

Forgiving Roads Design – Way to achieve SDG 3.6

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ABSTRACT

Road engineering is a major component of entire road ecosystem and its design plays a significant role in creating safe or unsafe road environment for any crash to be happen or not. Pillar 2 of Decade of Action for Road Safety talks about “Safer Road Infrastructure” where roads are to be designed to meet atleast 3 star safety ratings to 5 star ratings of safety standards of all types of road users – pedestrians, bicyclists, 2-wheeler and four wheeler motorized vehicles. Thus, a concept of Forgiving roads adopted where roads are designed with considering safety features that accepts the mistakes of road users and reduces the chances of intensity of fatalities and injuries on roads.

Key words: Forgiving Roads, SDG, MoRTH, WHO, Road Safety, Road Engineering, iRAP

Introduction

Road crashes deaths are listed as a leading cause of fatalities among 5-29 years of age group which has become a high public health problem as per the report on Road Traffic Injuries for 2018 published by World Health Organization. The 2nd Decade of Action for Road Safety (2021-2030) having focussed on 5 pillars of road safety viz : i. Road Safety Management, ii. Safe Roads and Mobility, iii. Safer Vehicles, iv. Safer Road Users, v. Post-Crash response. Pillar 2 is dealt with developing safe roads for all types of road users.

The Stockholm Declaration resolution on road safety passed in February 2020 in Stockholm extended the target of Sustainable Development Goals (SDG) 3.6, i.e reducing 50 percent road crash fatalities and injuries globally by 2020 to 2030. All member countries including India is signatory of this resolution and abide to achieve target of 50 percent decrease in road crash deaths and injuries by adopting various safety measures.

Road design and infrastructure is an important component of Safe System Approach to achieve this target of saving lives on roads.

Black Spot Observational Study

One black spot study is been carried out in January 2020 in the State of Jharkhand to identify the major causes of road crashes and issues in road designs which has resulted in black or crash prone spots. Following are the findings which explains about the need of improving safety standards of Road designs focusing on vulnerable road users including pedestrians, bicyclists and 2 wheeler motorized vehicles.

While studying India’s road accident data of year 2018, major road crashes are occurring on State highways in the State of Jharkhand. Following Table-1 shows the pattern of road crashes in Jharkhand and India as per road types:

These crashes are severe and put Jharkhand State on 6th position among other States of country. Following Table 3 also depicts that severity rate is more than double of average country rate of India and is

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State/ UT	Road Type	Road Accidents			Death			Injuries				
		2016	2017	2018	2016	2017	2018	2016	2017	2018	Rank	
Jharkhand	NH	1112	1130	1027	1935	1828	1616	19	1222	1250	1122	18
	SH	936	959	1035	1704	1678	1686	18	982	1035	1139	15
	Other	633	945	1199	1293	1692	2092	19	823	971	1281	17
India	NH	46406	47223	48550	142359	141466	140843		52075	53181	54046	
	SH	37497	35987	36429	121655	116158	117570		42067	39812	40580	
	Other	52168	51586	52747	216638	207286	208631		56643	54920	56791	

(Source: Road Accidents in India 2018, MoRTH, GoI)

State or UT	Persons Killed per 100 crashes			
	2015	2016	2017	2018
Jharkhand	56	61.4	62.6	65.7
India	29.1	31.4	31.8	32.4

Table 3. Road Crashes identified according to Road Features in 2018. According to Table 4, most of the road crashes and deaths are occurring on Straight and Curved roads in the State of Jharkhand.

State/UT	Straight Road			Curved road			Bridge		
	Road Accidents	Death	Injuries	Road Accidents	Death	Injuries	Road Accidents	Death	Injuries
Jharkhand	2209	1494	1685	1144	740	988	224	170	207
India	306855	96831	308476	64100	19996	68878	16125	5693	16782

Table 4. Road Crashes identified according to Type of Junctions in 2018. Following table shows that maximum deaths are occurring at T-Junction and Y-Junctions.

State/UT	T-Junction			Y-Junction		
	Road Accidents	Death	Injuries	Road Accidents	Death	Injuries
Jharkhand	1006	576	495	623	397	324
India	57652	15608	55589	26220	7866	24003

Table 5. Road Crashes identified according to Type of Impacting Vehicles/Object in 2018. Data clearly shows that Motorized Two Wheeler Riders are most affected vehicle occupants among all vehicle occupants.

State/UT	Motorized Two Wheelers			Auto Rickshaw			Car/Jeep/Van/Taxi			Bus		
	Road Accidents	Death	Injuries	Road Accidents	Death	Injuries	Road Accidents	Death	Injuries	Road Accidents	Death	Injuries
Jharkhand	3486	1376	1321	484	286	407	2214	284	3141	425	100	803
India	208881	47560	153585	27385	6624	33457	113490	30811	123517	30746	10507	42940

increasing every passing year. Table 2: Severity of Deaths per 100 road crashes in India: 2015-2018.

