Investigation report

S1/2005R-S

Safety Study on Level Crossing Accidents – A shortened version

This is a translation from the original Finnish version. This report is also available in Swedish.

The purpose of the investigation of accidents is to improve safety and prevent future accidents. It is not the purpose of the investigation or the investigation report to apportion blame or to assign responsibility. Use of the report for reasons other than improvement of safety should be avoided.

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INTRODUCTION

This report is a shortened version of the level crossing safety study (S1/2005R) published by the Accident Investigation Board of Finland on 20 June 2007. The investigation commission that prepared the study was chaired by Chief Rail Accident Investigator Esko Värttiö from the Accident Investigation Board, and the other members of the commission were Researchers Sirkku Laapotti and Kati Hernetkoski from the University of Turku Department of Psychology (behavioural sciences), Technology Student Aki Grönblom from the Tampere University of Technology (rail technology), Commercial Vehicle Instructor Pertti Mikkonen from the Tampere Vocational Adult Education Centre (vehicle structure technology), Training Officer Veli-Jussi Kangasmaa from the Jalasjärvi Vocational Adult Education Centre (driving practices, heavy vehicles), Investigator Hannu Räisänen from Lapua, Police Sergeant Veikko Alaviuhkola of the Tornio police force (traffic investigation) and Instructor Timo Kivelä from the Jalasjärvi Vocational Adult Education Centre Oulu Unit (driving practices and vehicle structure technology).

For the safety study, the commission investigated seven level crossing accidents of different types and different scopes that occurred in Finland in 2005–2006. Data on fatal accidents in 1991–2004 investigated by the Traffic Accident Investigation Teams of the Traffic Safety Commission of Finnish Motor Insurers' Centre (VALT) as well as data on all level crossing accidents in 2003–2005 collected by VR-Group Ltd were utilised. In addition, the commission made use of statistics relating to level crossing accidents and rail and road traffic for the period 1991–2004 as well as international statistics and accident reports on level crossing accidents, in order to obtain a point of reference for assessing level crossing safety in Finland and pondering how to improve it. At the end of the safety study, the commission analysed all the before mentioned material and drew conclusions based on it, as well as issued recommendations on how to improve level crossing safety.

The original safety study of the investigation commission covered over 200 pages, which has been shortened to four chapters and less than 30 pages. Chapter 1 presents the commission's findings on the seven level crossing accidents it investigated. Chapter 2 focuses on railway traffic and level crossing safety on the basis of statistics and accident data. This chapter also includes comparisons between different countries and a review of the causes of level crossing accidents on the basis of VALT's material on fatal accidents. Chapter 3 presents the commission's conclusions and chapter 4 the commission's recommendations and the grounds for them. This shortened version excludes a substantial amount of information gathered by the commission. Readers who wish to have more detailed information concerning the matters presented in this report should consult the original safety study (which can also be accessed via the net at the address www.onnettomuustutkinta.fi/39630.htm). The original safety study's abstract, foreword, tables on accidents, as well as the legends for the images, charts and tables are also provided in Swedish and English. This shortened version is available in Finnish, Swedish and English.

SISÄLLYSLUETTELO

1 ACCIDENTS INVESTIGATED BY THE COMMISSION

1.1 Collision of a Pendolino train with a lorry carrying livestock at an unprotected level crossing in Kälviä on 10 November 2005

On Thursday 10 November 2005 at 6.22 a.m., a Pendolino train en route from Oulu to Helsinki collided with a lorry carrying livestock at 132 km/h at an unprotected level crossing in Kälviä. As a result of the collision, the lorry crashed into a field next to the railway. The lorry's driver and co-driver were fatally injured. The engine driver and one passenger were slightly injured. Furthermore, the lorry was completely wrecked and the livestock perished. The first coach (= power car with cabin) was badly damaged.

The Pendolino train S 48 approached the level crossing at 140 km/h and the engine driver noticed the sidelights of the lorry approaching from the right, estimating that the train was about one kilometre from the crossing. The lorry was about 140 metres from the crossing at that time. According to the engine driver's estimate, the lorry was moving towards the crossing at roughly 20 km/h at a maximum. When the train was about 200 metres from the crossing, the engine driver saw the lorry pass the STOP sign at low speed and the front of the lorry reach the rails. The engine driver applied the emergency breaks 154 metres before the point of collision. Nevertheless, the train collided with the lorry towards the bogie, hurling the lorry to the left in terms of the direction taken by the train.

At the level crossing, the maximum permitted train speed was 140 km/h and the road speed limit 50 km/h. The crossing was equipped with road signs before and at the crossing. In addition, the crossing had a sign indicating a mandatory stop before the crossing (STOP sign). At 30 metres before the crossing, the train was freely visible from the direction of the approaching lorry to a distance of about 900 metres, and 8 metres ahead of the rails there was clear visibility for around two kilometres. Due to a bend in the track, however, the visibility in the other direction, 8 metres from the rails, was limited to around only 420 metres. About 57 trains passed the crossing every 24 hours, which was significantly more than the 27 trains per 24 hours according to the audit held in 2003. In addition, the train speeds had increased. About 52 vehicles passed the crossing every 24 hours, of which three were heavy vehicles. Most vehicles passed the crossing during daytime, during which period the number of high-speed trains was also greater.

The accident was caused by the lorry driver driving past the STOP sign without stopping and continuing on to the crossing in front of the approaching train. On the basis of technical investigations on the lorry, as well as calculations and the engine driver's observations, it can be assumed that the lorry driver did not notice the approaching train at all.

The unprotected level crossing and the conditions created possibility to an accident caused by lack of observation and failure to act as indicated by the road signs in place.

The lorry driver's spotting the approaching train was hindered by some or all of the factors below:

- the driver was focusing on driving and tried to avoid a bump as the lorry approached, entered and passed the crossing
- the driver focused on looking to the right because the view was poorer in that direction
- it was raining and dark
- the cabin lights may have been switched on
- the angle of crossing was sharp
- street and lawn lights and possible car running lights visible in the direction of the approaching train
- the train was approaching at high speed.

Passing the STOP sign without stopping may also have been influenced by:

- the upslope towards the crossing
- the driver considering visibility to the right to be so poor that he would not be able to pass over the crossing fast enough after a full stop
- sudden stops and starts are generally avoided when transporting livestock.

1.2 Collision of a freight train with a passenger car on a level crossing with light and sound warning signals in Kouvola on 14 February 2006

On Tuesday 14 February 2006 at 11.51 a.m., a freight train collided with the left front corner of a passenger car on Tanttari level crossing with light and sound warning system, along the Kouvola–Kuusankoski track. The train was travelling at 43 km/h. The car driver was slightly injured and the car wrecked beyond repair. Moreover, the equipment in the front of the locomotive incurred some damage.

The car approached the crossing at 30–40 km/h. As the car approached, the driver’s attention was elsewhere. When the driver looked at the warning lights, the red warning lights were blinking. However, the driver continued without slowing down, thinking it would be possible to make the crossing before the train. At the last moment, the driver noticed the train and accelerated to try to pass through before the train.

As the train approached the level crossing, the engine driver saw behind the trees a car approaching the level crossing. At this point, the engine driver could not figure out whether the car would stop. Just ahead of the crossing, the engine driver noticed that the car was continuing without stopping. As the collision occurred, the engine driver made whole service braking. The locomotive collided with the left front corner of the car.

The Tanttari level crossing is north of Kouvola, on the track between Kouvola and Kuusankoski. The speed limit for trains along this track is 50 km/h. The Tanttari road, which leads to the Tanttari residential area, has three successive level crossings. Approaching from the Tanttari residential area, the first two crossings are equipped with light and sound warning system, and the last with half-barriers. The road has a gravel surface and the speed limit is 30 km/h. From the Tanttari direction, the road rises 2 metres over a 25-metre stretch ahead of the crossing, which makes the average gradient 8 %. At its steepest, the gradient is around 10 %. The Tanttari road is used primarily by about 23 families of the area and the crossing frequency is estimated at 80–100 crossings per 24 hours. Eight freight trains regularly run the Kouvola–Kuusankoski route every 24 hours. The road is the only road for vehicles to the Tanttari residential area.

The cause of the accident was the driver's lack of focus at the crucial moment, and too high approaching speed of the car. In addition, the rising slope ahead of the crossing may encourage motorists to make too early a decision on crossing the track. The fact that the location was familiar might also have contributed to the driver's lack of vigilance in approaching the crossing.

1.3 Collision of a train consisting of two locomotives with a passenger car at an unprotected level crossing in Tornio on 16 March 2006

On Thursday 16 March 2006 at 9.54 a.m., a train consisting of two diesel locomotives, en route to Kemi, collided with a passenger car at 44 km/h at an unprotected level crossing in Konu. The driver of the car was slightly injured. Moreover, the front corner of the first locomotive incurred some damage, and the car was damaged beyond repair.

The driver of the car was approaching the crossing and noticed the train approaching from the right. In response, the driver braked and the car stopped on the crossing. Despite several attempts, the driver was unable to get the car going again.

About 200 metres ahead of the crossing, the engine driver saw that a car was approaching from the left. The train was moving at 63 km/h and the engine driver switched off the power and began braking. Nevertheless, the locomotive collided with the right front door of the car at 44 km/h. The car became attached to the train by its front buffer and was shunted for around 60 metres.

