility.

- Generally the most appropriate solution will be to design for a level of on-street parking that takes account of the following factors, where possible:
  - o The overall level of car ownership in the immediate area;
  - o The amount of off-street parking provided;
  - o The amount of allocated parking provided;
  - o The speed and volume of traffic using the street; and,
  - o The width and geometry of the street and its junctions.

(Palmer and Ferris, 2010)

An early study in to the effects of parking density on RTI rates considered that low parking densities were the most dangerous:

- RTI records for about 9,000 streets in local authority residential estates (from 20 towns), free from substantial through traffic, were analysed in relation to population statistics, traffic flow, observations of children and parked vehicles and design parameters.

- It was noted that the highest RTI rates occurred in streets where the parking density was the lowest; potentially due to the effect of traffic flow.

- The study concluded that although parking density may have a slight deleterious effect on the pedestrian RTI risk, it is unlikely to be a significant one.

(Bennett and Marland, 1978)

However, more recent research suggests that on-street parking is linked to an increase of RTI risk for all road users.

- On-street parking is associated with increased RTI risk compared to roads of the same category without on-street parking. One potential reason for increased RTI risk is narrowed road width. Parked vehicles leave less space for travelling vehicles, forcing them to drive closer to vehicles in the next lane (which may be travelling in the opposite direction).

- Modelling research has found that both parking and road width were significant predictors of RTI rates on road links, and that the contribution of parking to increased RTI rates was larger than that of road width. This implies that factors other than road width must underlie the higher RTI risk when on-street parking is present.

- A driving simulator study was conducted which examined the effects of on-street parking and road environment visual complexity on driver behaviour and surrogate measures of RTI risk.

- The results showed that in the presence of occupied parking bays drivers lowered their speed and shifted their lateral position towards roadway centre to compensate for the higher mental workload they reported experiencing. However, this compensation was not sufficient to reduce drivers' reaction time on a safety-relevant peripheral detection task or to an unexpected pedestrian hazard.

(Edquist et al, 2012)

- Statistical models have been used to assess the effect of street and street network characteristics on total RTIs, severe injury RTIs, and fatal RTIs. Data from over 230,000 RTIs taking place over 11 years in 24 Californian cities has been analysed.

- Streets with on-street parking were associated with more total RTIs and severe RTIs, but there was no significant association between on-street parking and fatalities.

(Marshall and Garrick, 2011)

- Research carried out in Kent suggests that residents' perceptions of the safety of their streets and their willingness to let their children own and use bicycles are undermined by ad hoc on-street parking. Conversely, developments that exhibit high cycle ownership and use tend to be those without parking problems and fears about safety. As such, getting the parking right appears to contribute towards the personal health agenda.

(CIHT, nd)

Footway parking

Footway parking can cause problems for pedestrians and others users if footways are not wide enough to accommodate whole or partial parking. This section lists a number of engineering measures that can be used to prevent parking if required, and also outlines an educational intervention that had a perceived positive effect on reducing footway parking. Parking restrictions cover the whole highway so where restrictions are in force on the carriageway they can also cover footways and verges which allows enforcement to take place.

- Footway parking (also called pavement parking) can cause hazards and inconvenience to pedestrians. It creates particular difficulties for blind or partially-sighted people, disabled people and older people, or those with prams or pushchairs. It is therefore recommended that footway parking be prevented through the design of streets.

- Footway parking may cause damage to the kerb, the footway and the services underneath. Repairing such damage can be costly and local authorities may face claims for compensation for injuries received resulting from damaged or defective footways.

(WSP et al, 2007)

- A variety of physical measures may be used to deter footway parking where required. These include:
  - Guard rails;
  - Bollards;
  - Amenity railings
  - Low railings;
  - Raised planters;
  - High kerbs;
  - Textured surfaces;

- o Formalised on street parking;
- o Traffic calming measures; and,
- o Street furniture.

- The choice between these measures depends upon:
  - o Desired effect;
  - o Location;
  - o Funds available;
  - o Safety factors;
  - o Aesthetic considerations;
  - o Access requirements; and,
  - o Need to consider requirements of disabled people, and not cause obstacles to their movements.

