



Cycling Facilities: Designing for Safety

Safe cycle facilities – basic requirements

The quality of cycling infrastructure is increasingly assessed through its safety benefits and also its role within the framework of sustainable transport development. These issues are explored in various Cycling Expertise dossiers (see last page for references), because the quality of cycle facilities is critical to reducing accidents. The basic requirements placed on cycling facilities to provide for the safety of cyclists are dealt with below. Against the backdrop of decades of accident and transport research, there is a broad consensus about the basic features of safe cycle facilities in Germany, which is documented in the road traffic regulations (Straßenverkehrsordnung, StVO) and the Recommendations for Cycle Facilities (Empfehlungen für Radverkehrsanlagen, ERA) of the Road and Transport Research Association (FGSV), and is more and more implemented. A Road Safety Audit is often conducted prior to construction where a consistent method is used to carry out a critical and independent revision of the layouts. Among all street layouts, almost 50 per cent of the critical areas have to do with provisions for cycling traffic, hence, making cycling quality a serious issue.

Quality criterion: Sufficient cycle path width

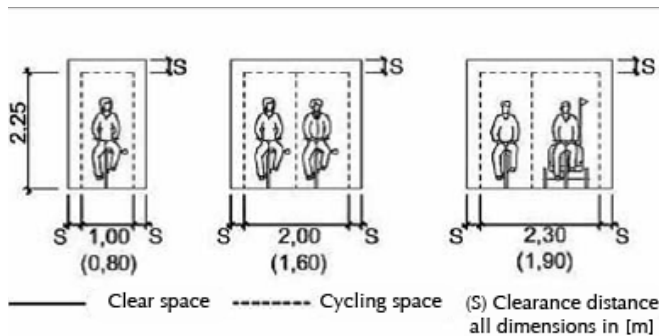
The main problems of cycle facilities will not be resolved unless a satisfactory solution is found regarding the issue of dividing and allocating road space, and the problem of excessive vehicle speeds is tackled. The German Guidelines for Urban Street Design (Richtlinien für die Anlage von Stadtstraßen, RAS 06 of FGSV) establish how to reach an acceptable compromise on street de-

sign. In the past, street environments were divided and allocated based on the space requirements of motorised traffic while pedestrians and cyclists had to make do with the remaining spaces at the edge of the road ('planning from the centre to the edge'). A reversal of this planning principle, i.e. that street environments are developed 'from the edge to the centre', is established by the Guidelines for Urban Street Design, also in accordance with urban design principles. In most cases, the limited street space does not allow for every mode of travel to have its own lane, thus making a compromise necessary. In these cases, provisions include that the moving traffic (including pedestrians and cyclists) is given priority over stationary traffic (parking cars and bicycles). (See also Cycling Expertise I-2 Cycling in Urban Main Streets)

Photo: Directly turning left where signal control for motor vehicles is provided

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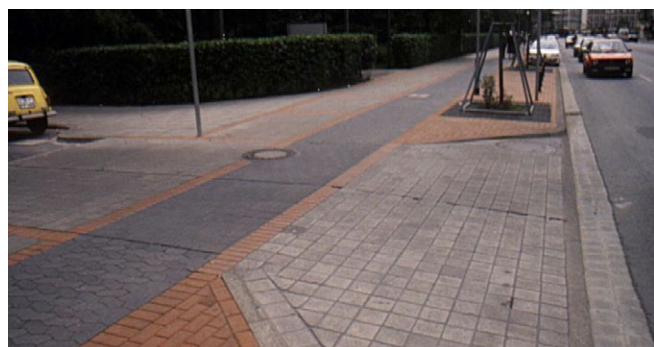
Cycling traffic spaces according to ERA

The ERA indicate the standard widths of 2.0 metres for one-way cycle paths (1.6 metres for low cycling intensities with no possibility to overtake) and 2.5 metres for two-way cycle paths and shared pedestrian and cycle paths. This includes the clear space required by cyclists, with additional clearance distances to kerbs, the traffic lane and adjacent obstacles (see figure 1). Wider cycle paths may be necessary in the future to accommodate cargo trikes or trailers.

Further crucial design standards include the minimum curve radii relative to cycling speeds, also dependent on the skidding resistance of the road surface (asphalt/concrete or unbound surface). Care must be taken to ensure a level surface and sufficient drainage if cycle links are to be suitable for daily use.

Safety through visibility

The main idea behind concrete design standards is to ensure intervisibility between motorists and cyclists. When the main causes for accidents are analysed, turning movements figure prominently at the top of the list again and again. Especially where separated off-car-



A physically separated cycle path is safe when good intervisibility between cyclists and moving motor traffic is provided where the cycle path crosses a side road

riageway cycle facilities continue across a side road, collisions with cyclists are caused by right-turning motor vehicles often due to poor visibility.

Visibility must not be obstructed before the side road so as to ensure that turning drivers see the cyclists travelling on the segregated cycle facility in good time. To facilitate this, it is advisable to bend in the cycle path towards the edge of the carriageway before the side road. Where the cycle path is continued across the side road, protection and give-way markings should be provided to indicate that, as is normally the case, priority is given to cyclists going straight ahead along the main road. This applies especially to situations with two-way cycle paths with a greater risk of accidents.



Off-carriageway cycle traffic must be able to cross a side road safely.

What to do where space is lacking

In general, it is better not to provide a cycle path at all than to provide a low-quality one, which is less safe. Where space is lacking to continue a cycle path, for example, along historical buildings or in railway underpasses, it should end at a distance of about 10-15 metres in advance of the obstacle, ideally indicated by corresponding road markings, allowing cyclists to join general traffic safely.

Separated cycle path or on-carriageway cycling facility

In practice, the choice of the appropriate cycling facility is based on various criteria. The Recommendations for Cycle Facilities indicate the following criteria (for more detailed information see Cycling Expertise I-1 State-of-the-Art Design for Cycling Facilities):

Sources

Presentations from Dankmar Alrutz (PGV, Hanover), Michael Haase (ISUP, Dresden), and Peter Gwiasda (VIA, Cologne) held at the training programme 'bicycle academy' (Fahrradakademie) of the German National Cycling Plan (NRVP).

Alrutz, D., Bohle, W. u.a., (2009): Unfallrisiko und Regelakzeptanz von Fahrradfahrern. BAST-Berichte Nr. V 184, Bergisch Gladbach (German). English Summary, http://www.bast.de/nn_40694/DE/Publikationen/Berichte/unterreihe-v/2010-2009/v184.html Gladbach



Two-way cycle paths require appropriate widths and protected crossings of side roads

On a clearly segregated, two-way cycle highway running around the outside of the roundabout, cyclists may be given priority over minor side road traffic.

- Intensity of motorised traffic
- Volume of HGV traffic
- Speed of motorised traffic
- Space requirements of cycling traffic
- Space requirements of motor-vehicle traffic
- Longitudinal gradient

Based on this, the decision is made whether to provide cycle facilities that are physically separated and segregated in terms of their design from motorised and other non-motorised traffic, or to mix cyclists with general traffic.

A physically separated cycle path facilitates objective and perceived safety as long as the main safety and quality standards (in terms of width, visibility, surface, radii, etc.) mentioned above are met. A two-way cycle path along one side of the road is sometimes preferred over one-way cycle paths along both sides of the road to save space and reconstruction costs. In urban locations, however, two-way cycle paths should only be used in exceptional cases. With cyclists usually being expected to move with the flow of motorised traffic and not against it, these 'counter-intuitive cycle paths' may well result in increases in accidents at side roads and junctions. Apart from road markings indicating priority for cyclists, clear signs (such as pictograms and additional road signs) must also be provided to make motorists aware that cyclists can approach from both directions.

A cycle lane is a part of the carriageway, separated from motorised traffic by continuous road markings. Cyclists are obliged to use it; riding of motor vehicles on them is

not allowed. Good intervisibility between motorists and cyclists normally provides for good safety conditions. The minimum cycle lane width should be 1.85 metres, with an additional clearance distance to parked cars.

A shared pedestrian and cycle path is suitable for urban locations only if cycle and pedestrian flows are low. As cyclists are obliged to ride on it, this shared-use area has to both provide safety and comfort for cyclists and serve the needs of pedestrians. Where a shared path crosses a minor side road, the priority path has to be indicated by road markings.

Partial and complete mix of road users

In Germany, as in many other European countries, so-called protection lanes are used more and more, especially in narrow road cross-section situations. The protection lane serves as an eye catcher to draw the attention of car drivers to the potential presence of cyclists; it indicates the lane suggested for cyclists on the carriageway, but is not exclusively reserved for cyclists. Riding of motor vehicles on them is allowed where necessary



Protection lanes in both directions of a through road

(when oncoming motor vehicles need to pass each other).

From the cyclists' perspective, protection lanes are often the best solution in terms of safety and comfort. Similar to cycle lanes, they can be implemented at very low costs. Protection lanes are marked and separated from general traffic with a dashed lane on the road; motorised traffic is also allowed to use them where, for example, oncoming motor vehicles need to pass each other. Protection lanes should have a minimum width of 1.5 metres.

Pucher, J., Buehler, R. (Ed.) (2012): City Cycling. Cambridge, MA, MIT Press

FGSV (2010): Empfehlungen für Radverkehrsanlagen (ERA) (German)

More informations can be found in
I-1 State of Art Design for Cycling Facilities
„ERA 2010“ Guidelines
I-2 Cycling in Urban Main Streets
I-7 Safe Cycling by Traffic Calming
S-9 Road Traffic Safety Campaigning



Cyclists are obliged to use the cycle lane; riding of motor vehicles on them is not allowed

The provision of optional shared-use pedestrian and cycle paths allow for faster cyclists to join the carriageway and at the same time provide a separated space for insecure and slower cyclists, such as elderly people for example. This is indicated through a 'cyclists allowed on pavement' sign ('Gehweg, Radfahrer frei'); the blue cycle sign for paths that cyclists are obliged to ride on is not used.

Junctions and crossings

Junctions and crossings require particular attention; they often have a high cycle accident record. Generally cyclists must be able to cross them safely and speedily. Desired cycle movements and signals must be unambiguous. In addition, the reservoirs and waiting areas for pedestrian and cycle traffic must be adequate in terms of size.

Avoiding conflicts between right-turning motor vehicles and bicycles going straight ahead is a top priority, as has been mentioned above. For segregated cycle facilities it may be necessary to remove parking spaces before junctions and side roads to provide visibility. Where the cycle path continues across the side road, it should be bent in as close as possible towards the carriageway, applying a standardised design across urban locations. Particular attention is also required where a separated cycle facility crosses a minor access (either private or commercial).

In mixed traffic situations, the different modes can be separated a sufficient distance in advance of the junction. Cyclists pass the junction on the carriageway going straight ahead on a linear route, segregated from right-turning motor vehicles. Cyclists making a left turn at the junction have two options: They pass the junction on the carriageway going along the flow of motorised traffic. Or they carry out the left turn in two stages, similar to pedestrians. For these indirect turning manoeuvres, advanced stop line reservoirs must be provided.

Introducing a new cycle facility – PR work

A cycling tradition has emerged in many cities over time, especially with regard to the existing cycling infrastructure. This has to be taken into consideration when introducing new facilities, as was done when road markings were more and more used.

Active press and PR work must be used to inform the public why it is often safer for cyclists to ride on the carriageway than on old, unsafe off-carriageway cycle facilities. It is crucial to address the reservations of motor vehicle drivers as well as experienced cyclists that have grown accustomed to off-carriageway cycling.

Conclusion

The German cycling design standards, which have been developed on the basis of accident research, offer a wide spectrum of design concepts to provide safe cycle facilities for a variety of different situations. The main features of safe cycle infrastructure are primarily based on good intervisibility between motor-vehicle drivers and cyclists. In this context, it is not a key issue whether on-carriageway or off-carriageway cycling facilities should be provided; the quality of the design of the individual cycle facility is much more important. The design must allow for an intuitive understanding of the facilities and the corresponding, desired behaviour. Where space is lacking, the default option is to provide on-carriageway facilities rather than a separated cycle path of poor quality. Given the increases in cycle traffic, cycling facilities introduced today should also be able to meet future demand, making costly investments at a later stage unnecessary.



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Zimmerstraße 13–15, 10969 Berlin
Department Mobility and Infrastructure
Editors: Jörg Thiemann-Linden, Susanne Wiechmann
cycling-expertise@difu.de