Increase width of clear-zone

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Please note: The studies included in this synopsis were selected from those identified by a systematic literature search of specific databases (see supporting document). The main criterion for inclusion of studies in this synopsis and the DSS was that each study provides *a quantitative effect estimate,* preferably on the number or severity of crashes or otherwise on road user behaviour that is known to be related to the occurrence or severity of a crash. Therefore, key studies providing qualitative information might not be included in this synopsis.

1 Summary

Usami, D.S., June 2017

1.1 COLOUR CODE: LIGHT GREEN.

According to studies on the effect of increasing the width of a clear zone on road safety it seems that increasing the clear zone width (i.e. by increasing the distance to fixed roadside obstacles) reduces the crash frequency. However, these results are based on only two studies.

1.2 KEYWORDS

Clear zone, Safety zone, clear zone width, remove obstacles, distance to fixed obstacles, roadside treatment, horizontal clearance.

1.3 ABSTRACT

The roadside clear zone is the distance from the edge of the travel lane which should be free of any non-traversable hazard such as steep slopes or fixed roadside objects. Increasing such distance might help the drivers to recover their vehicle in case of running off the road and improve visibility conditions. An increase of the width of a clear zone from around 1 metre to around 5 metres seems to decrease crash occurrence by 22%. Increasing the width from around 5 metres to around 9 metres has been found to reduce crashes by 44%. The results derived from a meta-analysis based only on two studies. Moreover, it is unknown whether the results also include the effects of other associated improvements such as improved sight conditions along the road. No details are available on whether these results apply to urban or rural areas.

1.4 BACKGROUND

1.4.1 What is meant by increase the width of clear-zone?

A clear zone is the unobstructed, traversable area provided beyond the edge of the road through a travelled way for the recovery of errant vehicles. Increasing the width of a clear zone means to increase the distance to fixed obstacles along the roadside.

According to the USA roadside design manual, the clear zone includes shoulders and bike lanes, and auxiliary lanes, except those auxiliary lanes that function like through lanes (AASHTO, 2011). Some road design guidelines distinguish two areas of the clear zone: the recovery zone and the limited severity zone (see Figure 1) (La Torre et al., 2013). The recovery zone is commonly defined as a hard or soft shoulder lane located immediately beyond the carriageway edge line. It enables drivers to perform easy recovery manoeuvres. The limited severity zone is the area beyond the recovery zone whose primary role is to minimise the severity of the accident in the event of a run-off road.

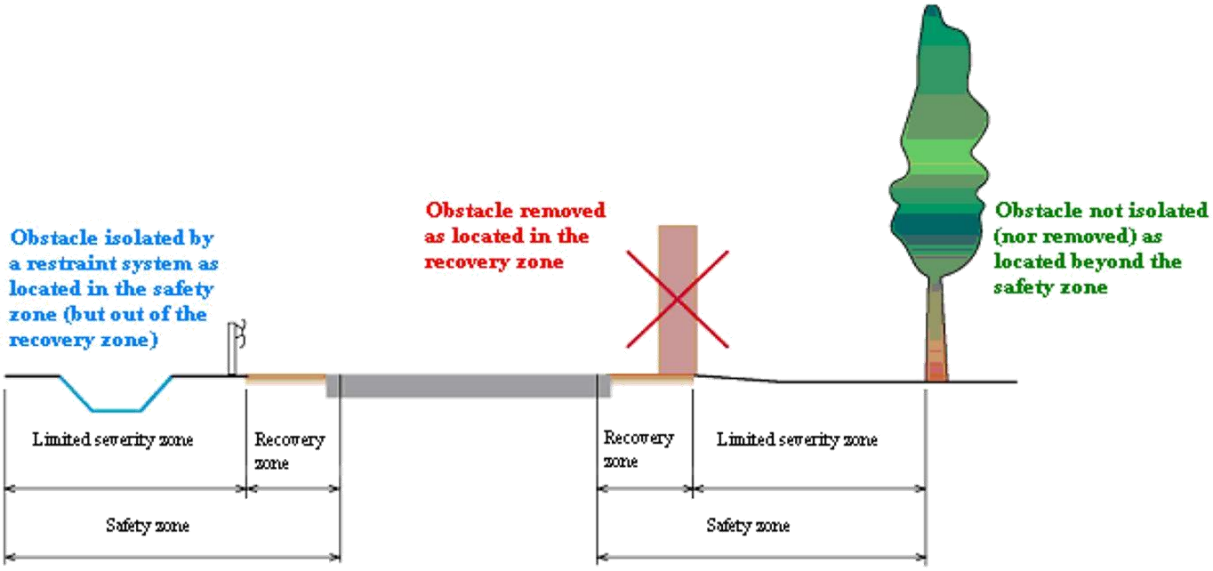

Figure 1: Clear zone specification (Patte et al., 2002 in La Torre et al. 2013)

