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Guide for designating cycle route networks*

Prepared by the secretariat and the European Cyclists' Federation

Summary

This document contains the final version of the Guide for designating cycle route networks. The Group of Experts on Cycling Infrastructure Module is invited to review and endorse it for submission to its parent body, the Working Party on Transport Trends and Economics, for consideration and publishing.

I. Introduction

1. This document presents a guide for designating cycle route networks at any geographical or administrative level of a country such as national, regional or municipal levels. It offers a set of steps to follow in an iterative way, when relevant, to put in place networks that will serve well their intended functions. The guide is directed at transport professionals responsible for developing cycling at municipal, or regional or national levels.

2. This guide was developed by experts working in the Economic Commission for Europe (ECE) Group of Experts on Cycling Infrastructure Module. Special thanks for developing this guide go to Mr. Martin Eder (Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, Austria) and Mr. Gregor Steklačič (Ministry of the Environment, Climate and Energy, Slovenia), who served respectively as Chair and Vice-Chair of the Group of Experts, as well as to Ms. Agathe Daudibon and Mr. Aleksander Buczyński (European Cyclists' Federation) who together with Mr. Lukasz Wyrowski (ECE) were the main authors of this guide.

* This document was scheduled for publication after the standard publication date owing to circumstances beyond the submitter's control.

II. Setting objective

3. Cycle route networks should be an important component of a mobility strategy of a country, region or a municipality. They need therefore to be, if not done so yet, an integral part of the infrastructure and mobility plans.

4. The designation of the cycle route network depends on the geographical area that is concerned and should focus on the relevance of the connections at the dedicated scale. Any pre-existing networks including the networks at the municipality and regional levels should be taken into account for detailed designation of intercity and inter-points-of-interest connections as part of the national network and vice-versa. When existing and appropriate, higher-level cycle routes networks, such as international networks, e.g. EuroVelo, should serve as a backbone for national cycle route network. In such a way, the networks are able to serve various types of users both as a whole or at their different sections. Such networks would support the everyday commuting and leisure needs of the population. It can also support the tourism offer of a country or region. At the same time, it is noted that commuting cycling routes and tourism or leisure routes may at some sections be separated so that each of them can serve their distinctive functions.

5. Therefore, when designating a cycle route network at any level, there should be a full clarity and understanding as to:

- types of users of the network,
- needs and priorities the different types of users have, and
- types of infrastructure the different users need.

6. When it comes to cyclists, one can distinguish them by the purpose for which they would undertake a cycle trip (commuting, leisure or tourism), by ability and/or experience they possess in cycling or by the type of cycle they use.

7. There are numerous and different needs and priorities that cyclists may have or perceive across the different groups of users. Among them,[1] e.g.:

- safety: the cycle route has to be safe both in terms of interaction with motorised traffic (external interaction), with other cyclists (internal interaction), pedestrians or users of other mobility devices and between the cyclist and the infrastructure,
- security: the cycle route should offer a good degree of personal security by providing frequent access points, lighting and passive surveillance as far as possible,
- directness: the cycle route should allow for a most direct, short connection between two places unless the route is designed for cycling leisure or tourism purposes, in which case directness should be considered from the angle of the attractiveness objective; the latter also applies when a route follows a geographical corridor (along a river valley or overpassing a mountain for example),
- continuity: the cycle route should be uninterrupted, well connected and signposted,
- attractiveness: the cycle route crosses through recommended points of interests and scenic environment, and
- comfort: the cycle route allows easy use (no steep slopes; clear signage, access to facilities, connectivity to public transport, rest areas and equipment along the route) and comfortable flow of traffic.

8. There are different types of cycling infrastructure developed and operated in accordance with specific parameters. Depending on the infrastructure type and its parameters it can be suitable to serve more some user needs and their priorities rather than other from the list above.

[1] The needs and priorities may vary for specialized cycle route networks such as e.g. a specialized local mountain bike network.

9. Availability of the already existing infrastructure which can be used by cyclists, or which would need to be adapted to the needs of cyclists is another important aspect in developing a cycle route network and in taking a decision on what specific type of infrastructure (and with which parameters) would be the most appropriate one, also from the angle of the investment needs, in constituting the network.

10. Generally, different cycling infrastructure types can be clustered into three groups, as below, to specify when cyclists could use the available road infrastructure depending on volumes and speed of motorised traffic.

11. These three clusters are:

- Cycle tracks (including cycle and pedestrian tracks, greenways and footpaths with cycling allowed)
- Cycle lanes (including bus-and-cycle lanes and contraflow cycle lanes)
- Mixed traffic (including cycle streets, streets with contraflow cycling, agricultural / forestry / industry / water management roads, other mixed traffic arrangements).

12. The analysis could be further reinforced by taking into account additional factors such as e.g. volume of cycling traffic but also other factors.

13. In situations, where the cycling traffic is significant, while the motorized traffic is low, an earlier built road serving motorized traffic can be reclassified for example to a cycle street or a cycle track in the process of cycle route network development. In the first case, the road will continue serving a mixed traffic, however it will give priority to cyclists over other users; in the second case it will allow for cycle and pedestrian traffic only.

14. It is important that directives are put in place to clarify when mixed traffic is not appropriate and should not be allowed. They should assist in prioritizing investments needs for upgrading infrastructure on a planned cycle route network.

15. As stated above, the designation of the cycle route network is a complex task. It should follow therefore a comprehensive, structured and iterative process. Steps recommended in this process are listed and explained in section III.