(DfT, 1993)

Derby City Council, for example, has previously introduced initiatives to reduce footway parking:

- In Derby, the Council placed 'Parking on Pavements' leaflets on vehicles parked on the footway. These leaflets give a clear message as to the negative effects of footway parking, along with an indication of the penalties that drivers could incur. Since 2002, over 300 'Parking on Pavements' leaflets have been placed on vehicles in hot spots, and the effect on footway parking has been positive.

(WSP et al, 2007)

'School Keep Clear' zig-zag markings

Stopping/parking on 'School Keep Clear' zig-zag markings is a problem that occurs across the UK. The markings are intended to keep the roads outside of school clear so that children can cross the road more easily, and they themselves can be more easily seen by drivers. It is usually parent/guardian drivers that are responsible for parking/stopping on the markings. The following section describes 2 council initiatives that have attempted to prevent illegal parking using parent/guardian education.

Medway Council

- Presenting the facts to drivers in the form of incentives, such as the Zig-Zag Banner Scheme, can assist with achieving a reduction in illegal and inconsiderate parking.

- The zig-zag banners initiative has three stages:

  o A 'soft approach' (green banner) requesting drivers not to park on the zig-zag yellow lines. This should be used during the first three weeks of the programme. Driver behaviour should be monitored each day to see if the banner is having an effect. If the green banner is not having the desired effect after the third week, then an amber banner is issued.

  o A 'stronger message' (amber banner) requesting drivers not to park on the zig-zag yellow lines. This should be used during the second three weeks of the programme. Driver behaviour should be monitored each day. If the amber banner is not having the desired effect after the sixth week, then a red banner is issued.

  o A 'very strong message' (red banner) requesting drivers not to park on the zig-zag yellow lines. This should be used during the final three weeks of the programme. Driver behaviour should be monitored each day. If the red banner is not having the desired effect after the final week, then alternative measures should be considered.

If the Zig-Zag Banner Scheme does not realise sufficient change in behaviour then alternative approaches could be introduced, such as:

- Naming and Shaming by stating the colour of the offending car and part of its number plate in the school newsletter. This means that the driver is aware of their wrong-doing. A school in Medway adopted this policy which proved successful.

- Offering a park and stride or a car-sharing scheme may also prove successful in reducing congestion at the school gates.

- Providing alternative parking away from the school can be an opportunity for schools to liaise with other surrounding businesses and use this as a means of promoting the whole issue (turning a negative issue into a positive solution).

Other activities which can be used to garner support/raise awareness include:

- Leaflets and handouts could be distributed to remind parents/guardians of the inherent danger in stopping on the 'School Keep Clear' markings and the possibility of penalty charges once signing is in place.

- Events such as parent evenings, open days and social events are ideal opportunities for raising awareness.

- An assembly, presentation or even a re-enactment of a road scene by the teachers and children can be held for parent/guardians in order to emphasise the importance of safe parking.

- A poster competition could be set up where the winning pupil will be rewarded by having their design promoted within the community.

(Medway Council, nd)

Oxfordshire County Council

- A number of schools across Oxfordshire experienced inappropriate parental parking on the Keep Clear 'Zig-Zags' outside the school at the beginning and the end of the school day.

- The 'Zig-Zag' parking programme was implemented to provide schools with a step-by-step guide to help them undertake a roadside event to raise awareness of the issue. Additional follow on activities were also included to prolong the impact of the event and effect a cultural and behavioural change whereby parking on the 'Zig-Zag' lines becomes unacceptable.

- One element of the programme encourages 'STARS' (School Travel and Road Safety) pupils to organise and be involved in a roadside event. This enables them to communicate to the local community how they feel about the issue.

- The programme is copyright free and Oxfordshire's road safety and travel behaviour teams are happy for people to use it, reproduce it or change/adapt it as they wish to suit their own particular circumstances (Oxfordshire County Council and Thames Valley Police should be credited).

(Oxfordshire County Council, 2010)

Car park design

The following outlines some design consideration for making car parks safe for both drivers and pedestrians.

- Facilities should, wherever possible, incorporate the one-way circulatory movement of traffic around the parking areas. Clear directional arrows or signs must be visible to avoid confusion, and contra-flow lanes, where vehicles are driven on the right hand side of a lane, should be avoided.

- Speed restrictors should be installed wherever there is a potential risk of injury to members of the public or staff.

- Pedestrian routes should be clearly defined and wherever possible segregated from vehicle routes. All pedestrian abilities and requirements should be considered.

