

DOKUMENTATION OF ROAD SAFETY DEFICITS

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ABSTRACT

While road safety audits for interurban roads are extensively implemented in Germany and in many other countries there is a lack of knowledge concerning the needs for training urban road auditors and the safety deficits of urban roads. Therefore audits were analysed which were made at the first training to the Road Safety Auditor for urban roads and cross-town links at the University of Wuppertal. The audits were evaluated with regard to the frequency of ascertained safety deficiencies in the planning. In 25 planning altogether 625 deficiencies have been found. 65 % of the safety deficiencies are violations of the road guidelines. Serious consequences could not be excluded at 54 % of the deficiencies. Urban planning is worthy to be improved and in principle should come under scrutiny of a safety audit.

1. INTRODUCTION

With the "Empfehlungen für das Sicherheitsaudit von Straßen (ESAS)" (recommendations for the road safety audit) [1] published by the FGSV (research company for streets and transport in Germany) the road safety audit was also introduced in Germany. The Federal Ministry of transport, building and urban affairs recommends with the "Allgemeines Rundschreiben Straßenbau Nr. 18/2002" (general circular road construction no. 18/2002) [2] to use at all planning of federal roads (Bundesautobahnen und Bundesstraßen) the ESAS.

Therefore in the administrations of the federal states, which are responsible for the federal roads, the audits of interurban roads were extensively implemented. The application of the ESAS for urban roads is voluntary. For this reason audits for urban roads are not established all over the municipal level yet.

The systematic determination of road safety deficits in planning shall contribute as a component of a quality management to design roads as safe as possible. The application of the ESAS can reduce accident blackspots and costs for the redesigning of roads. The road safety auditor is an equivalent to the inspecting structural engineer, how it is known in the constructive engineering in Germany.

The road safety audit is standardized into the ESAS. It is a systematic, checkable procedure. For a measure altogether four audit reports have to be prepared at different project stages:

- (AP1) Preliminary design
- (AP2) Detailed design
- (AP3) Execution design
- (AP4) Pre- and after opening the road.

The plans to be checked have to be submitted of the customer to the auditor. Then the independent check of the documents follows on the part of the road safety auditor. After that a walk-through is necessary to judge the safety deficits which were found in the plan. The deficits must be written in a report. The audit report contents project information, background information, finding deficits and if necessary recommendations. The customer

should comment every single deficit in writing and judge whether the recommendations of the road safety audit should be implemented or, where it is decided otherwise, to give reasons for the decision. After that the audit phase is completed.

Road safety auditors must attain an additional qualification besides a basic qualification [1]. The additional qualification can be a specialised training course to become a road safety auditor. Since 2002 the first road safety auditors are trained for interurban roads at the Bauhaus University of Weimar. The contents of the training course are tailored especially to the rural roads and cross-town links.

In the context of the research project “Qualifizierung von Mitarbeitern kommunaler Straßenbauverwaltungen zu Auditoren für das Sicherheitsaudit für Innerortsstraßen” (Training of municipal employees to road safety auditors of urban roads and cross-town links) [3] the Institute for Road Traffic Planning and Engineering of the University of Wuppertal concepts and develops contents for the training of the auditors for urban roads and cross-town links. It was supported by BSV Consulting for Urban and Transport Planning in Aachen and the German Insurance Association GDV. A curriculum was developed that takes into account especially the interests of the safety audit of urban roads. Another purpose of the training was that audits should be announced in the municipal administrations.

The prospective Road Safety Auditors for urban roads are trained in the context of a coordinated curriculum [9, 10] which contains the following 5 modules (Table 1):

1. Road safety (general)
2. Road safety audit (general)
3. Cross-town links
4. Main roads and
5. Side roads

Module	Road safety (general)	Road safety audit (general)	Cross-town links	Main roads	Side roads
Topic	Meaning of the road safety for planning and design or in sets of rules	Bases of road safety audits	Introduction	Introduction	Introduction
	Bases of the road safety work	Execution of road safety audits	Safety design of cross-town links	Road safety aspects of main roads and influence factors	Road safety aspects of side roads and influence factors
	Blackspots and road safety deficits		Road safety aspects of cross-town links and influence factors	walk-through and audit of stock main road	Safety design of side roads
	Accident analysis		walk-through and audit of stock cross-town links	Safety design of main road sections	
			Homework audit report of a cross-town link	Safety design of main road junctions	
				Safety aspects in execution designs	

				considerations of people re-stricted in mobility	
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Table 1: Overview of the Curriculum Road Safety Auditor for urban roads, Draft MAZS 2007 [10]

