



# CIVITAS INSIGHT

## Safer road infrastructure for cyclists and pedestrians

Roads can be made safer for everyone by separating faster and slower traffic streams, often by splitting motorised and non-motorised traffic users. New kinds of cycling infrastructure or approaches to encourage cycling must also be assessed carefully to avoid adding to problems they are designed to correct.





## Introduction

There are many benefits of cycling and walking; cyclists and pedestrians make little noise, do not emit pollutants or greenhouse gases, and create less traffic congestion. Regular physical activity has beneficial effects for many health conditions such as heart disease, diabetes, some types of cancer, aspects of mental health (including anxiety and depression), and low physical fitness in older people.<sup>1</sup> de Hartog J.J., et al states that on average, the estimated health benefits of cycling are substantially larger than the risks of cycling relative to car driving.<sup>2</sup>

However, from a road-user vulnerability perspective, travelling by car is inherently safer than travelling on foot or by bike, especially when the length of distances travelled increases. In comparison with cycling, it is much harder to come to harm when seated inside a steel cage. At slow speeds and with seatbelts not much harm will be done in most cases. Other than wearing helmets or protective clothing, pedestrians and cyclists are not very well protected in case of a collision with other cyclists or motorised vehicles. However, wearing a helmet will not prevent an accident from happening. Therefore, cyclists and pedestrians face the highest risk of severe injuries in urban areas.

In the 27 EU Member States and Croatia in 2013 45 percent of traffic fatalities were car occupants, although in 75 percent of all fatal crashes a car was involved. 22 percent of traffic fatalities were pedestrians, 15 percent motorcyclists and eight percent cyclists.<sup>3</sup> A larger decrease in the fatality rate of car occupants (21 percent) than for pedestrians (11 percent) and cyclists (3 percent between 2010 and 2013) was also recorded.<sup>4</sup> Roads are becoming safer in Europe for all road users, however these statistics are improving at a slower pace for pedestrians and cyclists.

To encourage people to walk and cycle, these modes have to be made much more attractive than they currently are to most people. Perceived lack of road

safety is often cited as a major barrier to walking, and cycling. Improving road safety and increasing comfort for these modes is a way to make them more appealing options. Safe cycle paths are especially important to encourage cycling. Assuming that safer infrastructure results in higher numbers of cyclists, additional safety effects, i.e. "safety in numbers" as studied by Jacobsen<sup>5</sup> and Elvik<sup>6</sup> will be achieved, especially if an increase in cyclists results in fewer cars on the road, such as when young males opt to cycle rather than drive.<sup>7</sup>

The main factors for creating safer infrastructure are: separating different road users by speed, reducing speeds, and providing sufficient space. Improving road safety can be accomplished partly through infrastructural changes, but often these are more expensive than other measures which can easily be implemented. Reducing car traffic and increasing the numbers of cyclists and pedestrians is possibly the easiest way to reduce road accidents in urban areas. Enforcing slower speeds and safer behaviour is also very efficient and leads to quick wins in terms of safety for all users on all road types.

One principle to bear in mind when it comes to safer roads is the difference in speeds between different road users. The greater the difference in speed in a collision, the higher the chance of severe injuries, especially when there is also a significant difference in mass between the two objects in collision. If the mass of one is greater than the mass of the other, the latter is likely to sustain severe injuries even at low speeds. Therefore, it is desirable to engineer roads so that car drivers are not tempted to increase their speed. Reducing the speed of motorised vehicles in possible conflict zones will lower the number of accidents involving severe injuries.

Taking measures to improve the safety of cycling and walking will help to further the development of these modes and deliver their associated benefits.