The unprotected Konu level crossing is located on the track between Laurila and Tornio, on Antinsaarentie road in the village of Ala-Raumo about 5.2 kilometres from Tornio. This road is a private gravel road, and branches off the Raumo local road about 20 metres ahead of the level crossing. The maximum train speed permitted at the crossing is 80 km/h and the road speed limit is 50 km/h. STOP signs for vehicles are located 9.5

metres from the closest rail. At 8 metres before the rails, visibility from the car in the direction of the train was about 600 metres, and about 240 metres in the other direction. Visibility for motorists coming from the opposite direction was roughly the same. About eight trains pass the crossing every 24 hours. The estimate for vehicles was about 100 vehicles every 24 hours.

The cause of the accident was the driver's faulty perception and actions. Other contributing factors were poor visibility and the STOP sign's poor location. The sharp angle formed by the road and the track, and blocked vision in the direction of the train in the angle of vision formed by the front seat's head support and the car's B pillar, also affected visibility.

The driver of the car was familiar with the level crossing. The driver was in a hurry, and his focus may have been on the next assignment, resulting in too little attention being paid to making a safe crossing. Once the driver of the car became aware of the danger, panic may have set in, with the result that the driver was unable to control the car in a normal fashion. Other factors affecting the accident may have been the slipperiness of the crossing and the potholes in the snowy road surface at the rails.

1.4 Collision of a freight train with a passenger car at an unprotected level crossing in Närpiö on 5 May 2006

On Friday 5 May 2006 at 11.57 a.m., a freight train en route from Kaskinen to Seinäjoki collided with a passenger car at an unprotected level crossing in Närpiö. The car driver was seriously injured and died later as a result of the injuries. In addition, the locomotive suffered slight damages to the nose and the car was damaged beyond repair.

The freight train approached the Prästö level crossing at 47 km/h, whereupon the engine driver saw that a car was approaching from the opposite direction on the left and gave an emergency whistle. According to the engine driver's estimate, the speed of the car was about 50 km/h. When the car was about 30 metres from the crossing, the engine driver lost sight of it due to the structure of the locomotive. The engine driver then heard the collision and saw that the car had rolled onto its side into a ditch on the left side of the track. During the collision, the left buffer of the locomotive smashed against the A pillar of the car and the automatic coupler against the right front wheel. The train stopped after braking 255 metres from the crossing.

The unprotected Prästö level crossing is located on Prästö road (leading to Kaskinen road) in Närpiö along the Kaskinen–Seinäjoki track, about nine kilometres east of Kaskinen. This road is a private gravel road with little traffic. At the time of the accident, the maximum permitted speed for trains at the crossing was 50 km/h (normally 80 km/h), while the speed limit for vehicles was 80 km/h. The crossing is equipped with crossing approach and crossing signs. Normally, four trains pass the crossing every 24 hours and the road is significantly lower than the track all the way up to the crossing, at which point the road veers sharply towards the track. There is also no wait platform. From both directions, the road rises about 2 metres over a 30 metre stretch prior to the crossing. The gradient is at its sharpest (at 10 %) just before the crossing. The crossing angle between the car and train was 105°. Because the road also rises from the opposite direction, it is difficult to see traffic approaching from the other side too.

The accident was caused by the driver of the car entering the level crossing without giving way to the train approaching from the right. Apparently, the driver completely failed to notice the train. The structure of the unprotected level crossing was also a contributing factor. The car driver's poor eyesight and state of intoxication, and the fact that the sun was in the driver’s eyes from ahead, inhibited the driver's observational capabilities. In addition, the driver may have behaved negligently in terms of personal safety.

1.5 Collision of a freight train with a passenger car at an unprotected level crossing in Raahe on 5 May 2006

On Friday 5 May 2006 at 7.11 p.m., a freight train en route to Raahe collided with a passenger car at 66 km/h at an unprotected level crossing in Raahe. The rear of the car was badly damaged, and the locomotive incurred some damage.

The freight train approached the crossing at 70 km/h. About 20 metres ahead of the crossing, the engine driver glimpsed an indeterminate, dark shape. After looking to the right, the driver saw the car and concluded that the train had collided with it. The engine driver did not have time to break before the collision. According to the driver of the car, the car’s speed was about 20–30 km/h upon impact. The driver of the car reported looking to the left before the crossing, and turning to look to the right only at the crossing. According to the car driver’s account, at this point the train was already about 10–15 metres from the crossing. Upon seeing the train, the driver claims to have accelerated in order to get out of the way, but the collision occurred anyway. The driver of the car was not injured.

The unprotected Kaara level crossing is located on Tuohinonperäntie road in the village of Ylipää in Raahe, along the Tuomioja–Raahe track. Furthermore, the track is electrified and used only for freight traffic. The maximum permitted speed on the track is 80 km/h, and 80 km/h on the road. The level crossing is unprotected and equipped with a level crossing approach and level crossing signs. In addition, there is a STOP sign 6 metres before the crossing. Visibility was two kilometres in both directions. Roughly 10 trains pass the crossing every 24 hours. There is little road traffic.

The accident was caused by the driver of the car passing the STOP sign without stopping and not checking the track to ensure a safe crossing.

1.6 Collision of a museum train with a passenger car at a guarded half-barrier level crossing in Alavus on 17 June 2006

On Friday 17 June 2006, a museum train en route to Haapamäki collided with a passenger car at a guarded level crossing with a half-barrier in Alavus. The museum train consisted of two Dm7 diesel motor units and an additional car. While the driver of the passenger car was slightly injured, the car was completely wrecked and the first motor unit of the train incurred some damage.

The train was moving approximately 80 km/h. As the train approached the level crossing, the train crew saw that, on the right, a passenger car was moving in the direction of the train on main road 18, approaching the crossing at a slightly lower speed than the train. The engine driver noticed that the level crossing barriers were working and assumed that the car would stop before the crossing. As the car approached the bend before the crossing, it transferred to the left lane in order to cut a straight line through the curves. At this point, the engine driver became aware of the danger, gave a warning whistle and began to brake.

According to the car driver, she did not see the warning light before the level crossing, nor that the barrier was down. The driver also did not see the approaching train. Being in the left lane, the driver noticed that the barrier on the other side of the level crossing was down, and made a quick turn to the right to avoid hitting it. This was when the driver obtained a side view of the train. The train collided with the left front side of the car. The car ended up overturned 40 metres from the crossing, with the rear pointing in the direction in which the car had been moving. Despite braking and the collision, the train continued 300 metres past the crossing before stopping.

The Kivekäs half-barrier level crossing is located in Alavus Sydänmaa on main road 18 from Seinäjoki to Jyväskylä, along the Haapamäki–Seinäjoki track. The maximum train speed at the crossing was 100 km/h, and the speed limit on the road was 80 km/h. From the direction of the approaching car, the road runs nearly parallel with the track, and about 150 metres from the crossing there is a small curve to the right, followed by a sharp curve to the left just before the crossing. The road passes the track at a 45-degree angle and turns sharply to the right after the crossing. A sign, indicating that a curvy road section is ahead with the first bend being to the left, and the maximum recommended speed of 40 km/h, is located 200 metres before the crossing. From the direction of the approaching car, the visibility to the left was 800 metres, and to the right 700 metres. About six passenger trains pass the crossing every 24 hours, while freight trains only occasionally do so. About 1 750 road vehicles pass the crossing each 24 hours, of which about 112 are heavy vehicles.

The accident was caused by the driver of the car failing to observe that the light and sound warning signal was on before the crossing and that the barrier was down on the driver's side of the road. Thus, the car continued onto the crossing without slowing down, using the left lane. This was affected by the following:

- the driver approached the crossing too fast and without due caution
- the driver switched to the left lane to cut a straight line through the curves even though there was a barrier lane, while focusing on approaching traffic and his own driving
- the driver was young and inexperienced and did not have prior experience of the functioning of the warning equipment at that level crossing.

The speed limit of 80 km/h on main road 18 is too high a speed before the crossing. Moreover, the recommended speed of 40 km/h does not signal strongly enough that slowing down is necessary, especially since it is possible to cut straight through the curves.

1.7 Collision of a freight train with a passenger car at an unprotected level crossing in Ylistaro on 21 June 2006

On Wednesday 21 June 2006, a freight train en route from Vaasa to Seinäjoki collided with a passenger car at an unprotected level crossing in Ylistaro. The car driver and passenger were unharmed. The car was badly damaged in the rear. The locomotive incurred some damage on its nose section.

According to the driver, the car was driving at 40–50 km/h and reduced its speed to 20–30 km/h as it approached the level crossing. The driver did not notice the train approaching from the left until the car was already passing the crossing. He first automatically braked and then attempted to accelerate over the rails.

After departing from Ylistaro towards Seinäjoki, the engine driver accelerated to 70–75 km/h. The engine driver saw that a car was approaching from the right ahead of the crossing. On the basis of the speed of the car, the engine driver concluded that the car would try to pass the crossing without stopping. According to the engine driver's report, the engine driver started braking and gave a whistle once the car was near the STOP sign. The car driver did not react to the whistle, and continued without stopping onto the crossing, where the train's left buffer collided with the car's left rear section, whereupon the car was smashed into a ditch on the left side of the track. The train stopped about 150 metres from the crossing.

The unprotected Haapoja level crossing is located next to main road 18 in Ylistaro municipality, at the intersection of the private gravel-surfaced Taipale road and the Seinäjoki–Vaasa track. At the level crossing, the maximum permitted train speed is 120 km/h. The road speed limit is 80 km/h. The crossing is equipped with crossing approach signs and a STOP sign 11 metres before the rails. At 8 metres ahead of the rails, visibility in the direction of the approaching train was about 1 200 metres. The road curves sharply to the right on both sides of the crossing, and the curve evens out on both sides about 17 metres before the track. Moreover, the road crosses the rails at about a 70-degree angle with a slight upward slope, which rises about 50 cm over a 20-metre distance. The track is mainly used by passenger trains, with about 16 trains passing the crossing every 24 hours. Road vehicle traffic on the level crossing is little local traffic.

