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**INSTITUTE OF HIGHWAY
INCORPORATED ENGINEERS**



IHIE GUIDELINES FOR MOTORCYCLING

**improving safety through
engineering and integration**

version 1.1

CHAPTER 9

MOTORCYCLING AND ROAD SAFETY AUDIT

9.1 Key Points

9.1.1 There is no exhaustive checklist for accounting for motorcycles in RSA work. Nor does anyone expect an RSA practitioner to undertake motorcycle training in order to understand the needs of riders. Gaining a better understanding of the safety problems likely to face motorcyclists includes:

- ✓ Awareness of the common characteristics of motorcycle accidents.
- ✓ Awareness of the more severe implications for riders of hazards that affect all road users.
- ✓ Awareness of the road dynamics of motorcycles and the safety implications of their relationship to road surface properties, street furniture and obstructions.
- ✓ The different problems faced by riders in the urban and rural environments.
- ✓ Informing RSA practice by discussions with local motorcycle forums or internal discussions with colleagues who ride.
- ✓ Road Safety Audits on larger schemes may include a rider to advise the audit team.

9.2 Context

9.2.1 Road Safety Audit (RSA) has existed in the UK since the late 1980s. Audits of trunk road and motorway schemes have been mandatory since 1991. Many local authorities voluntarily carry out such design-independent audits using the trunk road standard contained in the Design Manual for Roads and Bridges *HD 19/03* (DfT 2003) or the guidance given in the IHT document *The Safety Audit of Highways* [IHT 1996]. Other helpful documents on the basics of RSA practice include the book *Practical Road Safety Auditing* [TMS 2001].

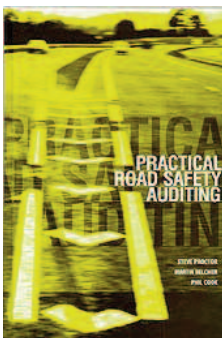
Under the *HD19/03* standard the RSA process audits at four key stages:

1. Preliminary design stage.
2. Detailed design stage (prior to starting construction).
3. Prior to opening to traffic (or after finishing construction if it is not possible to keep the scheme closed to traffic).
4. One and three years after opening.

9.2.2 Highway and traffic engineering practice in England and Wales usually separates safety auditing and user auditing. The latter focuses on encouraging better infrastructure provision for sustainable modes to encourage modal shift. However, it has always been good practice for safety auditors to take a multi-modal approach to the process, taking special care with safety implications for vulnerable road users; equestrians, cyclists and pedestrians. While not being completely overlooked, motorcyclists have had a lower profile in this "special care" regime, perhaps because the



Guidelines for the Safety Audit of Highways



Practical Road Safety Auditing

higher speeds of motorcycles push them, almost intuitively, into the same camp as twin track motor vehicles. This is a serious misapprehension. The dynamics of motorcycles and the vulnerability of their riders make motorcycling a unique mode in the traffic mix, demanding separate, informed consideration by designers and auditors alike.

9.2.3 No one expects special treatment for motorcycles and their riders. It will always be the safety auditor's prime objective to examine the safety of a new scheme from a holistic viewpoint. The RSA practitioner seeks an optimal balance of risk across all modes, using experiential and empirical judgement to identify hazards, quantify risks and estimate likely outcomes, both in terms of numbers and severity.

9.2.4 The point of this chapter is not to present motorcycles as a special case, but to redress an imbalance among RSA practitioners, with little or no experience of riding a motorcycle, of how the balance of risks shifts markedly on two wheels as opposed to four or more.

9.3 Accident Characteristics

9.3.1 The introduction to the Guidelines shows clearly that the road safety problem for motorcyclists differs sharply according to their environment. The typical urban motorcycle accident involves another vehicle, usually at a junction, and often when the motorcyclist has priority. The rural situation could not be more different. Often no other vehicle is involved, and the location is away from a junction, typically on a bend. It should be self-evident that the contributory factors that increase the likelihood of such accidents are equally diverse. This chapter will deal with these diverse factors of critical interest to the safety auditor.



Motorcycle on a roundabout.
Keith Sharples Photography.

9.4 Dynamics

9.4.1 The majority of non-motorcyclists might summarise the dynamic differences between motorcycles and other traffic as: "they accelerate faster and can get around traffic queues". Both these things are true, but there is much more to the dynamics of motorcycles than two headline factors, and auditors need to be aware of other, subtler, dynamic differences to properly include the needs of motorcycle riders in the balancing of risks. It should always be foremost in an auditor's mind that what may present a minor nuisance or a low risk, low severity hazard to a twin track vehicle driver, may present a low risk, high severity hazard to a motorcycle rider.



Rural riding.
Keith Sharples Photography.