1.4.2 How does increasing the width of clear-zone affect road safety?

The rationale behind clear zones is to maintain an area by the side of the road free of obstacles so that errant motor vehicles are able to manoeuvre, or at least decrease their speed safely, in case they depart from their travelled lane. In addition, increasing the width of clear-zone would provide more visibility for vehicles and side space for snow removal.

1.4.3 Which safety outcomes are affected by increasing the width of clear-zone?

In the international literature, the effect on road safety of widening a clear zone has been measured using the crash frequency. Run-off-road accidents are mostly affected by increasing the width of clear zone.

1.4.4 How is the effect of increasing the width of clear-zone studied?

International literature indicated that the effect of increasing a clear zone width is commonly evaluated by before-after studies. Some studies (not reported in this synopsis) also used simulation.

1.4.5 Which factors of increasing the width of a clear zone influence road safety?

The width of a clear zone along the horizontal alignment is dependent on roadside geometry, design speed, radius of horizontal curve, and traffic volume. Higher speeds mean vehicles will travel farther before recovering. Horizontal curvature increases the likelihood of a vehicle leaving the highway and increases the distance it will travel off the highway, as will steeper fill slopes. In general, hazards within the clear zone which cannot be removed, relocated, or made to breakaway on impact, will warrant a guardrail.

1.5 OVERVIEW RESULTS

1.5.1 Main results

According to results, the effect of an increase in the clear zone width show a positive effect on road safety. As presented in Elvik's meta-analysis from 2009, the number of crashes reduced. Results indicate, that increasing clear zone width from around 1 metre to around 5 metres significantly reduces the number of accidents by 22% or by 44% from around 5 metres to around 9 metres.

1.5.2 Transferability

The results derived from a meta-analysis based on only two studies from the USA, the topic does not seem to have been studied to a sufficient extent at international level.

1.6 NOTES ON ANALYSIS METHODS

The synopsis is mainly based on a meta-analysis study, itself based on only two studies. The studies included in the meta-analysis are from the US. The included studies have compared the road situation with/without obstacles thus increasing the clear zone width. The results may be affected by regression to the mean phenomenon.

2 Scientific overview

2.1 LITERATURE REVIEW

2.1.1 Analysis of study designs and methods

According to the literature search results it seems that there is a lack of research on creating/increasing width of a clear zone. Results are based on a fixed effects meta-analysis carried out in 2009. Only two studies were considered in the meta-analysis by Elvik, 2009, both carried out in the United States. The included studies have compared the number of crashes for various clear zone width.

It is unknown whether the results show the effect of increased distances to roadside obstacles alone or if they also include the effects of other improvements such as improved sight conditions along the road. Results may be affected by regression to the mean.

Table 1 illustrates an overview of the main aspects of coded study (sample, method and outcome).

Table 1 Description of coded studies

Author(s), Year , Country	**Sample and study design**	**Method of analysis**	**Outcome indicator**	**Additional information on analysis**
Elvik, R., 2009, Norway	Meta-analysis including 2 studies based on a before-after.	Fixed effects meta-analysis	Number of crashes	The meta-analysis includes only two studies from USA

2.1.2 Study results

Based on the meta-analysis study, an increase in the clear zone width at two way roads has a positive significant effect on road safety.

More specifically, results from the meta-analysis indicate that increasing clear zone width from around 1 metre to around 5 metres significantly reduces the number of crashes by 22%. Furthermore, increasing clear zone width from around 5 metres to around 9 metres significantly reduces the number of crashes by 44%.

2.1.3 Description of analysis carried out

Review-type analysis

Considering the availability of only a meta-analysis study a review-type analysis was feasible.

The meta-analysis results indicate that increasing the clear zone width at two-way roads from 1 to 5 metres and from 5 to 9 metres has a significant positive effect on road safety.

However, the meta-analysis included only 2 studies from the USA and it is unclear to what degree the results may be affected by regression to the mean. Hence, a light green colour code was assigned.

2.2 CONCLUSION

The roadside clear zone is the distance from the edge of the travel lane which should be free of any non-traversable hazard such as steep slopes or fixed objects.

The meta-analysis study indicated that the increase of clear zone widths is associated with a statistically significant reduction in crash occurrence.