Lectures and exercises are coupled in the respective parts. The participants are trained on recognizing and judging safety deficits in planning. They have to learn to find deficits from the view of all road users. With the aid of home exercises, the auditors have to prove there ability to formulate audit reports. Until 2006 almost 73 auditors for urban roads have been trained (Picture 1).



Picture 1: Trained Road Safety auditors in Germany, 2006

Up to now auditors did not have to take any examination at the end of the education. This shall change in future, so that only auditors that have taken part in several topic blocks of the education – and have taken an examination – will be certified. The certificate is valid for 3 years and is limited for urban roads. It will be extended after 3 years if auditors can prove audit practice and participate regularly in symposia about road safety audits.

At the moment, the road safety audit of urban roads in Germany is situated in the phase of implementation. Considerations to couple audits to subsidies have taken place, but this could not be realized yet. So now it is important to do propaganda work in communes. Therefore, evaluating and showing road safety deficits in planning can contribute that communes realise the necessity of road safety audits of urban roads.

2. ROAD SAFETY DEFICITS IN PLANNINGS OF URBAN ROADS

In the context of the research project “Training municipal employees to road safety auditors of urban roads and cross-town links” [3] three two-day trainings in four groups have taken place. A final workshop (one-day) ended the event. 60 municipal employees have been qualified from all of Germany to road safety auditors for urban roads and cross-town links. At the beginning of the training some urban road planning were called in from the participants. These became an audit during the trainings and in house exercises. Altogether, there are 11 audits of side roads as well as 14 audits of main roads. 20 audits are of detailed planning (AP2) and five of execution planning (AP3).

Several safety deficits were uncovered in all planning. All audits were evaluated and processed that frequent safety deficits of urban roads planning could be derived.

It has to be said that the drawn examples became audit in different intensity. On the one hand, they have very intensively been looked at in house exercises. On the other hand only audit-notes were analysed by exercises during the trainings. 10 house exercises have intensively been processed, audited and discussed. After that the lecturers corrected the house exercises. For every house exercise was written one “sample audit report” by the lecturers. This was consulted for the evaluation. The "sample audit report" can be considered as full audits.

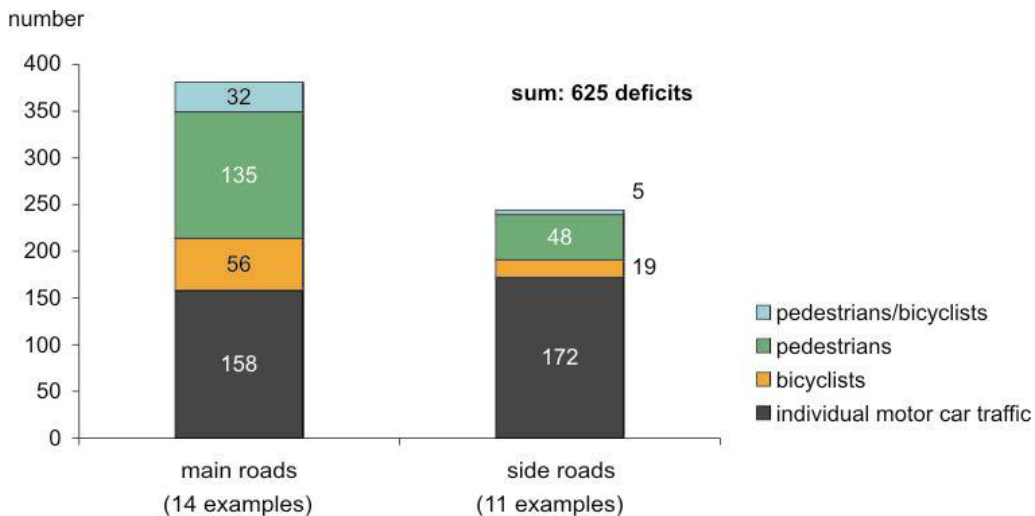
15 examples have been audited within the education with only less expenditure of time. They have been discussed in the 4 educations and edited with the cooperation of the instructors. That is why they are good in respect of content.