The reason for the accident was that the car driver drove onto the level crossing without stopping. The driver also failed to notice the approaching train early enough, may have been focusing on issues other than making the crossing and may have been tired. In addition, the fact that the car radio was on, and that the driver was engaged in a conversation with the passenger, may have inhibited hearing the approaching train. The driver of the car acted inappropriately when making the crossing, with which the driver was familiar. Moreover, the driver had the habit to cross the level crossing without stopping.

2 STATISTICS ON LEVEL CROSSINGS AND LEVEL CROSSING ACCIDENTS

2.1 Statistics on the number and nature of level crossing accidents

The number of level crossing accidents in Finland declined significantly in the beginning of the 1990s. However, this decline came to a halt at the end of the 1990s and there have even been recent signs of a slight increase (Figure 1).

The number of level crossing accidents can vary substantially from one year to the next. The number was at its lowest in 1998, when 39 accidents occurred. Over the period reviewed, i.e. 1991–2005, accident numbers peaked in 1991, when the total was 97. Nevertheless, considering averages, for example over a five year period, it can be observed that accident numbers decreased fairly evenly from the start of the review period until 1998, in total by a third. This trend petered out in 1996, since when there has been no significant change. The average for 1995–2004 is roughly 50 accidents a year.

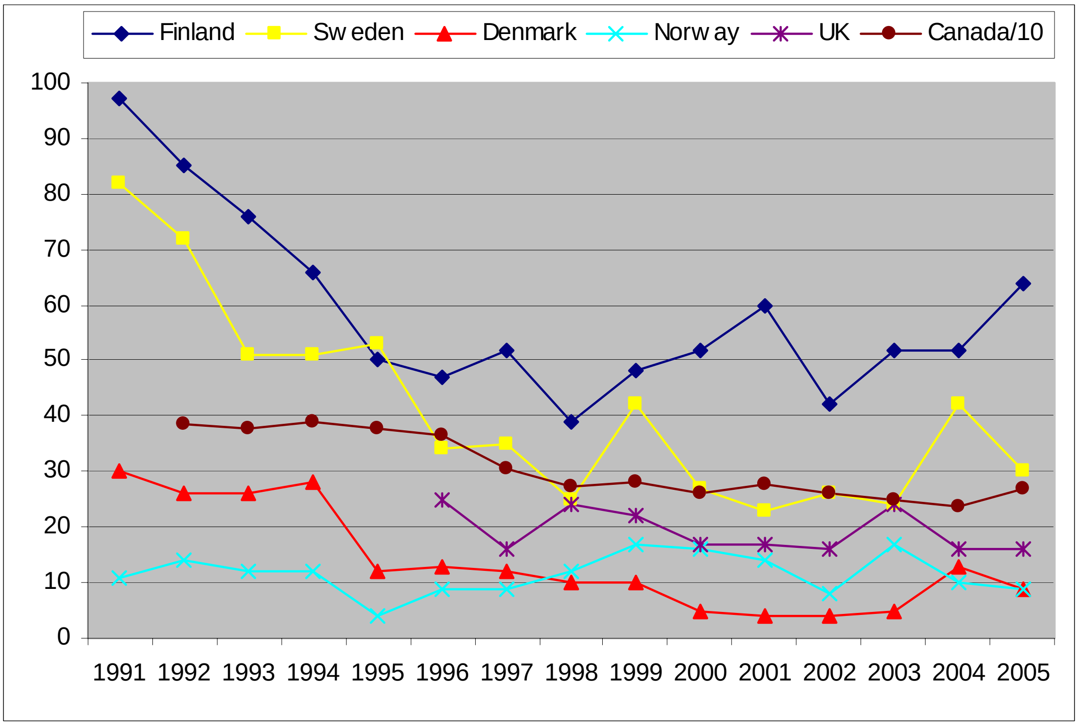

Figure 1. The number of level crossing accidents in Finland, other Nordic countries and the UK and Canada in 1991–2005.

The situation in Finland is similar to that of Sweden and Denmark in that the latter also experienced a decline in accident numbers in the beginning of the 1990s, after which the decline either slowed or came to halt. In 2005, in Finland occurred 64 level crossing accidents with eight fatalities, in Sweden 30 accidents with three fatalities, while in Denmark six accidents with three fatalities.

The number of level crossings in place obviously has a significant impact on the frequency of level crossing accidents. Small countries with few level crossings experience fewer accidents than big countries. Indeed, a comparison of the number of level crossing accidents with the total number of level crossings can be used as an indication of differences in level crossing safety between countries (Figure 2). Using this formula, occurs in Finland one level crossing accident for every one hundred level crossings. The corresponding figure for Sweden is fifty percent lower. This type of comparison is favourable to countries with a high ratio of level crossings equipped with a barrier. More detailed information on railway and road traffic as well as accidents in various countries for 2004 is available in appendix 1.

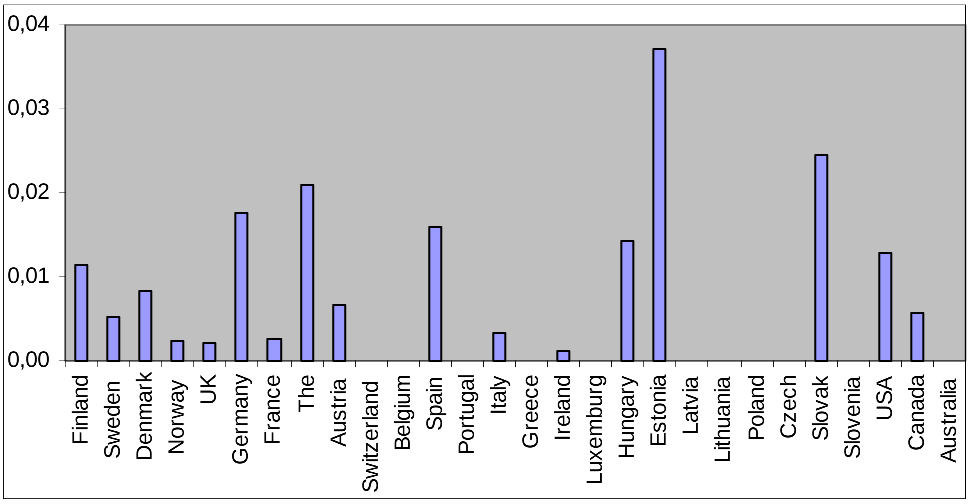

Figure 2. The relation between the number of level crossing accidents and the total number of level crossings in 2004.

A more detailed analysis of level crossing accidents in Finland reveals that most of them are minor in nature, for example comprising shunting unit collisions with cars at low speeds. In 2005, for example, roughly twenty-five percent of all level crossing accidents in Finland occurred in rail yards or on industrial or port area tracks. The situation was similar in earlier years (Figure 3). The investigation commission did not have sufficient information on how accurately other countries account for such accidents in their statistics. Indeed, it may be that Finland's high accident number in relation to other countries is partly due to different statistical methodologies.

More detailed information on level crossing accidents in 2005 is available in appendix 2.

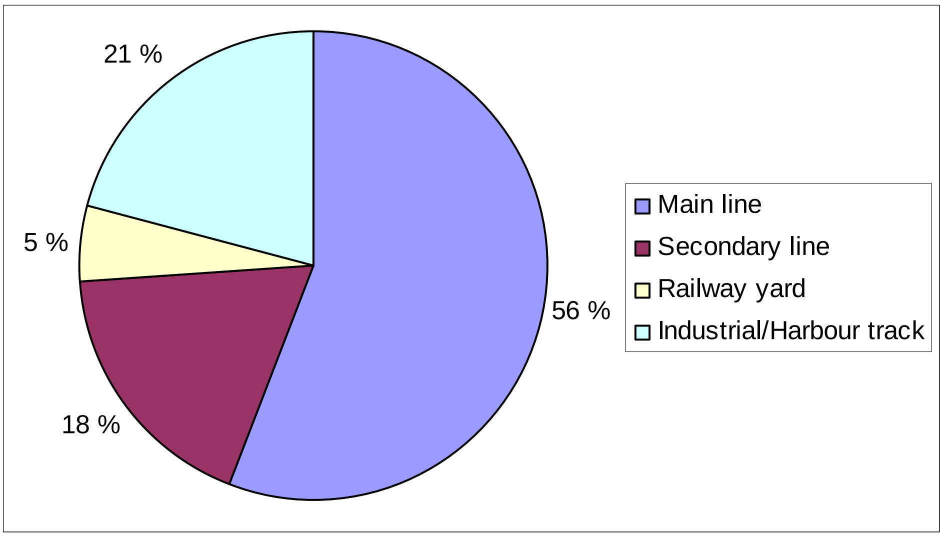

Figure 3. Level crossing accidents by track type in 2003–2005.

Of the 818 accidents that occurred over the period 1991–2004, most (78 %) took place at unprotected level crossings (Figure 4). Some 106 accidents (13 %) occurred at half-barrier level crossings, while 74 accidents (9 %) occurred at crossings with light and sound warning systems. Of the total level crossings in place over the review period, an average of 79.7 % were unprotected, 17.8 % had half-barrier and 2.5 % were equipped with light and sound warning systems. Therefore, there were proportionally more accidents at level crossings with light and sound warning signals than at half-barrier level crossings.

