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Summary

Traffic accidents on Norwegian road bridges 2010-2016

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During the years 2010-2016 there were 38 fatal crashes on or close to road bridges in Norway. Thirty-one accidents were judged to be related to characteristics of the bridge or of the road close to the bridge. Hitting the bridge guardrail, and sometimes driving through the guardrail, occurred in several crashes. In addition to the fatal crashes, there were 115 crashes with severe injury and 1280 with minor injury. Out of 7300 bridges over 10 metres long, personal injury crashes had occurred on 869 bridges. Crash risk is higher near the ends of the bridges and on the road close to the bridge than in the middle of the bridge. The total risk on bridges – including 50 metres before and after – is, however, somewhat lower than on the remaining road network. This is partly explained by the absence of intersections on and near most bridges. Another possible explanation, which should be investigated, is whether some drivers tend to reduce their speed when approaching a bridge. The share of crashes involving motorcycles or mopeds was twice as high on or near bridges as on other road sections. Several crashes might have been less severe if guardrails had been improved. Extended guardrails before bridges could have reduced the consequences of driving off the road on the approach to a bridge.

The main part of the project presented here, is an analysis of serious crashes on or near road bridges in Norway during the years 2010-2016. As a background for the analyses, we carried out a study of international research literature on road bridge crashes. The literature search revealed few studies addressing crash risk on bridges and its relationship with bridge characteristics. An issue pointed out in some studies was collisions with bridge guardrails. However, most studies were from outside Europe, and some research results may therefore have limited relevance to Norwegian road traffic. Further research on bridge crashes in Norway is therefore warranted.

Two different types of analysis were carried out. First, we analysed accident statistics of all personal injury crashes on or close to bridges. Second, for the fatal crashes we analysed reports from the crash investigation teams (UAG – "UlykkesAnalyse-Gruppe") of the Norwegian Public Roads Administration (NPRA). The UAGs carry out in-depth studies of every fatal road crash in Norway.

Analysis of injury crash statistics

Data for all road bridges in Norway longer than 10 metres were extracted from the bridge register BRUTUS of the NPRA. After filtering out irrelevant bridges and bridges without a road location reference, 7,298 bridges remained to be included in the analyses. Based on location data, for each bridge we defined a section from 50 metres before to 50 metres after the bridge. Data on all personal injury crashes during 2010-2016 were extracted from the NPRA crash database STRAKS. Using road location as matching key, we identified all crashes that had occurred on the mentioned road sections. We also identified whether the crash had occurred in the zone before or after the bridge, in the start or end zone of the bridge (up to 50 metres from each end), or in the middle zone.

There have been 38 fatal crashes on or close to road bridges. The crashes are distributed over 38 different bridges; i.e., no bridge had more than one fatal crash during the time period analysed. In addition, there were 115 crashes with serious injuries and 1280 crashes with minor injury.

Crash risk (crashes per million vehicle kilometres) is slightly lower on the bridge sections than on the remaining road network. Crash risk is higher in the transition zones at the ends of the bridge (including 50 metres before and after) than in the middle zone.

Out of the approximately 7300 bridges in total, 869 had one crash or more. Eight bridges had more than ten crashes.

The main determinant of the number of crashes is the amount of traffic; i.e., bridges that are long and/or have a high traffic volume, have most crashes.

The two most common types of bridges, beam bridges and slab bridges, have a slightly lower crash risk than other types of bridges.

Rear-end crashes and running off the road are the two most frequent crash types when including all severities. Rear-end crashes are particularly frequent in the middle zone on long bridges with high traffic volumes.

The lower risk on bridges compared to other roads may have different explanations. One possibility is that some drivers reduce their speeds when approaching a bridge. Another explanation may be that intersection crashes are almost absent on bridges, since very few bridges have intersections.

We find that bridges with pedestrian and bicycle facilities have higher odds for injury crashes than other bridges. This probably reflects that such bridges have a higher share of vulnerable road users. It is furthermore interesting that the odds for a crash increase with bridge width, but decrease with increasing speed limit. A possible explanation is that speeds are higher on wide bridges, at a given speed limit. In addition, higher speed limits are associated with higher road standard, rural areas, and a lower share of vulnerable road users, and consequently a lower crash risk. A possible relationship between bridge standard and crash risk is further indicated by increasing odds for injury crashes with age of the bridge.

Analysis of fatal crash reports

Seven out of the 38 fatal crashes were excluded from the analyses of crash reports since a preliminary review of UAG reports revealed that there was no likely association between bridge characteristics and the crash occurrence. Our judgement was that the reports from those crashes would have no added value for understanding crashes on bridges. Six out of those seven crashes occurred outside the bridge, and the seventh was a wrong-way driving crash (“ghost driver”). Thus, 31 crashes remained for which the reports were reviewed in detail.

Running off the road and head-on collisions are the two most frequent types of fatal crashes. Out of the 31 bridge-related fatal crashes, there were as much as 26 off-road or head-on crashes; i.e., almost nine out of ten. For a comparison, these crash types amounted to 38 % of crashes when including all severities. Vehicles with killed occupants included 18 cars, ten motorcycles, mopeds or ATVs, and three heavy vehicles.

The share of motorcycles, mopeds, and ATVs is twice as large for fatal bridge crashes as for fatal crashes on the remaining network. This is a finding that should be followed up by future studies. Motorcycle, moped, and ATV riders have little protection. Loss of control followed by impacts on guardrails, poles or noise-deflection walls have contributed to the outcome of most fatal crashes with a moped, motorcycle, or ATV.

Deficient guardrails have contributed to five out of eight off-road crashes with cars, whereas a missing guardrail was a factor in the remaining three crashes. Guardrails were either too weak, too low or had a too short end deviation.

There was no median barrier in any of the head-on crashes. Two car crashes involved vehicles on crossing paths.

Two heavy vehicles had run off the road before a bridge. In both cases the conventional guardrail was too weak to restrain the forces of a heavy vehicle.

Whereas most motorcycle and moped riders were killed by crashing into a barrier, frontal impacts were the most frequent fatal injury mechanism in car crashes. There were also some instances of roof compression after rolling over, and drowning after running into a river or lake.

Marked changes in road conditions or a lack of design consistency contributed to some crashes: Unexpected slippery road section (four crashes), changing curve radius or sharp curve (five crashes), and road narrowing before the bridge (three crashes). Hinge curls or bumps in the transition zone between a bridge and the adjacent road section have probably contributed to loss of control in two cases of two-wheeler crashes.

Six out of nine head-on crashes on bridges were probably unrelated to bridge characteristics.