1 Plas, G., European Parliamentary Research Service, Blog, What Are The Health Benefits Of Cycling And Walking? Accessed July 10, 2015, <http://eprthinktank.eu/2013/04/17/what-are-the-health-benefits-of-cycling-and-walking/>.  
2 Do the Health Benefits of Cycling Outweigh the Risks? from Environmental Health Perspectives, volume 118, number 8, August 2010, p.1112  
3 European Commission, DG MOVE, Unit C4: Road safety May – 2015 Interim evaluation of the Policy orientations on road safety 2011-2020, p 14  
4 Ibid.  
5 Jacobsen, P. L., Safety in numbers: more walkers and bicyclists, safer walking and bicycling. Injury Prevention, 2003, 205–209  
6 Elvik, R., The non-linearity of risk and the promotion of environmentally sustainable transport, Accident Analysis and Prevention, 2009, 849–855  
7 de Hartog, J.J., et al, Do the Health Benefits of Cycling Outweigh the Risks? from Environmental Health Perspectives, volume 118, number 8, August 2010, p.1112



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## Overview of experiences in CIVITAS cities with a focus on road safety

### Aalborg (Denmark): High-speed cycle lanes

An urban transport system needs road infrastructure and means of transport that are safe and secure for all users. CIVITAS looks into new ways to ensure the safety of urban travellers, including pedestrians and cyclists, in order to make sustainable transport options feasible and attractive.

Before Aalborg's second CIVITAS project (CIVITAS ARCHIMEDES 2008-2012), national figures indicated a decline in cycling over the previous few years. Aalborg was worried that the city was following this trend and wanted to address barriers to cycling. A high-quality commuter cycling route between the city centre and the university was created following three principles: free-flow conditions for cyclists, traffic safety and visibility, and services, such as lane lights for cyclists at intersections or positioning bicycle racks for parking next to or near the cycle lane.

Aalborg held an initial planning workshop with cyclists, residents and other stakeholders. Through this, the city generated new ideas and secured support for the measure. The stakeholder workshop constituted a basis for engagement in and common understanding of the project. The route (which has a total length of five km) was rebuilt and upgraded from an ordinary cycle lane to a first class cycle highway. The number of cyclists using the route increased by 20 to 30 percent in two years. Counts from 2012 indicate that the increase is stable, and historic trends and counts from other areas in the city indicate that the increase is related to the implementation of this measure<sup>8</sup>.

Elsewhere in Europe, cycle highways are being built to increase the use of bicycles for long-distance or intercity travel. Some examples already exist next to canals or on former train or tram tracks. These were not built purely as transit routes - they were intended for the maintenance of the canals and for leisure cycling. For example, in

France there are cycle paths next to canals promoted under the name 'les canaux à vélo'<sup>9</sup> (canals by bike). In the UK, disused train tracks are also used for safe leisure cycling trips and are promoted on GPS Cycle and Walking Routes<sup>10</sup>. These kinds of cycle paths exist all over Europe and are very well known to leisure cyclists. However, bicycle highways are increasingly being built as a traffic and mobility solution.

By engineering these roads with the qualities of highways for motorised traffic, governments give a clear incentive to cycle more and over longer distances, especially for commuting and daily use. The example from Aalborg indicates that the concept has great potential, even in urban areas. Cities in the Copenhagen metropolitan area are already connected by two such cycle highways, and a further 28 are planned by 2018.

The importance of this measure lies in the three principles as described above in the Aalborg example. It is very clear that through incorporating these principles, the city was able to attract more cyclists, even though the route was already a dedicated cycle path. The main feature is the free-flow conditions, which makes it different from a standard Danish cycle path. Free-flow conditions enhance safety by reducing the chance of conflict between different transport users. In the case of motorways, this is done by restricting their use to motor vehicles which drive in the same direction and at similar speeds. Conflicts between motorised vehicles and cyclists can be very dangerous and similarly, conflict situations between fast-moving bicycles and pedestrians may have serious consequences.

If applied by other cities, this measure will improve safety, but appropriate infrastructure for high-speed cycling must be built with features such as longer, more gradual turns. Communication campaigns may be necessary to make pedestrians and cyclists aware of the difference between cycle highways and standard cycle paths and the possible dangers that go along with high-speed cycling.

