European Cyclists’ Federation on Safer HGV Cabs

European Cyclists’ Federation
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Executive Summary

The vast majority of trucks are designed to maximise the load space that can be achieved within the legally permitted maximum dimensions. This means that the ‘brick’ shaped cab above the engine is virtually universal across the EU. These dimensions are laid down in Directive 96/53 which will soon be under review. The current dimensions play a part in the large number of serious injuries and fatalities that we see on European roads and that with a change in the law comes an opportunity to combat some of the features that make HGV HGVs such a threat on our roads.

There are many problems with the current dimensions including

- The inefficient aerodynamic structure
- The lack of direct vision at the front and front/side of the cab because of the poor shape, the high position of the cab and lack of sensible windscreen
- The box shape tends to knock cyclists/pedestrians over and then into the path of the wheels rather than deflecting away from the vehicle
- There is no absorption qualities at the front of the HGV for impacts with vulnerable road users
- There is no ‘crumple zone’ to protect the driver or other vehicles (usually cars) in the event of an accident

This brief report will focus on the possible advantages of changing the shape of the HGV for the reduction of direct vision blind spots and the deflection of cyclists and vulnerable road users. We also believe that extra dimensions allowed should also be used for the benefit of a Crash Management System to increase the safety of accident of other vehicles and a re-positioning of the cab to allow for a better seat position of the driver at a level of those road users around him/her. If there were to be a change in the shape and size of the cab of those cabs crossing European borders we believe that according to estimates this[1];

- could be a direct effect on the reduction of the severity of around 50% of the fatal accidents involving HGVs
- Could have a positive effect on 3200 to 3800 total road fatal accidents
- This could translate into a potential saving of around 300 cyclist and pedestrian injuries per year.

[1] Design of a Tractor for Optimised Safety and Fuel Consumption, FKA, 2011

In order to bring about safer design of HGVs with respect to unprotected road users we would like to see

- The amendment of Directive 96/53 should allow for the enlarging of the cab design to accommodate a safer shape for unprotected road user deflection
- The amendment of Directive 96/53 should allow for the enlarging of the cab design to accommodate better direct vision from the cab
- The amendment of Directive 96/53 should allow for the enlarging of the cab design to accommodate a better, lower seated position for the driver
- There should also be work towards a direct vision requirements for HGVs, related to this we would also like to see some change with how the front and side windows are placed, positioned and sized
- The amendment of Directive 96/53 and changes to the law on weights and dimensions is enabling legislation and so to be most effective must be accompanied by new vehicle standards within type approval to ensure that new cab designs fully realise the safety and aerodynamic potential identified with a view to mandatory implementation by around 2020 – 2025

Accidents with HGVs

Heavy Goods Vehicles (HGVs) make up 3% of the European vehicle fleet and 7% of driven kilometres, yet they are involved in 18% of fatal accidents, costing over 7000 lives across the EU in 2008[2]. Some 22% of the cyclists killed in the EU die following collisions with goods vehicles[3].

> *"This proportion is 43% in Belgium, higher than the number of deaths following collisions with cars. The same is true for the Netherlands where 38% of cyclist deaths follow collisions with goods vehicles. Goods vehicle collisions also account for a considerable proportion of cyclist deaths in Great Britain with 33%, Denmark with 31% and Slovakia with 29%."*[4]

HGV fatalities involving cyclist are more likely to result in serious injury or death than collisions with other vehicles. For example in the UK 10% of accidents between HGV and bicycles led to a fatality and over a third leading to serious injury or death. This has been shown to be a serious issue within urban areas. For example Transport Research Laboratory TRL (Figure 1 below) has shown this to be a particular problem in London.

In Berlin each year, according to a research study conducted by Hansjoerg Mueller[5] , approximately 20 cyclists die in traffic accidents. More than half of these were accidents involving right turning trucks colliding with cyclists. Based on this analysis the writers have predicted that

[2] TRL 2010 for EC DG Enterprise and Industry
[3] ETSC, Pedalling towards Safety, 2012 http://www.etsc.eu/documents/BIKE_PAL_Safety_Ranking.pdf
[4] ETSC, Pedalling towards Safety, 2012 http://www.etsc.eu/documents/BIKE_PAL_Safety_Ranking.pdf
[5] Right turning vehicle accidents in Berlin, Berlin Police

annually there are approximately 200 fatal accidents in Germany between right turning trucks and cyclists. They conclude that a common denominator of these incidents is the view from and the protection provided by the side rollovers of trucks.