At the following results it has to be considered that the examples in parts have been examined regarding specific problems (such as safety deficits in traffic signing).

To make a statement on the frequency of singular safety deficits, the deficits have been categorised with the help of groups of deficits (design and operation criteria, etc.), sub-groups of deficits (pedestrians, bicyclists, motorized private transport, etc.) and the character of the breach of the rules (grave violation of road guidelines, minor violation, etc.).

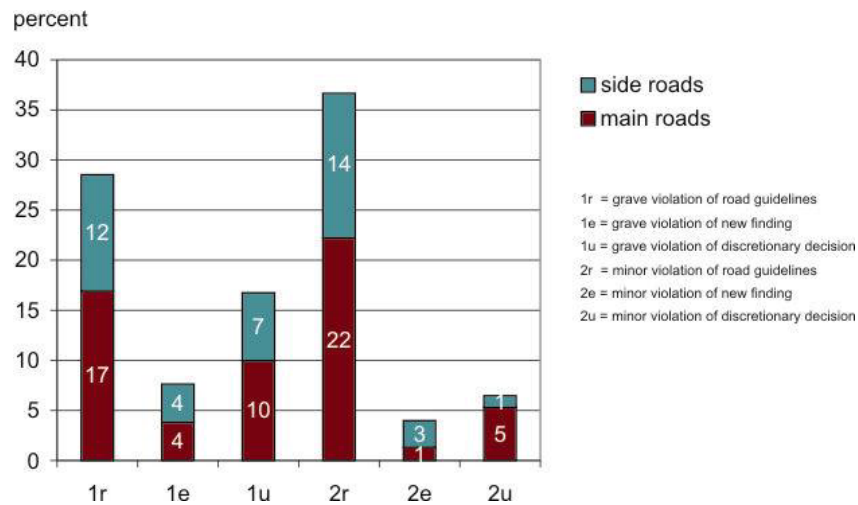
The analysis of the safety deficits of all audit stages added up to a total of 625 analysed deficits an average of 25 deficits per example. Per homework have been found on the average of 40 deficits, per audited example 15 what can be constituted by the more comprehensive design documents of the homework that have been audited more intensely.

Picture 2 shows the safety deficits ordered by main roads and side roads and the particular subgroups of deficits. Safety deficits for pedestrians and bicyclists accumulate at main roads compared to side roads.



Picture 2: Deficits for all audit phase according to subgroups of deficits

Analysing the safety deficits concerning the character of the violation (Picture 3), thus it appears that 65 % of all deficits are based upon a breach of the rules. 12 % are referred to the failing realisation of new findings resulting of research. 23 % of the deficits result of the inadequate use of the area of discretion in aid of road safety. More than half of the deficits (54 %) can bring out grave consequences.