8 E. Bossaert et al, CIVITAS Measure Directory 2014, 10 years of CIVITAS from Aalborg to Zagreb, 14, <http://civitas.eu/sites/default/files/civitas-measure-directory-final-www.pdf>.  
9 France Vélo tourisme, les canaux à vélo, accessed June 1, 2015, <http://www.francevelotourisme.com/contenus/decouvrir-la-france-a-velo/les-canaux-a-velo>.  
10 GPS cycling and walking routes, Rail Trails, accessed June 1, 2015, <http://www.gps-routes.co.uk/routes/home.nsf/rail-trail>.



## CIVITAS PLUS | Ghent (Belgium): Safe cycling corridor

At the start of the CIVITAS project (CIVITAS ELAN 2008-2012), Ghent had widespread cycling infrastructure, including both leisure and functional cycling routes. However, these routes often had gaps or unsafe crossings and junctions. This measure worked on developing safer and better cycling routes in the CIVITAS corridor by improving major crossings on the route from the main train station towards the city centre and the university area. During the CIVITAS project, the first Belgian cycle street was implemented, where cyclists have priority and cars are 'guests'. During a meeting at which four re-design scenarios were discussed, 88 percent of the participants showed interest in the cycle street concept. The measure was implemented as part of the city's Sustainable Urban Mobility Plan (SUMP), and the rate of cycling on this cycling corridor increased by 36 percent in two years. Cyclists were generally convinced of the usefulness of the cycle street, although they noted that at times they were not always sure about where they had priority over cars.<sup>11</sup>

There is often not enough space or funding to build cycle lanes, especially in urban areas. Cities therefore need to use other measures to improve cycle safety. Implementing a cycle street is not expensive and increases safety for cyclists and car drivers by proposing different parallel routes. Cyclists have priority in cycling streets and car drivers are not allowed to overtake or drive too fast (speed limits are often set at 30 km/h or 15 mph). Therefore car users may choose a different route. Cyclists can be granted priority at intersections, providing free-flow conditions as well.

This combination of shared access and strict speed limits is accompanied by road signs that separate drivers and cyclists by signalling which streets are used more by one or the other group. Car drivers can avoid designated cycling streets and cyclists can be encouraged to choose the cycling streets with fewer cars. The cycle street tends to attract more cyclists, as Ghent's experience shows. When in greater numbers, cyclists tend to feel safer.

Road users have to be notified about the existence of this measure since it is spreading quickly in cities in many countries. To improve visibility, infrastructure markings can be used, such as painted road markings.



## CIVITAS PLUS | Szczecin (Poland): Traffic Surveillance

Before CIVITAS (Plus –RENAISSANCE 2008-2012), the number of car accidents in Szczecin was on the rise due to the increased level of car ownership, road deterioration and lack of respect for traffic rules. The city decided to promote safe driving by extending the traffic surveillance system at the busiest and most dangerous intersections. The measure's implementation took into account recommendations from safety experts and was part of a larger-scale traffic surveillance strategy. The measures reduced the average response time by police from 16 to five minutes at monitored locations and the level of perceived security rose by 14.5 percent. In Szczecin, CIVITAS served as an engine for behavioural change and helped generate political will to secure future funding commitments.<sup>12</sup>

Infrastructural measures are generally very expensive, and not always easy or quick to implement. Other methods such as measures to change travel behaviour can also help to improve traffic safety. People are often very responsive to measures that involve financial incentives and disincentives.

Effective enforcement can calm traffic and reduce the number of accidents, even if minor offences continue to occur. Offenders also receive a benefit in terms of greater safety. They often do not see it this way, but after having to pay one or several fines, they may rethink their behaviour. This will not only improve traffic safety for other road users, but also for themselves. Accompanying campaigns focused specifically on this issue make people aware of the need for these actions and increase public acceptance of these measures.

