V. Case Studies

137. Four audit case studies are part of this manual to showcase some of the safety concerns that typically arise at different stages of audit, and on different types of CAREC road projects. The focus in these case studies is on design stage, preopening stage, and road works audits. They show audits of four different road projects and four different types of road.

138. The case studies have been shortened to highlight the relative differences in the typical safety concerns that might be identified at an early stage versus a later stage of audit. In some cases, they are composite reports of a number of similar audits undertaken on similar roads and/or highways for the same stage of audit. Examples have been sourced from several CAREC member countries to show situations known and typical for the CAREC program.

139. The main audit findings are summarized and are presented in a standard tabular format. The tabular format is a widely accepted way to present safety concerns together with a risk rating and a recommendation for each concern. This format is a good model to use as a standard for presenting audit findings.

140. As with any road safety audit report, the findings are presented to assist with the injection of road safety into a road project. They are not a criticism of the professionals responsible for the design or the works. These four case studies demonstrate several key points that may assist in understanding the audit process:

- Having an audit team of two or three accredited auditors is highly desirable. More pairs of eyes on site mean more chances to uncover a safety concern.
- Auditors need to be experienced in all aspects of road safety engineering: from safety barriers to signs, from vulnerable road users to geometric design. An auditor needs to appreciate and understand the drawings, and be able to assess the safety impacts the new road may have on all road users.
- Design stage audits offer opportunities to make safety improvements, while the concerns are still "mouse clicks on a computer screen." At this stage, changes are easier and usually of lower cost than changes detected at later audit stages. The earlier, the better with audits.
- Road work audits are important for the safety of road users and road workers. Substantial improvements can be made at very low cost through audits of road work sites. Action to rectify unsafe work sites often needs to be undertaken quickly. A client should prepare for this.
- Preopening stage audits are useful, but they often report safety concerns that could have been revealed if an earlier audit had been undertaken. Changes after a project is finished usually require extra work and additional expenditure to rectify. Sometimes this may lead to disputes between the contractor and the client about responsibility for the cost of rectification and/or improvement. This is one more reason for keeping very good records of road safety audit findings and agreements.

A. Case study 1: A Detailed Design Stage Audit of the Proposed Duplication of a National Highway

(i) Title

141. The complete technical title of the audit, including its location and aims.

(ii) Audit team

142. The name and the role of the team leader and each audit team member.

(iii) Project background

143. The project includes the design, construction, widening, and upgrading of a national highway. It involves upgrading and duplicating an existing national highway along the same alignment from the capital city to the western border crossing. The road commences in the capital (Km 4+560) and ends at the border post at Km 61+552. It is 57 kilometers (km) in length, of which some 43.5 km will be four-lane divided highway. From the roundabout at West Gate to Km 48, the highway is being upgraded to a class I, four-lane

divided road. For the final 13.5 km, the road will be built to a class II, two-lane highway according to the Trans Asian Highway design standard. The road is a major international route for road traffic and the transport of goods. The highway is generally quite flat with generous horizontal alignment. It passes through 1 large town and 12 villages.

(iv) Audit details

144. The road safety audit included four daytime and two nighttime site inspections: on Wednesday, 5 December; Friday, 7 December; Monday, 10 December (day and night); and Monday, 17 December (day and night). The weather during the inspections was varied. It was fine, sunny, and mild on the first 2 days; cool and dry on the third day; and wet, cold, and with light snow on the final day.

145. The audit findings are provided in table 8.

The existing single carriageway highway near Km 21 shows typical road user groups.

Table 8: Case Study 1–Findings of a Detailed Design Stage Audit of the Proposed Duplication of a National Highway