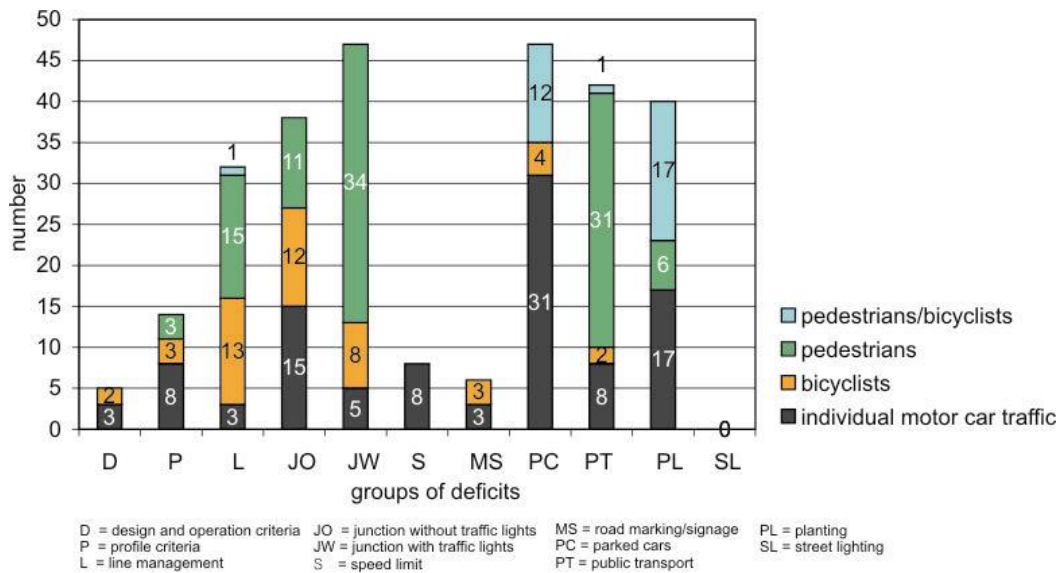


Picture 34: number of deficits for all audit phases concerning the character of the violation

According to this, preliminary and detailed designs regularly include in part grave safety deficits. Causes for this purpose are manifold. They are not picked out as a central theme here.

3. FREQUENT SAFETY DEFICITS IN PLANNINGS OF MAIN ROADS

9 main roads have been analysed in detailed planning. Overall 279 deficits have been found, average 31 deficits per example. Picture 4 illustrates the result of the analysis of the groups and subgroups of deficits.



Picture 4: categorised deficits of main roads in audit phase 2

Researching into the subgroups of deficits the accumulations shown in table 2 are to be found.

group of deficit	subgroup of deficit	number	deficit
L	bicyclist/pedestrians	12 x	lack of or insufficient pedestrians crossing
JW	pedestrians	22 x	lack of or insufficient waiting areas
PC	bicyclist/pedestrians	12 x	line-of-sight obstruction at bicyclist/pedestrians caused by parking cars
PC	motorized traffic	22 x	line-of-sight obstruction caused by parking cars
PT	pedestrians	10 x	lack of or insufficient waiting areas
		13 x	Lacking consideration of people reduced in mobility
PL	bicyclist/pedestrians	15 x	line-of-sight obstruction at bicyclist/pedestrians
PL	motorized traffic	17 x	line-of-sight obstruction

Table 2: accumulation of deficits in audit phase 2, main roads

5 main roads have been examined in execution planning. 102 deficits (average 20 per example) have been found. Most of them are represented in table 3. Attention should be paid to the fact that the examples were traffic lights in large part. That is why categorised deficits according to Picture 4 are not illustrated for the execution planning (characteristic deficits can not be deflected).

group of deficit	subgroup of deficit	number	deficit
JW	pedestrians	9 x	unfavorable traffic signaling for pedestrians
		6 x	not (sufficiently) regarded advanced time
	motorized traffic	5 x	danger of confusion the signal transmitter
MS	motorized traffic	4 x	lack of signage
		4 x	lack of road marking

Table 3: accumulation of deficits in audit phase 3, main roads

An assortment of the most frequent deficits of the detailed and execution planning concerning main roads is given below. The examples are made up of singular deficits (often

there were other (main) deficits beside this in the planning). That is to say that in addition to the named deficit further deficits can exist that are not illustrated.

Deficit „Line-of-sight obstruction at bicyclist/pedestrians caused by parking cars”

Description of the deficit:

For the road safety at main roads it is important to consider the sight distance (intervisibility) between individual motorized and non motorized traffic (see EAHV [4] chapter 3.1.2). Especially when choosing the number and character of the parking areas, the intervisibility between vehicles and pedestrians/bicyclists is to guarantee at crossroads, T junctions, access roads and pedestrians crossings. Obstructions of sight prevent the cognition of conflict situations in sufficient time.

Example (Picture 5)



Picture 5: Detailed design „Sight obstructions at pedestrians caused by parking vehicles“

Extract from the audit report

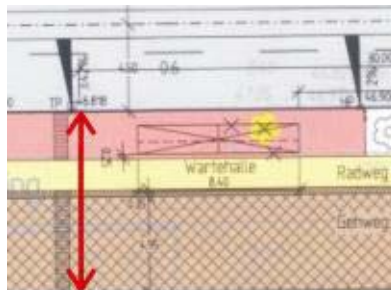
„The arrangement of parking areas near a roundabout hampers the sight between waiting pedestrians who want to cross the road. The necessary sight distances are to be guaranteed.“

Deficit „Lacking consideration of people reduced in mobility“

Description of the deficit:

To consider the needs of people reduced in mobility in public transport is important as this population group uses public transport twice as much as the total population. Risks of accident especially hide behind the accessibility of stops and the entrance/exit.