Figure 1: types of other vehicle involved in pedal cycle collisions, London and rural areas, showing the high numbers of HGV collisions with cyclists6

The most common incident involving HGVs occur when the HGV turns right (or left in Cyprus, Ireland, Malta and the UK) without being able to see the cyclist sitting in an unsighted area to the side or just in front and to the side. The cyclist is knocked off the bicycle and falls under the HGV as the HGV turns and the cyclists goes under the wheels. SWOV have estimated[7] that 68% of accidents between cyclists and HGV's occur at the front right with a right turning HGV. A Transport for London (TRL) report[8] shows that the high number of HGV collisions in London occurs with blind spot right turn (left in the UK) manoeuvres at junctions.

Vehicle Type	Number of vehicles	
	London	Rural
Motorcycle	4	-
Car/taxi	33	32
Minibus	-	1
Bus/coach	8	1
Goods vehicle <3.5t	13	-
Goods vehicle >3.5t	37	8
Other motor vehicle	-	2
Ridden horse	-	1*
Total	***95***	***45***

Collision Type	Number of Collisions
Vehicle turning into side road (cycle on inside)	18
Cyclist crossing or entering road into path of vehicle	1
Cyclist lost control – fell/went into path of vehicle	3
Vehicle moved to nearside colliding with cyclist	1

Table 1: Types of collision involving HGVs at London junctions

TNO have calculated that some 36% of fatalities are in "blind spot" accidents, defined as goods vehicles turning right and cycles/mopeds going straight ahead. With regards to positioning of the blind spot accidents TNO found that though many of the incidents occur behind the door and

[6] Knowles, Adams, Cuerden, Savill, Reid, and Tight (2009), Technical Annex to PPR445 Collisions involving pedal cyclists on Britain's roads: establishing the causes. Wokingham: TRL Limited

[7] De toedracht van dodehoekongevallen en maatregelen voor de korte en lange termijn Ing. C.C. Schoon, dr. M.J.A. Doumen & D. de Bruin, 2008

[8] Keigan, Cuerdan and Wheeler (2009) Analysis of police collision files for pedal cyclist fatalities in London, 2001-2006. TRL report PPR 4338. Wokingham: TRL Limited

along the side of the HGV there are also a significant amount that occur at the front, front/side and side, in other words to the front of the door or at the door of the HGV.

Area	Per cent
2	5.3%
2 and 5	5.3%
1 and 2	5.3%
3 and 4	5.3%
2, 3 and 4	5.3%
3, 4 and 5	5.3%
1	10.5%
1 and 5	10.5%
4 and 6	10.5%
5 and 6	36.8%
Total	100.0%

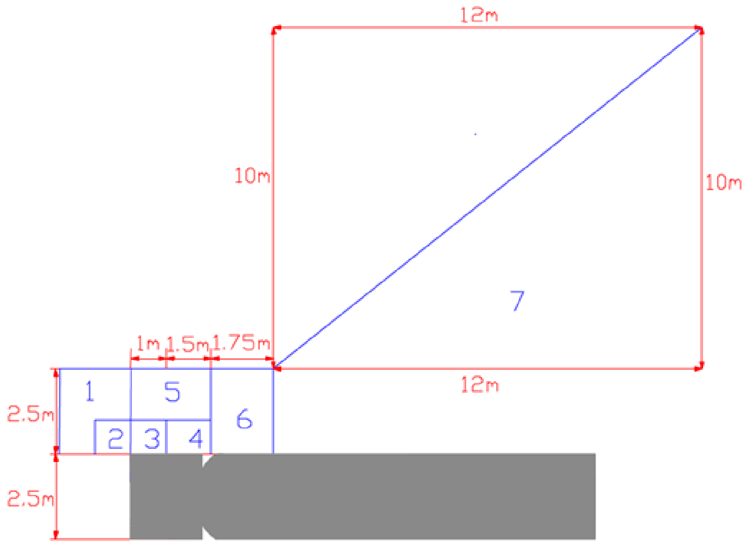


Figure 2: position of accidents with HGV and two wheel vehicles[9]

We can see that HGV accidents with cyclists are not isolated in one country; the table below shows other countries for which this is a serious issue. It must be borne in mind that these countries are amongst some of the safest in the EU with regards to road traffic accidents and all seem to still have serious problems with HGV accidents.