9.4.2 Most of the important dynamic differences between motorcycles and other vehicles arise from the way motorcycles make use of the laws of physics. For example, no other motor vehicles have wheels that can, indeed must, move significantly out of the vertical to enable manoeuvres such as cornering. At speed, the wheels behave like two large gyroscopes, adding a further dimension to their physical properties. A skilful rider can make good use of this gyroscopic effect. A novice will find it can produce

unexpected effects. For example, on bends, applying the front brake can cause the machine to “sit up” and take a line tangential to the bend. From this it is easy to see why predictable and consistent bend geometry is critical to rider safety. For those involved in providing or maintaining the road infrastructure these dynamic differences mean that a motorcycle is not a kind of “two-wheeled car”.

9.5 Dynamic Implications

9.5.1 The RSA practitioner needs to keep in mind a number of implications of the unique dynamics of motorcycles that are key to optimising safety for motorcyclists.

Awareness of the line that motorcyclists take through bends and junctions, keeping them clear of:

- ▼ **Service covers and gully gratings.** Locating ironwork out of the wheel tracks of twin track vehicles or on the outside of bends can place them on the line used by motorcycles. This presents a sudden change in road surface properties leading to stability problems. It should also be noted that water on service covers freezes sooner than water on the surrounding road surface. If the cover cannot be moved, it should be provided with a surface finish compatible with the skid resistance of the surrounding road.
- ▼ **Large areas of road marking.** Thermoplastic road marking material should be laid to an acceptable standard of skid resistance and retro-reflectivity. In practice, newly laid markings are rarely tested, and even if they are, the values often fall long before the road surface requires maintenance (see below). This leads to markings that are slippery when wet. Large areas of such markings, especially in areas likely to be used by motorcycles, can present a serious safety hazard. This has to be balanced against a realistic assessment of any road safety benefits to be gained from using large areas of road markings.



Service cover on a bend.
Keith Sharples Photography.



Road markings on a bend.
Keith Sharples Photography.

Awareness of the “clear zone” around the outside of bends, keeping it clear of:

- ▼ **Unprotected street furniture.** Best practice in street scene management recommends auditing of street furniture to see



Cluttered bend.
Keith Sharples Photography.

if, for example, signs can be rationalised into single assemblies to avoid a proliferation of posts. This should be taken a stage further, with sign locations considered carefully to make sure they do not present a collision hazard for a falling motorcyclist. If it is unavoidable to have street furniture in the “clear zone”, every effort should be made to make it as ‘impact friendly’ as possible.

- ▼ **Safety barrier products that have only been tested on twin track vehicles.** These can represent a serious hazard to a dismounted rider. More investigation is needed into after-market collision mitigation measures in locations where there is a higher risk of motorcycle loss of control (Chapter 4).



Retro fitted treatment to safety barrier.
Highways Agency.



Detritus on a roundabout.
Keith Sharples Photography.



Road markings at the point where motorcycle needs to brake before cornering.
Keith Sharples Photography.

Awareness of the effects of unpredictable surface irregularities, such as:

- ▼ **Poor surface tie-ins.** This is yet another example of a problem that can be a cause of mild irritation to a twin track vehicle driver, and yet potentially cause a motorcyclist to suffer a sudden shift in balance, with loss of control and possibly a crash to follow.
- ▼ **Badly designed or located traffic calming features.** As already described, motorcycles are machines that, to a point, become better balanced with increasing speed. Conversely, travelling at low speed can require more of rider and machine. In this situation, poor location, design or maintenance of traffic calming features can contribute to loss of balance, reduced control or even a crash (see Chapter 8).
- ▼ **Areas likely to retain surface detritus.** Motorcycles form just over 1% of the traffic mix by distance travelled in the UK [DfT 2003a]. Other vehicles tend to push surface detritus, chippings, broken lens glass and so on, into areas of the road they do not use. These same areas can be used by motorcyclists, either because it forms the correct line for a motorcyclist to take or because other, heavier traffic has pushed them there. In any case, motorcycles require the road to facilitate grip and braking; areas covered in road detritus facilitate neither. This subject is covered in more detail in Chapter 6.
- ▼ **Poorly designed drainage.** It should be self-evident that motorcyclists suffer sooner and more severely when surface water is not dealt with by carriageway drainage systems.

Awareness of the importance of consistent skid resistance properties:

- ▼ **Terminating anti-skid surfacing on straight sections.** Sudden changes in road surface properties on bends or junctions, especially skid resistance, can lead to stability problems as the rider tries to cope with the sudden change in the dynamics and response of the motorcycle.
- ▼ **Not using innovative road markings too close to bends.** This includes:
 - u Dragon’s teeth markings.
 - u Speed limit roundels or other surface “signs”
 - u Transverse markings or “jiggle” bars.