Km	Safety Concern	Risk	Photo	Recommendations	Client Response
Safety Concerns with the Proposed Duplication of the National Highway					
From Km 5+400 to Km 6+300	This section of road passes through a village, and it will be subjected to high-speed traffic once the road is built. There will be a risk of high-speed collisions between through traffic and pedestrians in this village. It warrants speed management to maintain speeds at or below 40 km/h because of the high numbers of pedestrians in this village. The drawings do not show any "traffic calming" treatments proposed.	Very high		• Install a "gateway" on both approaches to this village. • Install flat-topped road humps at spacings of approximately 150 m through the village. Ensure humps are located close to bus stops and the police station, that they are well-signed, marked, and lit. • Provide a physical median through the village (to serve as a refuge), but DO NOT install barrier or fencing on the median.	
From Km 13+500 to Km 14+300	This village is located at the end of a long, straight, downhill section of road (from the capital) and a long, straight, flat section of road (from the southwest). Speeds will be high through this village once the highway is duplicated. The highway takes a right-hand curve in this village, and a major side road continues straight. The village warrants speed management to maintain speeds at or below 60 km/h because of the many pedestrians in this village. The drawings are silent about this.	Very high		• Install a "gateway" on the three approaches to this village. • Install flat-topped road humps at spacings of approximately 150 m through the village. Ensure humps are located close to bus stops, mosques, and schools; and that they are well signed, marked, and lit. • Provide a raised concrete median 2 m wide through the village to serve as a pedestrian refuge. • DO NOT install barrier or fencing on the median.	

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Table 8: continued

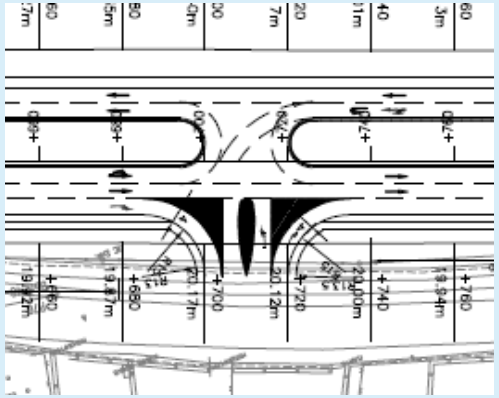
Km	Safety Concern	Risk	Photo	Recommendations	Client Response
Km 14+080	The design for the roundabout proposed for this key intersection in this village has insufficient deflection from the west and from the south to cause drivers to slow sufficiently. This lack of adequate deflection will increase crash risk at the roundabout.	Medium	 Source: China Road and Bridge Corp.	• Review this design, and attempt to improve deflection for these approaches. • If this is not possible, reconsider the use of a roundabout at this intersection. Seek alternative traffic control options instead.	
Km 15+710	At Km 15+710, a median opening and a T junction are proposed for access to the Village Access Road. The median opening will also serve as a U-turn opportunity. However, there are no sheltered left turn lanes proposed in the median for either direction. There will be a high risk of rear-end collisions at this location as vehicles slow down to turn from the "fast" lane.	Medium	 Source: China Road and Bridge Corp.	• Provide sheltered left turn lanes on both approaches to the break in the median. • Ramp down the median W-beam barrier at least 50 m in advance of the junction on each approach, so pedestrians are given good access to the median (to use it as a refuge) and sight lines are kept open for turning vehicles.	

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Table 8: continued

Km	Safety Concern	Risk	Photo	Recommendations	Client Response
Km 23+150	There is a large mosque on the southern side of the road. During Friday prayers, hundreds of men attend this mosque, parking their vehicles on both sides of the road. The drawings show no parking, and no pedestrian facility is to be provided, although both are needed. It will be more dangerous for pedestrians walking across the new duplicated highway due to increased speeds on it. The highway needs to be kept open for through traffic.	Very high		Consider providing off-road parking close to the mosque for use by those attending the mosque. If this is not possible, seal the shoulders of the highway (2 m wide) for at least 250 m either side of the side road leading to the mosque to encourage orderly parking. Construct an all-weather footpath between the mosque and suitable breaks in the W-beam barrier on the southern side of the highway to permit pedestrian access to parked vehicles.	
Km 61+200	Drivers approach the border, but the drawings show no new advance warning signs to alert drivers to the customs post ahead. There is a need for drivers to slow down and prepare to stop, but some will have been travelling at high speed for some distance and may not be thinking of what is ahead. The drawings are silent about any action in this regard.	Low		Install signs (at 2 km, 1 km, and repeated at 500 m) in advance of the border to inform drivers of the border ahead and their need to prepare to stop.	

Km = kilometer, km/h = kilometer per hour, m = meter.

Note: The audit team carried out this detailed design stage road safety audit according to the *CAREC Road Safety Audit Manual.*

SIGNED:

{INSERT NAME HERE} Team leader on behalf of the Road Safety Audit team {DATE}

Source: Asian Development Bank.