- The main rule for new car parks is that vehicular access and exit routes should be kept to a minimum.

- Ideally both the entry and exit routes should be in very close proximity. i.e. separate but adjacent lanes. On large installations more than one point of entry and exit may be required, but where possible should remain adjacent in order to effectively maintain control over the locations.

- Where possible all routes should incorporate a degree of control - this will vary dependent upon the location, the type of parking facility and management practices.

- Controlling the movement of vehicular routes can be achieved by a number of methods including barrier access, flow plates, staffed control points and CCTV.

- Features such as narrowed entrances or height restrictors may be included where it is necessary to control which vehicles are permitted within a parking facility. If height restrictors are fitted they must be able to be opened or removed to allow access for emergency or maintenance vehicles.

(British Parking Association, nd)

How effective?

The interventions discussed in this synthesis have been described as successful but are not backed up with quantitative or qualitative data that can show, for example, a percentage reduction in footway parking or stopping on 'School Keep Clear' zig-zag markings.

Gaps in the research

Generally there is a lack of fully peer reviewed research that is directly related to parking and associated road safety issues. Quantification of some of the positive impacts of the interventions described here would be beneficial.

REFERENCES

Title: Reported Road Casualties Great Britain: 2011 annual report
Author / organisation: P. Kilbey, D. Wilson, O. Beg, G. Goodman and A. Bhagat for Department for Transport (DfT) **Date:** 2012 **Format:** Pdf **Link:** https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/9280/rrcgb2011-complete.pdf **Free / priced:** Free
Objectives: This report produces statistics relating to all Road Traffic Incidents (RTIs) reported to the police in Great Britain in 2011.
Methodology: Statistics are compiled from the STATS19 database of road traffic RTIs.
Key Findings   - Of the 256,272 vehicles involved in reported Road Traffic Incidents (RTIs) in 2011, 10,223 of these were parked vehicles (4 per cent).   - In 16 per cent of RTIs involving pedestrian casualties in 2011, the pedestrian had 'pedestrian crossing road masked by stationary or parked vehicles' reported as a contributory factor. The equivalent figure for uninjured pedestrians was 14 per cent.   - In 2011, 'Pedestrian crossing road masked by stationary or parked vehicle' was the 4th most frequently reported contributory factor for reported RTIs involving pedestrians.   - In 2011, of all 118,403 RTIs attended by a police officer and in which a contributory factor was recorded, 'vision affected by stationary or parked vehicle(s)' was a contributory factor in 3,943 accidents (3 per cent).
Themes: RTI, Statistics, Parked vehicles.
Comments: The national road casualty statistics remain the single largest source of RTI data.

Title: Reported Road Casualties Great Britain: 2013 annual report
Author / organisation: Department for Transport (DfT)
Date: 2014
Format: Pdf
Link: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/359311/rrcgb-2013.pdf
Free / priced: Free
Objectives: This report produces statistics relating to all Road Traffic Incidents (RTIs) reported to the police in Great Britain in 2013.
Methodology: Statistics are compiled from the STATS19 database of road traffic RTIs.
Key Findings • Of the 252,913 vehicles involved in reported Road Traffic Incidents (RTIs) in 2013, 9,593 of these were parked vehicles (4 per cent). • In 14 per cent of RTIs involving pedestrian casualties in 2013, the pedestrian had 'pedestrian crossing road masked by stationary or parked vehicles' reported as a contributory factor. The equivalent figure for uninjured pedestrians was 11 per cent. • In 2013, 'Pedestrian crossing road masked by stationary or parked vehicle' was the 4th most frequently reported contributory factor for reported RTIs involving pedestrians. • In 2013, of all 108,934 RTIs attended by a police officer and in which a contributory factor was recorded, 'vision affected by stationary or parked vehicle(s)' was a contributory factor in 3,584 accidents (3 per cent).
Themes: RTI, Statistics, Parked vehicles.
Comments: The national road casualty statistics remain the single largest source of RTI data.

