Accident Data and Causal Analysis

IRF India 6th Webinar: Accident/Crash Data Collection & Management

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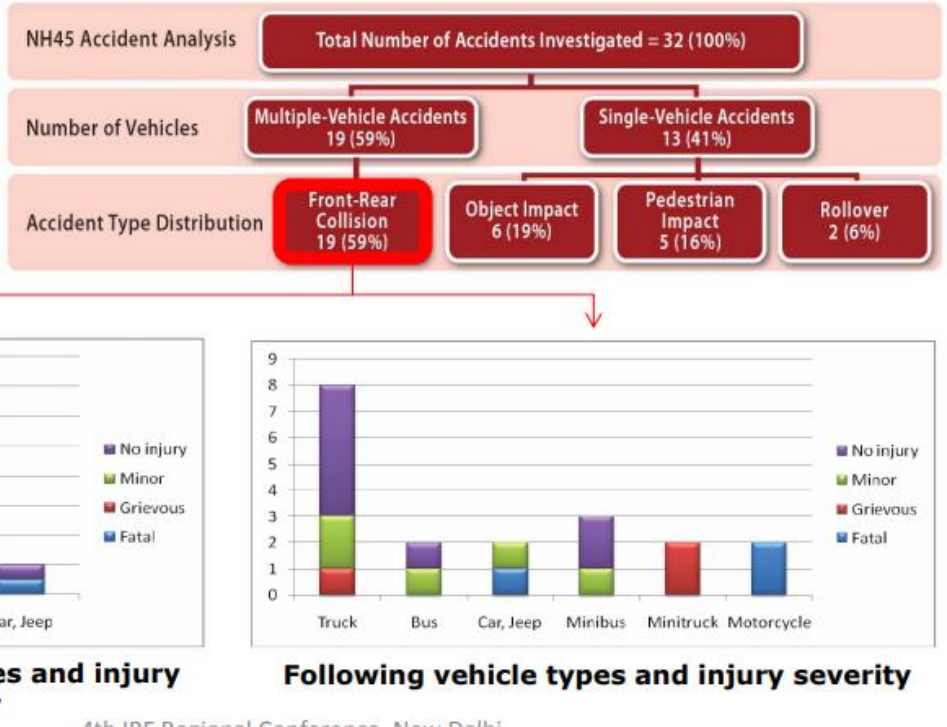
FIRST ON-SITE CRASH INVESTIGATION STUDY
NH45, KANCHIPURAM DIST (2008)

- 75 km stretch of NH45 from Otteri to Acharapakkam (Kanchipuram dist).
- 32 accidents investigated on-site in 45 days.



Leading vehicle types and injury severity

Following vehicle types and injury severity

24 Oct 2009 4th IRF Regional Conference, New Delhi 8

4th IRF Regional Conference on Accident Prevention: Road Safety Measures 23-24 Oct 2009

- No head-on collisions observed due to wide median.
- Problem:

  Front-Rear Collisions with trucks as "leading" vehicles.
- Cause: (Pre-accident condition of "leading" trucks)

  Trucks slowing down, stopping/parking or breaking down.
- Infrastructure:
  - U-turn (Gap in median) design.
  - Lack of acceleration and deceleration lanes.
  - Insufficient shoulder width.
  - Highway design does not consider truck dimensions and turning radius.

Source: IRF India website
https://www.indiairf.com/IRF%20CONFERENCE%20%20PROCEEDINGS/Presentations%20from%20Technical%20Sessions/Ravishankar%20Rajaraman.pdf

TODAY, 13 YEARS LATER…
INDIA'S ONLY IN-DEPTH ROAD ACCIDENT DATABASE

www.rassi.in

RASSI
FUELLED BY SCIENCE.DRIVEN BY DATA.

contact@jpri.in


Vehicle examination


Site examination


Victim interview


Medical reports


Crash reconstruction


Injury analysis

- 500 parameters covering accident characteristics, road engineering, vehicle engineering, victim details and injuries.
- Stored and analyzed in a relational database with in-depth data on 5000+ road accidents and counting.
- Nationally representative sample for a period of 9 years (2011-2019).

Personal identification such as names, vehicle regn, contact numbers, etc. are NOT stored in the analytical database.

