ROAD TRAFFIC ACCIDENT DATA COLLECTION AND ANALYSIS WORKSHOP
COUNTRY: MONGOLIA

TA-6763 REG: Accelerating Innovation in Transport

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PART 7:
CRASH DATA ANALYSIS FOR A HIGHWAY STRETCH

Identification of contributing factors, black spot analysis, treatment planning and implementation

CASE STUDY: MUMBAI-PUNE EXPRESSWAY

- In 2012, JP Research initiated scientific crash investigations.
- With the cooperation of Maharashtra State Highway Police.
- Over 150 fatalities annually.

- Over-speeding major cause of road crashes as per police and news reports.
- JP Research investigations and contributing factors analysis revealed:
  - Sleepy drivers an equally high problem as over-speeding.
  - Run-off road crashes were the highest crash type leading to fatalities and serious injuries.

ADB

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CAREC
Central Asia Regional Economic Cooperation Program

CRASH INVESTIGATION FINDINGS
MUMBAI-PUNE EXPRESSWAY (2012-2014)

Human (55%)	Vehicle (81%)	Infrastructure (36%)
Seat belt not used (52%)	Passenger Compartment Intrusion – Other (54%)	Object impact – roadside/median - manmade structures (24%)
Speeding (30%)	Seatbelts not available/usable (18%)	Roadside – Steep slope/Drop off (8%)
Driver sleep / Fatigue (29%)	Passenger Compartment Intrusion – Underride/Override (17%)	Sharp curvature (8%)

Source: JP Research Mumbai-Pune Expressway Road Accident Study Report 2012-2014

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MUMBAI-PUNE EXPRESSWAY *CRASH DATA ANALYSIS*

- From RASSI crash data analysis (2012-2014), 15 major contributing infrastructure factors identified.

- In 2015, Road Safety Survey Report was prepared by JP Research commissioned by SaveLIFE Foundation (NGO) with support from Mahindra Rise (sponsor)
  - http://savelifefoundation.org/wp-content/uploads/2016/12/V3_MPEW-Road-Safety-Survey-Report_SC2-1.pdf

MUMBAI-PUNE EXPRESSWAY
INFRASTRUCTURE CONTRIBUTING FACTORS

15 infrastructure contributing factors influencing accidents and injuries.

TABLE 1: LIST OF INFRASTRUCTURE FACTORS LISTED IN DESCENDING ORDER OF THE NUMBER OF ACCIDENTS, FATALITIES AND SERIOUS INJURIES INFLUENCED.

S. No	Contributing factor	No. of Fatal Victims (Average per year)	No. of Injured Victims (Average per year)
1	Narrow/No shoulder	19	66
2	Roadside/Median concrete structure	9	24
3	Poor/ineffective road signage	6	17
4	Roadside steep slope/drop-off	5	24
5	Sharp road curvature	5	18
6	Unguarded bridge pillar	4	2
7	Unguarded Bridge/Jersey wall	3	5
8	Gaps-in-median	2	16
9	Unguarded underpass	2	5
10	Entry/Exit road	2	1
11	Driver vision obstruction	1	4
12	Roadside trees	1	2
13	Curb stones	0	6
14	Guardrail end taper	0	2
15	Flower pots in the median	0	1

Source: MPEW Road Safety Survey Report (2015)

MUMBAI-PUNE EXPRESSWAY *INTERVENTION PLANNING*

- Each location has been specified with photograph and chainage location for validation by road engineers.
- Example: Photos of sharp curvature with no signage.

Source: MPEW Road Safety Survey Report (2015)

MUMBAI-PUNE EXPRESSWAY *INTERVENTION PLANNING*

5. Sharp road curvature

Details of all sharp road curvature locations are provided in Appendix A, page 389.

EXPECTED BENEFIT	INR 6.29 crores	
Number of fatal victims: 5 ; Number of serious victims: 18		
COST OF SAFETY MEASURE	INR 81,00,000	
Safety measure: Install adequate advance warning signage		
BCR	**1st year: 3.53**	**Subsequent Year(s): 62.15**

FIGURE 11: A SHARP CURVE AT KHOPOLI EXIT WHICH IS PRONE TO ACCIDENTS.