Findings

Above stated various classification of road accident data clearly depicts those major fatal crashes are occurring on State Highways on straight and curved roads at T and Y junctions. Motorized two-wheeler

riders and pedestrians are most vulnerable to these crashes and losing their lives in maximum number. The major cause of these fatal crashes is speeding and driving under influence of alcohol and drugs. These crashes are severe and shares more than double severity rate of average country rate.

Ensuring the minimum safety performance standards for all types of road users while adopting an

Table 6. Road Crashes identified according to Type of Collision in 2018. Pedestrians are second most vulnerable target group who are suffering injuries and deaths on roads of Jharkhand.

State/UT	Vehicle to Vehicle			Vehicle to Pedestrian			Vehicle to Non-Motorised Vehicle			Vehicle to Animal		
	Road Accidents	Death	Injuries	Road Accidents	Death	Injuries	Road Accidents	Death	Injuries	Road Accidents	Death	Injuries
Jharkhand	2412	1609	1599	961	345	617	593	339	298	179	106	88
India	253253	78766	256919	78974	22656	64997	22248	8753	20035	5902	2267	4917

Table 7. Road Crashes identified according to Type of Offenses/Causes in 2018. Following data clearly shows that Speeding is major cause of fatal crashes in the State of Jharkhand.

State/UT	Speeding			Driving under influence of Alcohol & Drug			Wrong side driving		
	Road Accidents	Death	Injuries	Road Accidents	Death	Injuries	Road Accidents	Death	Injuries
Jharkhand	3064	2052	2288	517	328	321	401	299	269
India	310612	97588	316421	12018	4188	9944	24781	8764	24100

State/UT	Red Light Violation			Mobile phone use while Driving		
	Road Accidents	Death	Injuries	Road Accidents	Death	Injuries
Jharkhand	47	31	34	310	206	130
India	4441	1545	4126	9039	3707	7878

integrated road safety approach are an important necessity for road infrastructure developments and its investments as per recommendation of Stockholm Declaration on Road Safety, 2020.

Also, to lower down speed of 30km/h maximum at those areas where mix traffic of VRUs and high-speed vehicles are prominent to protect the pedestrians and other VRUs from fatal road crashes by strengthening speed management programs and its law enforcement on ground is the key recommendation of Stockholm Declaration.

Further, there are 12 Global Performance Road Safety Targets to improve the road safety scenario by 2030 where target 3 and 4 dealt with achieving minimum three-star rating or better for all road users by 2030.

Motor Vehicle Rules Regulations 2017, Govt of India, point no. 16 defines "Speed Rules", where point no. 16.5 fixes maximum Speed Limit of 25kmph nearby School, Hospitals, Pedestrian Zones and Construction zones by all means of vehicles at all types of roads.

The Forgiving Roads

In 1960 a new concept has been emerged popularly known as Forgiving roads which stated that road infrastructure plays an important role in contributing enhance or decrease the impact of road crashes

intensity. There are various contributing factors of road crashes such as behavior of driver including driving in fatigue, high speed, under influence of alcohol, vehicle defects such as failure of tyre pressure, breaks or steering etc and poor road infrastructure such as low visibility, poor alignment, non-availability of road markings and signs, inadequate drainage, pavement friction and delineation etc.

Thus, according to Dupre and Bisson, the forgiving roads are self-explaining which provide safer road environment to driver by providing appropriate speed designed road infrastructure which reduces the need for various multiple road signs in a complex traffic which reduces the risk of driving errors as well.


Also, as per Herrstedt, there are multiple factors which depends on a road user behaviour that has been adapted while designing road network such as speed management, traffic laws, road markings and signages, road geometry, road lighting, road surface and curvatures etc. Hence the self-explaining roads or forgiving roads are designed as per combination of there factors.


Summary of Method Used for Black Spot Observational Study

A team of researchers visited over 40 km stretch from Bhagat Singh Chwok, Khunti to Marcha Mod

Location Name	Marcha chowk Mod	GPS Coordinator	22.904723, 85.003637
Location No.	01	Road Name	SH03



Location Summary: Two lane undivided road with a Y-intersection. Small road is joining from left side. This road has shops and houses on both side of the road. Pedestrian movement and bus stop is also present.

ROAD SAFETY CONCERNS	POSSIBLE INFRASTRUCTURE COUNTER MEASURES
<p>1. Wrong Speed Hump design and No warning sign of Speed Hump and Intersection ahead</p> 	<ul style="list-style-type: none"> a. Painted Speed Humps designs and warning signage in accordance with IRC 67 2012 to be visible at all time of the day. b. Doppler Audible Lines can be implemented at least 200m prior to intersection in both directions. (Details given in the Appendix) c. Provide an intersection sign board to warn vehicles about upcoming intersection in accordance with IRC 67 2012 for vehicles travelling in both directions. d. Blinkers can also be provided to warn vehicles approaching the intersection at night.