POLICE ACCIDENT DATA COLLECTION

Image Source: JP Research

- Extensive experience of collecting and coding police accident data.
- Over 40,000 police accident reports coded in a standardized format from these states.
  - Tamil Nadu
  - Karnataka
  - Maharashtra
  - Gujarat
  - West Bengal
  - Rajasthan
  - Delhi
  - Haryana
  - Kerala

POLICE ACCIDENT DATA HELPS IN IDENTIFYING…

Crash Configuration

JP Research India Pvt Ltd 6 June 2013

SH17 Police Data: Crash Configuration

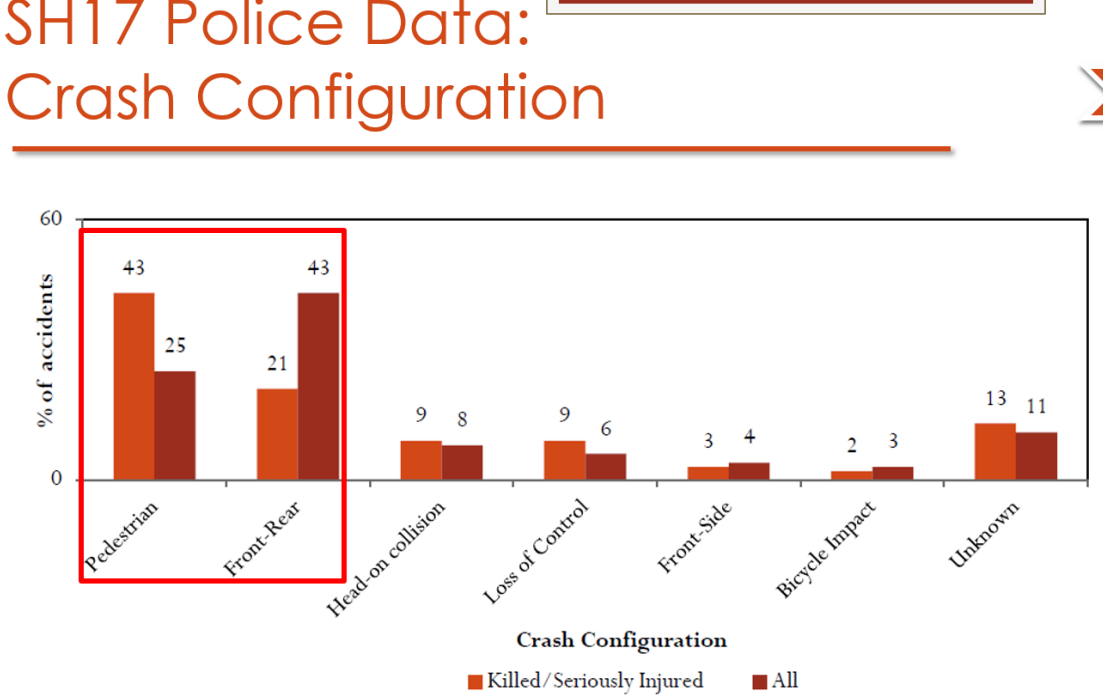