III. Steps in designating the cycle route network

16. The following steps are recommended, in an iterative process, for designating a cycle route network:

Step 1: Declare the ambition and set up a team for designating the cycle route network at the specific level and commence informal consultations with various stakeholders.

Step 2: Set objectives for the cycle route network service – define destinations and points to be connected, define users, their needs, and ways to address them, also define principles regulating the cycle route network.

Step 3: Assess available routes and existing infrastructure – identify what cycle routes exist at different administrative levels and of what type, which can constitute the given geographical/administrative level cycle route network according to principles defined at step 2 as well as evaluate available infrastructure which can be adapted to meet the cycle route network objectives.

Step 4: Define specific types of infrastructure for the network and its quality requirements.

Step 5: Designate the network – draw the network and identify links to other networks as necessary.

Step 6: Hold formal public consultations – involve administrative bodies, public, cycling organisations and associations and collect and consider their feedback on the network as well as redesign options.

Step 7: Detail the network and indicate the missing links or network section for improvement to achieve the criteria set up in steps 2, 3 and 4.

Step 8: Approve the cycle route network and implement it.

Step 9: Monitor and follow the evolution of the network.

Step 1: Declare the ambition and set up the team:

17. The relevant authority should officially declare its ambition before starting to implement the different steps leading to putting in place a cycle route network at a given geographical/administrative level. Depending on the administrative organisation of a country, to coordinate and to have a good insight into the work done at various administrative levels (municipality, provinces, etc.), it should be considered to set up a team consisting of experts from various administrative levels. The team, if possible, may also include experts from cycling associations and industry. The team should identify stakeholders, not part of the team, including representatives of the public, who it would work with and consult on solutions proposed throughout the network designation process.

18. Another way of approaching this step is by setting up a core team for the designation of the network and separate technical groups of experts and advisory group of cycling agencies and industry to provide targeted advice in support of the core team's work.

Step 2: Set objectives for the cycle route network service, define destinations and points to be connected and principles:

19. In this step, the objectives as discussed in section II should be considered and defined. This step should include defining general principles to be followed in establishing cycle route network, through which the purpose of network uniformity can be achieved. Such principles can concern the network's density or characteristics of cycle routes part of the network (e.g. minimum length). For example, when establishing a national cycle route network trans-regional aspect of cycle routes, their minimum length or the network's density can serve as general principles guiding the network's designation and evolution. To offer a gauge for network density, Annex I, table I.1 provides density indicators for national networks established in selected ECE countries.

20. The general principles need to be set up separately network by network, as there is no one-fit-all set of principles and often they depend on administrative organisation of a country/region/municipality, its territory and population. Consideration needs to be given to destinations and points of interests that the future network should connect so as to serve best its users. At sections, where and as necessary, routes serving commuters and routes serving leisure and tourists cyclists could be separated. Ideally, cycle route networks should include higher-level cycle route networks, such as international networks e.g. EuroVelo, especially to guarantee cross-border continuity.

21. As any network should follow the priority for safety, criteria need to be set up for achieving adequate safety level taking into consideration the external (with motorized traffic) and internal (among cyclists) interactions as well as with pedestrians and users of other mobility devices and the cyclist interaction with the infrastructure.

22. If legislation and policies are in place/in force on user classification or on separation requirements, they may need to be further reviewed.

23. In principle the following user classification with three user categories is recommended:

Category A: cyclists who have good cycling skills and fitness level, are in good physical and psychological condition, for which minimum acceptable infrastructure parameter values should be set;[2]

[2] The Category A should not be confused with the "strong and fearless" group distinguished in some user classifications or sport cyclists, willing to cycle even if no cycle-specific infrastructure exists. The "strong and fearless" category is not included in the guide.

Category B: cyclists who want to cycle safely, for example they travel occasionally or with children or are less skilled or less confident themselves (beginner cyclists, elderly cyclists); they have higher needs in terms of quality parameters, such as separation from motorised traffic, infrastructure forgiving errors, good signposting and clear intersections;

Category C: cyclists who have additional needs related to their disabilities and/or the type of cycle they use, for example a hand-cycle, a tandem, a side-by-side tandem, a speed cycle or a carrier cycle; they have the highest needs in terms of quality parameters.[3]

24. Accepting the above recommended user categories, cycle routes can be also divided into three categories, where the targeted user group is considered together with the expected volume of cycle traffic. These categories are:

- Level 1: basic cycle route
- Level 2: main cycle route
- Level 3: cycle highway

25. While the user categories impact the needs of individual users, expected volume of cycle traffic impacts quality parameters and width necessary for safe and fluent traffic, and might impact the socio-economic cost-benefit balance of providing higher quality cycle infrastructure. Table 1 provides the guidance matrix.

Table 1
Guidance matrix for route categorization in cycle route network

User category/volume	*Up to 750 cyclists/day*	*500 – 3000 cyclists/day*	*More than 2000 cyclists/day*
Category A	Basic cycle route (level 1)	Basic cycle route (level 1)	Main cycle route (level 2)
Category B	Basic cycle route (level 1)	Main cycle route (level 2)	Cycle highway (level 3)
Category C	Main cycle route (level 2)	Cycle highway (level 3)	Cycle highway (level 3)

26. The categories of cycle route influence the selection of specific type of infrastructure and their parameters, including quality parameters, as referred to in step 4 and detailed in Annex II.

Step 3: Assess available routes:

27. The aim of this step is to obtain an up-to-date status of the existing cycling infrastructure and relevant services (access to facilities, connectivity to public transport) existing and already connecting the destinations and the points of interests identified in step 2 as well as identify missing links.