Title: Reported Road Casualties Great Britain: 2014 annual report
Author / organisation: Department for Transport (DfT)   **Date:** 2015   **Format:** Pdf   **Link:**   https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/463797/rrcgb-2014.pdf   **Free / priced:** Free
Objectives: This report produces statistics relating to all Road Traffic Incidents (RTIs) reported to the police in Great Britain in 2014.
Methodology: Statistics are compiled from the STATS19 database of road traffic RTIs.
Key Findings   • Of the 268,527 vehicles involved in reported Road Traffic Incidents (RTIs) in 2014, 10,024 of these were parked vehicles (4 per cent).   • In 14 per cent of RTIs involving pedestrian casualties in 2014, the pedestrian had 'pedestrian crossing road masked by stationary or parked vehicles' reported as a contributory factor. The equivalent figure for uninjured pedestrians was 10 per cent.   • In 2014, 'Pedestrian crossing road masked by stationary or parked vehicle' was the 4th most frequently reported contributory factor for reported RTIs involving pedestrians.   • In 2014, of all 115,673 RTIs attended by a police officer and in which a contributory factor was recorded, 'vision affected by stationary or parked vehicle(s)' was a contributory factor in 3,858 accidents (3 per cent).
Themes: RTI, Statistics, Parked vehicles.
Comments: The national road casualty statistics remain the single largest source of RTI data.

Title: Pavement Parking (Traffic Advisory Leaflet 4/93)
Author / organisation: Department for Transport
Date: 1993
Format: Pdf
Link: http://webarchive.nationalarchives.gov.uk/20090505152230/http://www.dft.gov.uk/adobepdf/165240/244921/244924/TAL_4-93
Free / priced: Free
Objectives: Local authorities can use various physical measures to prevent or deter parking on the footway. The purpose of this leaflet is to describe these physical measures and to outline their good and bad points.
Methodology: Description of physical measures.
Key Findings:

Key Findings:

- Parking on the footway can cause inconvenience to pedestrians. It can create hazards for visually impaired, disabled and elderly people or those with prams or pushchairs.
- It may also cause damage to the kerb, the footway, or the services underneath. Repairing such damage can be costly and local authorities may face claims for compensation for injuries received resulting from damaged or defective footway.
- The various physical measures described in this leaflet are however largely self-enforcing.
- A variety of physical measures may be used to deter footway parking. The choice between these measures depends upon:
    - Desired effect;
    - Location;
    - Funds available;
    - Safety factors;
    - Aesthetic considerations;
    - Access requirements; and,
    - Need to consider requirements of disabled people, and not cause obstacles to their movements.
- Physical measures include:
    - Guard rails;
    - Bollards;
    - Amenity railings
    - Low railings;
    - Raised planters;
    - High kerbs;
    - Textured surfaces;
    - Formalised on street parking;
    - Traffic calming measures; and,
    - Street furniture.

Themes: Footway parking, self-enforcing, physical measures.

Comments: Outlines the different physical measures that can be used to deter footway parking, doesn't specially mention whether these measures are effective.

Title: Does street network design affect traffic safety?
Author / organisation: W.E. Marshall and N.W. Garrick, Accident Analysis and Prevention, Volume 43(3):769-781.
Date: 2011 **Format:** Pdf **Link:** http://www.sciencedirect.com/science/article/pii/S0001457510003179 **Free / priced:** Priced
Objectives: Assess the effect of street and street network characteristics on total RTIs, severe injury RTIs, and fatal RTIs.
Methodology: Negative binomial regression models were used to assess the effect of street and street network characteristics on total RTIs, severe injury RTIs, and fatal RTIs. Data from over 230,000 RTIs taking place over 11 years in 24 California cities was analyzed at the U.S. Census Block Group level of geography.
Key Findings: • The findings suggest that for all levels of RTI severity, street network characteristics correlate with road safety outcomes. Denser street networks with higher intersection counts per area are associated with fewer RTIs across all severity levels. Conversely, increased street connectivity as well as additional travel lanes along the major streets correlated with more RTIs. • The results suggest that in assessing safety, it is important to move beyond the traditional approach of just looking at the characteristics of the street itself and examine how the interrelated factors of street network characteristics, patterns, and individual street designs interact to affect RTI frequency and severity. • Increasing the percentage of Citywide Streets with on-street parking was associated with more total RTIs and severe RTIs, but there was no significant association between on-street parking and fatalities.
Themes: On-street parking, Road traffic incidents, Assessing safety.
Comments: Useful research but only limited reference to parking, there is no explanation why on-street parking was associated with more total road traffic incidents.

