

What Roadside Changes Can Be Made To Reduce Motorcycle Crashes?

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Project Goal

To identify three to five infrastructure-based motorcycle crash countermeasures that might be considered for future research.



Project Activities

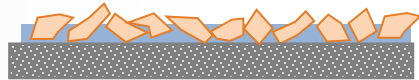
- Analysis of the FHWA MCCS database to identify crash causation factors that could be addressed by infrastructure-based safety countermeasure.
- Review of literature of infrastructure-based motorcycle crash countermeasures.
- Pre-Workshop meeting to narrow down countermeasures list.
- Workshop to identify three to five countermeasures to be considered for future research.



Review Countermeasures

2.1 High Friction Surface Treatment

To address issues associated with smooth pavement, high friction surface treatments have been developed. A high friction surface treatment consists of a thin layer of high-quality polish resistant aggregate bonded to a pavement surface with polymer resin.



An example of aggregate bonded to existing pavement.



A depiction of a high surface friction treatment application.

2.2 Textured Pavement Markings

In response to pavement marking, engineers have developed pavement markings that can incorporate finely-graded aggregate or crushed glass to improve friction properties. The material can be mixed into paint or two-part resin systems or can be embedded into the surface of thermoplastastics.



Example of textured pavement markings: crushed colored glass (Ruby Lake, 2017) and racetrack marking (Advanced Pavement Marking, 2017).

2.3 Pavement Condition Repair

To address common pavement conditions issues (e.g., potholes, concrete punch-outs), common pavement techniques are employed to improve ride quality and safety. These techniques include pothole patch repair, removal of road debris (e.g., sweeping), diamond grinding on concrete, overlay or mill and overlay of flushed/bleeding surface, overlay or mill and overlay of rutting surface, seal coat over polished surface, and warning signs (e.g., Rough Road) of pavement disrepair to warn drivers.



Patch repair



Sweeping



Diamond Grinding

Examples of pavement condition repair techniques (left, City of Norfolk, 2017; center, Selbig & Bannerman, 2007; right, Roads and Bridges, 2017).

2.4 Pavement Shoulder/Edge Drop-Off Treatment

A pavement edge drop-off treatment is a construction technique or maintenance activity that minimizes the height difference and/or provides a slope from the pavement edge to the unpaved shoulder.



Examples of pavement edge drop off (left, FHWA, 2017), Safety Edge (center, Carlson Paving, 2017), and notched wedge joint (right, Willow Designs, 2017) treatments.

2.5 Steel Plate Danger Mitigation

Several techniques have been implemented to improve the level of safety associated with the use of steel plates, such as placing warning signs ahead of steel plates (Cottrell, 2006), visible markings on the corners of plates (Cottrell, 2006), Plate Locks[®], SlipNOT[®] textured plates or non-proprietary skid surface (Siyahi, Kavussi & Boroujerdian, 2016), Plasticade[®] road plate which is a modular, plastic covered plate with a self-locking mechanism and rubber-edge ramps, and asphalt tapering to ease the transition onto and off steel plates.



Plate Locks[®]



Asphalt Taper



Plasticade[®] plate

Examples of steel plate danger mitigation techniques (left, Plate Locks, 2017; center, National Trench Safety, 2017; right, Plasticade, 2017).

2.6 Pavement Change Warning Signs

Warning signs for pavement changes notify a rider of a change in roadway surface conditions so they can preemptively adopt appropriate riding techniques. Many of these warning signs are located in advance of work zones.



Examples of pavement change warning signs (top left to bottom right Dairyland, 2017; DWKLAW, 2017; DWKLAW, 2017; Roadway Safety Consortium, 2017; Alberta Transportation, 2017).

5.1 Guardrail Continuous Protection System

The purpose of the Guardrail Continuous Protection System (GCPS) is to prevent a motorcycle rider from sliding under the guardrail and contacting the guardrail barrier posts, a situation which can cause significant injury to riders.



Examples of guardrail continuous protection systems (Department of Planning, Transport, and Infrastructure, 2017).

5.2 Retrofit Concrete Barrier

The Retrofit Concrete Barrier (RCB) is a solid concrete barrier with an added protection system, such as a chain-link fence or acrylic sheeting, mounted on top of the barrier. The RCB can help prevent the rider from falling to the other side of the barrier when impacting the concrete barrier in an upright motorcycle configuration.



Example of different types of retrofit concrete barriers (Transpo Industries, 2017).

5.10 Remove Roadside Trees and Set Back Utility Poles

The removal of roadside trees or posts can be implemented along roadways to prevent riders from impacting fixed objects and causing severe injury to a rider.



Example of tree removal (Westport News, 2017).