28. In this context, it is also important under this step to have a good overview of available road and other infrastructure that could be used or adapted and used for safe and comfortable cycling. This would involve assessment of ordinary roads or special roads such as service roads, or evaluation of river valleys, canal towpaths or even unused railway lines on their appropriateness for locating cycle routes. The assessments should be data driven and different sources of data should be used. The volumes and speed of motorised traffic as well as the potential for cycle traffic are the key factors influencing the choice of infrastructure type for cyclists. Mobility patterns should also be an important part of the analysis. Market research, as far as feasible, may also be conducted to collect views on mobility patterns and needs from a representative sample of society. To support decision on selection of suitable linear

[3] While it might seem counterintuitive to include both cyclists with disabilities and for example speed cycle users in the same category, in terms of design parameters the quality requirements are very similar: both groups need for example additional width, although for different reasons.

infrastructure, Annex II, table II.1 provides a guidance decision matrix for a given combination of volume and speed of motorized traffic.

29. Moreover, the assessment should encompass for each cycle route or its section the type of the infrastructure and its parameters and be compared against parameters proposed in Annex II. It is recommended that this information is collected and stored in the Geographic Information System (GIS) environment.

Step 4: Define specific types of infrastructure for the network and its quality requirements:

30. The aim of this step is to define specific types of infrastructure for the network (if not done so yet), and their parameters. Furthermore, depending on the targeted user category and the expected volume of cycle traffic introduced in step 2, the parameters can be defined for different categories of cycle route (level 1: basic cycle route, level 2: main cycle route, level 3: cycle highway).

31 Selecting the type of linear cycling infrastructure depends on the category of cycle route chosen but also external factors such as volume and speed of motorized traffic. Types of linear cycling infrastructure are cycle tracks (one or two ways, including greenways), cycle lanes, mixed traffic (including cycle streets). A guidance decision matrix for selection on suitable types of linear infrastructure is provided in Annex II, table II.1. For clarity of these terms, the definitions of the various types of cycle infrastructure are provided in Glossary in Annex IV.

32. Legislation and standards in place which define already parameters for cycle infrastructure should be examined. Efforts should be made to have in place a consistent system of parameters which are encompassed in binding standards in the country.

33. It is recommended to consider and set values at least for the following parameters: separation from pedestrians, width, distance from obstacles, design speed, horizontal curve radius, stopping sight distance, gradients and surface quality. Recommended values for sections of the network are provided in Annex II, tables II.2 to II.10 and their annotation, and for crossings in Annex III, tables III.2 and III.3 and their annotation.

Step 5: Designate the network:

34. The aim of this step is to designate an achievable cycle route network at a given geographical/administrative level taking into account:

- the defined objectives, principles, categories and quality parameters,
- the existing infrastructure, and when necessary, the indications for upgrade,
- the creation of new cycling infrastructure, when necessary,
- the numbering/coding system of cycle routes, with attention to higher-level cycle route network compatibility.

35. The network plan should be drawn up in GIS environment.

36. When drawing it, the following issues should be re-analysed in connection with the objectives set for the network:

- connectivity to important urban, employment and education centres at relevant geographical/administrative for meeting commuter daily mobility objectives,
- linking to the important tourist attractions,
- route attractiveness – along waterways, in nature,
- route comfort (inclination, surface quality, number of stops),
- connectivity to public transport,
- cross-border-connectivity, and alignment with international cycle route networks such as EuroVelo, when relevant and especially for national cycle route networks,
- environmental requirements or the need for environmental impact assessment.

Step 6: Hold formal public consultations:

37. While informal consultation should, as far as possible, take place at any step of the process in designating the network, formal public consultations is an important step to collect the feedback on the network. It can also help adapt its design to the future users, public at large as well as users from neighbouring countries, regions or municipalities and other important stakeholders, including the local communities and administration through which the network would cross. For the connectivity across borders, also administration from neighbouring countries should be consulted.

38. Public consultation and public participation may be in any case a requirement as per national legislation in force, in particular for countries, Contracting Parties to the Aarhus Convention.

39. Through the public consultation the following should be confirmed:

- is the network meeting the expectations and requirements of the stakeholders,
- does it support cycling for commuting,
- does it support cycling for leisure or tourism purposes,
- does it encourage an uptake in cycling,

Step 7: Detail the network

40. The aim of this step is the preparation of a detailed plan for the development and maintenance of the network, including assurance of funding. For the development phase the focus needs to be given to putting in place an achievable plan for construction of the missing links and for upgrades of the available but deficient infrastructure. The construction plan should detail sections of the network prioritized for development, i.e. assign priority for development linked to annual funding disbursements. It should also identify responsible bodies and shared responsibilities for implementation. Sections of networks to serve highest traffic volumes or providing greatest improvement in cyclist safety should be prioritized for development.

41. In detailing the network, the necessary attention should be given to crossings between cycle routes and roads for motorized traffic. It is recommended that crossings are designed taking into account factors such as: volume of motorized traffic, volume of heavy traffic, speed of traffic, number of lanes to cross, presence of merge or slip lanes, length of crossing, width (including present of pinch points), sharing space with pedestrians, crossing angle and visibility splays. Form these factors, volume and speed of motorized traffic are key to influence the choice of type of crossing between cyclists and motorized traffic. For high volumes and speeds of motorised traffic, grade separated or traffic light-controlled crossing should be the only options. Grade separation may also be the right choice for reducing the interruptions and delays on a cycle route. To gauge the choice for crossings, Annex III, table III.1 provides recommended parameters and values. Annex III also contains other recommendations regarding crossings located on and outside intersections of motorized traffic and visibility splays at intersections.