Example (Picture 6)



Picture 6: Detailed design „Lacking consideration of people reduced in mobility“

Extract from the audit report

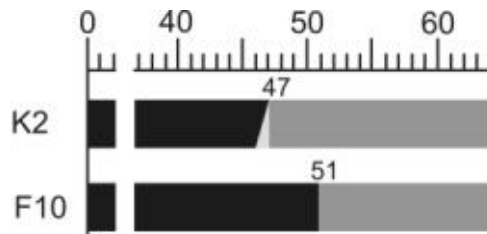
„People reduced in mobility using tactile elements are not called attention to the area of entrance/exit well timed. The tactile element directly leads to the carriageway. The Stops should be planned according to DIN including tactile element (see DIN 32984 [5], May 2000, Picture 6, p.7).”

Deficit „Not (sufficiently) regarded advanced time in a lightning phase“

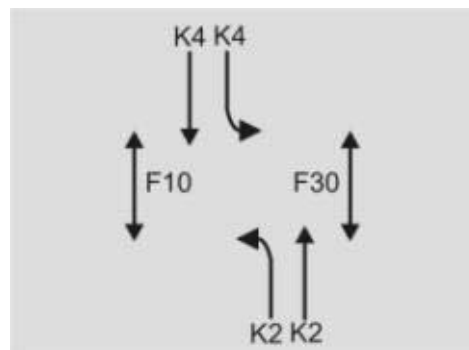
Description of the deficit:

The advanced time of pedestrians in a phase which is combined with vehicles turning off is important to avoid misunderstandings according the priority. Otherwise pedestrians might not be seen early enough so conflicts may cause. That is why pedestrians are not allowed to be added later in a phase. The advanced time in the phase has to enable pedestrians to reach the crossing 1 to 2 seconds before the car turning off reaches (see RILSA [6]).

Example (Pictures 7 and 8)



Picture 7: Signalisation „Insufficient advanced time“



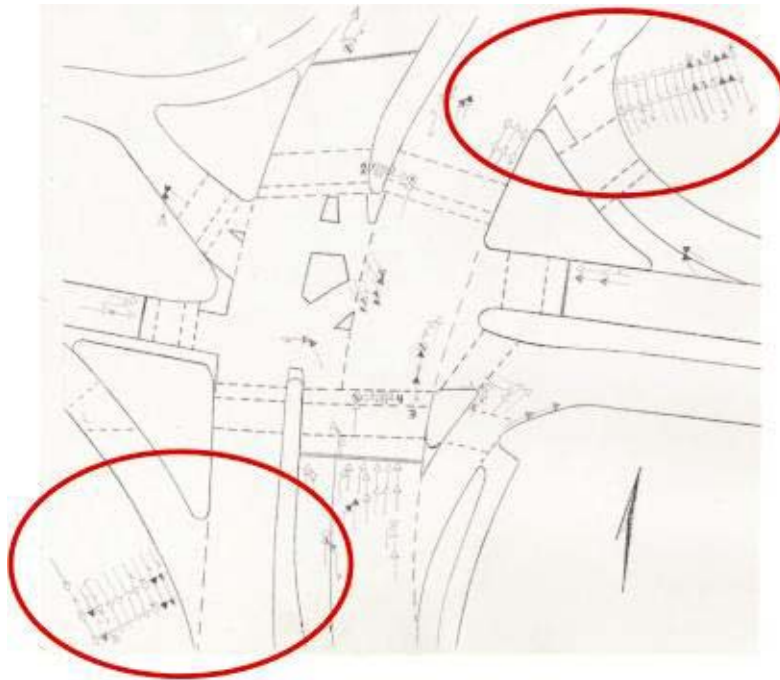
Picture 8: Signalisation „Insufficient advanced time“

Extract from the audit report

„The pedestrian F10 is not allowed to be added 4 seconds after the conditionally compatible car is turning to its right (K2). The signalisation is to be planned newly.“

In many projects a not continuous and inconsistent bicyclist routing could be noticed. For bicyclists using routes not regularly, an often changing bicyclist routing is difficult to detect and abstract. This can lead to false use which is in part even deliberately done (such as using the pavement). Other road users do not count on this behaviour so conflicts, perhaps accidents may follow.