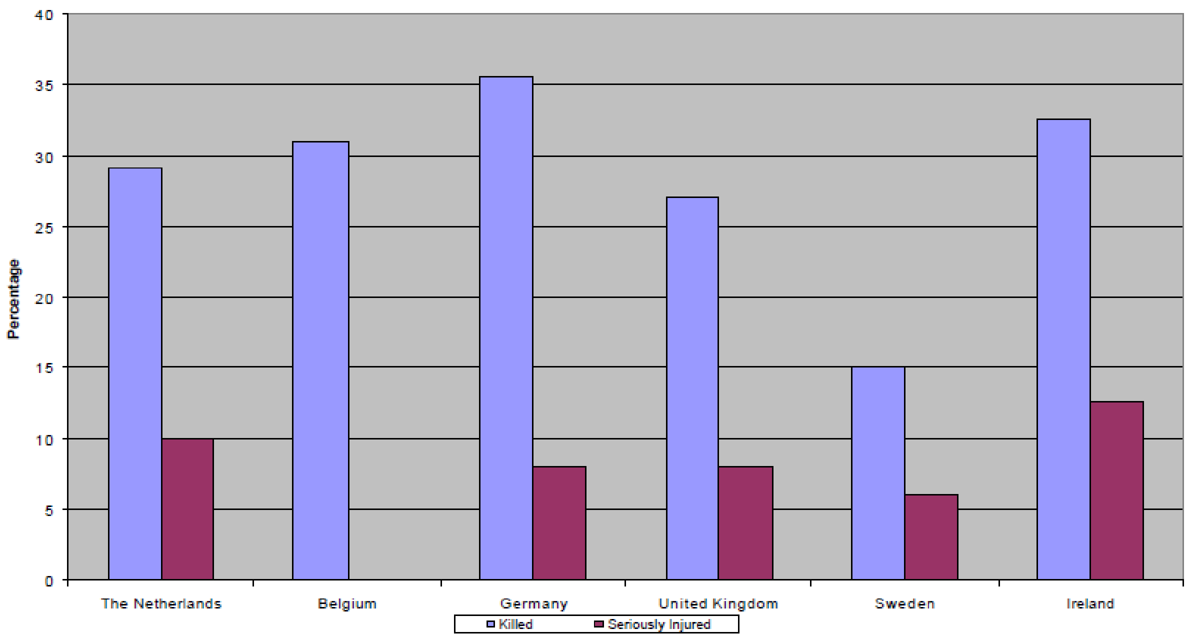


Table 2: Goods vehicles involved in small two wheeled accidents 2000[10]

[9] ibid
[10] Fields of vision related victims among small two-wheeled vehicles: a European perspective, TNO, November 2001

Direct and indirect Vision

The below picture represents the current field of vision requirements of mirrors for new HGVs Directive 2003/97/EC. There still seems to be a danger zone with regards to what can be seen by the driver, particularly around the front and front side of the HGV where many accidents still occur.

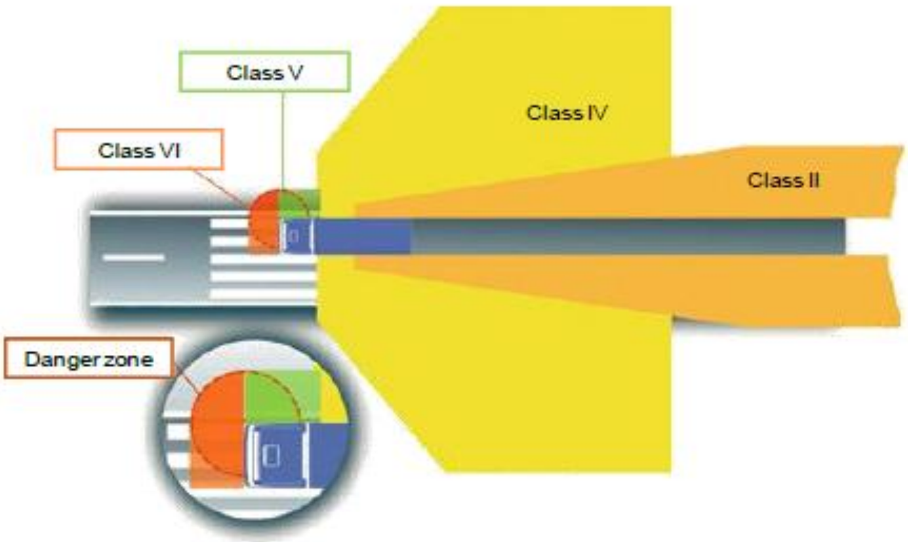


Figure 3: Field of vision requirements 2003/97/EC[11]

There is lack of direct vision particularly at the front and front/side of the cab

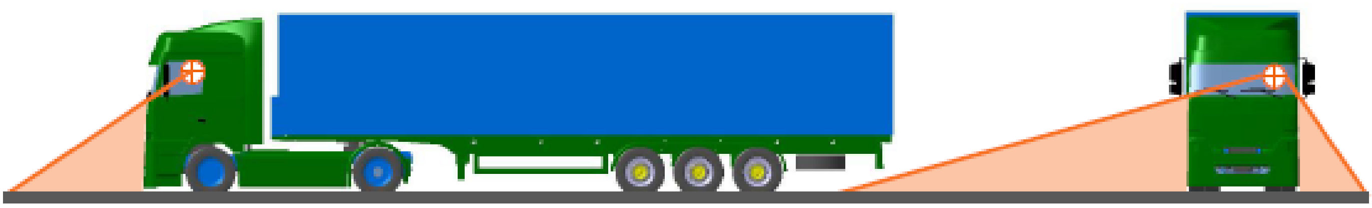
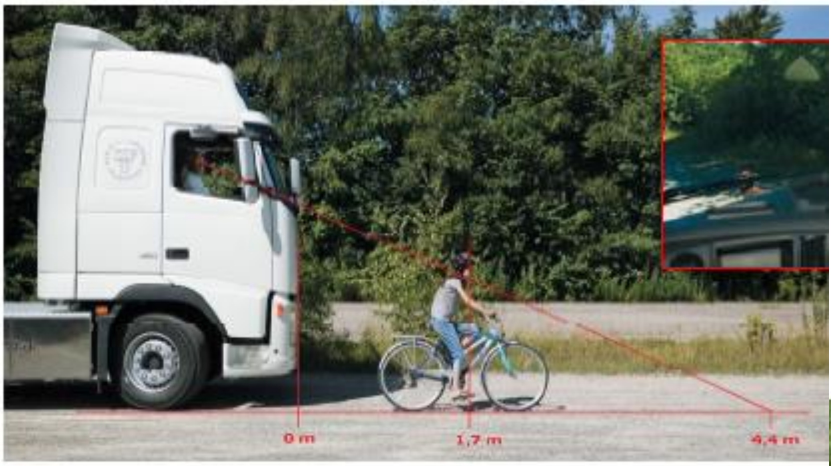