Since high speeds are among the main causes for fatal accidents, speed reduction by law enforcement is an effective tool to reduce this and public acceptance is fairly high in countries where speed checks already exist.<sup>13</sup>

<sup>12</sup> E. Bossaert et al, CIVITAS Measure Directory, 10 years of CIVITAS from Aalborg to Zagreb, 2014, 141

<sup>13</sup> Poppeliers et al., Percentage of respondents that find specific types of speed checks (very) acceptable, 2009 ed. SWOV, Fact sheet, Police enforcement and driving speed, 2014, 5, table 1



## What is happening now

### The focus on cycling and walking in sustainable urban mobility planning

In many European countries or regions the development of sustainable urban mobility plans (SUMP) has been increasing over the past few years, as this method of transport planning gains importance and recognition. The European Commission has asked CIVITAS CAPITAL's Advisory Group on Road Safety to advise the Commission on how to tackle road safety within SUMP. Some aspects are already clear:

- Firstly, data collection is crucial. Gathering sufficient data on traffic volumes and accidents enables cities to define where safety concerns are most urgent. Robust data also allow cities to measure the effects after measures are implemented. This helps to engage public support and counters opposition to needed measures.
- SUMP principles emphasise inclusive planning and design. If a city and its roads are planned and designed to accommodate the needs of the most vulnerable users such as children and older road users, safety will increase for all users.
- Implementing infrastructure to support sustainable urban mobility often demands political courage. In Bogota (Colombia), the city's infrastructure was totally re-designed in just a few years, but in most countries it takes longer to implement infrastructural changes, often because of resistance from residents.
- Setting up infrastructural pilot projects to measure the effect of proposed or planned changes can be useful to examine and test public behaviour and acceptance. Pilots are generally cost-effective

and will encourage people to change their travel behaviour. In the meantime new habits are created, making acceptance for a new road layout easier. This technique is very widespread globally. When accompanied with information and awareness campaigns, it helps to reduce opposition to sustainable urban mobility measures.

### Cities and companies innovating in walking and cycling

Beginning in the 1960s, a major aspect of urban planning was building more road capacity in cities as well as roads with higher speeds and traffic volumes, such as motorways. This was based on a car-centric model popular in the US. As a result, it is likely that the number of accidents resulting in severe injuries or deaths increased, even if total numbers of accidents did not. This urban planning model is therefore seen as insufficient in regards to road safety, and even in more car-centric countries like the US, urban planning is evolving to encourage multimodality.

One good example is the superblocks model<sup>14</sup> in Vitoria-Gasteiz (Spain). The city transformed 17 blocks in the city centre into superblocks. In this area, cars are restricted to dedicated roads and parking is only allowed at certain areas at the margins of every superblock, making way for safe cycling and walking inside the superblock. The implementation of superblocks is accompanied by measures such as improving tram services and more bus lines to ensure mobility for the citizens. Public space inside the superblocks is renewed as a pedestrianised area for spending free time.



Image: © Eitis



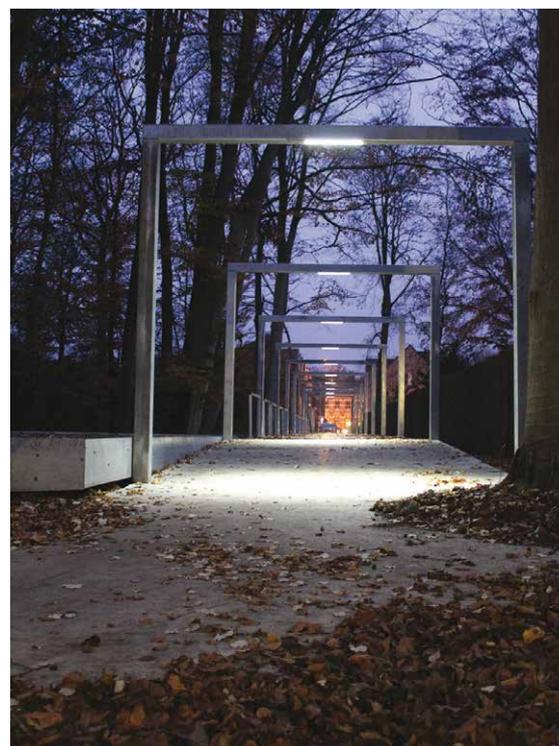
As a result of the implementation of the superblocks, ambient noise levels have decreased by 5.5 dBA (decibel A-weighting) and CO<sub>2</sub> emissions have been reduced by 42 percent. There is little doubt that traffic safety has increased, due to lower speeds and a reduced risk of conflict situations, and proven by Nilssons Power Model.<sup>15</sup> This is particularly so for users in the new pedestrian zones which now account for 74 percent of public space in the city centre.