A further circumstance that is to be mentioned is the frequent use of segregated right turning lanes, although they often are black spots of main roads. Segregated right turning lanes are characterised by accumulations of rear-end collision accidents, to some extent with involved bicyclists and pedestrians. This circumstance is shown in the collusion diagram (1-year) below (Picture 9). Nevertheless segregated right turning lanes are popular to reduce time of waiting at highly frequented junctions (by the account of road safety).

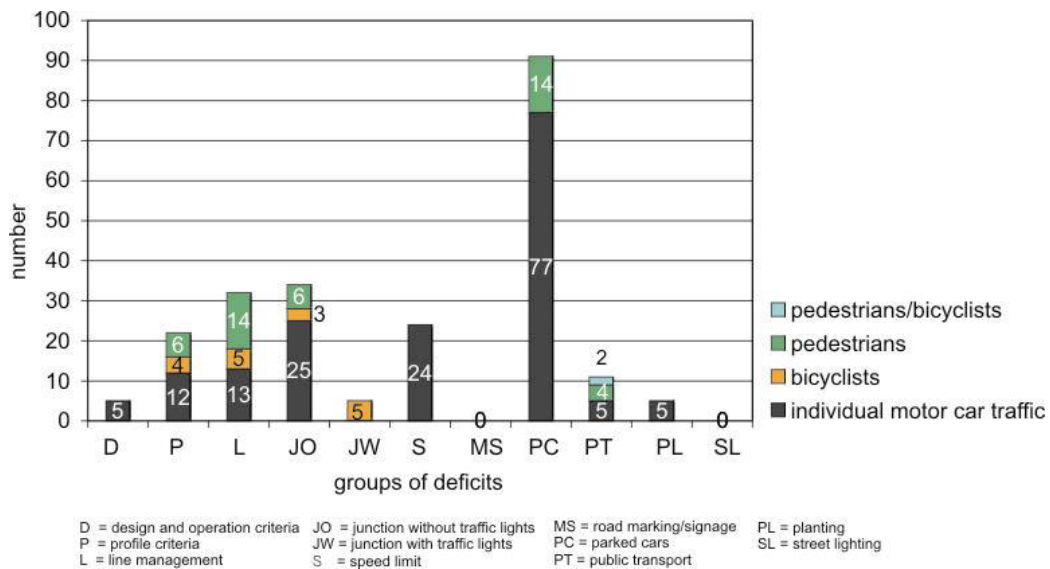


Picture 9: Collusion diagram / Segregated right turning lanes

4. FREQUENT SAFETY DEFICITS IN PLANNINGS OF SIDE ROADS

11 audited side roads (design planning) were analysed. 229 deficits have been found (that comes up to 21 deficits per example on the average).

Picture 10 shows the result of the categorized analysis of the deficit groups and subgroups.



Picture 10: categorised deficits of side roads in audit phase 2

Looking at the subgroups, the accumulations shown in table 4 resulted.

group of deficit	subgroup of deficit	number	deficit
P	motorized traffic	8 x	combination of minimum sizes
L	pedestrians	11 x	lack of or insufficient pedestrians crossing
	motorized traffic	7 x	adversarial line management (excessive speed)
JO	motorized traffic	7 x	line-of-sight obstruction
S	motorized traffic	17 x	lack of or insufficient speed reduce
		7 x	unsuitable elements
PC	pedestrians	12 x	line-of-sight obstruction at bicyclist/pedestrians caused by parking cars
	motorized traffic	55 x	line-of-sight obstruction caused by parking cars
		12 x	lacking/inadequate measures to prevent illegal parked cars

Table 4: accumulation of deficits in audit phase 2, side roads

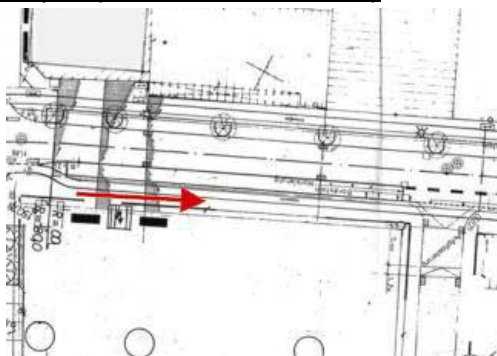
In execution plannings no side roads have been audited. A choice of frequent deficits in the detailed planning is given below. Even the following examples deal with singular deficits (although often there were other (main) deficits beside this in the plannings). That is to say that in addition to the named deficit further deficits can exist that are not illustrated.