Title: The effects of on-street parking and road environment visual complexity on travel speed and reaction time
Author / organisation: J. Edquist, C. M. Rudin-Brown, M. G. Lenné, Accident Analysis and Prevention, 45, 759-765
Date: 2012 **Format:** Pdf **Link:** http://trid.trb.org/view/2012/C/1132885 **Free / priced:** Priced
Objectives: Examine differences in driver behaviour which may help to explain RTI risk differences between different environments
Methodology: Driving simulator study examining the effects of on-street parking and road environment visual complexity on driver behaviour and surrogate measures of RTI risk. Twenty-nine participants drove a simulated urban commercial and arterial route.

Key Findings:
- On-street parking is also associated with increased RTI risk compared to roads of the same category without on-street parking.
- One potential reason for increased RTI risk is narrowed road width. Parked vehicles leave less space for travelling vehicles, forcing them to drive closer to vehicles in the next lane (which may be travelling in the opposite direction). Similarly, narrow roads are associated with shifts in lateral position closer to the centreline as well as higher RTI rates than standard roads.
- Modelling research found that both parking and road width were significant predictors of RTI rates on road links, and that the contribution of parking to increased RTI rates was larger than that of road width. This implies that factors other than road width must underlie the higher RTI risk when on-street parking is present.
- In complex urban environments, drivers must monitor movements of both pedestrians and vehicles. Parked cars may obstruct the view of the road ahead, making it more difficult to see crossing pedestrians.
- Parked cars may also suddenly become moving cars, and rejoin the traffic stream. It has been found that the number of (moving) vehicles in a scene negatively affects situation awareness and hazard avoidance, and parked vehicles may contribute to this effect, as they require monitoring to determine whether or not they are moving. The presence of parked cars therefore increases the uncertainty, mental load and potential risk associated with the road environment.
- Traffic observations in residential areas have found that high parking densities correlate with slower speeds.
- Compared to sections with no parking bays or empty parking bays, in the presence of occupied parking bays drivers lowered their speed and shifted their lateral position towards roadway centre to compensate for the higher mental workload they reported experiencing. However, this compensation was not sufficient to reduce drivers' reaction time on a safety-relevant peripheral detection task or to an unexpected pedestrian hazard.
- Compared to the urban road environments, the less visually complex arterial road environment was associated with speeds that were closer to the posted limit, lower speed variability and lower workload ratings. These results support theoretical positions that proffer workload as a mediating variable of speed choice. However, drivers in this study did not modify their speed sufficiently to maintain safe hazard response times in complex environments with on-street parking. This inadequate speed compensation is likely to affect real world RTI risk.

Themes: On-street parking, RTI risk, Driving simulation

Comments: Useful research but was conducted in Australia where road environment might be different to the UK.

Title: 'Zig Zag' parking programme
Author / organisation: Oxfordshire County Council **Date:** 2010 **Format:** Webpage **Link:** http://www.roadsafetyknowledgecentre.org.uk/knowledge/96.html **Free / priced:** Free, but registration required
Objectives: Provide guidance.
Methodology: This programme provides schools with a step-by-step guide to help them undertake a roadside event to raise awareness of this issue. Additional follow on activities are also included to prolong the impact of the event and effect a cultural and behavioural change whereby parking on the 'Zig-Zag' lines becomes unacceptable.
Key Findings: - A number of schools across Oxfordshire experience inappropriate parental parking on the Keep Clear 'Zig-Zags' outside the school at the beginning and the end of the school day.   - The programme can provide a number of learning opportunities for young people including team working and research and communication, and can also provide them with the opportunity to take responsibility and contribute to the organisation of activities.   - One element of the programme encourages 'STARS' (School Travel and Road Safety) pupils to organise and be involved in a roadside event. This enables them to communicate to the local community how they feel about the issue.   - The programme is copyright free and Oxfordshire's road safety and travel behaviour teams are happy for people to use it, reproduce it or change/adapt it as they wish to suit their own particular circumstances. All they ask is that Oxfordshire County Council and Thames Valley Police should be credited.
Themes: Zig-Zag parking, Guidance, Communication
Comments: Outlines a programme of measures but doesn't whether the intervention is effective.