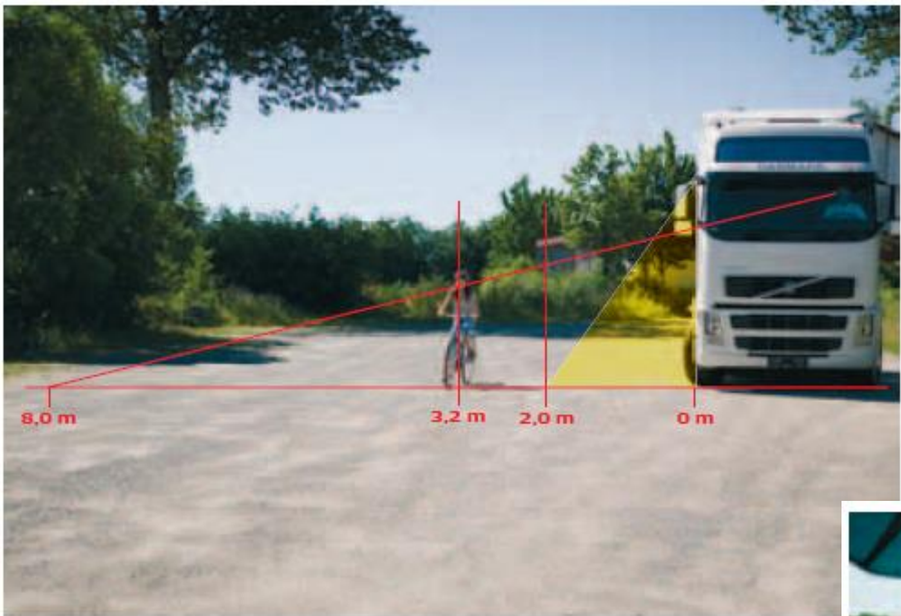
Figure 4: Downward vision of trucks

The flat snub nose of the modern day EU HGV brings with it limited direct visibility at the front and side/front of the cab, we think that this could be improved with a change in the design of the cab as we shall see later. A better representation can be seen with respect to cyclists with the below picture[12]

[11] Design of a Tractor for Optimised Safety and Fuel Consumption, FKA, 2011
[12] Ulykker mellem højresvingende lastbiler og ligeudkørende cyklister, HVU, 2006, http://www.hvu.dk/SiteCollectionDocuments/HVUrapp04_Hoejresving.pdf



Figures 5: Distance in front of vehicle, necessary for cyclist to be seen directly by driver and the view from the cab, showing little leeway for error[13]



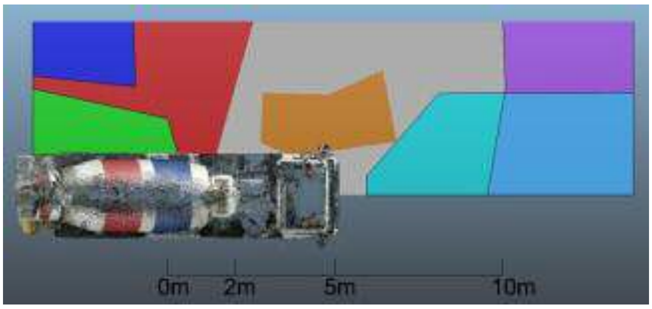
Figures 6: Distance to side of vehicle, necessary for cyclist to be seen directly by driver

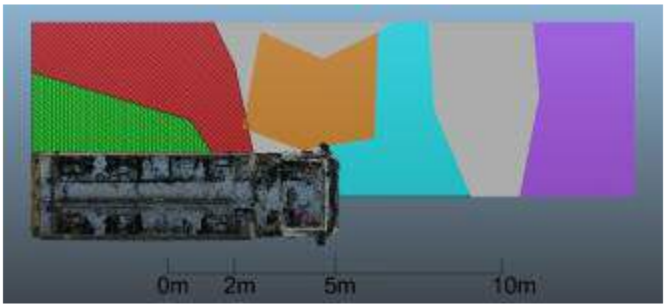
Again from the front and the cab

[13] ibid

TFL Report

A recent Transport for London report[14] found that different vehicles had very different non-visible areas both at front, front/side and behind the cab. Mirrors, though set to EU standards, were often not able to cover major areas. Mirrors themselves were getting in the way of direct vision, dashboards and windscreen designs also had a major effect, as did the height and position of the driver in the cab. This was particularly the case concerning construction vehicles, tippers and cement mixer vehicles. This has major implications for cyclists and indeed all VRU's since these types of HGVs are most commonly used in urban areas and settings. In fact this report was initiated due to extremely worrying figures from the city, such as "of the 16 fatalities in 2011, nine involved an HGV, and seven of these were a construction vehicle"[15].