42. In detailing the network, it should also be considered in which conditions cycle and pedestrian traffic can be mixed. Annex II, section II elaborates on conditions for mixing cycle and pedestrian traffic.

43. As part of this step, also aspects such as shade or requirement to stop by cyclist can be considered. Shade would concern parameters to make routes suitable to use in hot climate. The minimization of stops or interruptions would be important to increase comfort but also safety of cyclists. Recommended values for maximum number of stops/interruptions are provided in Annex II, table II.11.

44. This step should also incorporate preparation of legislative acts, if not yet available in the country and not done in the work under the previous steps, for introducing binding standards.

45. The plan should be supported by the information and analysis of benefits for the society from investments in cycling and its network.

Step 8: Approve the cycling network and implement it

46. The aim of this step is the approval of the network development plan at the relevant administrative level and assurance of funding for its implementation. It is also the adoption of the legal acts and standards and their publication.

Step 9: Monitor and follow the evolution of the network

47. The aim of this step is to define a framework for the future monitoring and evolution of the network over time. It should take into account the principles defined in step 2 and consider the governance established in step 1. The implementation and progress of the cycle route network should be based on GIS data according to step 5.

48. Modifications to network over time should be done through an iterative process taking actions as described under the appropriate steps.

Annex I

Density indicators

Table I.1
Density indicators for national networks established in selected ECE countries

Country	*Density indicator (per 1000 km^2)*
Austria	50
Belgium	44
Bulgaria	40
Croatia	83
Czechia	32
Denmark	60
France	55
Germany	29
Greece	13
Hungary	43
Ireland	57
Netherlands	62
Norway	33
Romania	30
Slovenia	31
Spain	15
Switzerland	74
United Kingdom of Great Britain and Northern Ireland	40

Annex II

Recommended types of cycle infrastructure and their parameters

I. Guidance decision matrix for mixing or separating cycle and motorised traffic

Table II.1 presents the guidance decision matrix for categories of linear cycling infrastructure and categories of cycle routes taking into account the volumes and speeds of motorized traffic.

Table II.1
Guidance decision matrix

	Up to 30 km/h	*31-50 km/h*	*51-65 km/h*	*70+ km/h*
1-500 pcu/day	Mixed traffic (1, 2) Cycle street (2, 3)	Mixed traffic (1, 2) Cycle track (3)	Mixed traffic (1, 2) Cycle lane (2, 3) Cycle track (3)	Mixed traffic (1) Cycle lane (2) Cycle track (2, 3)
500-2000 pcu /day	Mixed traffic (1, 2) Cycle street (2, 3)	Mixed traffic (1) Cycle lane (2) Cycle track (3)	Mixed traffic (1) Cycle lane (1, 2) Cycle track (2, 3)	Mixed traffic (1) Cycle lane (1) Cycle track (1, 2, 3)
2000-4000 pcu/day	Mixed traffic (1, 2) Cycle lane (2) Cycle track (3)	Cycle lane (1, 2) Cycle track (2, 3)	Cycle lane (1, 2) Cycle track (2, 3)	Cycle lane (1) Cycle track (1, 2, 3)
4000-10000 pcu/day	Cycle lane (1, 2) Cycle track (1, 2, 3)	Cycle lane (1) Cycle track (2, 3)	Cycle lane (1) Cycle track (2, 3)	Cycle track
> 10000 pcu/day	Cycle lane (1) Cycle track (1, 2, 3)	Cycle track	Cycle track	Cycle track

Where multiple infrastructure types are provided for a specific combination of volume and speed, numbers in parenthesis included after the infrastructure type indicate the cycle route category level for which the given infrastructure type is suitable for the combination of volume and speed of motorised traffic (level 1 – basic cycle route; level 2 – main cycle route; level 3 – cycle highway).

Where cycle track is indicated in the table, infrastructure types allowing cycle and pedestrian traffic to share the same surface can also be considered, taking into account the guidance decision matrix for mixing or separating cycle and pedestrian traffic (see subsequent section).

The volume of traffic is expressed in passenger car equivalent or passenger car units (pcu) per day to incorporate the share of heavy traffic (heavy good vehicles, busses etc.) The EuroVelo "European Certification Standard – Handbook for route inspectors" (ECF, 2022) provides specific pcu equivalence factors fine-tuned for the purpose of determining suitability of cycling in mixed traffic.

For speeds, further to many design manuals, actual speeds (the 85th percentile speed) should be considered. In practice, however, reliable data about speed distribution on local, low-traffic roads (most suitable for mixing cycle and motorised traffic), are rare, and would be expensive to collect for a large-scale evaluation (for example, for the purpose of designating itineraries for national or regional cycle routes). In such case, it is proposed to use speed limit as approximation.

II. Guidance decision matrix for mixing or separating cycle and pedestrian traffic

For cyclists and pedestrians sharing the same surface, three main types of infrastructure should be considered:

(a) cycle tracks,[4]

(b) cycle and pedestrians tracks, and

(c) footpaths (including pedestrian zones) with cycling allowed.

Table II.2 presents applicability of these types of infrastructure on different categories of cycle routes. Table II.3 presents maximum density of pedestrian traffic (per hour and per metre of obstacle-free width) and additional considerations.

