APPENDIX 8. AUSTRIAN STATISTICAL STUDY OF 2005: COMPARATIVE ANALYSIS OF SAFETY IN TUNNELS, DURING 1999-2003 PERIOD

INTRODUCTION

The study deals with accidents occurring in Austrian tunnels between the years 1999 and 2003. The analysis includes 20 tunnels with bi-directional traffic on motorways and expressways and 24 selected tunnels on federal roads and furthermore 52 tunnels with 2 tubes and uni-directional traffic.

The project explores the traffic safety of road tunnels on motorways and expressways compared with safety on other types of roads, and also compares traffic safety in tunnels carrying bi-directional traffic (single-tube tunnels) with safety in tunnels with uni-directional traffic (twin-tube tunnels). A variety of relative rates (accident rate, casualty rate, accident cost rate, involvement rate and fatality rate) of bi-directional tunnels on motorways and expressways are compared with the corresponding rates of uni-directional motorway and expressway tunnels and relationships between relative rates and tunnel length or traffic intensity are shown.

SUMMARY

In Austria, an average of 88 accidents with personal injury occur in tunnels along motorways or expressways every year, leaving 13 persons dead, 24 severely injured, and 108 slightly injured. The annual macroeconomic cost of accidents is about EUR 13 million. This study explores how safe tunnel sections on motorways and expressways are compared with other types of roads and compares the traffic safety of (single-tube) tunnels with bi-directional traffic with that of (twin-tube) tunnels carrying uni-directional traffic. Moreover, accidents with personal injury are examined in detail considering various characteristics (point of origin, fault and cause), and conclusions about accidents with damage to property, breakdowns, and fires in tunnels are drawn.

SAFETY IN TUNNELS VERSUS SAFETY ON OTHER TYPES OF ROADS

The probability of an accident occurring in a tunnel or of being injured or killed in a tunnel is lower than on the open stretches of motorways, expressways and federal roads. However, if an accident does happen in a tunnel, the severity of injuries is significantly higher than on the open stretches of motorways. As a consequence, the accident cost rate is 52% higher than on the open stretches of motorways. In tunnels the risk of being killed in an accident is twice as high as on the open stretches of motorways.

Safety in tunnels with bi-directional versus uni-directional traffic While in tunnels with bi-directional traffic each accident produces an average of 2.1 casualties, this figure is significantly lower in tunnels with uni-directional traffic and on the open stretches of motorways at respectively 1.6 casualties per accident. In tunnels with bi-directional traffic accidents occur mainly in same-direction and opposing-direction traffic, whereas accidents in tunnels with uni-directional traffic are mainly same-direction and single-vehicle accidents. Nearly every second accident occurring in a tunnel is a same-direction accident (rear-end collisions or accidents while changing lanes) which is due to the failure to maintain a safe distance to the vehicle in front.

When comparing tunnels with bi-directional traffic on motorways and on federal roads we can see that the severity of injuries is significantly higher on motorways. The accident rate is approximately at the same level, but in tunnels on motorways the casualty rate is 17% higher than in tunnels on federal roads. It is significant that in tunnels with bi-directional traffic on motorways the casualty rate is twice as high and the fatality rate three times as high as the corresponding rates of tunnels on federal roads. This is mainly due to higher speeds and the break of the homogenous traffic flow caused by bi-directional tunnels on motorways.

Looking at all motorway and expressway accidents in the 130 tunnels studied, it is not possible to draw any clear conclusions about the safety of tunnels with bi-directional traffic versus those with uni-directional traffic as one major factor influencing accidents is tunnel length. In order to prevent an excessive impact of tunnel length on relative accident rates, tunnels of a length of more than one kilometre with bi-directional traffic and uni-directional traffic were analysed separately. The accident rates of bi-directional and uni-directional tunnels with a length of over one kilometre are approximately at the same level. However, traffic safety is significantly higher in tunnels with uni-directional traffic than in tunnels with bi-directional traffic. The probability of being killed in an accident is 19% higher in tunnels with bi-directional traffic than in tunnels with uni-directional traffic. In tunnels with bi-directional traffic the accident cost rate and the fatality rate are respectively twice and 2.3 times as high as the corresponding rates in tunnels with uni-directional traffic.