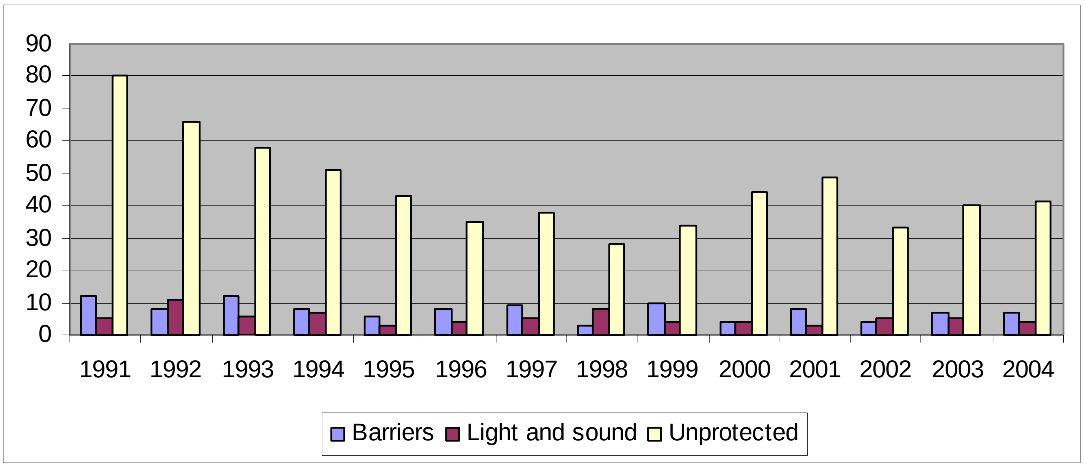

Figure 4. Number of accidents at unprotected, half-barrier and light and sound warning level crossings.

In Finland the highest ratio of accidents occurs at unprotected level crossings. In other countries, including those with a high number of level crossing accidents, accidents are more common at protected level crossings. It is likely that such crossings also have heavy traffic. Finland's level crossings and level crossing accidents are distributed over a wide area, which is natural for a sparsely populated country.

2.2 The causes of level crossing accidents on the basis of accidents investigated by VALT

The level crossing safety study reviewed fatal level crossing accidents investigated by VALT over the period 1991–2004. Annual distributions for such accidents are presented in appendix 3. The study used both coded data (n = 110 accidents) and original accident reports (n = 105 accidents) as its source material. Of the 105 accidents investigated, 78 (74 %) occurred at unprotected level crossings, 22 (21 %) at half-barrier level crossings, and 5 (5 %) at level crossings equipped with light and sound warning system.

With regard to the trains involved, 60 were passenger trains and 45 were freight trains, locomotives or track work machines. The track speed limit was most commonly 120 km/h (48 % of cases) and the road speed limit 80 km/h (49 % of cases). Over 60 % of the roads were private roads.

Most accidents occurred during the morning or daytime. The level crossing was often familiar to the driver of the vehicle, and the driver was usually on a work-related trip or driving on errands.

The data on fatal accidents enabled an analysis of their causes. Risk factors relating to level crossing accidents were compared with those relating to other types of fatal accidents. Observation error of the vehicle driver was the most prevalent direct risk factor in all crossing accidents (Figure 5). In level crossing accidents the most typical observation error was that the driver failed to see the train or fully grasp the risk involved in the situation (53 cases). Five drivers had an insufficient understanding of their position when approaching the crossing. Three drivers took insufficient or inaccurate note of their surroundings.

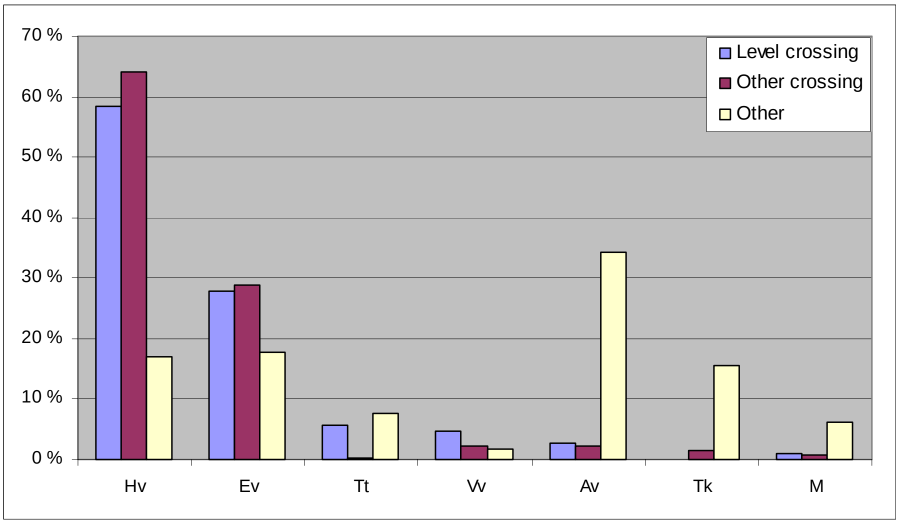

Figure 5. Immediate risk factor for car driver in fatal level crossing, other crossing and other traffic accidents. In diagram: Hv = observation error, Ev = anticipation and assessment error, Tt = knowingly running into the situation, Vv = driving with disregard for the hazard, Av = errors in road vehcile handling, Tk = change in capacity to act, M = other.

Observation error was affected by several factors:

- familiarity with the crossing and a routine approach, and therefore insufficient observation
- focus on something else than driving
- hurry
- observation-inhibiting factors in the environment (trees, bushes, cliffs, buildings, other vehicles, or a structure of own vehicle)
- observation-inhibiting factors in the driver (difficulty in turning head, poor eyesight, decline in driving ability due to fatigue, illness, alcohol or medicine, inexperience).

In addition, the driver's aural perception were impeded by poor hearing, listening to the radio or CD or similar, the sound of own vehicle, and ear mufflers.

Road type, speed limit and speed of approach

In comparison with other fatal road accidents, level crossing accidents occurred relatively more often on private roads. Of fatal level crossing accidents, 61 % occurred on private roads, while the corresponding figure for all other fatal road accidents was less than 10 %. Indeed, not a single fatal level crossing accident took place on highways or main roads.

The road speed limit was 80 km/h at the highest, and this was also the most common speed limit (49 % of cases; Figure 6). A comparison of speed limits with road types showed that 80 km/h was the most common speed limit in private road accidents (63 %). In district or connecting road accidents, 80 km/h was the speed limit in only 30 % of cases.

Vehicle speed averaged 34.4 km/h in areas that had an 80 km/h speed limit, and 31.8 km/h in areas that had a maximum 60 km/h speed limit. Although the speed limit did not seem to affect the speed of approach, the 80 km/h speed limit may give the wrong signal about crossing safety to the driver, resulting in insufficient vigilance when approaching the crossing.

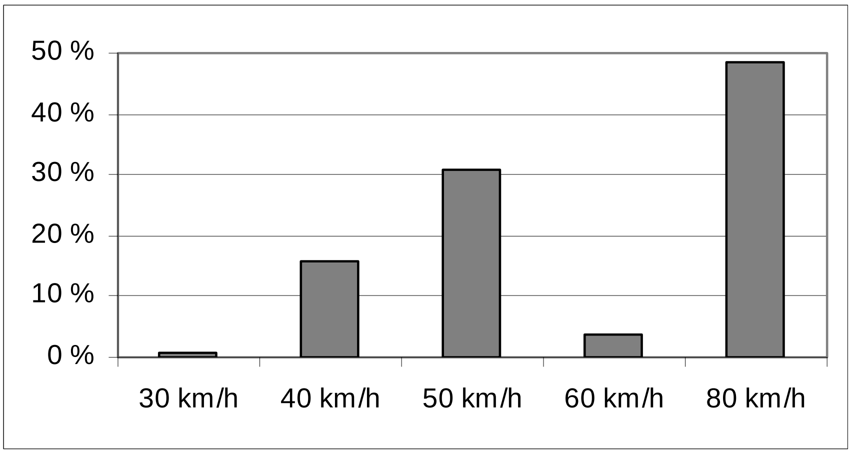

Figure 6. The speed limit on road in fatal level crossing accidents.

At level crossings the track usually runs along its own embankment and is on a different level from the surrounding environment and the road. For this reason, approaching the track usually involves a rise or a decline. Limits for slopes have been defined in the regulations concerning level crossings.

The road sloped upwards in 61 % of cases (Figure 7). Only about 25 % of level crossings was flat. The weather conditions in level crossing accidents were generally poorer than in other fatal accidents. An analysis of fatal accidents for September–May showed that level crossing accidents occurred more often on snowy roads (28 %) than other fatal road accidents (13 %). If the road is rising towards level crossing and the road surface is snow-covered, may these conditions reduce the driver's willingness to stop before the crossing.

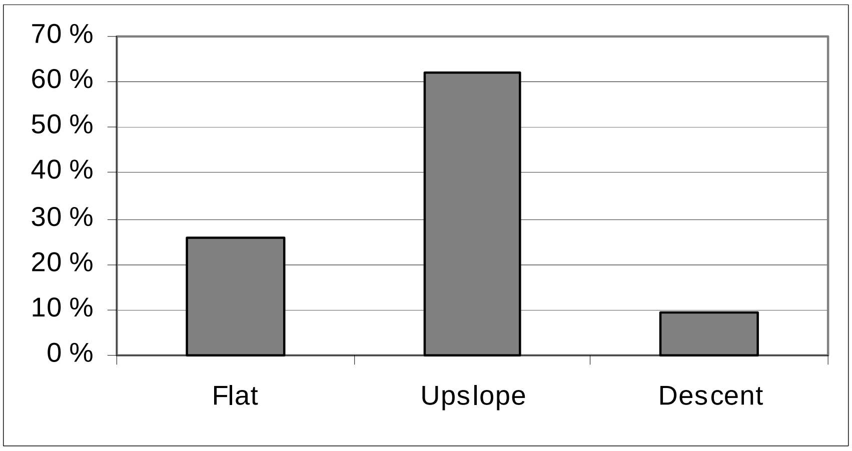

Figure 7. Evenness of road in fatal level crossing accidents.