Table II.2
Selection of type of infrastructure for mixing cycle and pedestrian traffic per category of cycle route

	Basic cycle route	*Main cycle route*	*Cycle highway*
Cycle track	+	+	+
Cycle and pedestrian track	+	Exceptionally, e.g. on bridges or low density of pedestrian traffic	-
Footpath with cycling allowed	Exceptionally, e.g. on bridges, or as an access to trip destination, e.g. a shopping street	-	-

Table II.3
Recommended maximum density of pedestrian traffic on shared cycle infrastructure

	Max density of pedestrian traffic [pedestrians/m/h]	*Additional considerations*
Cycle track	25	If it is not possible to use pavements (sidewalks) or verges, or if none is provided, pedestrians may walk on cycle track in line with article 20 paragraph 3 of the Convention on Road Traffic.
Cycle and pedestrian track	100	Should be lit during night-time to make it possible for cyclists to notice pedestrians early enough. Need to ensure quality parameters such as stopping sight distance, or distance from obstacles.

[4] Cycle track” in this section refers only to situation where no usable sidewalk for pedestrians is present and the pedestrians may use the cycle track in line with article 20 paragraph 3 of the Convention on Road Traffic (typically outside built-up areas). If there is both a cycle track and a sidewalk, cyclists and pedestrians do not share the same surface, and the section is not applicable.

	Max density of pedestrian traffic [pedestrians/m/h]	*Additional considerations*
Footpath with cycling allowed	200	Usage by cyclists non-compulsory. Includes pedestrian zones in city centres, parks etc.[5]

It should also be noted that cycling traffic is highly self-regulating.[6] When the pedestrian density makes cycling difficult, cyclists seek an alternative route. The best way to avoid conflicts between pedestrians and cyclists in a crowded area is to provide a high-quality cycle route that bypasses the area.

III. Quality requirements for cycle infrastructure

A. Width

Width of cycling infrastructure should be determined based on expected volume of cycle traffic, and categories of cycles and users targeted to use the infrastructure. To this end, width parameters in Table II.4 are differentiated for basic cycle route, main cycle route and cycle highway. They are defined under the assumption that:

- most of cycles (regular users) do not exceed 0.75 m width,
- no standard cycles (regular and occasional users) exceed 1.0 m width,
- extra-wide cycles (side-by-side tandems, wider carrier cycles – demanding users) do not exceed 1.5 m.

Table II.4
Minimum width considering category of cycle route and type of cycling infrastructure

Minimum width	*Basic cycle route*	*Main cycle route*	*Cycle highway*
One way cycle track	1.5 m	2.0 m	3.0 m
Two way cycle track	2.5 m	3.0 m	4.0 m
Cycle lane	1.5 m	2.0 m	2.25 m
One way cycle and pedestrian track	2.0 m	N/A	N/A
Two way cycle and pedestrian track	3.0 m	N/A	N/A
Cycle street	N/A	4.5 m	4.5 m

Moreover, the widths are recommended also under the assumption that the cycle infrastructure maintains a safe distances from obstacles and other parts of the road, as listed in Table 2.5. If these distances are not observed, this must be compensated with width of the infrastructure (and preferably also horizontal markings denoting the edge of the safe zone). For example, if there is a wall or fence 0.3 m from the edge of the cycle track, the width of the cycle track is effectively reduced by 0.2 m.

B. Distances to obstacles

Table II.5
Recommended distances of cycling infrastructure to obstacles

[5] As the volume of pedestrian traffic in pedestrian zones varies during the day (typically lower in the morning, higher in the afternoon and evening), allowing cycle traffic only in selected hours (for example until 10 am or until noon) might be an option.

[6] See for example the PRESTO implementation fact sheet: https://www.eltis.org/sites/default/files/trainingmaterials/07_presto_infrastructure_fact_sheet_on_cyclists_and_pedestrians.pdf

Distance between:	*Cycle track*	*Cycle lane*
Physical obstacles (walls, fences, lamp posts etc.)	0.5 m	0.5 m
Carriageway up to 50 km/h	0.35 m	0.0 m
Carriageway over 50 km/h	0.75 m	0.5 m
Parked cars	0.75 m	0.75 m

C. Geometric requirements

Table II.6
Recommended geometric requirements for cycle traffic considering cycle route category

	Basic cycle route	*Main cycle route*	*Cycle highway*
Design speed	20 km/h	30 km/h	40 km/h
Minimum horizontal curve radius	10 m	22 m	45 m
Minimum stopping sight distance	15 m	35 m	57 m

The applicability of the geometric requirements is independent from the type of infrastructure, but in practice they mostly need to be verified for cycle tracks (and cycle and pedestrian tracks). The values for radii are provided for clean asphalt surfaces. Non-asphalted or poorly maintained surfaces require roughly 1.5-2 times higher curve radii because of lower friction coefficient.

The values provided in tables 2.4-2.6 are a result of the review of the most common requirements in already existing national and regional regulations and guidelines. It should however be noted that there are also more in-depth, non-normative models, that allow fine-tuning of geometric design of cycling infrastructure. For example:

- "Geactualiseerde aanbevelingen voor de breedte van fietspaden 2022"[7] provides a more detail methodology for estimating the necessary width for cycle tracks and evaluating widths of existing cycle track, taking into account also the share of different types of users, and provide more fine-grained intervals for cycle traffic volume.
- "Analytical Geometric Design of Bicycle Paths" (Zain Ul-Abdin, Sarmad Zaman Rajper, Ken Schotte, Pieter De Winne, and Hans De Backer, 2020)[8] considers also ratio of curvature for upcoming and previous road segments, and transition curves.