Brussels (Belgium) is aiming to increase the modal share for walking in the Brussels-Capital Region from 32 percent in 2010 to 35 percent in 2020, with a long-term goal of 40 percent by 2040. According to Brussels' Strategic Pedestrian Plan 2012, this would bring the modal share in line with other leading European cities, such as Barcelona (36 percent), Zurich (36 percent), London (37 percent), Lyon (40 percent) and Geneva (40 percent).

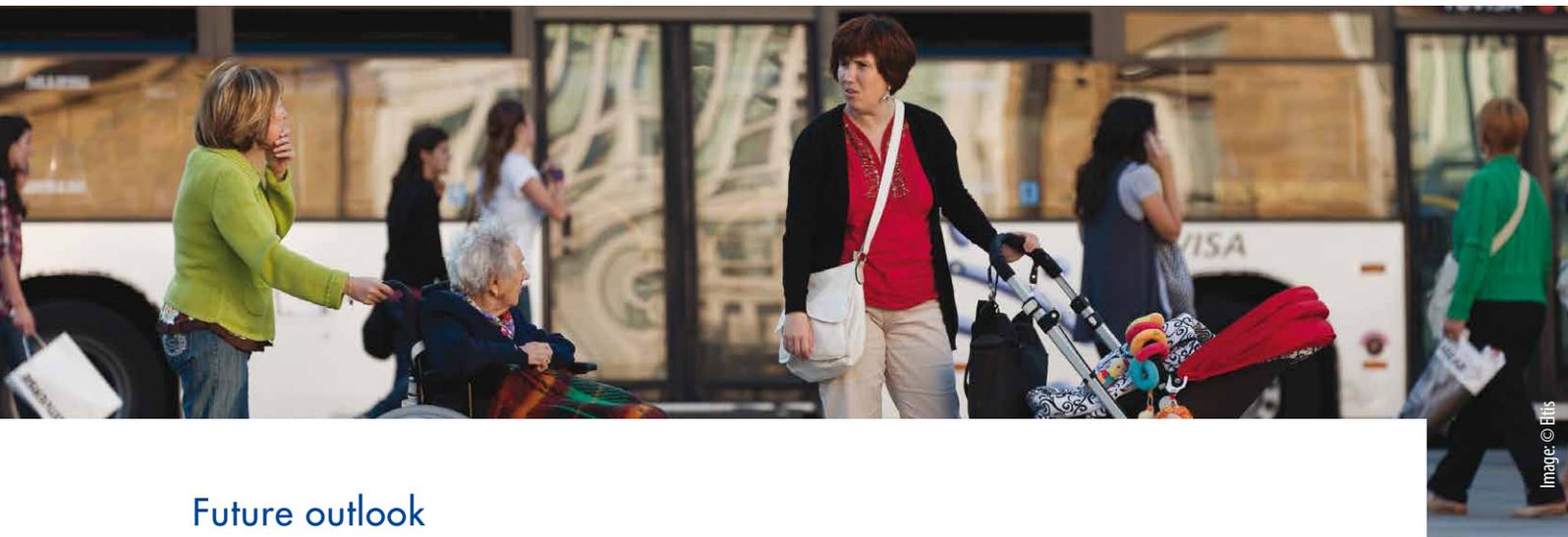
The plan includes guidance for achieving a pedestrian-friendly city (CAHIER Go 10<sup>16</sup>, March 2014). It sets out 10 quality guidelines to be used according to the Regional Plan for Sustainable Development. Two out of 10 guidelines directly address traffic safety: traffic calming and guaranteeing pedestrian safety. Traffic calming is done by implementing more low traffic or traffic-free zones, especially when new construction projects are developed. As a result, more space will be created for pedestrians. Improved safety will be ensured by lowering traffic volumes, adapting speeds to pedestrians, developing safer and shorter pedestrian crossings and footpaths, and giving right of way to pedestrians. Such rules must always be followed by efficient enforcement measures to yield good results. Lastly, the Brussels plan focusses on improving physical comfort by designing public space for every possible user, especially older people and children, making connections with other means

of transport easy to reach, and ensuring the creation of direct pedestrian routes and improved public spaces. Brussels aims to have 20 km of pedestrian zones by 2018 and 40 km by 2040.