Accidents at unprotected level crossings

A total of 78 (74 %) accidents occurred at unprotected level crossings, of which 29 (37 %) were equipped with a STOP sign. However, almost all of the drivers failed to stop. They generally reduced their speed significantly, and tried to assess the situation from a moving vehicle. The failure to stop was influenced by several factors. In most cases, the crossing was very familiar to the driver. Half of the drivers made the crossing daily or almost daily, and 18 % on a weekly basis. In general, crossings had only occasional train traffic and, for this reason, the crossings were not considered dangerous. Other factors explaining the failure to stop included slippery conditions and/or a rising incline towards the crossing, lack of concentration or driving behind another vehicle.

Accidents at half-barrier level crossings

A total of 22 accidents (21 %) took place at level crossings which were equipped with a half-barrier. The accident reports indicated that approaching such crossings without stopping was caused by late observation of the warning signals, faulty assessment or interpretation of the situation, as well as intent. Late observation often involved a high approach speed and slippery conditions, with the result that the vehicle skidded trough the barrier despite lock braking. Some drivers may even have driven against the barrier without seeing it at all. They may not have left sufficient time to start braking either. Faulty assessment or interpretation of the situation involved inexperience, poor judgement as well as conscious risk taking ('I'll make it'). Faulty assessment or interpretation of the situation occurred for example in cases when the barrier remained down and the warning signals remained switched on after a train passed, because another train was approaching. The driver did not understand this and tried to pass the barriers. In addition, some drivers tried to pass the barriers in places where they had noted faulty functioning of the warning equipment. Five cases out of six recorded as suicides took place at half-barrier level crossings.

Summary

As a summary of all fatal level crossing accidents, it should be noted that several factors were simultaneously at the background an accident, and their combined effect made the accident possible. In the final analysis, the driver of the vehicle made a crucial mistake (e.g. did not observe, continued without stopping), but the chain of events nevertheless began much earlier. Most of the accidents took place at unprotected level crossings, in which responsibility for a safe crossing has been left solely to the driver.

3 CONCLUSIONS

1. In all seven accidents investigated by the commission, the road vehicle drove to the level crossing without stopping, in spite of the level crossing being equipped with a STOP sign in four cases.

2. In the level crossing accidents in 2003-2005, most road vehicle drivers drove to the level crossing without stopping.

3. In the fatal level crossing accidents in 1991-2004 studied by VALT, the majority of the road vehicle drivers drove to the level crossing without stopping.

4. The road vehicle driver either failed to observe the train or observed it too late.

5. In the accidents investigated by the commission and those investigated by VALT, the accident most often took place on a familiar level crossing.

6. The consequences of a level crossing accident are unpredictable.

7. Of the level crossing accidents that occurred in 1991-2004, 78% of the cases took place on unprotected level crossings, 9% on level crossings with a light and sound warning system, and 13% on level crossings equipped with half-barriers.

8. Of the fatal level crossing accidents in 1991-2004 investigated by VALT, 74% of the cases took place on unprotected level crossings, 5% on level crossings with a light and sound warning system, and 21% on level crossings equipped with half-barriers.

9. In four accidents (out of seven) investigated by the commission and 52 accidents (out of 107) investigated by VALT, the speed limit on the road was 80 km/h.

10. In four accidents (out of seven) investigated by the commission, the wait platform failed to meet the requirements of the Track Technological Rules and Regulations (RAMO), and in 61% of the accidents investigated by VALT, the road featured an upward slope to the railway.

11. When adjusted for their total numbers, level crossings with light and sound warning systems are relatively more dangerous than level crossings with half-barriers.

12. In two unprotected level crossing accidents (out of five) investigated by the commission, the sightline areas failed to correspond to the maximum permitted speed on the track.

13. Three accidents (out of seven) investigated by the commission took place at a private road level crossing.

14. According to the 2003-2005 statistics, 60 out of 168 accidents took place at a private road level crossing.

15. Among the fatal level crossing accidents investigated by VALT, 61% took place at a private road level crossing.

16. According to the 1991-2004 statistics, a lorry was involved in 30% of all level crossing accidents, which often featured a collision on a port or railway yard area.

17. In fatal level crossing accidents investigated by VALT, the share of lorries was less than 5%.

18. According to the 1991-2004 statistics, a bus was involved in seven level crossing accidents. Only one accident was fatal.

19. According to the 1991-2004 statistics, a tractor or work machine was involved in 51 level crossing accidents.

20. A passenger train was involved in 57% of the fatal level crossing accidents investigated by VALT and in 17% of all level crossing accidents in 2003–2005.

21. From 1991 to 1996, the number of level crossing accidents shows a clear downward trend while in 1996–2004, the number of the accidents has remained more or less stable.

22. In 1991–1996 the number of road vehicles remained almost stable while in 1996–2004, their number increased by 22%.

23. According to the VALT statistics for 1991–2004, 4,430 persons died in road accidents involving motor vehicles, 142 of whom in level crossing accidents.

24. Only about 10% of all unprotected level crossings are equipped with STOP signs. According to the documentation produced by VALT, more than one third of the unguarded level crossings where fatal accidents took place, were equipped with STOP signs.

4 RECOMMENDATIONS

The investigation commission considers that the basis for improving level crossing safety should involve the following:

- the removal of a level crossing should always be considered as the primary means of improving safety
- the number of level crossings should be reduced significantly over the long term
- level crossing removal should follow an established plan and the authorities should maintain a relevant strategy
- the removal process should prioritise safety
- society should allocate sufficient funds to removing and improving the safety of level crossings.

S213 Stopping as model of behaviour at unprotected level crossings

The investigation commission found out that in most accidents the vehicle ran onto the crossing without stopping. However in Finland the sightline requirements on unprotected level crossings ensure a safe sightline area only at a distance of eight metres from the railway line. Stopping a vehicle over this distance is not possible unless the driver has prepared for it. In order to improve safety, the investigation commission recommends that:

Stopping should be adopted as the regular model of behaviour at unprotected level crossings in which the sightline along the railway isn't attained earlier than at a distance of 8 metres from the track. [S1/05R/S213]

The implementation of this recommendation could be promoted by means of the following:

- inventory of level crossings to identify on which level crossings the sightline toward the railway isn't attained earlier than at a distance of 8 metres from the railway, and consequently the installation of STOP signs at these level crossings
- the road profile should be designed and carried out in terms of its wait platform so as to prevent any risk of jamming in any instance and to ensure the driver's confidence in being able to stop before the level crossing without such a risk
- by information and education people should be made aware of the great importance of stopping at a level crossing
- by information and education people should be made aware of the fact that a safe sightline is generally attained not earlier than at a distance of 8 metres from the railway
- in basic and advance driver training, more attention should be paid to level crossing behaviour

– increasing the monitoring of level crossings, possibly including camera surveillance.

The implementation of these measures requires cooperation among all parties involved (rail operators, infrastructure managers, road keepers, communities, etc.).

S214 Modification of sightline requirements

Level crossings of very different types belong to the same category according to the sightline requirements presently valid in Finland. Requirements do not take account of the good visibility that exists at many level crossings.

The sightline requirements for level crossings should be modified so as to also consider the possibility of passing a level crossing without stopping in case a sufficient sightline along the railway is attained substantially before 8 metres from the railway. [S1/05R/S214]

Hence stopping is not always necessary when the sightline area ratings enable the road vehicle driver to stop before the level crossing upon having perceived the train.

Existing unprotected level crossings should also be equipped in accordance with the new regulations.

S215 Perceptibility of train and level crossing

As the road vehicle driver's perception error is often the cause of his failing to stop at a level crossing, the perceptibility of both the train and the level crossing should be improved. For example, in the accidents investigated by the commission, the road vehicle driver either failed to perceive the train or only perceived it too late.

Perceptibility of the train and the level crossing should be improved. [S1/05R/S215]

The perceptibility of a train may be improved, e.g. by non-static lights that stand out from the environment and by lights or reflectors mounted on the sides of railway cars. A study for identifying the best measures could be completed, focusing on how trains are perceived and how one becomes aware of them.

The perceptibility of an unprotected level crossing may be improved, e.g. by portal structures, various types of retarders or jiggle bars on the road.

S216 Road speed limits before level crossings

A great number of level crossings feature high speed limits, even 80 km/h. This impacts the road vehicle driver's impression of a safe level crossing and hence his/her driving behaviour at the level crossing.

At a level crossing the maximum speed allowed on the road should be 50 km/h or lower depending on the place and the characteristics of the level crossing. [S1/05R/S216]

The speed limit on a road before a level crossing with a STOP sign should be gradually decreased to an appropriate level. This might contribute to the observance of the STOP sign.

An adequate speed limit on level crossings without half-barriers could be 20 km/h. A corresponding speed limit sign should be installed at a distance of about 30 m before the level crossing. The speed limit sign could moreover have an additional sign indicating the "Level crossing".

S217 Wait platform

At a number of level crossings, the condition of the wait platform fails to meet the relevant RAMO[1] specifications. This often results in an unwillingness to stop at the level crossing.

Wait platforms that are in poor condition should be repaired to meet the RAMO specifications. [S1/05R/S217]

A road running to a level crossing should be raised to the same level with the railway line early enough to ensure appropriate sightline conditions and an adequate wait platform.