Figure 10: Percentage of accidents by crash configuration and injury severity

Collision Partner

JP Research India Pvt Ltd 6 June 2013

SH17 Police Data: Pedestrian Crashes

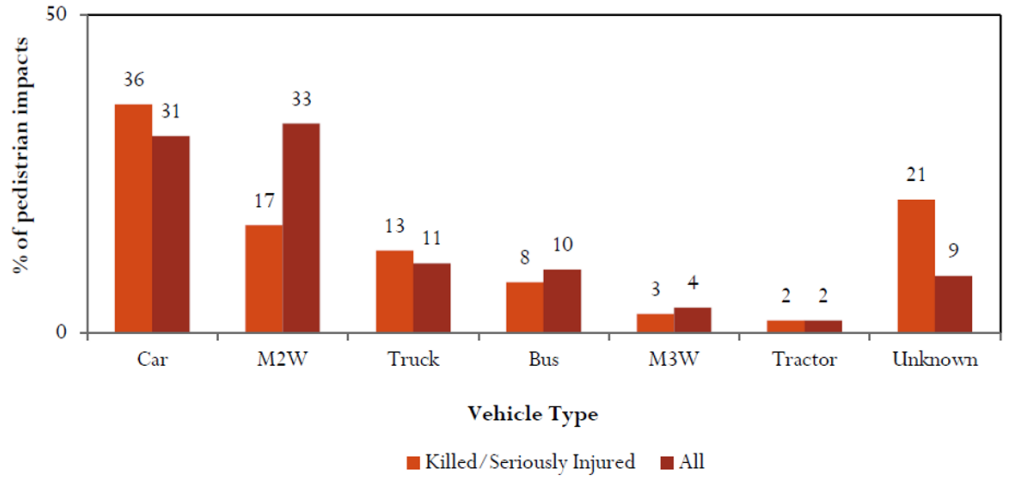
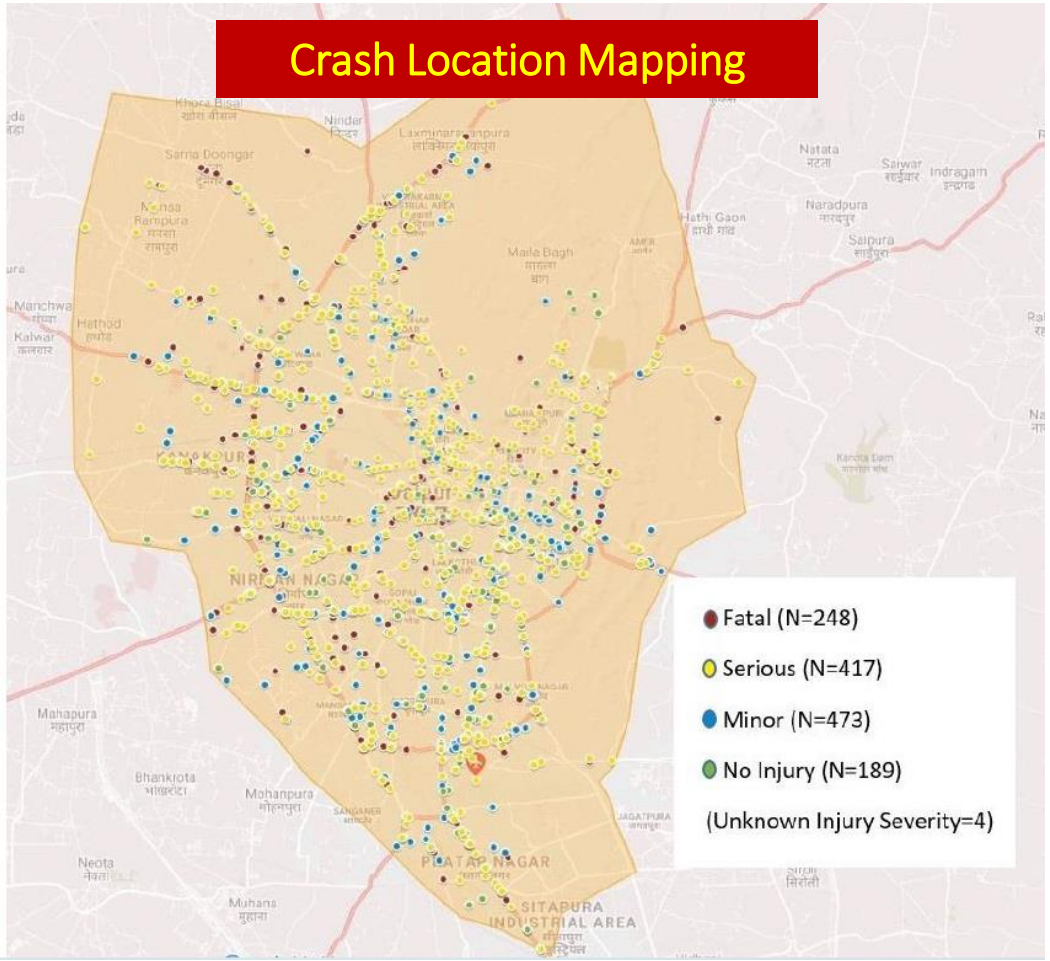


Figure 13: Percentage distribution of vehicles involved in pedestrian impacts by struck vehicle type and the resulting injury severity of the pedestrian on SH17

Source: iRAP Baseline Data Collection Report – Gujarat Phase (2011-12); Slides from JP Research presentation at GRSF, World Bank Workshop, 4-7 June 2013

