Post Construction iRAP Assessment, India

Mehsana – Himmatnagar SH-55, Gujarat
April 2019

GRSF Global Road Safety Facility

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iRAP INTERNATIONAL ROAD ASSESSMENT PROGRAMME

IndiaRAP INDIAN ROAD ASSESSMENT PROGRAMME

About iRAP

The International Road Assessment Programme (iRAP) is a registered charity dedicated to saving lives through safer roads.

iRAP works in partnership with government and non-government organisations to:

- inspect high-risk roads and develop Star Ratings and Safer Roads Investment Plans
- provide training, technology and support that will build and sustain national, regional and local capability
- track road safety performance so that funding agencies can assess the benefits of their investments.

The programme is the umbrella organisation for IndiaRAP, EuroRAP, AusRAP, usRAP and KiwiRAP. Road Assessment Programmes (RAP) are now active in more than 70 countries throughout Europe, Asia Pacific, North, Central and South America and Africa.

iRAP is financially supported by the FIA Foundation for the Automobile and Society and the Road Safety Fund. Projects receive support from the Global Road Safety Facility, automobile associations, regional development banks and donors.

National governments, automobile clubs and associations, charities, the motor industry and institutions such as the European Commission also support RAPs in the developed world and encourage the transfer of research and technology to iRAP. In addition, many individuals donate their time and expertise to support iRAP.

About IndiaRAP

IndiaRAP is proudly hosted by the Asian Institute of Transport Development, an independent, not for profit organization based in Delhi and supported by iRAP with sponsorship from FedEx Express. IndiaRAP benefits from the global charitable work of iRAP across more than 90 countries worldwide. As part of the iRAP family that includes development agency, government and non-government partners the IndiaRAP team joins a global community committed to a world free of high-risk roads.

For more information

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To find out more about the programme, visit www.irap.org.
You can also subscribe to 'WrapUp', the iRAP e-newsletter, by sending a message to icanhelp@irap.org.

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Table of Contents

List of Figures

List of Tables

1 Introduction

As part of efforts to curb road deaths and serious injuries, the World Bank Global Road Safety Facility (GRSF) invited the International Road Assessment Programme (iRAP) to work with the Ministry of Road Transport and Highways (MoRTH), public works departments, research institutes, and local engineering firms. The Ministry of Road Transport and Highways (MoRTH) and the State Public Works Departments (PWDs) of Kerala, Andhra Pradesh, Karnataka and Gujarat prepared road improvement projects financed by World Bank loans, and the iRAP road safety assessments were undertaken as part of these projects in the year of 2012-2013. The iRAP assessments were conducted for major state highway network in these states at two stages, (1) before improvement (baseline), and (2) during design stage. The iRAP assessment at design stage served a tool to ensure that proven and cost-effective road safety treatments are included in the designs.

The Mehsana-Himmatnagar road (SH-55) was assessed post-construction in April 2019. This brief report shows the baseline and as built Star Ratings and comparison of key road infrastructure risk attributes.

SH-55 connects major cities Mehsana and Himmatnagar and approximately 66km long. The road has been developed from single carriageway to dual carriageway (except one major bridge and two railway crossings) as part of GSHP-II project. The construction began in February 2017 and finished in August 2018.

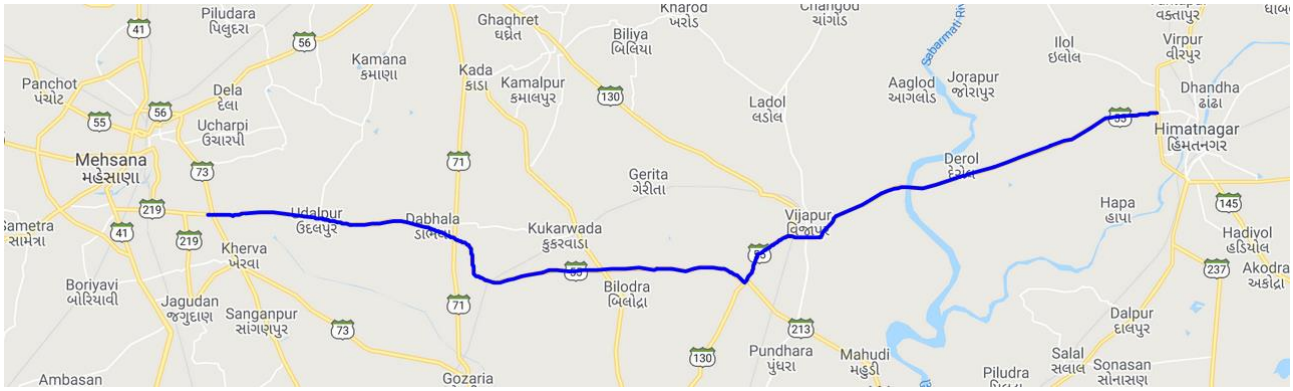

Figure 1 Mehsana – Himmatnagar SH-55 key map

2 Key road attributes

The road has been upgraded to four-lanes from two-lanes (except a bridge and two railway crossings) with provision of concrete barrier median which reduces the risk of head-on collision. Other road improvements for SH-55 include provision of paved shoulder in some sections of road, road markings and signs, improved quality and delineation of intersections, streetlights and pedestrian crossing treatments. Comparison of key road attributes between baseline and as built SH-55 is shown below in the form of pie-charts.