The regulations concerning the wait platforms are included in RAMO. However in practice, it is often a private road keeper who is responsible for their maintenance and who is not necessarily familiar with the RAMO specifications. The Finnish Rail Administration should ensure that the wait platforms are maintained and that the party responsible for the maintenance is familiar with the relevant regulations.

S218 Level crossing maintenance instructions

The regulations in Part 9, RAMO are not applied to old level crossings. Consequently it is not quite clear what regulations apply to the maintenance of level crossings.

Maintenance instructions should be drawn up for level crossings. [S1/05R/S218]

The instructions should specify the requirements set on, e.g. the sightlines, wait platforms, approach angles, level crossing traffic signs, speed limits and winter maintenance. This would allow the authority to demand the parties responsible for road maintenance and railway maintenance to ensure that the level crossing meets the applicable requirements.

S219 Restricting traffic at level crossings

At the moment it is not possible to restrict traffic on level crossings or prohibit the use of level crossing, e.g. for heavy-duty road vehicles, even in case of an extremely dangerous level crossing. For example, on the rail network there are level crossings with sight-

[1] RAMO = The Track Technological Rules and Regulations.

lines that are insufficient for a safe crossing of the level crossing by a combined transport vehicle. Nevertheless the use of the crossing cannot be prohibited.

The railway keeper and the safety authority should be allowed to restrict road vehicle traffic on level crossings. [S1/05R/S219]

A restriction could mean for example, that only the traffic control operator could give permission cross a dangerous level crossing.

S220 Research program on train horns

In many countries, the warning whistle given by a train is a key safety element. In some countries this is even mandatory and in some countries, it is customary to whistle at all level crossings. On the other hand, whistling generates noise nuisance. Furthermore no Finnish research data exists as for the audibility and conspicuousness of whistles.

A study should be conducted on the use of train horns at level crossings. [S1/05R/S220]

On the basis of the study, decisions should be made as for an eventual increase or decrease of the use of horns and whether the characteristics of horns may be developed so as to generate less noise nuisance and greater perceptibility.

S221 Importance of level crossings in route planning

If the advance route plan has been drawn up poorly or on an erroneous basis, leads this to unnecessary and dangerous crossings, especially for heavy vehicles.

Transport companies should take level crossings into account in route planning. Crossings should be minimised and directed through the safest crossing. [S1/05R/S221]

Crossings of railway should be minimised particularly in the route planning for post services, school transports, and dangerous goods transports, as well as for heavy-duty operations in general. The purchasers of transport services, for example municipalities, should take the route selection into account when processing tenders.

Both private and corporate motorists should strive to avoid level crossings in route planning. Educational campaigns and other communication channels could be used to encourage individual motorists to avoid dangerous level crossings and choose safe routes instead. Companies, too, can instruct their drivers to choose safe routes.

S222 Consideration of level crossings in planning

As the amount of building land continuously diminishes especially in big population centres, new areas are planned with only poor transport connections. A road may cross a railway in a place where the crossing was originally designed and built for only one house or one farming road. The planning of transport connections should be carefully carried out so as to ensure safe access to the area.

In planning, special attention should be paid to safe railway crossing, and building of new level crossings should be avoided. [S1/05R/S222]

Instead of level crossings, graded solutions should be adopted. In planning, existing level crossings should be removed by the design of safer replacement routes and by an interconnection of roads before a railway crossing.

This requires cooperation between the authorities and other parties involved.

Restatement of recommendations presented in earlier accident investigations

The safety study's observations with regard to rescue operation problems and delays in emergency notification support earlier recommendations that have not yet been implemented:

S143 Identification of level crossings

Level crossings should be equipped with signboards displaying at least the name of the level crossing and its location in the coordinates and relevant track-km. The signboard should be clearly visible in both running directions of the road. [B1/00R/S143]

The name and coordinates of the level crossing could be communicated to the emergency centre by anyone present at the site.

S211 Direct mobile phone connection from the accident site to the emergency centre

The instructions for the drawing up of an emergency notice should be developed to ensure that whenever urgent aid is needed from the rescue service, also the general emergency number is called from the accident site, in addition to the notifying of the traffic control unit. [B1/05R/S211]

A call to the emergency centre would help in determining the accident site because the Emergency Rescue Centre Administration's ELS information system can pinpoint the location of an emergency call while the mobile phone remains on.

S212 Transfer of track-kilometre information into the emergency centre information system

The compliance of the localization data used by the railway with the data system of the Emergency Response Centre Agencies shall be ensured, e.g. by installing the track-kilometre data in the data system of the Emergency Response Centre Agencies. [B1/05R/S212]

Although the information is already available, sufficient knowledge did not exist for its use in some of the accidents investigated.

Helsinki 11.2.2008

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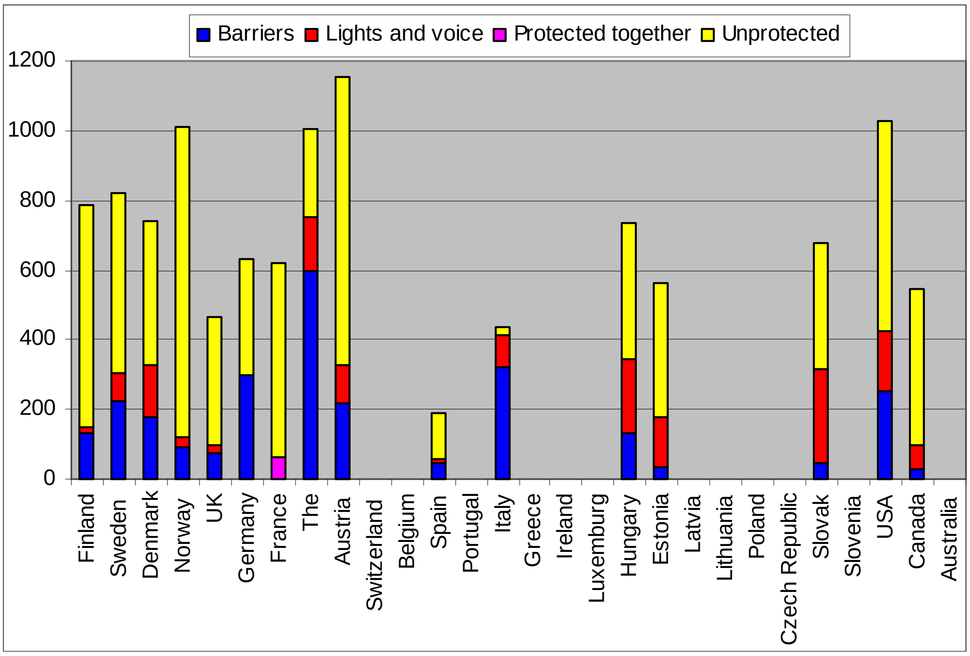
Basic railway facts 2004

Country	Track	Train traffic			Level crossings				
	[km]	[million train km]	[million person km]	[million ton km]	Protected			Unprotected	All together
					Barriers	Lights and voice	Together		
Finland	5 741	48,7	3 352	10 105	744	104	848	3 662	4 510
Sweden	9 895	126,4	5 544	13 122	2 230	769	2 999	5 103	8 102
Denmark	2 141	56,5	5 390	2 148	387	312	699	883	1 582
Norway	4 077	28,2	2 390	2 092	378	111	489	3 622	4 111
UK	16 514	492,6	42 626	20 700	1 241	382	1 623	6 051	7 674
Germany	34 728	1 002,5	70 286	77 640	10 296	114	11 450	11 440	22 880
France	29 246	521,7	74 014	45 121			1 865	16 294	18 159
The Netherlands	2 812	115,2	14 097	4 026	1 672	444	2 116	712	2 828
Austria	5 675	143,1	8 259	19 027	1 234	616	1 850	4 689	6 539
Switzerland	3 378	157,3	12 869	9 313					
Belgium	3 521	102,0	8 676	8 725					
Spain	14 395	175,8	20 137	14 117	625	210	835	1 869	2 348
Portugal	2 849	36,5	3 415	2 675					
Italy	16 235	331,2	46 768	21 581	5 184	1 540	6 724	322	7 016
Greece	2 449	17,6	1 668	588					
Ireland	1 919	15,1	1 582	399					1 550
Luxemburg	275	8,8	266	559					
Hungary	7 950	100,2	7 384	8 940	1 054	1 686	2 740	3 100	5 840
Estonia	959	8,9	192	9 567	31	142	173	367	540
Latvia	2 270	18,4	810	16 887					
Lithuania	1 782	14,3	443	11 637					
Poland	19 576	219,8	18 626	47 847					
Czech Republic	9 511	148,5	6 553	16 214					
Slovak Republic	3 660	46,8	2 227	9 675	162	998	1 160	1 319	2 479
Slovenia	1 229	19,9	764	3 462					
USA	233 730	920,3	8 869	2 427 268	58 468	40 496	98 964	140 660	239 624
Canada	75 135	132,9	1 369	298 100	2 227	5 166	7 393	33 786	41 179
Australia	54 652	38,2	1 347	41 314					

[1] Source: UIC railway statistics and ERA statistics (based on Eurostat) for 2004; Level Crossing Symposium 2006 presentation; accident investigation, railway authority or railway statistics from different countries.

[2] Level crossing figures include level crossings on private tracks. Source: Finnish Rail Administration Railway statistics 2006.