<p>2. Insufficient pedestrian infrastructure on the intersection</p> 	<ul style="list-style-type: none"> a. Provide pedestrian crossing at the intersection to be visible at all times of the day. b. Warning signage for Speed limits, joining road and pedestrian crossings in accordance to IRC 67 2012 to be placed on both sides of the road in either travel direction.
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Location Name	Left turn to Marcha- Rania marg 500 mts : Marcha chowk Satal	GPS Coordinator	--
Location No.	1.1	Road Name	Other District Road linked to SH03



Location Summary: Single lane undivided road with S-Curved shape. This road is joining from left side to Marcha Mod, SH03. Mostly barren land however Hatwada market opens every Wednesday and Friday at corner of this road. Hence heavy pedestrian and vehicle flows on both days every week. This road also has bicycle movement. Vehicles travelling on high speed at both sides.

ROAD SAFETY CONCERNS	POSSIBLE INFRASTRUCTURE COUNTER MEASURES
<p>1. Speed limit Sign is present however no speed calming measures adopted looking to the Hatwara Market heavy pedestrians and vehicles movement days.</p>  	<ul style="list-style-type: none"> a. Painted Speed Humps designs and warning signage in accordance with IRC 67 2012 to be visible at all time of the day. b. Warning signage for Speed humps, joining road and pedestrian crossings in accordance to IRC 67 2012 to be placed on both sides of the road in either travel direction. c. Blinkers can also be provided to warn vehicles approaching the intersection at night.

Location Name	Dorma Jharkhand 835227	GPS Coordinator	23.007788, 85.166077
Location No.	02	Road Name	Dorma Village Mod, SH03

Location Summary: A two-lane undivided straight section of the SH03 passing through Dorma village intersection. Joining roads on the both sides of the road along with other unofficial joining. Heavily populated intersection with bus stops and shops on both sides. Parking of Heavy vehicles on both sides of roads encroaches and obstruct clear vision of drivers of both sides and joining roads.

ROAD SAFETY CONCERNS	POSSIBLE INFRASTRUCTURE COUNTER MEASURES
<p>1. Repainting of Speed Humps and Correct placement of Warning Signs at both sides</p> 	<ul style="list-style-type: none"> a. Painted Speed Humps designs and warning signage in accordance with IRC 67 2012 to be visible at all time of the day. b. Doppler Audible Lines can be implemented at least 200m prior to intersection in both directions. (Details given in the Appendix) c. Provide an intersection sign board to warn vehicles about upcoming intersection in accordance with IRC 67 2012 for vehicles travelling in both directions. d. Blinkers can also be provided to warn vehicles approaching the intersection at night.
<p>2. Insufficient pedestrian infrastructure on the intersection</p> 	<ul style="list-style-type: none"> a. Provide pedestrian crossing at the intersection to be visible at all times of the day. b. Warning signage for joining road and pedestrian crossings in accordance to IRC 67 2012 to be placed on both sides of the road in either travel direction.

<p>3. Vision Obstruction on joining roads and main roads due to Roadside parking of vehicles.</p>  	<ul style="list-style-type: none"> a. Provide speed breakers and other markings for joining roads in accordance with IRC 67 2012 to be visible at all times of the day. b. Posting warning signage for intersection ahead and speed limit signs on highway in accordance with IRC 67 2012 for vehicles travelling in both directions from side roads merging to main road of State Highway. c. Reconsider placement of STOP sign. Without STOP on the road marking and solid lines, the STOP is misleading at this position. Also it is encroached by illegal parking. d. Provisions for proper parking of vehicles. e. Trimming of bushes and trees time to time basis. f. Electric Poll also obstructs and could be dangerous object which is wrongly placed. Must be shifted to safer place.
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on SH03, Jharkhand for observational field study. Two major spots named Marcha Mod and Dorma Village Intersection, identified black spots, were studied.

- The most frequent concern identified is faded speed humps, its design and wrong placement of warning signs. IRC codes observe the importance of speed humps in guiding and mandates that the speed humps are to be visible at all times of the day. The identified locations requiring repainting and updating of these faded speed humps designs and its warning signage placements.
- Another important concern identified is the missing pedestrian facilities like pedestrian crossing, pedestrian refuge spaces and pedestrian crossing signage. Pedestrian refuge spaces are of importance given that most locations are on highways. Refuge spaces are clear spaces of 2m width accommodated within the median space. The space should be at-level with the pedestrian crossing. This will provide space for pedestrians to wait and be without physically interacting with motor traffic.
- Most locations were improperly lit or not lit. Provision of light does improve conspicuity and a sense of security but further studies are recommended to be done to quantify the need for the lights to decide on the modalities of lighting.

Conclusion

A major concern for all the roads is higher speed limits according to the road type and environment which is leading severity of road crashes and increasing deaths and serious injuries. Thus, it is highly recommended to notify new safe speed limits as per road type and environment according to MoRTH Speed limit guidelines and rules.

A proven measure for speed control, Doppler Audible Lines, is recommended at locations with high-speed accidents. This measure has been proven to be effective in reducing the accidents on a busy highway in India.

The compilation is a preliminary report based on the site visit and the pictures taken then. Hence, the recommendations are limited to those immediately identifiable concerns. It must be noted that some locations have concerns of speeding, vision obstruction, exposure road side objects, channelizing of traf-

fic and the like which would require further in-depth study to make informed recommendations.

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