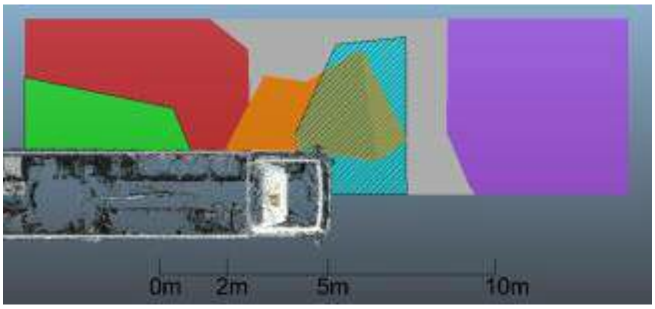


Figure 7: From the TFL report. The Grey zones show areas not directly or indirectly visible at ground level for three different types of HGVs; A DAF Mixer; a DAF Tipper; and MAN HGV.

This report provides crucial evidence for the need to look again at how we are designing HGVs with regards to road safety and VRU's, particularly in urban areas.

Lack of deflection of HGVs

Most accidents involving serious injury occur with run-over by the front wheels not those further behind, and a TRL report shows that in a quarter of fatal cyclist accidents, the front of the vehicle hit the rear of the bicycle setting up the successive fatal fall under the wheels[16].

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[14] Delmonte et al, Construction logistics and cyclist safety, Technical report, 2012, TRL http://www.tfl.gov.uk/microsites/freight/publications.aspx; Construction logistics and cyclist safety - Summary report (PDF 1MB); Construction logistics and cyclist safety - Technical report (PDF 5MB)

[15] ibid

[16] Collisions Involving Cyclists on Britain's Roads: Establishing the Causes, TRL Report PPR 445, 2009

An EU funded project, APROSYS, claimed that "A major problem of the predominantly flat fronts of trucks used in Europe with respect to accidents involving vulnerable road users are the kinematics of the vulnerable road user after the impact". Often the flat front of the truck pushes the cyclist or pedestrian to the floor causing a high risk of run over. This is different to the dynamics of a car accident in which the VRU is pushed up and over the vehicle and concluded that even in a low speed collision, there is a 70% risk for pedestrians or cyclists to be knocked or dragged under the vehicle and run over by the wheels, with likely fatal consequences[17].

How the cab can be optimised

An FKA study[18] commissioned by Transport and Environment tested the best results of the APROSYS report and other studies and optimised the suggested shapes further aerodynamically. The study also explored in depth safety possibilities of new shapes and put them through a range of safety simulations to assess active (crash avoidance) and passive (impact reduction) safety performance. The results of the crash test simulations were assessed in light of accident causation and impact research. The study also analysed statistics of collisions between HGVs and vulnerable road users, to quantify the benefits of the rounded frontal shape and improved direct vision.

Following this assessment of different design concepts, the FKA study concludes that the optimal solution would be an 80cm increased cab length in order to improve both safety and environmental performance. This could be achieved by a rounded frontal shape and inclusion of a crash management system. It was found that an 80cm length increase would yield better results compared to a 40cm or a 120cm increase. Moreover, an 80cm increase would achieve both aerodynamic and safety improvements while ensuring full compliance with existing EU safety regulations, without requiring a redesign of the basic structure (wheelbase).

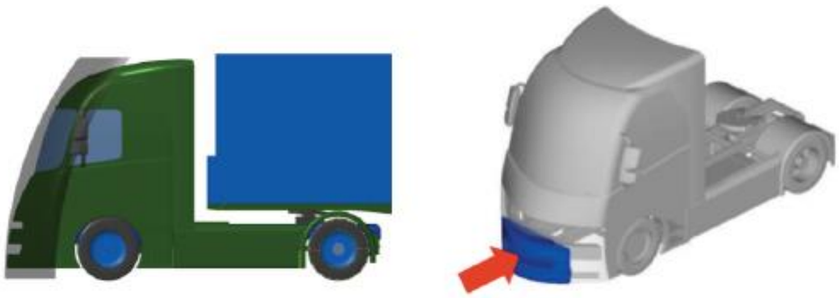

Figure 8: round nose cab with crash management system (crumple zone)[19]

[17] APROSYS, EU-funded research project, 2008.
[18] Design of a Tractor for Optimised Safety and Fuel Consumption, FKA, 2011
[19] Ibid

Benefits for Direct Vision

In the new FKA design the direct vision particularly at the front of the HGV is increased

Figure 9: Direct visibility trough front screen[20]

And here again at the front and to the side, this is important for cyclists as often their height is lower than the pedestrian as they can be hunched over handle bars.