The expressway has many sections of sharp road curvatures which require the driver to reduce speed and steer carefully. Excessive speed, or improper steering maneuvers, result in the vehicle running off the roadway or rolling over due to centrifugal forces.

Since it is not easy to rebuild and realign curved roads, the only suitable solution is to provide adequate advance warning signs for the driver so that he/she can reduce the speed of the vehicle and maneuver through the curve safely.

Safety measures that can mitigate accidents and injuries

Adequate advance warning signage, such as chevron markers, should be placed so that the driver is given sufficient time to react to the scenario and adapt the speed and steering maneuver accordingly. Wherever possible, the width of the shoulder at the outer edge of the curve should be increased to accommodate space for vehicles, especially large trucks.

Source: MPEW Road Safety Survey Report (2015)

CRASH INVESTIGATION AND ANALYSIS *FOR IMPROVING IMPLEMENTATION EFFECTIVENESS*

S. No	Contributing factor	No. of Fatal Victims (Average per year)	No. of Injured Victims (Average per year)
1	Narrow/No shoulder	19	66
2	Roadside/Median concrete structure	9	24
3	Poor/ineffective road signage	6	17
4	Roadside steep slope/drop-off	5	24
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Source: MPEW Road Safety Survey Report (2015)

Guardrails are a solution for the 4 problems identified.

But some locations with guardrails did not show effectiveness.

Image Source: RASI Database

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7. Unguarded overhead bridge pillars

Details of all unguarded overhead bridge pillars are provided in Appendix A, page 518.

EXPECTED BENEFIT	INR 3.01 crores	
Number of fatal victims: 4 ; Number of serious victims: 2		
COST OF SAFETY MEASURE	INR 6.1 crores	
Safety measure: Install impact attenuators (water/sand filled barrels)		
BCR	**1st year: 0.22**	**Subsequent Year(s): 3.95**

There are many overhead bridges under which the expressway passes. The pillars supporting these overhead bridges are located on the roadside and median. Vehicles losing control and running off the road may hit these unguarded pillars, which act as rigid barriers for the vehicles impacting them, and hence aggravate severity of the impacts. In addition, bridge pillars also need to be guarded from heavy vehicle impacts, as they may reduce the structural integrity of the pillar, or worse, bring down the bridge.

FIGURE 15: CRASHES ON THE EXPRESSWAY WITH OVERHEAD BRIDGE PILLARS.

Source: MPEW Road Safety Survey Report (2015)

Safety measures that can mitigate accidents and injuries

Since such pillars are very rigid and can create catastrophic vehicle damage leading to fatal or serious injuries, impact attenuators need to be installed in front of them so that they can reduce the crash severity by absorbing the impact energy. In addition, barriers must also be installed around the pillar, from well before the pillar location, to prevent any vehicle from approaching the bridge pillars.

FIGURE 16: BRIDGE PILLARS GUARDED WITH IMPACT ATTENUATORS AND ROPE WIRE BARRIERS.

WHY ARE GUARDRAILS INEFFECTIVE? CRASH INVESTIGATION FINDINGS

Guardrail run-out length too short

(Indian road standard) IRC:SP:99-2013, 10.7.7

*"The barrier shall be extended at full height not less than **30 m** in advance of the hazard on the approach side, and shall continue at full height for 7.5 m beyond the hazard on the departure side."*

Image Source: RASSI Database

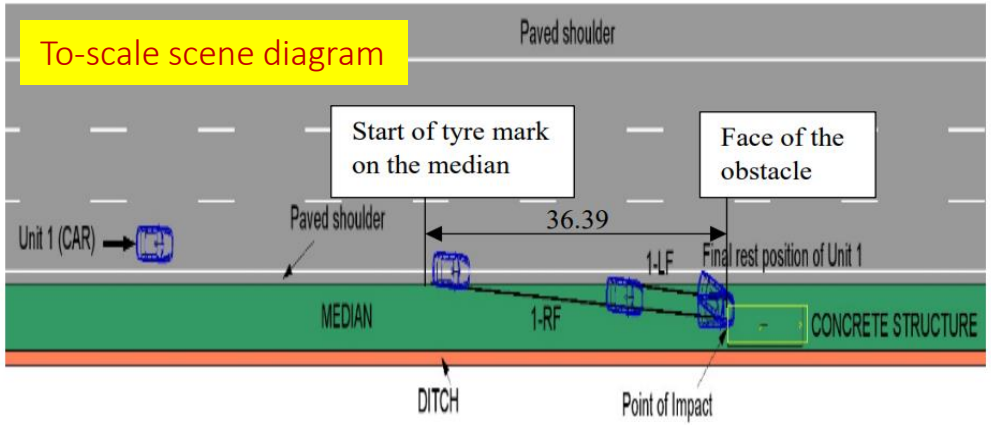
Guardrail-end tapers can launch a speeding vehicle into air