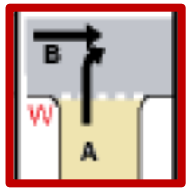
POLICE ACCIDENT DATA HELPS IN IDENTIFYING…

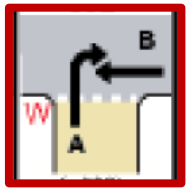
Crash Location Mapping



Source: JP Research Jaipur Accident Investigation Report (2019)

Pre-crash events



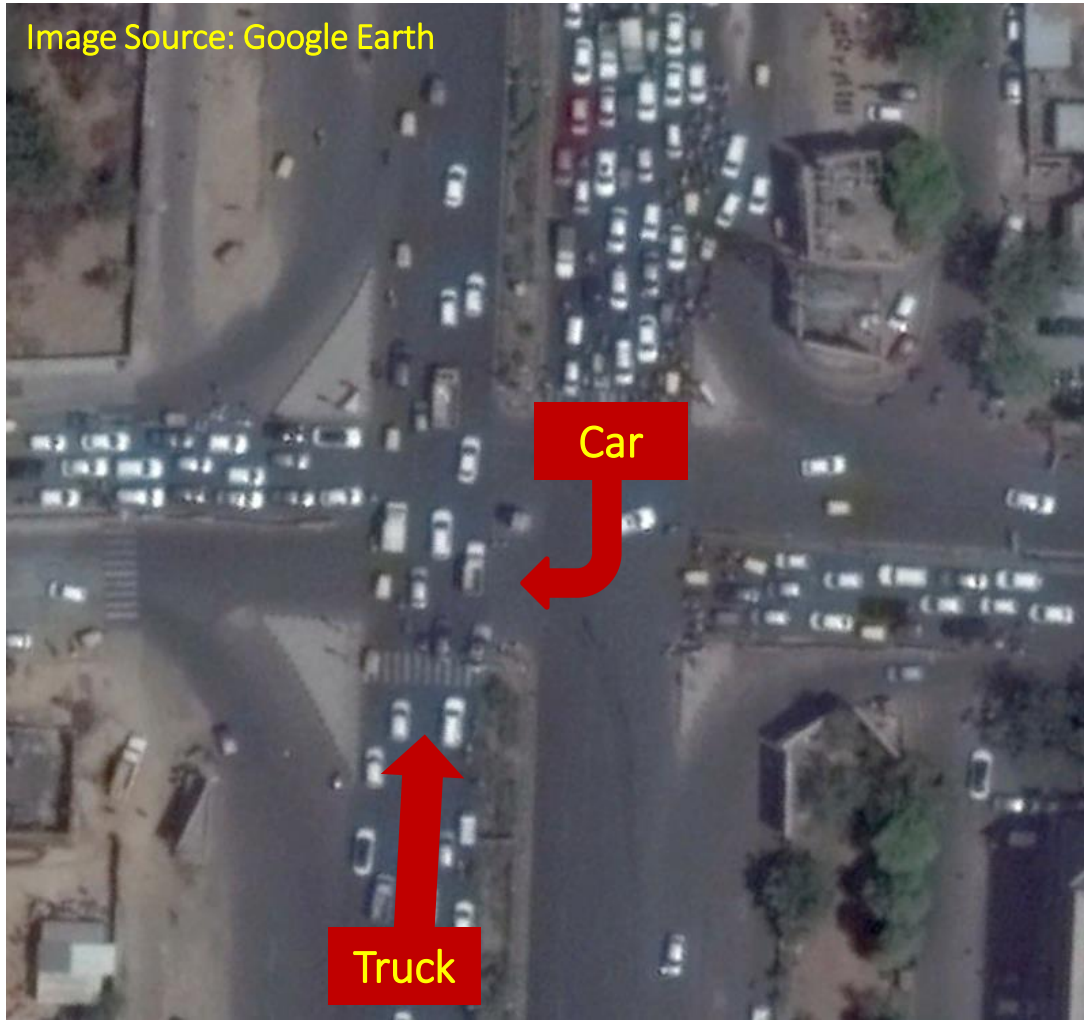


TURNING/ CROSSING VEHICLE	GOING STRAIGHT / CROSSING VEHICLE				
	GOING STRAIGHT - Same direction	GOING STRAIGHT - Opposite Direction	GOING STRAIGHT - Unknown direction	CROSSING STREET	REVERSING
Turning Left	4	0	0	1	1
Turning Right	66	49	11	3	0
Turning unknown direction	6	0	13	0	0
Crossing street	0	0	0	49	0
Reversing	0	0	1	0	0
Stopped for crossing/ turning	2	0	0	0	0

Table 4-7 Pre-Crash Manoeuvres of Vehicles in Side/Angle Impact Collisions

Source: Kerala State Transport Project, Final Report by TRL and JP Research

LIMITATION OF POLICE ACCIDENT DATA: *ALL CONTRIBUTING FACTORS ARE NOT CAPTURED*



Truck Driver's Point of View

TTC = 3.785 sec

TTC = 1.985 sec

TTC = 0.885 sec

TTC – Time To Collision
Source: RASSI Database

CAUSAL ANALYSIS USING RASSI DATA
HADDON MATRIX APPROACH

Purpose of scientific crash investigation is to identify all the failures in each of these 9 cells.

		FACTORS		
PHASES		HUMAN	VEHICLE	INFRASTRUCTURE
PRE-CRASH	Crash prevention	1 • Information • Attitudes • Impairment • Police enforcement	2 • Roadworthiness • Working lights • Good brakes • Handling • Speed control	3 • Road design and layout • Speed limits • Pedestrian Facilities
CRASH	Injury prevention during the crash	4 • Use of safety systems	5 • Crash worthiness • Crash protective design • Occupant restraints • Other Safety devices	6 • Crash protective roadside objects
POST-CRASH	Life Sustaining	7 • First-aid skill • Access to medics	8 • Ease of access • Fire risk	9 • Rescue facilities • Congestion

CAUSAL ANALYSIS USING RASSI DATA
HADDON MATRIX APPROACH

		FACTORS		
PHASES		HUMAN	VEHICLE	INFRASTRUCTURE
PRE-CRASH	Crash Prevention	*Car – Violation of right of way* *Tipper – Overloading*	• Roadworthiness • Working lights • Good brakes • Handling • Speed control	*Vision obstruction due to median plantation and fences*
CRASH	Injury prevention during the crash	• Use of safety systems	*Car – Passenger Compartment Intrusion*	• Crash protective roadside objects
POST-CRASH	Life Sustaining	*Car – Improper accident management*	*Car – Occupant Entrapment*	• Rescue facilities • Congestion

Which failure will you address first?

CAUSAL ANALYSIS USING RASSI DATA
KOLKATA CITY - INFRASTRUCTURE FACTORS

Contributing Infrastructure Factors	Number of Accidents	Percentage Influence
Poor pedestrian infrastructure – crossing (102 fatal pedestrians accidents)	102	72%
Poor pedestrian infrastructure – walking alongside (40 fatal pedestrian accidents)	40	28%

TABLE 1: CONTRIBUTING INFRASTRUCTURE FACTORS INFLUENCING THE OCCURRENCE OF 142 FATAL PEDESTRIAN ACCIDENTS.

Contributing Infrastructure Factors	Number of Accidents	Percentage influenced
Poor road markings/signage (27 M2Ws, 16 Unknown vehicles, 13 Trucks, 5 Cars, 5 Buses)	66	100%
Object impact - roadside/median - manmade structures (14 M2Ws)	14	21%
Undivided road (5 M2Ws)	5	8%

TABLE 6: CONTRIBUTING INFRASTRUCTURE FACTORS INFLUENCING THE OCCURRENCE OF THE 66 FATAL M2W ACCIDENTS.

Source: JP Research Kolkata Accident Study – 2015 Annual Report

CAUSAL ANALYSIS USING RASSI DATA
KOLKATA CITY – IMPROVING ROAD MARKINGS

- For every fatal accident, Kolkata Traffic Police (KTP) was provided a report with infrastructure counter measures.
- Counter measures mainly focused on repositioning and maintaining lane lines and stop lines.
- KTP has a Road Marking and Signage team for implementation.
- Other measures, not in their control, were forwarded to concerned authorities.

CAUSAL ANALYSIS USING RASSI DATA
KOLKATA CITY – IMPROVING ROAD MARKINGS

- Poor placement of road markings
- Inappropriate road user behavior

- Proper placement of road markings
- Improved road user behavior through effective enforcement

Year	Fatalities	% Reduction from 2015
2015	413	-
2016	407	1.5%
2017	329	20%
2018	294	29%
2019	267	35%

Source: Kolkata Traffic Police

RASSI crash data analysis indicates that a lot is still to be done to reduce fatalities further. Footpath width and surface quality, traffic signal timings, sight distance issues due to median plantation, bus stop locations, etc.

Image Source: JP Research, Kolkata

SMALL DETAILS MATTER…

Image Source: https://circleofcricket.com/post_image/post_image_583da66.PNG

CAUSAL ANALYSIS USING RASSI DATA
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

CAUSAL ANALYSIS USING RASSI DATA
MPEW - INFRASTRUCTURE FACTORS (2012-2014)

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

Guardrails are a solution for the 4 problems identified.

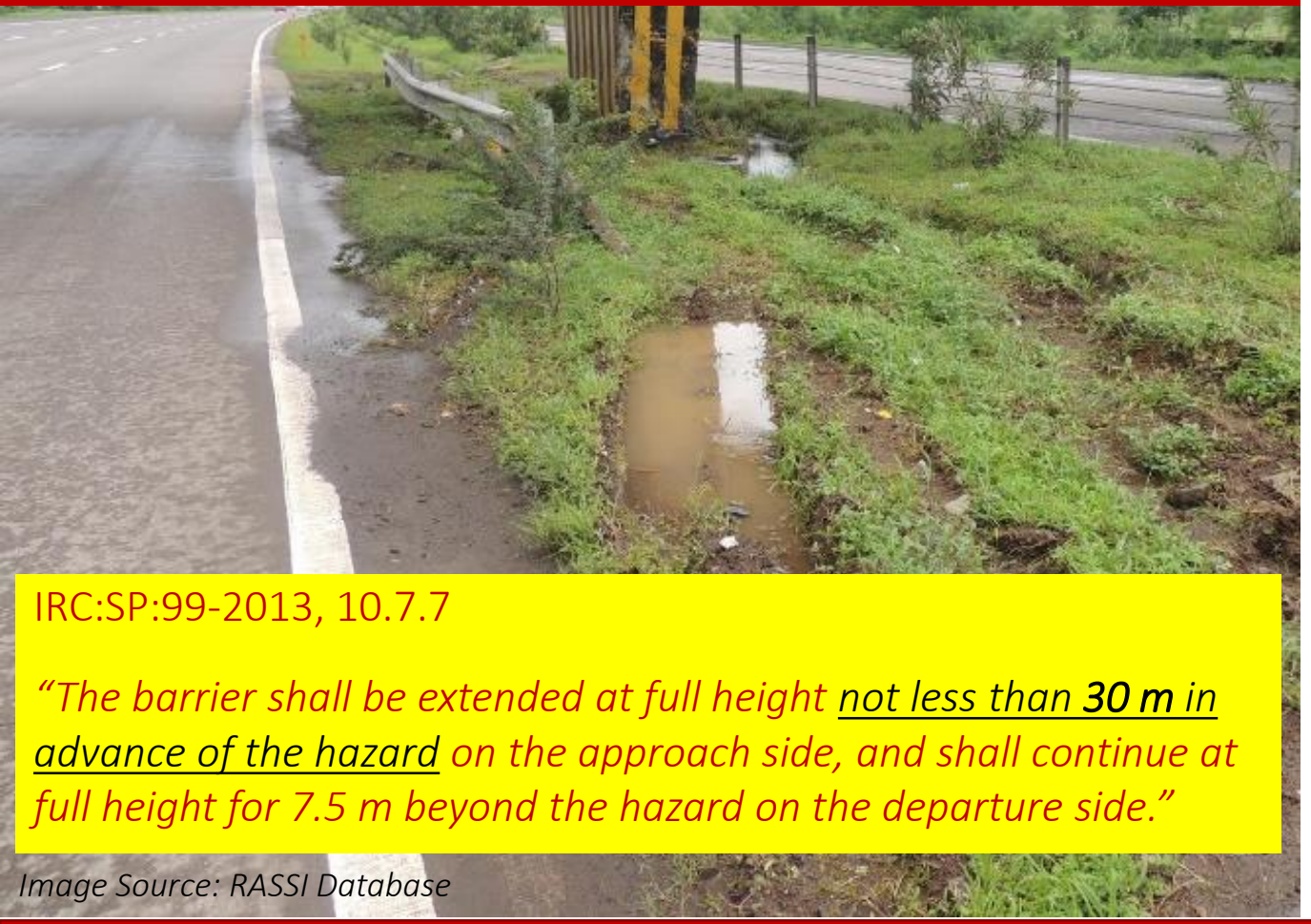
But some locations with guardrails did not show effectiveness.

Image Source: RASSI Database

Table Source: MPEW Road Safety Survey Report (2015), http://savelifefoundation.org/wp-content/uploads/2016/12/V3_MPEW-Road-Safety-Survey-Report_SC2-1.pdf

CAUSAL ANALYSIS USING RASSI DATA
MPEW - WHY ARE GUARDRAILS INEFFECTIVE?

Guardrail run-out length too short



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

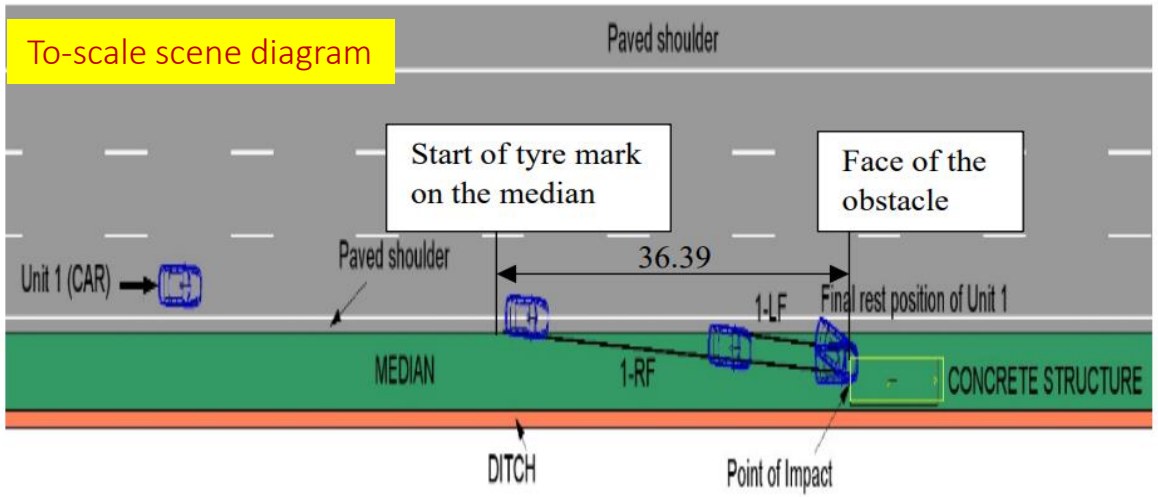
Guardrail-end tapers can launch a speeding vehicle into air

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."

CAUSAL ANALYSIS USING RASSI DATA
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

CAUSAL ANALYSIS USING RASSI DATA
MPEW – BEFORE/AFTER ANALYSIS

Run-out length improved

Bull-nose type end treatment

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

Source: RASSI Database

Effect on overall fatalities on MPEW

Year	Killed	% Reduction from 2016
2016	151	-
2017	105	30%
2018	110	27%
2019	95	37%

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

SUMMARY

1. Police data helps in identifying road safety problems.

- Crash configurations, Collision partners, Locations, Pre-crash events, etc.

2. In-depth scientific crash data helps in understanding road safety problems.

- Causal analysis using Haddon Matrix
- Cases studies were causal analysis using RASSI crash data
  - Kolkata city experience – road markings and enforcement improved intersection safety
  - Mumbai-Pune Expressway experience – effective guardrails reduced run-off road fatalities

3. Share learnings from data-driven approaches.

- Create a baseline and conduct before/after analysis for effectiveness of implemented measures
- Cite data sources clearly

SUMMARY

GOOD QUALITY CRASH DATA

DATA-DRIVEN ACTION

TARGETED IMPROVEMENTS

Image Source: JP Research

"THE ULTIMATE PURPOSE OF COLLECTING DATA IS TO PROVIDE A BASIS FOR ACTION OR A RECOMMENDATION."
~ W. EDWARDS DEMING

THANK YOU!

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