3 Supporting document

3.1 METHODOLOGY

3.1.1 Literature Search strategy

The literature search was conducted in January- 2017. The search strategy aimed at identifying the best quality and most recent studies to estimate the effectiveness of not only increasing clear zone width but also creating a clear zone and removing any obstacles from the roadsides. During the screening phase the search focused on treatments to increase width of a clear zone.

A meta-analysis carried out in 2009 is available in The Handbook of Road Safety Measures (Elvik et al., 2009). As this meta-analysis is available, only recent journal studies (after 2000) in the field of Engineering and Social science were considered from "Scopus" And "TRID" database. No "grey" literature was evaluated.

Search terms used to identify relevant papers included, but were not limited to: "clear zone", "safety zone", "horizontal clearance", "lateral offset". Detailed search terms, as well as their linkage with logical operators and combined queries are shown in Tables 2 and 3. A total of 106 pieces of potentially eligible studies were identified (Table 4). After a preliminary abstract screening text, no studies were found to be eligible to the topic (Table 5).

Table 2 Literature search strategy **(Scopus database) - Date:** 3rd January 2017

search no.	search terms / operators / combined queries	hits
#1	ALL (("clear zone*" OR "horizontal clearance" OR "lateral offset" OR "relocat* fixed" OR "safety zone") AND ("casualt*" OR "fatalit*" OR "accident*" OR "crash*" OR "collision*" OR "injur*") AND ("effect*" OR "evaluation" OR "impact*") AND ("before" AND "after")) AND DOCTYPE (ar OR re) AND PUBYEAR > 2000 AND SRCTYPE (j) AND LANGUAGE (english) AND SUBJAREA (engi OR soci)	8

Table 3 Literature search strategy **(TRID database)**- **Date:** 3rd January 2017

search no.	search terms / operators / combined queries	hits
#1	Keywords ("clear zone*" OR "horizontal clearance" OR "lateral offset" OR "relocat* fixed" OR "safety zone" AND ("effect" OR "evaluation")) in: Safety and Human Factors, Transportation (General)	98

*Results limited to studies published from 2005

Table 4 Results Literature Search

Database	Hits
Scopus (remaining papers after several limitations/exclusions)	8
TRID	98
Total number of studies to screen title/ abstract	**106**

Table 5 Screening results

Total number of studies to screen title/ abstract	106
-De-duplication	0
-exclusion criteria A (part of a meta-analysis)	0
-exclusion criteria B (no measure)	100
-exclusion criteria C (effect on behavior / no sound evaluation)	6
Remaining studies	0
Not clear (full-text is needed)	-
Eligible papers	**0**

3.1.2 Exploratory analysis of results

Table 6 presents information on the main outcomes of coded studies on increase clear zone width.

Table 6 Main outcomes of coded studies for increase clear zone width,

Author, Year, Country	**Exposure variable**	**Outcome variable / Outcome type**	**Effects * Confidence interval**		**Main outcome - description**
Elvik, R., 2009, Norway	Increasing the distance to fixed obstacles from 1 to 5 metres at two way roads	Crash numbers	(↘)	-22 (-24,-20)	Significant positive effect on road safety
	Increasing the distance to fixed obstacles from 5 to 9 metres at two way roads	Crash numbers	(↘)	-44 (-46,-43)	Significant positive effect on road safety

*Significant effects on road safety are coded as: positive (↘), negative (↗) or non-significant ( )

3.2 LIST OF STUDIES

3.2.1 Meta-analyses

Elvik, R., Hoya, A., Vaa, T., Sorensen, M. (2009) The Handbook of Road Safety Measures. 2nd Revised edition, Emerald.

The list of studies included in the meta-analysis:

Cirillo, J. A. (1967). Interstate System Accident Research - Study II. Federal Highway Administration. http://www.tfhrc.gov/pubrds/pubrds.htm.

Zegeer, Charles V., Reinfurt, Donald W., Hunter, William W., Hummer, Joseph., Stewart, Richard., Herf, Lynne. (1988). Accident Effects of Sideslope and Other Roadside Features on Two-Lane Roads. Transportation Research Record. Issue Number: 1195.

3.2.2 References on further background information

American Association of State Highway and Transportation Officials (AASHTO). (2011). Roadside Design Guide. 4th Edition, Washington, D.C.

L. Patte et al. Handling lateral obstacles on main roads in open country. Sétra Guidelines. November 2002

La Torre F. (2013). Forgiving roadsides design guide. Conference of European Directors of Roads (CEDR).