Title: Parking Measures and Policies Research Review
Author / organisation: D. Palmer and C. Ferris, TRL prepared for the Department for Transport
Date: 2010
Format: Pdf
Link: http://assets.dft.gov.uk/publications/parking-measures-and-policies-research-review/parkingreport.pdf
Free / priced:
Objectives: To investigate the evidence about the impact of different types of parking measures and policies on road traffic, congestion and transport safety, car ownership, on the level of carbon emissions from transport, on the activity of businesses, and on townscapes. The project aimed to support the Department for Transport's (DfT) analytical and modelling capability in terms of improving its understanding of how economic activity is affected by transport investment and interventions such as parking.
Methodology: Systematic review of evidence from original and relevant studies.
Key Findings: - The term 'parking' can be used to describe: - The infrastructure provided for the storage of vehicles whether on or off-street; and   - Parking as an activity forming part of the overall process of car travel.   - The types of parking to be found at origins varies: - Private off-street parking;   - Public off-street parking (short stay, long-stay, contract);   - Controlled (paid) on-street parking; and   - Uncontrolled (free) on-street parking.   - Destinations may be categorised in a variety of ways: - General town centres (including P&R and controlled (paid) on-street parking);   - Railway stations;   - Shopping centres;   - Workplaces - Private Non-Residential (PNR) parking;   - Stadia; and   - Airports.   - In undertaking this research we have considered the policy context set by DaSTS (Delivering a Sustainable Transport System, DfT, 2008) which sets out five goals for our transport system, one of these goals is related to safety: - To contribute to better safety, security and health and longer life expectancy by reducing the risk of death, injury or illness arising from transport, and by promoting travel modes that are beneficial to health.
Themes: Parking, On street, Off street.
Comments: Useful definitions related to parking but overall little reference to safety aspects.

Title: Manual for Streets
Author / organisation: WSP, with Llewelyn Davies Yeang (LDY), Phil Jones Associates (PJA) and TRL Limited on behalf of the Department for Transport, and Communities and Local Government. **Date:** 2007 **Format:** Pdf **Link:** https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/3891/pdfmanforstreets.pdf **Free / priced:** Free
Objectives: To recommend revised key geometric design criteria to allow streets to be designed as places in their own right while still ensuring that road safety is maintained.
Methodology: Guidance document.

Key Findings:

- A clear distinction can be drawn between streets and roads. Roads are essentially highways whose main function is accommodating the movement of motor traffic. Streets are typically lined with buildings and public spaces, and while movement is still a key function, there are several others, of which the place function is the most important.
- Accommodating parked vehicles is a key function of most streets, particularly in residential areas. While the greatest demand is for parking cars, there is also a need to consider the parking of cycles, motorcycles and, in some circumstances, service vehicles.
- The way cars are parked is a key factor for many issues, such as visual quality, street activity, interaction between residents, and safety.
- A failure to properly consider this issue is likely to lead to inappropriate parking behaviour, resulting in poor and unsafe conditions for pedestrians.
- Parking can be provided on or off the street. Off-street parking includes parking within a curtilage (on-plot) or in off-street parking areas (off-plot).
- On-street parking can introduce a road safety problem, particularly if traffic speeds are above 20mph and there are few places for pedestrians to cross with adequate visibility.
- Generally the most appropriate solution will be to design for a level of on-street parking that takes account of the following factors:
  - The overall level of car ownership in the immediate area;
  - The amount of off-street parking provided;
  - The amount of allocated parking provided;
  - The speed and volume of traffic using the street; and,
  - The width and geometry of the street and its junctions.
- Footway parking (also called pavement parking) causes hazards and inconvenience to pedestrians. It creates particular difficulties for blind or partially-sighted people, disabled people and older people, or those with prams or pushchairs. It is therefore recommended that footway parking be prevented through the design of the street.
- Footway parking may also cause damage to the kerb, the footway and the services underneath. Repairing such damage can be costly and local authorities may face claims for compensation for injuries received

resulting from damaged or defective footways.

- It is also possible to deter footway parking through physical measures, such as by installing bollards, raised planters or other street furniture, and by clearly indicating where people should park.
- Derby City Council – tackling footway parking. In a number of footway parking hot-spots in Derby, the Council placed 'Parking on Pavements' leaflets on vehicles parked on the footway. These leaflets give a clear message as to the negative effects of footway parking, along with an indication of the penalties that footway parkers could incur. Since 2002, over 300 'Parking on Pavements' leaflets have been placed on vehicles in hot spots, and the effect on footway parking has been positive.

Themes: Parking, Safety, Footway parking.

Comments: Provides one intervention example. Overall limited reference to safety.

Title: Road accidents in traditionally designed local authority estates (TRRL Supplementary Report 394)
Author / organisation: G.T. Bennett and J. Marland, Institute of Highway Engineers **Date:** 1978 **Format:** Pdf **Link:** https://trl.co.uk/reports/SR394 **Free / priced:** Free
Objectives: Contribute towards the solution of the problem of the safe design of residential area, and in particular to attempt to assess: - The general nature and frequency of RTIs associated with residential access traffic;   - The overall extent to which the frequency of such road traffic incidents (RTIs) appears to be affected by the design of the road and footpath system and; the extent to which individual design features, such as width of a street, appear to affect the frequency of the RTI.
Methodology: RTI records for about 9000 streets in local authority residential estates, free from substantial thorough traffic, in 20 towns, were analysed in relation to population statistics, traffic flow, observations of children and park vehicles and design parameters using multiple regression.
Key Findings: - RTI rates (per house, or per person, per year) were found to be strongly correlated with traffic flow and with design factors such as street length, highway width, presence of shops, school and buses which were themselves strongly correlate with traffic flow.   - The multiple regression analysis suggested that the direct effects of factors such as carriageway width and curvature were probably not large.   - All the zero-order correlation coefficients were 'significant' and negative, indicating that the highest RTI rates occur in streets where the parking density is lowest.   - This effect is no doubt largely due to the effect of traffic flow, because there was a 'significant' negative correlation between traffic flow and parking density, and most of the partial correlation coefficients between parking density and RTI were positive, though not significant'.   - Although parking density may have a slight deleterious effect on the pedestrian RTI risk, it is unlikely to be a great one.
Themes: Parking density, road traffic incidents, highway width.
Comments: Dated research but shows that parking density affects RTI rates.

Title: New Build Car Park Guidelines for Car Park Designers, operators and owners
Author / organisation: British Parking Association **Date:** [No date] **Format:** Pdf **Link:** http://www.britishparking.co.uk/write/Documents/safer%20parking/SPS%20New%20Build%20Guidelines%20-%20web%20version.pdf **Free / priced:** Free
Objectives: Provide guidance for car park designers.
Methodology: Description of guidelines.
Key Findings: - Facilities should, wherever possible, incorporate the one-way circulatory movement of traffic around the parking areas. Clear directional arrows or signage must be visible to avoid confusion, and contra-flow lanes, where vehicles are driven on the right hand side of a lane, should be avoided   - Speed restrictors should be installed wherever there is a potential risk of injury to members of the public or staff   - Pedestrian routes should be clearly defined and wherever possible segregated from vehicle routes.   - The main rule for new car parks is that vehicular access and exit routes should be kept to a minimum.   - Ideally both the entry and exit routes should be in very close proximity. i.e. separate but adjacent lanes. On large installations more than one point of entry and exit may be required, but where possible should remain adjacent in order to effectively maintain control over the locations.   - Where possible all routes should incorporate a degree of control - this will vary dependent upon the location, the type of parking facility and management practices.   - Controlling the movement of vehicular routes can be achieved by a number of methods including barrier access, flow plates, staffed control points and CCTV.   - Features such as narrowed entrances or height restrictors may be included where it is necessary to control which vehicles are permitted within a parking facility. If height restrictors are fitted they must be able to be opened or removed to allow access for emergency or maintenance vehicles.
Themes: Speed restrictors, pedestrian routes, Vehicular access
Comments: This isn't a piece of research but gives useful guidance on car park design.

Title: Zigzag Banner Scheme Information Pack
Author / organisation: Medway Council
Date: [No date]
Format: Pdf
Link: http://www.school-portal.co.uk/GroupDownloadFile.asp?GroupID=883889&ResourceId=3604980
Free / priced: Free
Objectives: Provide information.
Methodology: Information pack.
Key Findings:

- The purpose of providing School Keep Clear markings is to keep the space outside of schools free from parked vehicles so that children can be seen more easily when crossing the road.
- It would seem that the main violators are parent/guardian drivers. Presenting the facts to drivers in the form of incentives, such as the Zig-Zag Banner Scheme, can assist with achieving a reduction in illegal and inconsiderate parking.
- Medway Council, like most other authorities, has a persistent problem with congestion outside schools at the beginning and end of the school day. A notable problem comes in the form of parking on the keep clear markings. The Safer Routes to School, Parking and Road safety Education teams have jointly developed the zig-zag banners initiative in an attempt to address this particular problem.
- The green banner is intended to represent a 'soft approach', requesting drivers not to park on the zig-zag yellow lines. This should be used during the first three weeks. Driver behaviour should be monitored each day to see if the banner is having an effect. If the green banner is not having the desired effect after the third week, then an amber banner is issued, which carries a slightly stronger message than the green banner.
- The amber banner is intended to give a 'stronger message', requesting drivers not to park on the zig-zag yellow lines. This should be used during the second three weeks. Driver behaviour should be monitored each day to see if the banner is having an effect. If the amber banner is not having the desired effect after the sixth week, then a red banner is issued, which carries a strong message.
- The red banner is intended to give a 'very strong message', requesting drivers not to park on the zig-zag yellow lines. This should be used during the final three weeks. Driver behaviour should be monitored each day to see if the banner is having an effect. If the red banner is not having the desired effect after the final week, then alternative measures should be considered.
- There are various ways schools can get actively involved in promoting the Zig-Zag Banner Scheme to raise community awareness. For example, a poster competition could be set up where the winning pupil will be rewarded by having their design promoted within the community.

- The children can also wear items such as high-visibility vests as a means of being seen by drivers on the school journey, as well as having adult supervision when crossing the road outside the school gates.
- Distributing leaflets and hand outs are other ways to remind parents of the inherent danger in stopping on the 'school keep clear' markings and the possibility of penalty charges once signing is in place.
- Promoting school events such as parent evenings, open days and social events are also ideal opportunities for raising awareness. This could be in the form of an assembly, presentation or even a re-enactment of a road scene put on by the teachers and children in order to prove the point.
- Another idea could be for the children to conduct surveys and then present findings in the school newsletters, entrance boards, and school intranet and group presentations.
- If the Zig-Zag Banner Scheme does not produce the desired results, there are a number of alternative schemes, such as the ones listed below:
  - Naming and Shaming involves putting the colour of the offending car and part of its number plate into the school newsletter. This means that the driver is aware of their wrong-doing. A school in Medway adopted this policy which proved successful.
  - Offering a park and stride or a car-sharing scheme may also prove successful in reducing congestion at the school gates. Here parents would park their cars a given distance away from the school and walk their children the remainder of the way.
  - Providing alternative parking away from the school can be an opportunity for schools to liaise with other surrounding businesses and use this as a means of promoting the whole issue (turning a negative issue into a positive solution).
  - Schemes such as the Walking Bus and Green Footsteps Challenge continue to prove very successful in Medway, as the benefits to all parties involved are vast. This charity-run project operates in Medway on a partnership basis known as the Kent and Medway Walking Bus Group.

Themes: Zig-zag yellow lines, Illegal parking

Comments: Provides useful information about possible interventions but do not highlight whether these interventions are effective.

Title: Guidance Note: Residential Parking
Author / organisation: The Chartered Institution of Highways & Transportation (CIHT)
Date: [No date]
Format: Pdf
Link: http://www.ciht.org.uk/download.cfm/docid/E34534FB-7F12-45CC-BD55250FBA289C28
Free / priced: Free
Objectives: Provide guidance.
Methodology: The Chartered Institution of Highways and Transportation (CIHT) and the Institute of Highway Engineers (IHE) have worked together to produce a joint publication to offer those working on planning, design and delivery of the most up to date good practice guidance.
Key Findings: - Parking problems manifest themselves in footway parking, obstruction of driveways and accesses, hindrance to larger delivery vehicles and refuse freighters, damage to soft landscaping and footways, and cluttered, unsightly streets.   - Parking can affect people's feelings about street safety, personal security and the potential for car crime, as well as having an actual effect upon those aspects of communities and neighbourhoods.   - The Government has concluded that national constraint policies have led to "significant levels of on-street parking causing congestion and danger to pedestrians".   - Research carried out in Kent suggests that residents' perceptions of the safety of their streets and their willingness to let their children own and use bicycles are undermined by ad hoc on-street parking. Conversely, developments that exhibit high cycle ownership and use tend to be those without parking problems and fears about safety. As such, getting the parking right appears to contribute towards the personal health agenda.
Themes: Guidance, Parking, Street safety
Comments: Useful guidance but does not describe road safety issues in detail.