Deficit „Combination of minimum sizes“

Description of the deficit:

Combining minimum sizes the risk of using other, not assigned areas by road users rises (for example at duplex traffic). This involves a certain amount of risk (conflict or accident), especially for pedestrians and bicyclists. Official (for example ERA [7] chapter 4.2.2-3) minimum sizes shall not be combined.

Example (Pictures 11 and 12)



Picture 11: Detailed design „Combination of minimum sizes“



Picture 12: Photograph „Combination of minimum sizes“

Extract from the audit report

„In the examined area, minimum sizes of traffic centres for pedestrians, bicyclists and parked cars are combined. To avoid conflicts it is to check if adequate spaces can be offered to these traffic modes.“

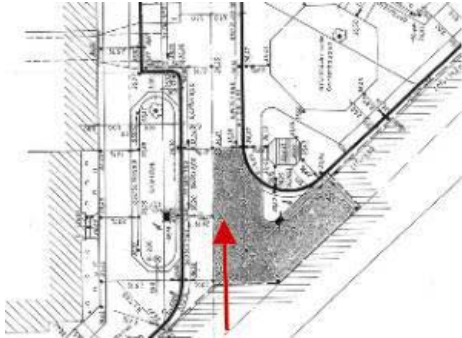
Deficit „Adversarial line management (excessive speed)“

Description of the deficit:

Straight-line roads without line sections lead to high speed. The delay of break, the possibility to avoid and the impact in case of collision depend on the cruising speed. To provide

for adequate road safety it is important to make the driver the recommended speed clear with the help of artistic elements (see EAE [8] chapter 4.1.2).

Example (Pictures 13 and 14)



Picture 13: Detailed design „Adversarial line management (excessive speed)“



Picture 14: Photograph „Adversarial line management (excessive speed)“

Extract from the audit report

„The road is oversized (width of the carriageway) and therefore has an effect from interlinear space. This may lead to high speed. It has to be checked if this effect from interlinear space can be reduced with the help of line sections.”

Deficit „Lacking/inadequate measures to prevent illegal parked cars”

Description of the deficit:

Illegal parked cars often lead to line-of-sight obstruction and lacking safe distance to pedestrians or bicyclists. In areas with few parking it is important to make arrangements to avoid illegal parked cars, especially near junctions and gateways.

Example (Pictures 15 and 16)



Picture 15: Detailed design „Lacking/inadequate measures to prevent illegal parked cars”



Picture 16: Photograph „Lacking/inadequate measures to prevent illegal parked cars”

Extract from the audit report

„Cars are parking in junction areas – it is important to make arrangements avoiding illegal parked cars.”

Looking at side roads, restrictions for pedestrians and bicyclists often result of lacking or too small safe distance beside parked cars. Too few parking and illegal parked cars restrict the width of footpath additionally, so that people with reduced mobility often can not use the footpath.

5. PROSPECT

With implementing the safety audit, an improvement of the planning and a reduction of accidents are expected. All participants concerning with safety audits remain of the conviction. The economic profit is high. Detecting failings in planning at an early stage and avoiding rescheduling (or even conversions) later on, microeconomic profits rise above the additional costs.

Some communes have already implemented the safety audit compulsive. Their operating experiences are positive. Topical safety audits are optional, but in the future allocations might depend on the certificate of safety audits.

A further, significant step will be the documentation, analysis and publication of experiences with safety audits, especially the publication in the communes. It is a fact that municipal planning does always include safety deficits. That is why the implementation in Germany is not only sensible but also necessary.

All these conclusions can help to improve planning's concerning road safety and thus to avoid accidents and their consequences.

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