Interim measures for reducing speeds of cyclists

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ABSTRACT

Interim measures for reducing speeds of cyclists when passing road work is often necessary to create a safe work environment for the road workers moving on and along the road while the work is in progress. On this basis four different interim measures for temporary speed reducing of cyclists have been tested in real traffic. The measures include 1) portable black rumble stripes, 2) narrowing a cycle track and lateral displacement, 3) black/yellow portable bumps and 4) a special designed black/yellow rubber map with rumble effects. The results shows that bumps/rumble stripes work best. The bump will preferable because cyclists are rewarded with higher comfort if they pass the speed bump with low speeds.

Keywords: Cyclist, Speed reduction, Roadworks, Safety, road worker.

1 INTRODUCTION

If cyclists are riding too fast for conditions when passing roadworks, they can pose a risk not only to themselves but also to road workers. When road workers are working just next to passing cyclists, it can be necessary to reduce speeds of cyclists temporary during roadworks not only for the sake of cyclist but also

to avoid closing down a cycle track and forcing cyclists to take a detour. The requirements of such interim measures are that they should be easy for the road workers to carry, easy to place at the bicycle track, easy to remove when not needed anymore, and of course not pose a danger to cyclists. The aim of this project has been to find suitable existing measures and /or develop new suitable measures and afterwards test the effect of each measure. Since it has not been possible to find any suitable existing measures developed for reducing speeds of cyclists temporarily the tested measures include existing measures aimed for motorists and development of a new measure aimed at cyclists.

2 METHOD

2.1 Test design

In the beginning of the project different kinds of speed reducing measures for cyclists were tested in a closed area. The purpose was to find measures that was not dangerous for cyclist to pass, but at the same time sufficiently uncomfortable (user comfort) to pass at high speed. This led to a number of test designs of interim measures that were suitable for testing on a cycle track in real traffic. Based on the experiences on the closed area four different kind of interim measures have been tested:

1) Black portable rumble strips, 2 cm high and 33 cm long. Each module is 110 cm wide, and modules can be clicked together (**Figure 1**). Three different settings.

2) Narrowing of cycle track and lateral displacement of cyclist using 1.1 m high and 38 cm wide delineators (**Figure 2**). Two different settings.

3) Black/yellow portable speed bumps with a height of 3 cm and a length of 48 cm. Each module is 60 cm wide, and modules can be clicked together (**Figure 3**). Three different settings.

4) Prototype of a black/yellow rubber mat with rumble effects. Each module is 120 cm long and has a width of 50 cm and modules can be clicked together (**Figure 4**). One setting.

Figure 1. Black portable rumble strips. Three different settings were tested. The left design (1.1) has 4 strips spaced 20 cm apart. The design in the middle (1.2) has 3 strips spaced 20 cm apart. The design on the right (1.3) has 4 strips where the distance between the first two is 6 m, while the distance between the last three is 20 cm.

Figure 2. Narrowing of cycle track and lateral displacement of cyclist using delineators. Two different settings were tested. On the left (2.1), the bicycle area is narrowed from the left with 2 delineators and then from the right with 3 delineators with a gap between delineators of 4 m. On the right (2.2) the bicycle area is narrowed with 3 pairs of delineators spaced 4 m apart, first from the left then from the right and then again from left.

Figure 3. Prefabricated Black/Yellow portable speed bumps. Three different settings were tested. The left design (3.1) consists of two bumps spaced 1 m apart. The design in the middle (3.2) consist of a single bump and the design to the right (3.3) consist of two bumps spaced 0,75 m apart.

Figure 4. Prototype of a black/yellow rubber mat with rumble effects aimed for cyclists. This prototype has a groove height of 7 mm, groove width of 5 cm and a distance between grooves of 10 cm. 4.1 on both left and right.

Between one and three different settings have been tested for each measure, corresponding to a total of nine different settings.

2.2 Test set-up

All nine settings were tested in real traffic on a one-way cycle track with fictitious roadworks but no road workers at the site, see **Figure 5**.

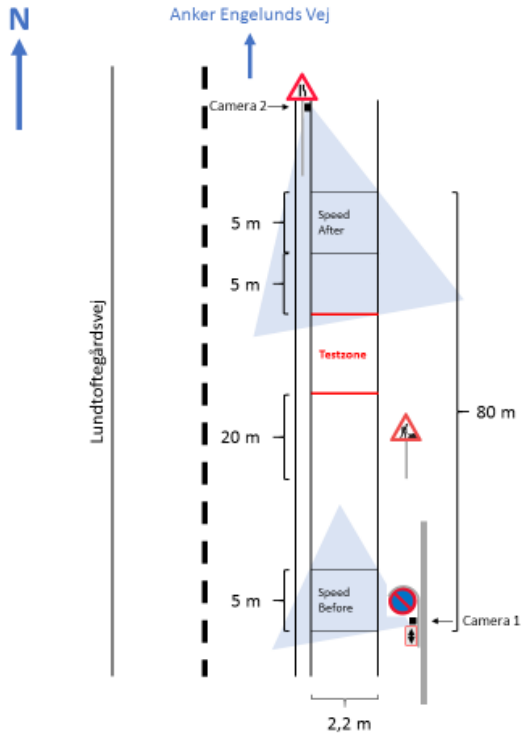

Figure 5. Principle sketch of test sections with testzone and speed fields on the cycle track. Speeds of cyclists were measured both before and after passing the speed reducing measures. The speed reducing measure is placed in the Testzone. Cameras was placed so the cyclist could not see them.