Amsterdam (The Netherlands), a well-known cycling city, states in its implementation document "Uitvoeringsagenda Mobiliteit 14 | 4 | 2015"<sup>17</sup>, that it will enlarge space for cyclists and pedestrians and will also introduce traffic-calming measures, such as a 30 km/h zone in the entire city centre. It will create high-quality pedestrian zones, and will even ban cycling in these zones at specific times. More cycle streets will be implemented with priority for cyclists at some crossroads, and more space for public transport will improve arrival times and service quality.



15 Nilsson, G. (2004A), Traffic safety dimensions and the Power Model to describe the effect of speed on safety, Bulletin 221, Lund Institute of Technology, Department of Technology and Society, Traffic Engineering, Lund, 2004.  
16 Timenco, Cahier Go 10, Richtlijnen voor een voetgangervriendelijke stad (guidelines for a pedestrian friendly city), 2014  
17 Gemeente Amsterdam, Uitvoeringsagenda Mobiliteit, 14 | 4 | 2015 | consultatieversie, 2015 April



## Future outlook

The importance of safe infrastructure for pedestrians and cyclists is widely acknowledged. Many European cities are encouraging their residents to cycle and walk more. Cycle highways, road adaptation, awareness campaigns, incentive schemes and more effective enforcement are becoming common practice and will eventually lead to more and safer cycling and walking. However, some challenges call for action and adaptation in the near future. Use of high-speed bicycles assisted by electric motors (pedelecs) is growing due to improved technologies and growing market share. As more cyclists begin to use these vehicles, we can foresee an increasing risk of accidents involving them and other cyclists.

### More high speed cycling with more pedelecs and s-pedelecs

The market for pedelecs and more powerful S-pedelecs is booming. In Germany there are some 30,000 s-pedelecs in operation, and all over Europe the use of pedelecs is growing rapidly. Pedelecs and S-pedelecs account for between 10 to 20 percent of the cycling market in countries such as Belgium, Germany, and the Netherlands.

According to European regulations<sup>18</sup> S-pedelecs are mopeds and need to follow national traffic rules for such vehicles. In several Member States mopeds are banned from cycle paths. However, cycle highways may offer a great opportunity for higher-speed and long-distance cycling. This raises the question of whether mopeds or vehicles classed as such can legally operate on cycle highways or separate cycle lanes for high-speed cycling. On the other hand, speeds are already restricted to 30 km/h in many European city centres – these speed limits apply to S-pedelecs too.

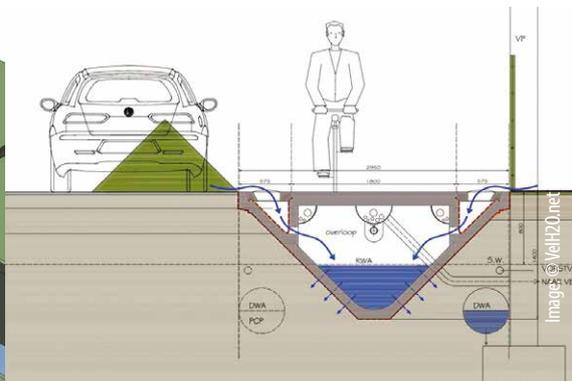
There is no doubt that cycle highways will soon attract cyclists using s-pedelecs, travelling at higher

speeds than other cyclists, even when it is forbidden by national legislation. This does pose a potential increase in risk of accidents and an extra challenge in terms of enforcement, but a question remains over how severe this risk is. Although research data is lacking, it seems fair to assume that the chances of serious accidents with s-pedelecs are lower on separated cycle lanes than when they are mixed with motorised traffic. A solution could be to build two-lane cycle paths with a fast lane and a slow lane. However, this measure might require new or updated national regulation and a great deal of space.