9.5.2 The same principle about sudden changes in road surface properties applies here: road markings rarely have the same skid resistance value as the surrounding road surface. Placing markings in areas of the road likely to be used for braking or cornering by motorcyclists can significantly increase the risk of stability problems. This can often be avoided by relocating the marking, rather than losing its general road safety benefit by deleting it altogether.

- ▼ Using road-marking material that has an acceptable level of skid resistance and remains close to that level for the life of the marking. This implies:
 - u Using profiled lining instead of flat lining.
 - u Using material that has a similar skid resistance to the surrounding surface.
 - u Using material that has retro-reflectivity that enables a rider to maintain good forward visibility at night, especially in the wet, when riding conditions and retro-reflectivity are both at a minimum.
 - u Setting high, achievable standards for retro-reflectivity and skid resistance - and testing for them.
 - u Using new marking materials and methods of laying, for example polymethylmethacrylate materials, that make it more likely that good skid resistance and retro-reflectivity levels are met and maintained. The extra cost of these materials and methods should be set against the penalty to be paid for permitting poor standards: increased injury accidents.

- ▼ Measures to ameliorate the problems caused by mud or leaves on the road. This should include:
 - u Location of new field accesses away from bends and junctions.
 - u Providing warning signs at locations where mud is likely to be a recurring problem.
 - u Considering leaf fall problems when designing landscaping and the “soft estate” on new schemes.

Awareness of the need for street lighting:

- ▼ Motorcycle headlights are weaker than those of other motor vehicles.
- ▼ Refer to guidance from the local authority street lighting team or the Institution of Lighting Engineers (ILE 1995).

Awareness that the eye height of a motorcyclist is much higher than a car driver:

- ▼ Usually this is a good thing, affording the rider a better view of the road ahead or any developing traffic situation. However, check sight lines at RSA Stage 2 and Stage 3, taking account of the increased eye height of the motorcycle rider. An object may intrude into the visibility splay at rider eye height that may not obstruct a car driver’s view.



Motorcycles may be difficult to distinguish from following traffic. *BMF.*

9.6 Urban Schemes

9.6.1 Motorcycle accidents in urban areas typically involve another vehicle and often occur in situations where the rider has priority:

- ▼ Check that side road sight lines for emerging drivers at junctions do not “hide” motorcycle riders, especially those on



Obscured sightline to right, on exit from side road.

Keith Sharples Photography.

lower-powered machines, who tend to ride nearer to the kerb (*see inset photo*).

- ✓ Check that skid resistance at junctions is appropriate, especially where a change in junction control is being made, for example from a priority junction to a signalised junction.
- ✓ Check that lane widths are appropriate, especially nearside lanes on multi-lane single and dual carriageways. This is important in areas governed by a 40mph speed limit, where mopeds (limited to 30mph) can be swamped by passing traffic, especially where there are high numbers of HGV.
- ✓ Check that traffic calming schemes take account of the needs and vulnerabilities of motorcyclists (Chapter 8).

9.7 Rural Schemes

9.7.1 Rural motorcycle accidents often involve no other vehicles, and frequently occur on bends. Check for:

- ✓ Location of service covers and their skid resistance (see above).
- ✓ Road markings (see above). The reduced effectiveness of motorcycle headlights makes the night-time retro-reflectivity performance of road markings in rural areas especially important.
- ✓ Cross-sectional profile. This can be a safety issue for all road users, but can be particularly unforgiving for motorcyclists. Cornering on a motorcycle, especially at rural road speeds, is an activity that involves a degree of planning, skill and technique. If the cross-sectional profile of the road does not conform to expectations, the rider may not have time to make the necessary adjustments and may crash.
- ✓ The “clear zone:” on the outside of bends is especially pertinent in the rural environment (see above)
- ✓ Too much visibility to the right on high-speed approaches to rural roundabouts. This is a safety issue for all road users and is not catered for in the current design standard. It has two implications for motorcyclists:
 - u When the motorcycle is the approaching vehicle, it can encourage excessive entry speed, leading to loss-of-control accidents.
 - u When the motorcycle is the circulating vehicle, it can encourage drivers of other motorised vehicles to use excessive approach speeds, increasing the chance of drivers “looking but not seeing” and an entering-circulating accident.
- ✓ Poor “offside deflection” on rural, high-speed roundabout approaches, especially on dual carriageways. The current design standard gives mandatory values for deflection based on entry path curvature, a line intended to emulate the easiest route through a junction, ignoring lane markings. This works well when vehicles can choose such a path; however, under modern traffic conditions riders (and drivers) often use the offside lane when the nearside lane is occupied by slower vehicles. This can lead some drivers and riders to collide with the central island. Implementing the advice in section 7.17 of the standard should reduce this problem (DTp 1993).



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