For all 9 settings, cyclist speed has been measured from video recordings (25 frames per second) on a short segment (5 m long) both ahead of the roadworks and just after passing the measure. In order to ensure that cyclists' speed in the two speed fields is comparable, a reference speed measurement has been made on the two speed fields for a situation WITHOUT any speed reducing measures. Only speeds of cyclists whose speed and behavior are not affected by other cyclists were measured. Significance of differences of average speed between the two segments were tested with a t-test. All data was collected on weekdays during summertime.

3 RESULTS

All nine settings reduce cyclists' average speed significantly and the 85-percentile speed is reduced as well (Table 1). However, the effectiveness seems to differ. Measure 1 and 3 are most effective. All three settings

with measure 1 reduce the average speed by around 3 km/h, corresponding to a reduction of average speed by 12-15%. Two settings using two speed bumps (measure 3) both reduce average speed by 4-5 km/h (21-23%), while the setting using only one speed bump reduces the average speed by around 3 km/t (13%). Measure 2 and 4 only reduce average speed by 1-2 km/h (6-9%).

Measure	Average speed (km/h)			85% percentile (km/h)			Number of observations	
	Before	After	Speed change	Before	After	Speed change	Before	After
1.1	21,7	19,1	-2,7	26,5	23,7	-2,8	491	521
1.2	21,5	18,5	-3	25	22,5	-2,5	322	340
1.3	20,5	17,5	-3	25	21,4	-3,6	338	346
2.1	20,5	19,2	-1,2	25	22,5	-2,5	450	496
2.2	19,8	18,3	-1,5	23,7	22,5	-1,2	185	203
3.1	20,8	16,1	-4,8	25	19,5	-5,5	556	568
3.2	20,9	18,2	-2,7	25	22,5	-2,5	412	414
3.3	21	16,7	-4,3	25	20,5	-4,5	499	479
4.1	24,8	22,4	-2,3	30	28,1	-1,9	509	500

Table 1. Results of speed measures, average speed and 85%-percentile. For each setting the change in average speed is significant on a 95% - level.

4 DISCUSSION

The test set-up was easy to apply which was necessary both due to time and budget constraints. Measuring speeds from video recordings was chosen because it is easy applicable in real traffic conditions. The short segments were chosen because cyclists started accelerating almost immediately after passing the speed reducing measure. Unfortunately, the short segment also means a higher level of measurement uncertainty of about +/- ½ -1 km h - the uncertainty is greatest at high speeds. Despite the limitations the speed measurements followed a normal distribution with good approximation. Testing measure 4, was done in another location because the development of the rubber mat was delayed, and the cycle track of the original test site was closed. The track design of the new test site was very similar, but cyclists tend to ride faster at the second site. At both sites reference data was collected for situation WITHOUT roadworks and the tested measures and cyclists were riding at same speed in the speed fields at both sites. Portable speed bumps (measure 3) seem to be the most effective measure. The mix of black and yellow colors improve the

visibility of the speed bumps compared to measure 1 which may have a positive effect on the speed reduction. Furthermore, cyclists are rewarded with higher comfort if the pass the speed bump (measure 3) with low speed. When passing the rubber mat (measure 4), the comfort was pretty much the same regardless of the speed level however a changing of groove height (from 7 to 10 mm), will probably change the comfort as speed increases. When passing the strips (measure 1) it is uncomfortable no matter the speed. The latter seems unfair and may affect cyclist's attitude in a negative way. When designing measures with rumble effect it is important that the distance between the grooves is large enough for the wheels of the bike to hit the ground between the grooves while the distance must be small enough to achieve a rumble effect. The heights of grooves should be high enough for cyclist to feel when passing bit may not pose any danger to cyclists.

4 CONCLUSIONS

All tested measures in this analysis resulted in a significant reduction in average cycle speed but the size of the reduction varied. Speed bumps (measure 3) seem to be the best of the tested measures. The black/yellow design makes them visible for cyclists in sufficient time before arrival, and at the same time they are comfortable to pass with low speed and uncomfortable when passing with high speed. It is believed that the appearance of the speed reducing measure is very important to the effect of the measure. Furthermore, it is believed that the appearance of roadworks and the presence of road workers will affect the cyclists' choice of speed as well.