Looking at all accidents occurring in tunnels over the five-year period reviewed, it is significant that the severity of injuries has decreased significantly, whereas on the entirety of the motorway and expressway net a similar decrease is not identifiable. The relative accident rates have decreased especially in tunnels with

bi-directional traffic, which may be due not only to statistical variations but also to the measures taken following the disaster in the Tauern tunnel and the greater attention paid to tunnels with bi-directional traffic.

▶ SPECIAL ANALYSES OF SAFETY IN TUNNELS

Both in tunnels with bi-directional traffic and in tunnels with uni-directional traffic most accidents occur in the portal area. It is significant that in both types of tunnels the accident rate is higher in the area before the entrance and after the exit than in the interior zone of the tunnel.

In tunnels with bi-directional traffic rear-end collisions are the most frequent accident type in all areas excepting the portal area. In the area of the portals single-vehicle accidents are most frequent, whereas in the interior zone of the tunnel, besides rear-end collisions, mainly frontal collisions occur. In tunnels with uni-directional traffic most accidents occurring in the area before the entrance and after the exit as well as in the area of the portal are single-vehicle accidents, whereas in the area of the entrance and in the interior zone of the tunnel, the main cause of accidents is rear-end collisions.

Most of the accidents occurring in tunnels are caused by passenger cars. However, it is significant that the proportion of lorries being at fault in accidents is higher in tunnels with bi-directional traffic. On average, nearly every fifth accident occurring in a tunnel is caused by a lorry, while the corresponding proportion in tunnels with bi-directional traffic is 13.2 % lower.

Almost all single-vehicle accidents in tunnels are due to passenger cars speeding. In rear-end collisions, the proportion of lorry drivers being at fault (100%) is significantly higher, which means that the failure to maintain a safe distance to the vehicle in front is a major problem also as far as lorry drivers are concerned. What is significant is that the most frequent accident type caused by lorries is opposing-direction accidents. Particularly in tunnels with bi-directional traffic, this is because lorries occupy more space than other types of vehicles.

Generally, the most frequent cause of accidents in tunnels is a lack of vigilance (over-fatigue, distraction and inattentiveness). In second place is the failure to maintain a safe distance to the vehicle in front, inappropriate behaviour while overtaking and the failure to remain within the marked lane as well as misinterpretation of meteorological conditions and other vehicles. Particularly in tunnels with bi-directional traffic, poor vigilance represents by far the most important problem, whereas in tunnels with uni-directional traffic wrong driving behaviour plays an as important role as poor vigilance. Moreover, it must be

said that in tunnels with uni-directional traffic the number of accidents caused by speeding is significantly high.

Poor vigilance is a major problem, especially in the interior zone of the tunnel. This is particularly true in longer tunnels, where a lack of vigilance resulting from over-fatigue and inattentiveness may have a high impact. Most of the accidents occurring in the area of the portal are caused by speeding or by misinterpretation.

Single-vehicle accidents in tunnels are caused mainly by lacking vigilance and speeding, while the most frequent causes of rear-end collisions are, in equal proportions, wrong driving behaviour, misinterpretation and lacking vigilance. Wrong driving behaviour, followed by poor vigilance, is the most frequent cause of opposing-direction accidents.

▶ SPECIAL ANALYSES OF PROPERTY DAMAGE ACCIDENTS, BREAKDOWNS AND FIRES

The evaluation on property damage accidents, breakdowns and fires is based mainly on data derived from the control centres of the Tauern tunnel and the Katschbergtunnel.

Accidents as well as breakdowns and fires occurring in tunnels are caused mainly by passenger cars. What is striking is that the proportion of lorry drivers being at fault is significantly higher in accidents with damage to property, breakdowns and fires than in accidents with personal injury.

The most frequent cause of personal injury accidents is poor vigilance. Accidents with damage to property are caused mainly by wrong driving behaviour, while by far the most frequent cause of breakdowns and fires is technical defects.

The final report was produced by the Austrian Road Safety Board and is available from the Austrian Association Road and Transport under the website www.fsv.at/publikationen/strassenforschung.

APPENDIX 9. THE “FIT” DATABASE EXPERIENCE

▶ INTRODUCTION (EXTRACTS FROM FIT INTERNET SITE: HTTP://WWW.ETNFIT.NET/)

FIT is a European Thematic Network on Fire in Tunnels [7]. FIT provides a European platform for dissemination and information of up-to-date knowledge