D. Surface quality

There is no established standard on how the surface quality measurements for cycle infrastructure should be performed and results quantified. Results from different measurement vehicles using laser sensors or accelerometers obtained in different countries or even different municipalities are currently not comparable. For motorised vehicles, methods of calibrating and processing the data have been developed, to create International Roughness Index[9] (IRI). However, IRI is calculated using a quarter car-model, reflecting mass, tire size and suspension characteristics of a motorised vehicle, therefore it does not necessarily describe well the impact of the surface on cycling safety and comfort. As cycle models exist, but are country- or region-specific, it would be beneficial to carry out a similar research project in to order to establish common standard surface quality measurements for cycles.

7 https://www.fietsberaad.nl/Platform-Veilig-fietsen/dossier/Aanbevelingen-Fietsvriendelijke-infrastructuur/kennisdetail/Aanbevelingen-breedte-fietspaden-2022/26099
8 https://doi.org/10.1680/jtran.17.00162
9 World Bank Technical Paper Number 45: The International Road Roughness Experiment. Establishing Correlation and a Calibration Standard for Measurements. Michael W. Sayers, Thomas D. Gillespie, and Cesar A. V. Queiroz. Washington 1986.

Therefore, qualitative assessment can be used to approximate the surface quality. Table 2.7 presents a classification framework based on EuroVelo "European Certification Standard – Handbook for route inspectors". Table 2.8 compares it with the framework used in "Cycle infrastructure design" (LTN 1/20)[10] and with OpenStreetMap smoothness classification scheme.[11] Table 2.9 uses the classification to formulate requirements for surface quality for different categories of routes.

Table II.7

Cycle infrastructure surface classification framework

Surface quality	*Rideable with*	*Example surfaces*
perfectly rideable	road, folding or children's bike in every weather condition; roller blade; skateboard	smooth asphalt or concrete with low rolling resistance
well rideable	trekking bike in every weather condition	raw granulation or slightly bumpy asphalt; well-laid paving blocks or slabs; well-maintained and undamaged stabilised gravel
moderately rideable	rugged touring bike in most weather conditions	patched, uneven asphalt with occasional potholes; uneven paving blocks or slabs; smooth gravel, neither sandy nor muddy
badly rideable	mountain bike and comparable	multiple potholes and puddles, large cracks or longitudinal rifts; missing blocks, broken slabs, cobblestones; loose stones or tree roots; somewhat sandy or muddy gravel roads
not rideable	-	deep sand, deep mud, large rocks, deep holes

Table II.8

Comparison of different cycle infrastructure surface classification frameworks

Surface quality	*LTN 1/20 Cycling Level of Service*	*OSM smoothness*
perfectly rideable	2 (Green)	excellent
well rideable		good
	1 (Amber)	
moderately rideable		intermediate
badly rideable	0 (Red)	bad
		very_bad
not rideable		horrible
		very_horrible
		impassable

10 https://www.gov.uk/government/publications/cycle-infrastructure-design-ltn-120

11 https://wiki.openstreetmap.org/wiki/Key:smoothness

Table II.9
Summary of cycle infrastructure surface quality considering the category of cycle route

	Basic cycle route	*Main cycle route*	*Cycle highway*
New infrastructure	Well rideable	Perfectly rideable	Perfectly rideable
Infrastructure in operation	Moderately rideable	Well rideable	Well rideable

IV. Inclination

The gradient impacts on two issues: the physical limitations of a cyclist to climb inclines, and their safety when descending. While a short steep gradient might be acceptable, a longer climb or descent requires gentler slope. It is therefore proposed to express the maximum acceptable gradient in function of the height difference to overcome,[12] as stipulated in table II.10.

Table II.10
Recommended maximum inclination gradient values per category of cycle routes.

Height difference to overcome	*Basic cycle route*	*Main cycle route*	*Cycle highway*
1 m	10.0%	8.0%	6.0%
2 m	10.0%	7.0%	4.5%
3 m	7.0%	6.0%	4.0%
5 m	5.5%	5.0%	3.5%
7.5 m	4.5%	4.0%	3.0%
10 m	4.5%	3.0%	2.5%
15 m	4.0%	3.0%	2.5%
100 m or more	3.0%	3.0%	2.0%

In addition, for cycle route with inclination exceeding 3 per cent, the following is recommended:

(a) Infrastructure width should be increased by at least [value] m,

(b) Design speed of at least 40 km/h should be assumed and all the related geometric parameters, i.e. curve radii and sight distances,[13] should be increased accordingly,

(c) Timings of traffic signals should be increased for cyclists travelling in the uphill direction.

The following recommendations should also be considered:

(a) No sharp curves, obstacles or crossings without priority should be located in the middle or at the bottom of the slope; a section of flat, straight cycle track is necessary to safely reduce the speed after descending the slope.

(b) Level sections can also be used in-between inclines to provide opportunity to rest or reduce speed, especially if the height difference exceeds 5 m. The recommended length of such level section varies between 5 and 25 m.

(c) There should be no sudden changes of gradient, which may cause “bumps” and crashes. Transition between flat sections and slopes, or between slopes with different

[12] Alternative ways to formulate the same requirement is to vary the maximum acceptable gradient depending on the length of the slope (Germany, Norway, Slovakia, UK), or to use „slope severity” instead of gradient (Netherlands). The different requirements were recalculated to be expressed in the same way for the purpose of the analysis.

[13] See https://ecf.com/files/reports/geometric-design-parameters-cycling-infrastructure

gradient, should be designed with the use of vertical curves. See Geometric design parameters for cycling infrastructure[14] (table 4) for specific parameters.

V. Stops/interruptions

Stops/interruptions can be expressed by number of stops per kilometre or time lost when ridding over one kilometre due to stops/interruptions. Table II.11 provides the maximum values per category of cycle routes.

