Effects on road safety of new urban arterial roads

Astrid H. Amundsen, Rune Elvik

Institute of Transport Economics, P.O. Box 6110, Etterstad, N-0602 Oslo, Norway

Received 25 February 2002; received in revised form 15 October 2002; accepted 30 October 2002

Abstract

This paper presents an evaluation of the effects on road safety of new urban arterial roads in Oslo, Norway, and a synthesis of evidence from similar studies that have evaluated the safety effects of new urban arterial roads in other cities. A before-and-after study was made of four urban arterial road projects in Oslo. The study controlled for general accident trends in Oslo and for regression-to-the-mean. A statistically non-significant reduction of 9% in the number of injury accidents was found for all four projects combined. The effects on safety of new urban arterial roads were found to vary, depending on whether a new arterial road was built, or an existing arterial road upgraded by means of lane additions and reconstruction of junctions to interchanges. New arterial roads tend to induce more traffic, which tends to offset the benefits of a lower accident rate on the new roads. The results for other cities are very consistent with those for Oslo. For a total of seven cases in which new arterial roads were built, a statistically non-significant reduction of 1% in the number of injury accidents was found. Two cases that involved lane additions and converting at-grade junctions to interchanges resulted in a mean accident reduction of 51%, which was highly significant. On the average, the nine arterial road projects from which evidence was summarised resulted in a net induced traffic of 16%, and a net reduction in accident rate (accidents per million vehicle kilometres) of 18%. These effects almost cancel each other, leading to a very small net change in the expected number of accidents.

© 2003 Elsevier Science Ltd. All rights reserved.

Keywords: Arterial road; Urban area; Oslo; Safety effects; Evaluation

1. Introduction

Traffic congestion is a problem in many major cities. Norwegian cities, although comparatively small by international standards, are no exception to this rule. During the last 15 years, major road construction projects have been carried out in the Norwegian cities of Oslo (population 500,000), Bergen (population 230,000), and Trondheim (population 150,000). The main objective of these projects has been to reduce traffic congestion by expanding road capacity. Another objective has been to improve road safety, by providing new urban freeways built according to high design standards.

This paper presents an evaluation of the effects on road safety of four new urban arterial roads in the city of Oslo. In addition, the results of other studies that have evaluated the effects on road safety of new urban arterial roads are summarised.

2. New urban arterial roads in Oslo

The four new urban arterial roads in Oslo whose effects on road safety have been evaluated are:

1. the Festning tunnel;
2. the Granfoss tunnel;
3. upgrading of Store Ringveg between Sinsen and Storo;
4. the Ekeberg tunnel.

The Festning tunnel was opened in 1990. It is a dual tunnel built under the central business district of Oslo, designed as a six-lane urban freeway. The length of the tunnel and the adjacent roads is 3.3 km. Annual average daily traffic (AADT) in 1998 was about 87,000. The old arterial road consisted of a pair of one-way city streets with mixed traffic and many signalised junctions. Length is 4.1 km and AADT in 1998 was about 23,000. The old main road system consisted of a pair of two-lane roads, passing
mostly through residential areas, and having a number of
signalised junctions.

Store Ringveg between Sinsen and Storo was opened in
1994. This project consisted of constructing two new inter-
changes, widening the road from four to six lanes, and mov-
ing a tramline from the road to a separate track alongside it.
The interchanges replaced a major signalised junction and a
congested roundabout. The length of the upgraded section
is about 2.3 km. AADT in 1998 was about 46,000. The road
remained open to traffic during the period in which it was
being upgraded.

The Ekeberg tunnel was opened in 1995. It is a six-lane
dual road tunnel of freeway standard. The length is about
2 km. The previous main road was a narrow four-lane road,
passing close to a residential area and having a major sig-
nalised junction. AADT in the tunnel was about 75,000 in
1998.