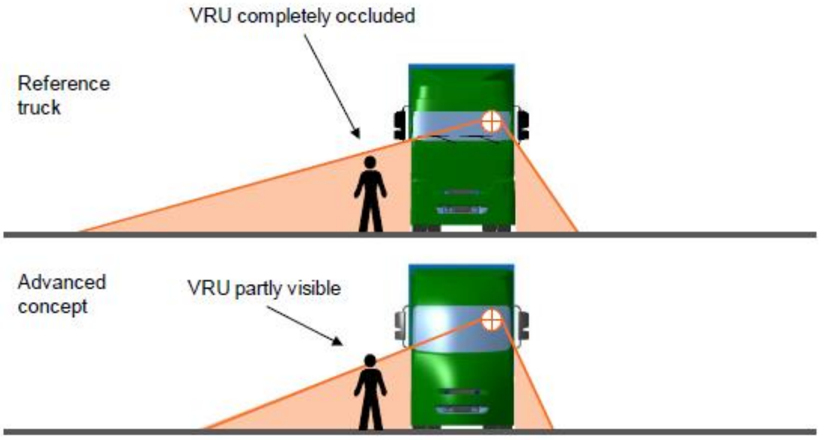

Figure 10: Occultation of VRUs in front view

Importantly if we go back to the photographs in Figures 5 and 6 the areas where the cyclist is positioned are better seen from the cab.

However we think there could be more work done here to find the maximum benefit of changing the cab for direct vision improvements. Regardless of this we can with confidence say that direct vision would be improved in those areas at the door, front/side and front of the cab if a cone shaped cab were the norm in Europe. We would also like to see some way of lowering or enlarging the side window in the cab of the HGV, though this would perhaps need to be dealt

[20] Design of a Tractor for Optimised Safety and Fuel Consumption, FKA, 2011

with as a direct vision regulation for HGVs in the same way that it is regulated for cars as ECE-R 125.

Direct vision regulations

Whether this is directly related to Directive 96/53 or not, there should also be direct vision requirements for HGVs as these do not exist in EU. These are needed to minimise frontal and lateral blindspots from the position of the driver. With regard to details the Danish transport ministry made a proposal last year to this end[21]. An excellent design has been proposed by London Cycling Campaign[22] to lower the cab of HGV and construction HGVs to approximate the superior windscreen and cab position of N2, N3 vehicles such as buses and coaches that are used exclusively in urban areas and have much better safety records.

Figure 12; comparison between a traditional construction HGV and its possible redesign with lower, better placed cab[23]

The lower cab position and excellent all round view from the driver position overcomes much of the blind spot in front of, to the side and even from behind the cab. This position also allows for better positioning of mirrors. This gives an indication of how blind spots can be eliminated and blind spot regulation could be applied to any HGV by a re-positioning of the driver seat and good front and side windscreen design.

[21] For example "The driver shall be able to directly see an object placed 1.5 m above ground level, at a distance more than 0.5 from the side or front of the vehicle, and in front of the rear cabin wall. Exceptions shall be allowed for areas around pillars, door-frames, and mandatory mirrors." http://circa.europa.eu/Public/irc/enterprise/automotive/library?l=/technical_committee/meeting_december_2009/denmark_visionpdf/_EN_1.0_&a=d

[22] http://lcc.org.uk/articles/lcc-challenges-construction-industry-to-adopt-its-safer-urban-HGV-to-reduce-HGV-cyclist-deaths

[23] A video of these two views can be found here http://www.youtube.com/watch?v=Nqvd2fxlhXk&feature=youtu.be

Deflection of Unprotected Road Users

Much of the work on deflection has been done with respect to deflecting pedestrian from the front of the HGV; however we see very little differences in the deflection of a pedestrian or that of a cyclist that has fallen from the bicycle at the front of the HGV. The EU funded project Aprosys looked into many different shapes and designs and tested all for deflection and under run prevention. Examples of the sort of shapes that were looked at include those below