Level crossings per thousand track kilometres



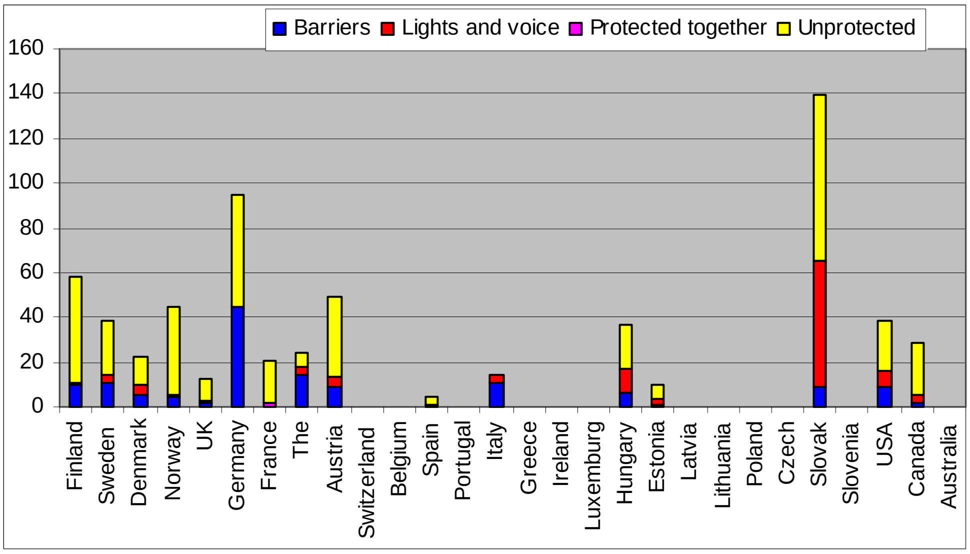
Appendix 1/2 (4)

Basic road system facts 2004

Country	Road network [km]	Road traffic [million person km]		million ton km]	Vehicles [thousand]			
		Cars	Busses		Cars	Lorries and vans	Busses	All together
Finland	78 168	60 940	7 605	28 230	2 347	355	11	2 713
Sweden	212 961	93 800	10 100	32 700	4 113	422	14	4 549
Denmark	71 847	59 900	9 000	10 500	1 916	332	14	2 262
Norway	91 916	49 400	4 100	14 500	1 934	438	32	2 404
UK	619 398	634 000	46 000	154 300	27 765	3 060	173	30 998
Germany	231 581	700 800	76 500	232 300	45 023	2 586	86	47 695
France	891 290	740 000	40 300	179 200	29 560	6 000	82	35 642
The Netherlands	116 500	144 200	7 200	33 900	6 992	684	11	7 687
Austria	133 718	69 800	13 400	12 400	4 109	346	9	4 464
Switzerland	71 220	85 300	3 400		3 811	292	18	4 121
Belgium	149 757	109 400	13 600	19 400	4 874	578	15	5 467
Spain	666 292	335 900	50 100	155 000	18 688	4 189	56	22 933
Portugal	72 600	94 700	9 900	17 400	5 788	334	18	6 140
Italy	479 688	711 700	97 500	158 200	33 706	3 639	87	37 432
Greece	114 607	86 600	22 400	20 500	3 840	1 131	27	4 998
Ireland	95 736	37 200	6 400	13 200	1 582	251	9	1 842
Luxemburg	5 201	5 300	900	500	293	23	1	317
Hungary	160 757	46 400	18 700	11 000	2 828	411	17	3 256
Estonia	52 981	10 000	2 300	1 500	471	86	5	562
Latvia	59 434	10 000	2 600	2 400	686	108	11	804
Lithuania	84 676	19 400	2 600	2 200	1 316	116	14	1 446
Poland	377 694	172 400	30 000	58 800	11 975	2 393	83	14 451
Czech Republic	127 747	68 600	9 400	16 000	3 706	396	20	4 122
Slovak Republic	17 773	25 200	7 800	5 400	1 337	152	9	1 498
Slovenia	38 400	15 500	1 100	23 000	911	66	2	980
USA	6 304 000	7 008 000	226 000	1 845 000	135 921	81 614	729	218 264
Canada	1 420 000				17 755	3 626	68	21 449
Australia	812 000				10 404	2 113	64	12 581

Sources: Liikennetilastollinen vuosikirja 2005 [Traffic statistics yearbook 2005]; EU Energy & Transport in Figures 2005; Bureau of Statistics publication Maailma numeroina, 20. Liikenne [The world in figures 20. Traffic].

Level crossings per thousand road kilometres

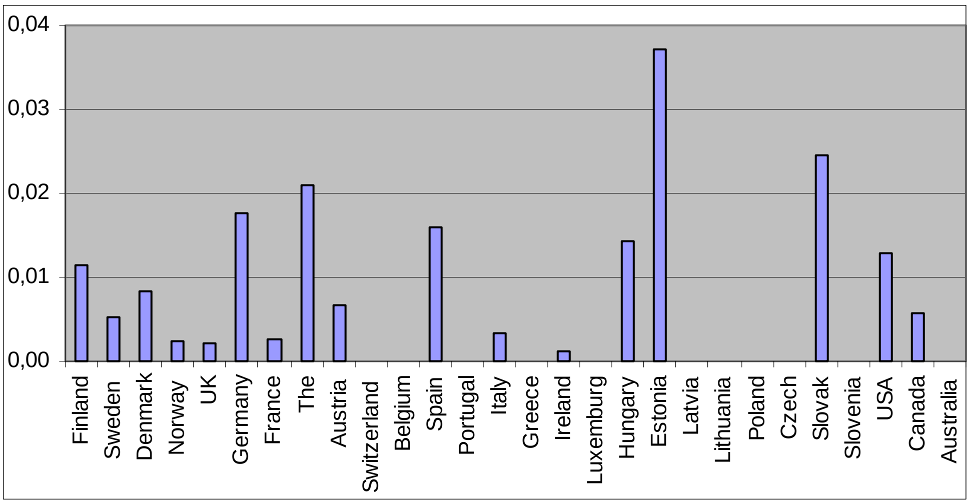


Accidents 2004

Country	Railway		Road accidents		Level crossing accidents					
	Total	Fatal	All with personal injury	Fatal	All together					Fatal
					Protected level crossings			Unprotected	Total	
					Barriers	Lights and voice	Total			
Finland	109	21	6 767	323	7	4	11	41	52	4
Sweden	117		17 254	420	16	12	28	14	42	11
Denmark	55	15	6 207	341	7	2	9	4	13	4
Norway	46	3	8 270		5	0	5	5	10	1
UK	1 306		214 194	3 114	3	9	12	4	16	3
Germany	1 172		339 310		107	91	198	205	403	
France	142		85 390	4 766					49	
The Netherlands	80	19	31 635	940	35	8	43	16	59	15
Austria	119		42 657	878					44	
Switzerland			23 840							
Belgium	150		43 708	1 001					20	8
Spain	162	110	94 009	3 643	9	4	13	12	38	24
Portugal	890		41 495	1 222					104	
Italy	144		224 557	5 082					24	
Greece	716		15 751	1 400					534	
Ireland	2		5 984	301					2	0
Luxemburg	0		769	52					0	0
Hungary	2 198	13	20 957	1 168	16	46	62	22	84	13
Estonia	38	21	2 244	170	0	9	9	11	20	6
Latvia	18		5 081						13	
Lithuania	99		6 357						11	
Poland	964		51 069						272	
Czech Republic	268		26 516		7	29	36	31	67	
Slovak Republic	514	10	8 443		6	27	33	28	61	7
Slovenia	49		12 721						5	1
USA	14 459	837			919	594	1 513	1 562	3 075	322
Canada	1 129	95	151 300	2 730	42	75	117	120	237	21
Australia									100	9

Sources: For EU countries: European Railway Agency statistics 2004 (Eurostat data) . For Norway, Germany, France, Austria and Spain: Finnish railway statistics. For U.S.: FRA statistics. For Germany: Level Crossing Symposium 2006 information. Road accidents statistics from CARE database. Other data from accident investigation, railway authority or railway statistics from different countries. The figures for railway accidents include level-crossing accidents.

Level crossing accidents in relation to total number of level crossings



Appendix 1/4 (4)

Railway and road accident fatalities 2004

Country	Railway accidents[1) 3)]	Road accidents[2)]	Level crossing accidents[4)]				
			Protected level crossings			Unprotected	Total[1)]
			Barriers	Lights and voice	Total		
Finland	24	375	0	0	0	7	7
Sweden	26	480					13
Denmark	16	369	4	0	0	0	4
Norway	3	257	1	0	0	0	1
UK	93	3 371	8	0	8	1	9
Germany	167	5 842	32	8	40	14	54
France	93	5 509					38
The Netherlands	19	804	9	3	12	3	15
Austria	47	878					18
Switzerland	9	510	1	1	2	9	11
Belgium	19	1 162					8
Spain	162	4 042	9	4	13	12	25
Portugal	101	1 546					26
Italy	59	5 625					17
Greece	32	1 605					13
Ireland	0	379					0
Luxemburg	0	62					0
Hungary	94	1 296	3	11	14	4	18
Estonia	20	170	0	2	2	4	6
Latvia	3	516					3
Lithuania	37	752					4
Poland	276	5 712					51
Czech Republic	232	1 382					57
Slovak Republic	10	603	1	2	3	7	12
Slovenia	12	274					1
USA	897	42 643	163	59	222	146	368
Canada	95	2 730	8	10	18	7	25
Australia	66	1 621			19	16	37

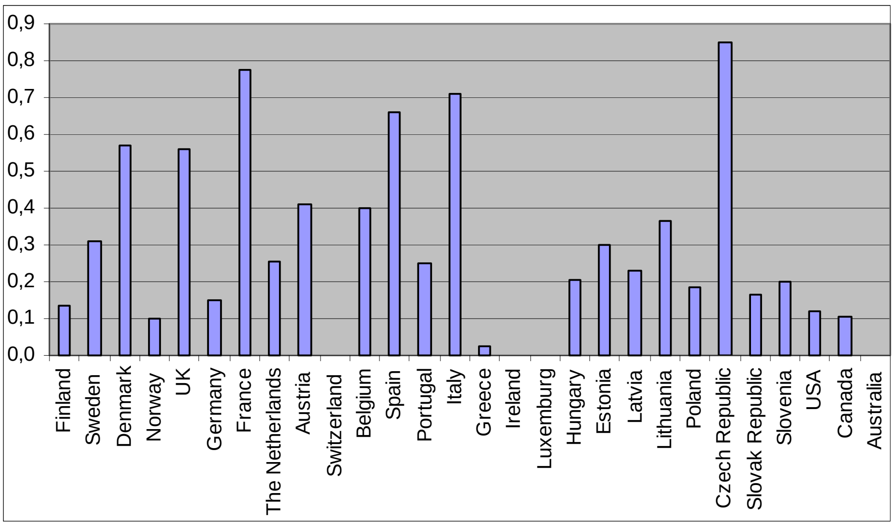
[1)] Source for EU countries: European Railway Agency 2004 (source Eurostat data).