Increasing the speed of many cyclists may however increase the amount of severe injuries as the result of accidents. Because of the difference in speed between fast cyclists on the one hand and slower cyclists and pedestrians on the other, more conflict situations may occur. Other factors increase the risks for collisions, such as longer braking distance, tunnel vision, more difficulty in controlling vehicle speeds, and possible miscalculation of how fast cyclists using S-pedelecs travel by other road users. Although many cyclists argue that a fit person on a road bike can easily travel at 35 km/h and there is no difference with S-pedelec users, S-pedelec users should still be thought of as a separate class of cyclists.



<sup>18</sup> EU, Regulation (EU) No 168/2013 of the European Parliament and of the Council, 15 January 2013 on the approval and market surveillance of two- or three-wheel vehicles and quadricycles



### The more people cycle, the more accidents involving cyclists

Dutch research<sup>19</sup> has shown that collisions between cyclists are increasing, regardless of the kind of infrastructure where they occur. One reason for this is an increase in bicycle traffic. These collisions also tend to happen on the generally well-designed and maintained cycling infrastructure in the Netherlands. Making cycle paths safer may require more than just building them as the Dutch do.

Other measures which can make a real difference include:

- A better cycling culture. Danish cyclists are very conscientious about the difference between slow or fast cycling. Slower cyclists are willing to let faster travellers overtake and always cycle on the right, a courtesy which is not always observed in other countries.
- Raising awareness among cyclists about paying attention to other road users.
- Allowing groups of cyclists to cycle on the roads, when roads permit mixed traffic.
- Making cycle paths wider. In countries without widespread cycle infrastructure it may be possible to take an ambitious first step and build cycle paths with larger capacity, without having to build smaller ones first. In this case, there is a good opportunity to construct cycle highways if the necessary space is available. Engineers will also have to keep in mind the difference between slower users (such as pedestrians) and faster ones when designing these highways.

Enhancing cycle infrastructure and encouraging safer cycling behaviour will also contribute to decreasing the amount of individual bicycle collisions and possibly even influence the severity of the injuries.

### Combining different domains of land use

When space for constructing cycle paths is limited, the [VelH2O.net](#)<sup>20</sup> concept, designed by a Belgian architect, is another interesting solution. The concept is based on the assumption that more cycling is needed and that building safe cycle paths may be difficult because of a lack of space or difficulties in expropriating land. Many roads have trenches running parallel to them which collect rainwater. With the VelH2O.net concept, the cycle path is built over the trench, bypassing the need to expropriate anyone and maintaining the trench's function, which is collecting rainwater and letting it drain into the ground. The concept uses concrete deck plates and also allows for siting utility connections under the cycle path, which are accessed more easily and do not require excavation.

This concept can be viewed as a good approach to separate slower cyclists from fast motorised traffic easily and relatively cheaply, improving road safety for cyclists as well as for pedestrians and motorised traffic. Acceptance by road users may be greater for this kind of infrastructure, since with other solutions, motorists may get the impression that space is being taken away from them in favour of cyclists.

### Conclusions

As described, a variety of measures have been tested in several countries which are already becoming common practice. Roads are made safer for everyone by separating faster and slower traffic streams, often by splitting motorised and non-motorised traffic users. New kinds of cycling infrastructure or approaches to encourage cycling must also be assessed carefully to avoid adding to problems they are designed to correct. Where developing new infrastructure is not possible, as in very dense urban areas, traffic calming measures like speed reduction, pedestrian zones and cycle streets may be suitable alternatives to improve safety for these modes and thus better deliver their benefits.

19 Huib Valkenberg, veiligheid NI, Fietsbotsingen (cyclist collisions), 2014

20 BIBM, The European Federation for Precast Concrete, Concrete perspectives 2013, National award winner projects- Belgium, accessed June 1, 2015, [velh2o.net](#). Gestroomlijnd Mobiel (Streamlined Mobile), accessed June 1, 2015



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