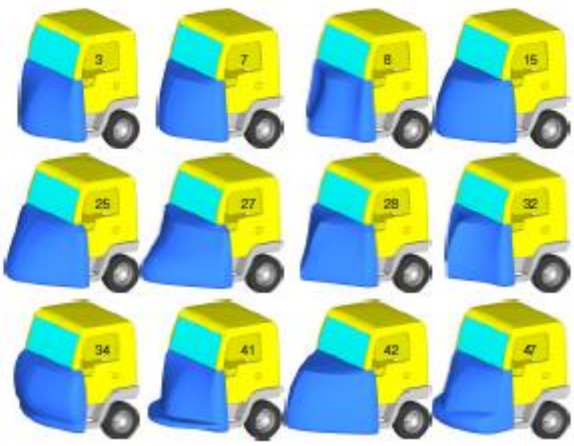

Figure 11: Examples of the 90 front geometry concepts in the APROSYS project

During the development of the new front structure in APROSYS a large number of design versions were generated and assessed. The resulting final principal shape was compared to the basic truck in various numerical simulations with different accident scenarios, pedestrian models and parameter settings. Due to the deflection principle, which is used in the rounded front design for the weakest traffic participants, the structure underneath can be designed mainly for protecting the heavy vehicle's occupants and integrating partner protection relating to passenger vehicles (improved compatibility). The deflection is not only a solution for the protection of pedestrians, but also reduces the impact energy introduced into the heavy vehicle and the passenger car in a HGV-to-car-accident. Such a convex truck front can significantly reduce the risk of a run over for VRU and also deflect passenger cars. In addition, it provides a crush zone for energy absorption. The enhanced passive safety could be shown in avoiding serious rollover accidents by 87.5 % of the simulated cases in APROSYS. The APROSYS report concludes by saying that "Accident experts expect a possible decrease of about 30 % cycling and pedestrian fatalities through better design of the cab.

With regards to the 800mm change in cab length proposed and shape at the front of the cab proposed by FKA, the report claims that there would be a direct effect on the reduction of the severity of around 50% of the fatal accidents involving HGVs, having a positive effect on 3200 to 3800 fatal accidents. This could translate into a potential saving of around 300 cyclist and pedestrian injuries per year. It would also be important that the extra space permitted by the deflection area should not be used by engine or other rigid parts of the cab (except perhaps for flexible cooling systems which are difficult to pack into the current cab design). This area should be used for crumple zones to increase safety for accidents involving larger vehicles to continue the extra safety benefits that a change in cab shape and size can bring.

Conclusion and Policy

An increase in 800mm of the front of the cab would entail the amending/repealing of Directive 96/53, this can be achieved by allowing HGVs to reach a length of 17.30m and road trains to reach a length of 19.55m, while leaving maximum trailer lengths unchanged at 12m. It has also been shown that an improvement in the shape of the cab by 800mm would have no effect on current regulations regarding manoeuvrability and external projections[24].

Changes to the law on weights and dimensions should be accompanied by new vehicle standards within type approval to ensure that new cab designs fully realise the safety and aerodynamic potential identified. To ensure that the extra space is devoted to safer and cleaner cabs, rather than other purposes, new laws should mandate for this use only. Legislation could also mandate for crash management system equipping HGVs with CMS would also significantly improve their safety performance. Specific energy absorption criteria for HGVs should be set and appropriate test procedures must be developed. There should be appropriate direct vision regulation for HGVs similar to that of ECE-R 125 for cars.

In conclusion ECF would like to see

- Directive 96/53 updated to allow for safer cab design with respect to other road users and in particular Unprotected Road Users
- New vehicle standards within type approval to ensure that new cab designs fully realise the safety and aerodynamic potential identified
- Regulations overseeing minimum direct vision requirements

Major blind spot reduction can be achieved by good design and good regulation to support that design. Mirrors and cameras will never be able to replace the judgement of a good driver. It is important that those who are driving these larger vehicles are well trained and made responsible for their use.

[24] Welfers et al, Design of a Tractor for Optimised Safety and Fuel Consumption, FKA, 201, Report 104190

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