Ref.	Countermeasure	Vehicle Type	Crash Type	Injury Type	Road Sgmt	MC CMF	MC Effect	MV CMF	MV Effect	Cost
1.1	Red Light Violation Warning	MV/MC	FYRoW	RI	I	Not Est	Not Est	Not Est	Not Est	\$
1.2	Limited Sight Distance Warning Signs	MV/MC	FYRoW	RI	C	Not Est	Not Est	1.07	Effec ~	\$
1.3	Prohibitive Signs	MV/MC	FYRoW	RI	S	Not Est	Not Est	.55-.80	Effec +	\$
1.4	Signals	MV/MC	FYRoW	RI	I	Not Est	Not Est	.01-1.0	Effec +	
1.5	Intersection/Merging Traffic Warning Signs	MV/MC	FYRoW	RI	C, S	Not Est	Not Est	.60-.70	Effec +	\$
1.6	Lighting	MV/MC	FYRoW	RI	C, I, S	.61-.63	Effec +	.71-.79	Effec +	
2.1	High Friction Surface Treatment	MV/MC	LoC	RI/RS	C, S	Not Est	Not Est	.15-.80	Effec +	\$\$-\$\$\$
2.2	Textured Pavement Markings	MC	LoC	RI/RS	C, I, S	Not Est	Not Est	Not Est	Not Est	\$\$
2.3	Pavement Condition Repair	MV/MC	LoC	RI/RS	C, I, S	Not Est	Not Est	.65-.95	Effec +	\$\$-\$\$\$
2.4	Pavement Shoulder/Edge Drop-Off Treatment	MV/MC	LoC	RS/RI	S	Not Est	Not Est	.94	Effec +	\$
2.5	Steel Plate Danger Mitigation	MC	LoC	RI/RS	C, I, S	Not Est	Not Est	NA	NA	\$
2.6	Pavement Change Warning Signs	MC	LoC	RI	S	Not Est	Not Est	NA	NA	\$
3.1	Design for Motorcycle Sight Distance	MC	RE	RI	C, I, S	Not Est	Not Est	NA	NA	\$\$\$
4.1	Roadway Vehicle Parking	MC	SDSW	RI	C, S	Not Est	Not Est	NA	NA	\$
5.1	Guardrail Continuous Protection System	MC	SVRD	RI/RS	C	Not Est	Not Est	NA	NA	\$
5.2	Retrofit Concrete Barrier	MC	SVRD	RS	C, S	Not Est	Not Est	NA	NA	\$\$
5.3	Punctual Energy Absorber	MC	SVRD	RS	C	Not Est	Not Est	NA	NA	\$
5.4	Ensure Proper Cross Slope (Superelevation)	MV/MC	SVRD	RI	C	Not Est	Not Est	.85-.98	Effec +	\$\$
5.5	Curve Speed Warning	MV/MC	SVRD	RI	C	Not Est	Not Est	.93-.95	Effec +	\$
5.6	Advanced Curve Warning Signs	MV/MC	SVRD	RI	C	Not Est	Not Est	.45-.92	Effec +	\$
5.7	In-Curve Warning Signs	MV/MC	SVRD	RI	C	Not Est	Not Est	.73-.82	Effec +	\$
5.8	Pavement Markings	MV/MC	SVRD	RI	C, S	Not Est	Not Est	.71-.92	Effec +	\$
5.9	Rumble Strips	MV/MC	SVRD	RI/RS	C, S	Not Est	Not Est	.30-.93	Effec +	\$\$-\$\$\$
5.10	Remove Roadside Trees	MC	SVRD	RS	C, S	Not Est	Not Est	Not Est	Not Est	\$
5.11	Positive Guidance in a Work Zone	MV/MC	SVRD	RI	C, I, S	Not Est	Not Est	Not Est	Not Est	\$

Broad Crash Type Category	Countermeasure	Annual Number Potential Crashes Impacted
Failure to Yield Right of Way	Sight Distance – Intersection	2,317
	New Signal with Protected Turn Cycle	770
	Add Protected-Only Turn Cycle	144
	Prohibit Left Turn Sign	3,271
	Stop Sign	1,130
	Red Light Violation Warning	489
	Warning Intersection / Driveway Ahead Sign	1,363
	No U-Turn Sign	45
Loss of Control & Run Off Road	Curve Speed Warning Sign	530
	Retro-reflective striping	1,577
	Increase Lighting	264
	Set back utility poles	187
Multiple Types	Sight Distance -Segment	2,687

Pre-Prioritization Results

Response options	Rank
5.1 Guardrail Continuous Protection System	1st
2.3 Pavement Condition Repair	2nd
2.1 High Friction Surface Treatment	3rd
5.7 In-Curve Warning Signs	4th
1.6 Lighting	5th
5.10 Remove Roadside Trees and Poles	6th
1.4 Signals*	7th
5.3 Punctual Energy Absorber	8th
1.2 Limited Sight Distance Warning Signs*	9th
1.3 Prohibitive Signs*	10th



Identifying Infrastructure-Based Motorcycle Crash Countermeasures