Table II.11
Recommended maximum values for number of stops and delay time

		Maximum value		
Parameter	*Unit*	*Basic cycle route*	*Main cycle route*	*Cycle highway*
Interruptions per kilometre	Stops/km	1.5	1	0.4
Delay per kilometre	Seconds/km	40	20	15

VI. Final remarks on quality parameters

In case when the quality parameters listed above cannot be attained for various reasons, other solutions should be sought. For example, if on a cycle track it is not feasible to provide width or sight distances adequate to the category of the route, an alternative solution could be such as:

- Encourage (by making the cycle track not compulsory) or oblige (by specific panels or lack of them under the cycle track sign) users of wider and/or faster cycles to use the carriageway, in order to reduce the expected volume of cycle traffic on the cycle track, or
- Reduce the speed on the carriageway for motorized traffic and/or redirect a part of motorised traffic to another road, to make cycling in mixed traffic a feasible option.

[14] Design manual for bicycle traffic. CROW 2017. https://www.crow.nl/publicaties/design-manual-for-bicycle-traffic

Annex III

Recommendations concerning cycle crossings

I. General parameters for cycle crossings

Several parameters should be observed when deciding about setting up a controlled versus uncontrolled crossing. Table III.1 lists these parameters and their values. They are distinguished for the three categories of routes: basic cycle route, main cycle route and cycle highway.

Table III.1
Decision matrix for determining controlled versus uncontrolled at-grade crossings

	Basic cycle route	*Main cycle route*	*Cycle highway*
Max speed of intersecting traffic [km/h]	80	70	50
Max volume of intersecting traffic – without central traffic island [PCU/day]	8 000	5 000	3 000
Max volume of intersecting traffic – with central traffic island [PCU/day]	16 000	12 000	8 000
Max number of lanes to cross [lanes]	1/direction	1/direction	1/manoeuvre
Max length of the crossing [m]	-	8.0	7.0
Min traffic island width [m]	2.5	3.0	4.0

II. Recommendations for crossings depending on their location

For cycle crossings located on intersections, the following is recommended:

(a) Priority on intersection with cycle crossing should be established by appropriate traffic signs; priority prescribed by the general priority rule (for example, “give way to the vehicle from the right”) is not recommended.

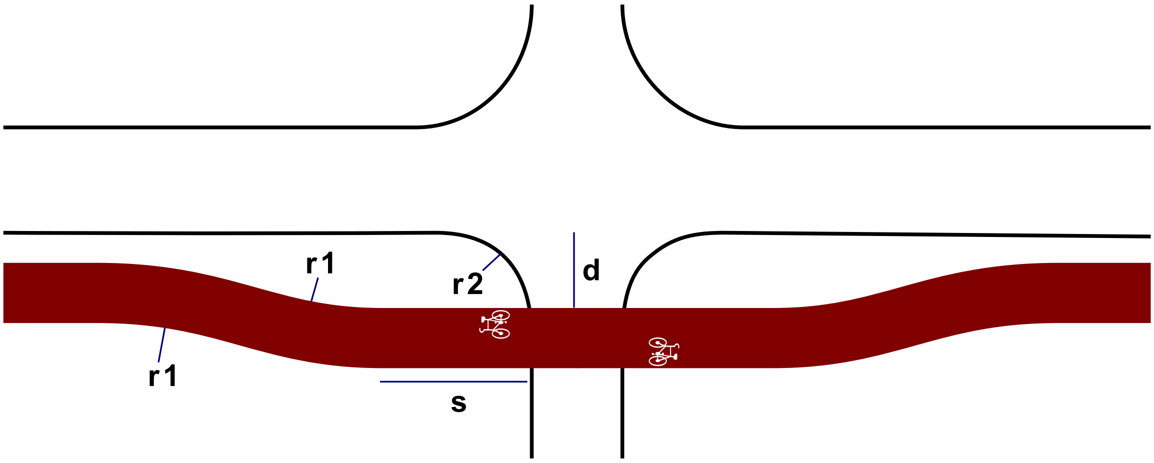
(b) No bends in the priority road are recommended.

(c) Priority on the cycle crossing should be aligned with the priority on the intersection. This means:

- A cycle track along a priority road will have priority over a road on which a “give way” or a “stop” sign is placed,
- Cyclists crossing a priority road will give way to vehicles travelling on that road.

(d) Cycle track might be bent-out before crossing if the cycle track runs close to the carriageway of the main road; this is done to provide a space for a turning car to stop between the carriageway and the crossing– see Figure I.

Figure I
Additional parameters for bent-out cycle crossings



where:

d – Distance between the carriageway and the crossing = 5 m; up to 8 m outside built-up areas;

r1 – Horizontal curve radius used to bend out the cycle track ≥ 20 m

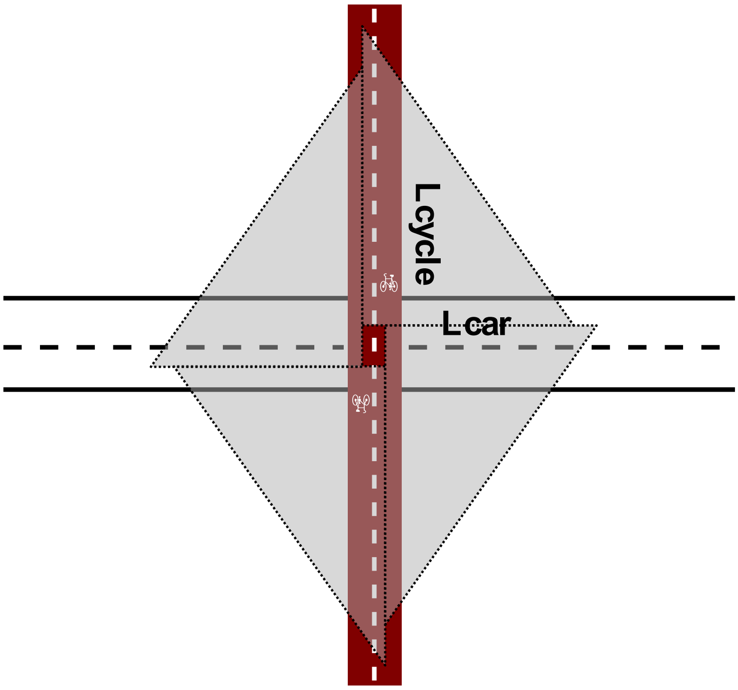
s – Length of the straight section of a cycle track before the crossing ≥ 5m

For cycle crossings outside of intersections, priority should be established by appropriate traffic signs, taking into account the role of the cycle route and the role of the road crossed.

III. Recommendations for visibility splays at cycle crossings

Sufficient visibility splays should be ensured at crossings – see Figure II. The visibility splay is composed of triangles defined by Lcycle (distance along the cycle track) and Lcar (distance along the carriageway crossed). The number and location of triangles depends on whether the cycle track and carriageway are uni- or bidirectional. The values of Lcycle and Lcar are affected by which kind of traffic has the right of way on the crossing, the speed of motorised vehicles and the class of the cycle route (indirectly implying also speed of the cycles).

Figure II
Visibility splays on a cycle crossing of a bidirectional cycle track and a bidirectional carriageway in right hand traffic



Source: Interreg North-West Europe, CHIPS, ECF

Table III.2 presents recommended minimum values for Lcycle and Lcar for crossings with right of way for cyclists and table 3.3 for crossings where cyclists are obliged to give way.

Table III.2
Recommended minimum values for Lcycle and Lcar for crossings with right of ways for cyclists

	Basic cycle route	*Main cycle route*	*Cycle highway*
Lcycle	14	22	48
Lcar	4	10	15

Table III.3
Recommended minimum values Lcycle and Lcar for crossings with right of ways for motorized traffic

		Basic cycle route	*Main cycle route*	*Cycle highway*
Lcycle		2	4	8
Lcar	30 km/h	23	33	48
	50 km/h	45	63	84
	60 km/h	59	83	99
	70 km/h	97	105	120
	80 km/h	120	140	145

IV. Additional recommendations

(a) Raising a cycle crossing improves its recognisability and reduces the speed of motorised vehicles in the conflict area.

(b) On an intersection, the minor arm can be arranged in a form of so-called “exit”, with continuity of cycle track and sidewalk across the whole crossing

(c) If a cycle crossing is bidirectional, signage should indicate to the approaching drivers that they should expect cyclists from both directions.

Annex IV

Glossary of terms

Definitions of types of cycle infrastructure.

Mixed traffic is a road on which cyclist share the carriageway with motorised traffic, without having a part of the carriageway (cycle lane) designated for cycles.

Related infrastructure:

Cycle street is a specially designed section of road or an area where special traffic rules apply and it is signposted as such at its entries and exits.

Specific service road is a non-public road closed to general traffic, but open to cycles and selected motor vehicles, for example agricultural, forestry, industry and/or water management vehicles.

Cycle lane is a part of a carriageway designated for cycles. A cycle lane is distinguished from the rest of the carriageway by longitudinal road markings.

Related infrastructure:

Bus-and-cycle lane is a lane reserved for (public transport) buses and cycles.

Street with contraflow cycling is a road that is one-way for general traffic but may be used by cyclists in both directions.

Cycle track is an independent road or part of a road designated for cycles, signposted as such. A cycle track is separated from other roads or other parts of the same road by structural means.

Related infrastructure:

Cycle and pedestrian track is an independent road or part of a road designated for cycles and pedestrians sharing the same surface, signposted as such. A cycle and pedestrian track is separated from other roads or other parts of the same road by structural means.

Greenway is an independent road designated for non-motorised users, including pedestrians and cyclists, signposted as such. Its use might be open to other non-motorised users, for example horseback riders, if signposted as such or defined in the national legislation.

Footpath with cycling allowed is a part of the road (pavement/sidewalk) or an independent road originally designed for pedestrians where cycling has been (conditionally) authorised, either by general rules or through a cycle panel under the footpath sign.

Cycle crossing is the place where a cycle track, cycle and pedestrian track or a greenway intersects with a carriageway.

Related infrastructure:

Grade-separated cycle crossing is a cycle tunnel or bridge on a cycle track which offers cyclists a way of crossing a barrier, such as a busy road or a railway line.

Other definitions

Cycle route connects at least two points through a combination of various infrastructure types (for example cycle tracks, cycle lanes, cycle streets or roads with low volumes of motorised traffic) and is equipped, where appropriate, with wayfinding solutions (road direction, confirmation and identification signs as well as road markings). A cycle route can serve commuting, recreation, tourism, or mix different purposes. Depending on its geographical scope and role in the network, a cycle route can be international, national, regional or local.

Cycle route network is a combination of interconnected cycle routes to respond to the needs of cyclists in a specific geographical area. A cycle network can serve commuting, recreation, tourism, or mix different purposes. It can be international (such as EuroVelo), national, regional or local.

Other definitions elaborated by the ECE Group of Experts on Cycling Infrastructure Module can be consulted here: https://unece.org/transport/events/wp5ge5-group-experts-cycling-infrastructure-module-sixth-session.