Speed limits on the new urban arterial roads is 70 or
80 km/h. The most common speed limit on the old main
roads was 50 km/h. The new arterial roads do not have ac-
cess roads to abutting properties, nor do these roads have any
at-grade junctions. By contrast, the old main roads had nu-
merous minor access roads, as well as a number of signalised
junctions serving fairly large traffic volumes (generally in
the range of 25,000–30,000 entering vehicles per day).

3. Sources of data and design of evaluation study

3.1. Sources of data

Accident data were obtained from statistics kept by high-
way authorities in the city of Oslo. These statistics are con-
fined to injury accidents. Property-damage-only accidents
are not reported in official road accident statistics in Nor-
way. Detailed accident records going back at least 15 years
are available for main roads only. For secondary roads, only
summary accident data are available.

In addition to accident data, data on traffic volume were
collected. These data were mostly based on counts made
by highway authorities. Data on traffic volume were incom-
plete, and estimates had to be made for some years. Details
on these estimates are given in the main report (Amundsen
and Elvik, 2002).

3.2. Design of evaluation study

The effects on road safety of the new arterial roads were
evaluated by means of a before-and-after study (Hauer,
1997). The city of Oslo was used as a comparison group. A
separate evaluation was made of the effects of each of the
four new arterial roads. Results were then combined into an
overall estimate of the effect of all four projects by means
of the log odds technique of meta-analysis (Fleiss, 1981;
Shadish and Haddock, 1994).

The before-and-after periods covered different years for
each project. In general, 4 years of before data and 4 years
of after data were used. Table 1 gives a summary of data for
each project.

The count of accidents each year for each project was in
the range of 10–40. This means that year-to-year changes in
the number of accidents were strongly influenced by random
fluctuations. In view of this fact, the evaluation was based
on the total number of accidents for all years before and
all years after. The years during which construction was in
progress were omitted from the study.

<table>
<thead>
<tr>
<th>Project</th>
<th>Years</th>
<th>Road or area</th>
<th>Number of injury accidents</th>
<th>Million vehicle kilometres of travel</th>
<th>Accident rate (accidents/ million vehicle km)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before After</td>
<td></td>
<td>Before After</td>
<td>Before After</td>
<td></td>
</tr>
<tr>
<td>Festning tunnel</td>
<td>1986–1989</td>
<td>Old</td>
<td>117 14</td>
<td>107.10 52.95</td>
<td>0.39 0.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New</td>
<td>125</td>
<td>371.95</td>
<td>0.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>117 139</td>
<td>297.10 424.90</td>
<td>0.39 0.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rest of Oslo</td>
<td>4441 4443</td>
<td>11,344.20 11,570.30</td>
<td>0.39 0.38</td>
</tr>
<tr>
<td>Granfoss tunnel</td>
<td>1986–1989</td>
<td>Old</td>
<td>73 29</td>
<td>198.01 81.76</td>
<td>0.37 0.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New</td>
<td>34</td>
<td>127.65</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>73 63</td>
<td>198.01 209.41</td>
<td>0.37 0.38</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rest of Oslo</td>
<td>4485 4414</td>
<td>11,443.30 11,414.59</td>
<td>0.39 0.39</td>
</tr>
<tr>
<td>Sinsen-Storo</td>
<td>1988–1991</td>
<td>Old</td>
<td>70 35</td>
<td>118.37 147.00</td>
<td>0.59 0.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N.A.</td>
<td>N.A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>70 35</td>
<td>118.37 147.00</td>
<td>0.59 0.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rest of Oslo</td>
<td>4418 4547</td>
<td>11,406.43 11,848.20</td>
<td>0.39 0.38</td>
</tr>
<tr>
<td>Ekeberg tunnel</td>
<td>1991–1994</td>
<td>Old</td>
<td>40 11</td>
<td>159.58 13.72</td>
<td>0.25 0.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New</td>
<td>28</td>
<td>190.75</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>40 39</td>
<td>159.58 204.47</td>
<td>0.25 0.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rest of Oslo</td>
<td>4392 4582</td>
<td>10,799.62 12,076.53</td>
<td>0.41 0.38</td>
</tr>
</tbody>
</table>
دریافت فوری
متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات