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United Nations Economic Commission for Europe cycling network

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Submitted by the European Cyclists Federation and the secretariat

I. Introduction

1. The Group of Experts on cycling infrastructure module (GE.5) agreed at its second session on four key parameters to be considered for determining a relevant type of infrastructure. These are: volume of motorized traffic (i.e., number of vehicles per day) (including share of heavy traffic), volume of cycle traffic (i.e., number of cyclists per day), speed limit/observed speed of motorized traffic and width of the infrastructure. These four parameters should be supported by parameters defining quality of the infrastructure and affecting comfort and safety of cyclist using the infrastructure. In this document a slightly modified approach is proposed, with width considered a quality parameter, and taking the feasibility of achieving the quality parameters into account when determining the type of infrastructure best suited to a given location.

2. With regard to user classification, GE.5 agreed on three groups of user categories. The first group would encompass everyday (regular) cyclists for which minimum acceptable infrastructure parameter values should be set. The second group would refer to attentive (occasional) cyclists. The third group would encompass special (demanding) cyclists (e.g., carrier cyclists or vulnerable cyclists). For the groups two and three enhanced values should be recommended.

3. GE.5 requested the secretariat and ECF to prepare tables with parameters value propositions differentiated for the three user categories for each of the agreed types of infrastructure for consideration at the next session.

4. This document proposes definitions of cycle route parameters in section II and a classification of routes in section III. It further provides in section IV the principles of selecting the type of infrastructure, and in section V selected quality parameters for each of the route categories, basing on the classifications and overviews presented in Informal document WP.5/GE.5 (2022) No. 2, as well as additional sources referenced further in the document.

II. Cycle route parameters

5. To take into account the share of heavy traffic (heavy good vehicles, busses etc.), it is proposed to consider the volume of motorised traffic expressed in passenger car equivalent or passenger car units (pcu) per day. 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.

6. Speed is a critical factor both for the risk of accident and its severity. Many design manuals recommend considering actual speeds (the 85th percentile speed). 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 cycle routes). Therefore, it is proposed to use speed limit as approximation.

7. Expected volume of cycle traffic impacts width necessary for safe and fluent traffic, and might impact the socio-economic cost-benefit balance of providing segregated cycle infrastructure. It is proposed to consider the volume of cycle traffic as one of the determinant of the cycle route category, together with the categories of users, as set out in section III.

8. Width of cycling infrastructure should be determined on basis of expected volume of cycle traffic, and categories of cycles and users targeted to use the infrastructure. The parameters listed further in section IV are provided on the assumptions that:

- most of cycles 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.

If, in the course of work on the definition of cycle, GE.5 decides on different width thresholds for some or all categories of cycles, the values provided for cycle infrastructure will need to be adjusted accordingly.

9. In addition to width, the following quality parameters were included in the document: design speed, horizontal curve radius, stopping sight distance and surface. The list of parameters is by no means exhaustive and may be supplemented through further analysis of guidelines, standards and additional research.

10. As far as surface is concerned, 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[1] (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. As for now, qualitative assessment such as described in the EuroVelo "European Certification Standard – Handbook for route inspectors" can be used to approximate the surface quality.

III. Classification of routes

11. It is proposed to categorise routes into three categories, depending on user groups targeted and the expected volume of cycle traffic:

[1] 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.

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

Table 1

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

12. The categories influence the selection of specific type of infrastructure, as specified in section IV, and expected level of quality parameters, as specified in section V

IV. Selection of specific type of infrastructure

13. Volume and speed of motorised traffic are the key factors influencing the choice of infrastructure type for cyclists. Table 2 presents a guidance decision matrix. In case multiple infrastructure types are presented 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.

Table 2

	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

14. Quality parameters listed in section V might affect the final decision. For example, if on a cycle track it is not feasible to provide width or sight distances adequate to the category of the route, alternative solutions should be sought, such as:

- encouraging (by making the cycle track not compulsory) or obliging (by specific panels or lack of them under the cycle track sign) users of wider and/or faster cycles to use the carriageway, to reduce the expected volume of cycle traffic on the cycle track,

- reducing the speed and/or redirecting a part of motorised traffic to another road, to make cycling in mixed traffic a feasible option.

15. GE.5 might also wish to discuss the influence of volume of pedestrian traffic on the decision whether to segregate or not this groups of users from cyclists (choice between a common cycle and pedestrian track, separate cycle track and pedestrian track, or cycle track only).

V. Quality parameters for specific infrastructure

16. Table 3 presents minimum widths for selected types of cycle infrastructure.

Table 3

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 (2.0 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

17. The widths are given under the assumption that the cycle infrastructure maintains a safe distances from obstacles and other part of the road, as listed in table 4. 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.

Table 4

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

18. Table 5 presents further geometric requirements for cycle traffic. Their applicability 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.

Table 5

	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

19. The values listed in this section 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"[2] 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)[3] considers also ratio of curvature for upcoming and previous road segments, and transition curves.

20. Table 6 presents requirements for surface quality in terms of ECS qualitative assessment.

Table 6

	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

[2] https://www.fietsberaad.nl/Platform-Veilig-fietsen/dossier/Aanbevelingen-Fietsvriendelijke-infrastructuur/kennisdetail/Aanbevelingen-breedte-fietspaden-2022/26099

[3] https://doi.org/10.1680/jtran.17.00162