[2)] Source: Liikennetilastollinen vuosikirja 2005 [Traffic statistics yearbook 2005] and CARE database. For Norway and Sweden: EU Energy and Transport in Figures 2005. For USA, Canada, New Zealand and Australia: Bureau of Statistics publication Maailma numeroina, 20. Liikenne [The world in figures 20. Traffic

[3)] The figures for railway accidents include level-crossing accidents. In the statistics for Finland, fatal level crossing accidents are also classified as road traffic accidents.

[4)] Level-crossing accident figures from accident investigation, railway authority or railway statistics from different countries.

Fatalities in relation to the total number of level crossing accidents



Information on level crossing accidents 2005

Time	Place	Fatali-ties	Injuries	Investigated by	Level crossing	Track	Road	Train	Vehi-cle
3.1.05	Loimaa	0	1		PP	PR	S/Y	M	ha
7.1.05	Kotka	0	0		Ei VL	SR	T	VY	ka
11.1.05	Kerava	1	0	VALT	PP	PR	KV	T	pp
11.1.05	Viinijärvi	1	0	VALT	Ei VL	PR	YT	M	ha
17.1.05	Äänekoski	0	0		Ei VL/S	PR	K	T	ha
20.1.05	Helsinki	0	0		VÄ	SR	K	VY	ha
21.1.05	Lahti	0	1		Ei VL	PR	YT	T	ha
21.1.05	Salla	0	2		Ei VL	PR	PT	T	ha
25.1.05	Tammisaari	0	1		Ei VL	PR	YT	T	ha
2.2.05	Helsinki	0	0		Ei VL	TR	T	VY	ha
14.2.05	Kotka	0	0		Ei VL	TR	T	VY	ka
2.3.05	Tornio	0	1		Ei VL	SR	K	VY	ha
4.3.05	Joensuu	0	0		Ei VL	RP	T	VY	ha
9.3.05	Kyrö	0	1		PP	PR	S/Y	M	ha
9.3.05	Kaskinen	0	0		Ei VL	PR	K	T	ha
10.3.05	Pori	0	0	OTK	Ei VL/S	SR	K	VY	ka
11.3.05	Alahärmä	0	0		PP	PR	YT	T	ha
14.3.05	Kurikka	1	0	?	Ei VL	PR	YT	T	he
20.3.05	Maavesi	0	0		Ei VL	PR	YT	M	ha
22.3.05	Nivala	0	1		Ei VL/S	PR	YT	T	ha
1.4.05	Oulu	1	2	VALT	Ei VL	TR	T	VY	tk
26.4.05	Kotka	0	0		Ei VL/S	TR	T	VY	ha
10.5.05	Kiukainen	0	0		Ei VL/S	PR	YT	T	ha
16.5.05	Tornio	0	0		Ei VL/S	TR	T	VY	ka
24.5.05	Helsinki	0	0		Ei VL	TR	T	VY	ka
31.5.05	Joutseno	0	0		Ei VL,S	SR	K	VY	ha
17.6.05	Kouvola	0	0		Ei VL	RP	T	VY	ha
23.6.05	Loviisa	0	1		VÄ	SR	YT	T	ha
30.6.05	Vierumäki	0	0		Ei VL/S	PR	S/Y	T	ha
9.7.05	Pello	0	0		Ei VL/S	PR	YT(v)	M	ha
12.7.05	Pori	0	1		Ei VL	SR	K	T	ka
14.7.05	Tornio	0	0		Ei VL	PR	K	M	ha
25.7.05	Hanko	0	0		Ei VL	TR	K	VY	ka
22.8.05	Turku	0	0		VÄ	PR	K	M	ka
23.8.05	Ilmajoki	0	2		Ei VL	PR	S/Y	RK	ha
24.8.05	Kajaani	0	0		Ei VL	SR	KV	VY	pp
1.9.05	Helsinki	0	1		Ei VL	TR	T	VY	tk
1.9.05	Kemi	0	0		Ei VL	TR	T	VY	tk
8.9.05	Orimattila	0	1		Ei VL	PR	YT(v)	T	ha
18.9.05	Huutokoski	0	0		Ei VL/S	PR	YT	M	tk
20.9.05	Varkaus	0	0		Ei VL	TR	T	VY	ka
23.9.05	Vilppula	0	0		Ei VL/S	TR	S/Y	VY	ha
27.9.05	Parikkala	0	0		Ei VL/S	PR	YT	T	ha
29.9.05	Kauhajoki	0	1		Ei VL/S	PR	YT	T	ha
23.10.05	Rauma	0	0		Ei VL	PR	YT	T	ha
2.11.05	Ylivieska	0	1		Ei VL/S	SR	K	VY	ha
8.11.05	Kuopio	0	0		Ei VL	TR	YT	VY	ha
9.11.05	Pyhäsalmi	0	0		Ei VL	RP	T	VY	ka
10.11.05	Kälviä	2	0	OTK, VALT	Ei VL	PR	S/Y	M	ka
11.11.05	Maanselkä	0	0		Ei VL/S	PR	S/Y	T	ha
15.11.05	Hamina	0	0		Ei VL/S	TR	T	VY	tk
17.11.05	Kauhajoki	0	1		Ei VL	PR	K	RK	ha

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17.11.05	Ylitornio	0	0		Ei VL	PR	YT	RK	ha
17.11.05	Ylivieska	0	0		Ei VL	SR	K	VY	ha
23.11.05	Helsinki	0	0		Ei VL	TR	T	VY	ha
1.12.05	Pori	0	0		EI VL	SR	K	VY	ha
9.12.05	Otalampi	0	1		Ei VL	PR	S/Y	T	ha
14.12.05	Pori	0	0		Ei VL	SR	K	VY	ha
16.12.05	Lohja	0	0		Ei VL/S	PR	YT	T	ka
20.12.05	Mänttä	0	0		VÄ	TR	K	VY	ha
23.12.05	Hamina	0	0		Ei VL	SR	T	VY	ka
26.12.05	Tornio	2	0	VALT	Ei VL	PR	YT(v)	M	(1)
27.12.05	Rauma	0	0		Ei VL	SR	T	VY	ka
29.12.05	Murtomäki	0	0		Ei VL	SR	YT	RK	ha
YHT.	**64**	8	20	VALT 5 OTK 2	PP 4 VÄ 4 Ei VL 56	PR 31 SR 15 RP 3 TR 15	PT 1 S/Y 8 K 16 YT 17 YT(v) 3 T 17 KV 2	T 20 M 10 VY 30 RK 4	ha 41 ka 14 la 0 tk 5 pp 2 (1) 1 he 1

Definition of table abbreviations:

Investigated by: VALT = Investigation commission of the Finnish Motor Insurers' Centre, OTK = Accident Investigation Board of Finland.

Level crossing: FB = full-barrier, HB = half-barrier, LS/W = light and sound warning, N/W = no warning equipment, N/WS = no warning equipment, STOP sign

Track: MT = main track, ST = side track, RY = rail yard, IP/T = industrial or port track

Road: MR = main road (highway or main road), M/C = municipal or community road, S = street, PR = private road, FR (v) = farming road, IP/R = industrial, port or rail yard path, LT = light traffic.

Train: PT = passenger train, FT = freight train, SU = shunting unit, TE = track equipment, EC = engine coach.

Vehicle: pc = passenger car or van, b = bus, t/av = lorry or articulated vehicle, wm = work machine or tractor, mc = motorcycle or scooter, b = bicycle, p = pedestrian, h = horse, (1) = dog team.

Fatal motor vehicle accidents in 1991–2004 investigated by VALT

Year	Fatal accidents			Fatalities		
	LA	**TA**	**LA%**	**LA**	**TA**	**LA%**
1991	16	350	4,6	20	410	4,9
1992	16	328	4,9	16	391	4,1
1993	7	266	2,6	8	320	2,5
1994	7	267	2,6	12	322	3,7
1995	7	247	2,8	8	279	2,9
1996	5	242	2,1	5	290	1,7
1997	10	255	3,9	13	302	4,3
1998	8	254	3,3	11	286	3,9
1999	8	261	3,1	10	302	3,3
2000	8	240	3,3	10	282	3,6
2001	7	270	2,6	12	316	3,8
2002	2	272	0,7	4	320	1,3
2003	5	260	1,9	6	295	2,0
2004	4	262	1,5	7	315	2,2
TO / ave	**110**	**3 774**	**2,9**	**142**	**4 430**	**3,2**

Abbreviations: LA = level crossing accidents, TA = traffic accidents (includes level crossing accidents), LA% = level crossing accident percentage, TO = total and ave = average.