(Indian road standard) IRC:SP:99-2013, 10.7.5.b

"End treatment shall be such that it does not spear, vault or roll a vehicle for head on or angled impacts. The end treatment shall be as per manufacturer's system and satisfying the test standards as perEN1317 or NCHRP350."

CRASH INVESTIGATION AND ANALYSIS
MPEW - EFFECTIVE GUARDRAIL RUNOUT LENGTH

To-scale scene diagram



Determination of crash barrier runout lengths for expressways in India based on crash data analysis.
Vernon Chinnadurai, Ravishankar Rajaraman, Muddassar Patel

Source: "Determination of crash barrier runout lengths for expressways in India based on crash data analysis.", JP Research, IRF World Road Meeting 2017

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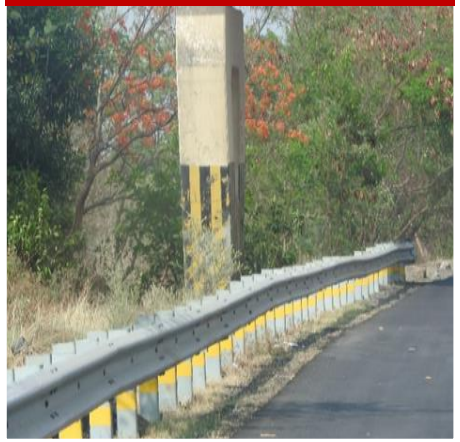
CRASH INVESTIGATION AND ANALYSIS
MPEW – BEFORE/AFTER ANALYSIS

Contributing Infrastructure Factors (Mumbai-Pune Expressway)	2016		2017		2018	
	Killed	Serious	Killed	Serious	Killed	Serious
Roadside/Median Concrete Structure	15	28	0	0	0	6
Unguarded Overhead Bridge Pillars	4	2	0	0	1	2
Unguarded Bridge/Jersey Wall	3	5	1	3	0	0
Unguarded Underpasses	6	9	0	0	0	0

Guardrails absent or ineffective (2016)

Run-out length improved



Bull-nose type end treatment

Source: RASSI Database – JP Research India Pvt. Ltd.

Effect on overall fatalities on MPEW

Year	Killed	% Reduction from 2016
2016	151	-
2017	105	30%
2018	110	27%
2019	92	39%

Source: Maharashtra State Highway Police
https://highwaypolice.maharashtra.gov.in/en/reports/

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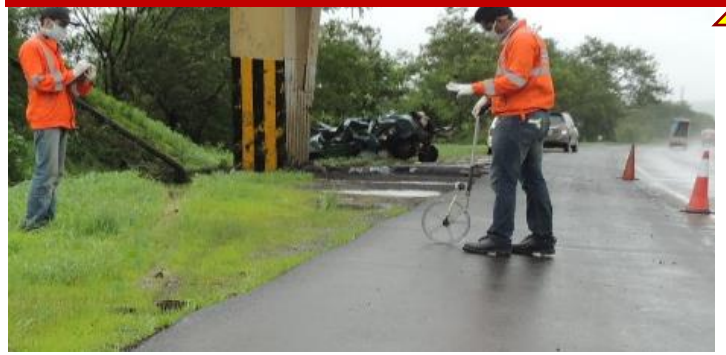
SUMMARY

CRASH DATA COLLECTION &ANALYSIS

DATA-DRIVEN ACTION

Kolkata City:
35% reduction in fatalities
(413 in 2015 to 267 in 2019)
Source: Kolkata Traffic Police

TARGETED IMPROVEMENTS



Mumbai – Pune Expressway:
39% reduction in fatalities
(151 in 2016 to 92 in 2019)
Source: Maharashtra State Highway Police

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PART 7:
CRASH DATA ANALYSIS FOR A HIGHWAY STRETCH

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