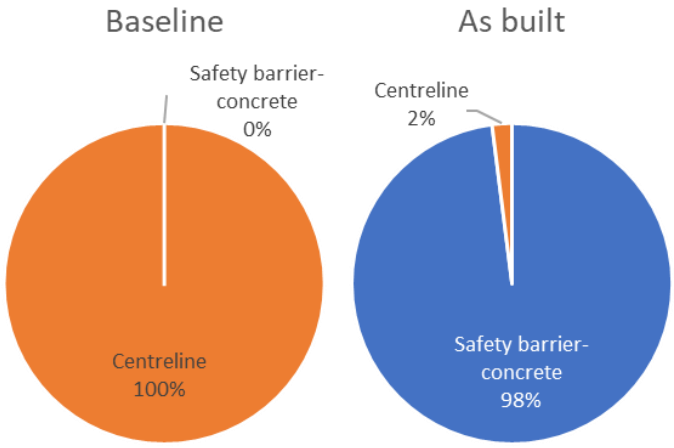

Figure 2 Type of road median

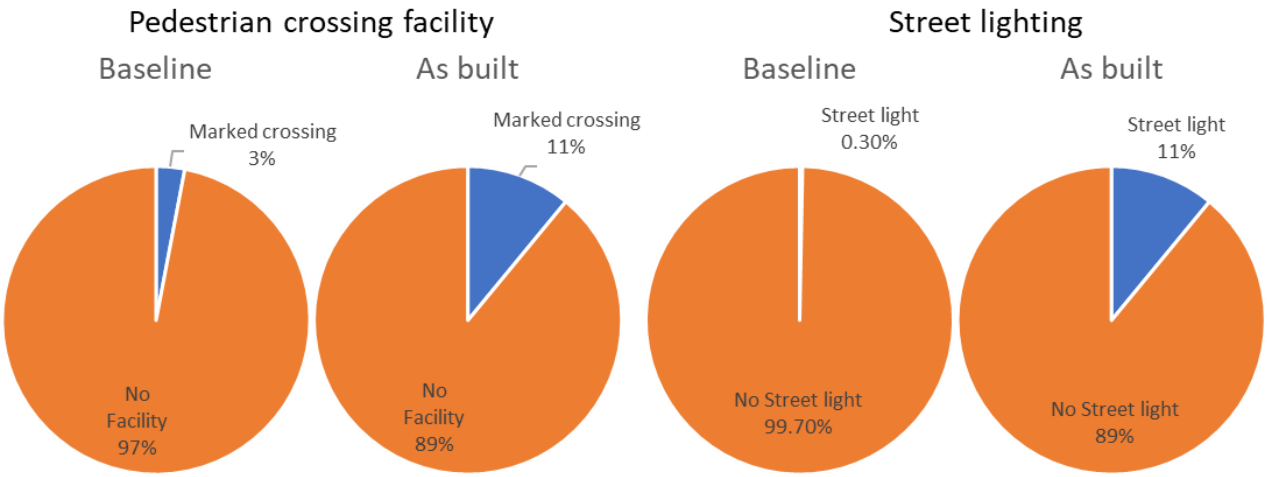

Figure 3 Type of pedestrian crossing facility and presence of streetlight

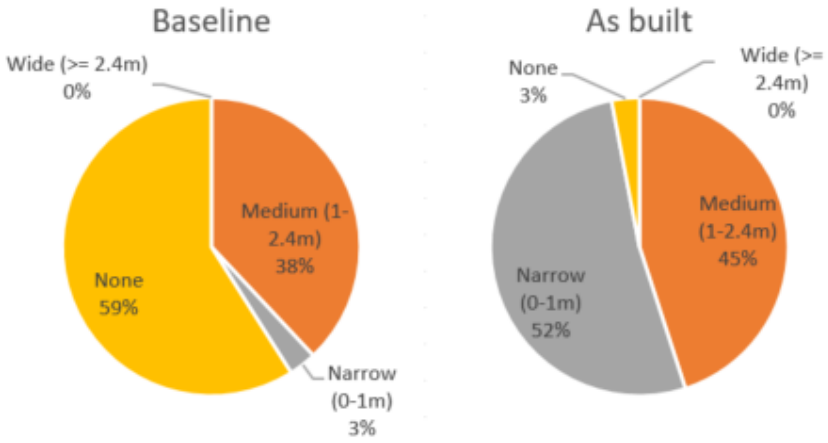

Figure 4 Paved shoulder type

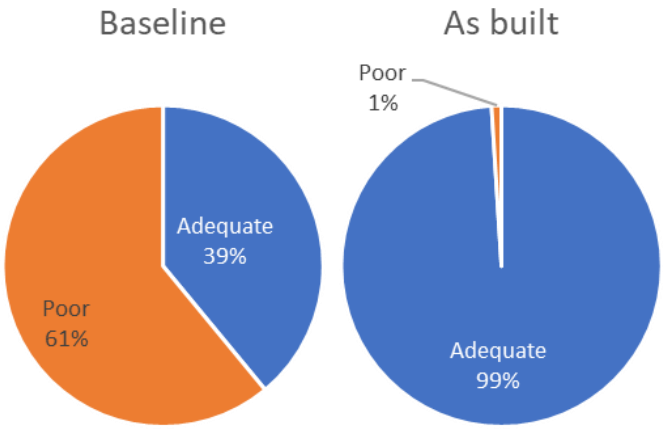

Figure 5 Road delineation (markings and signages)

Vehicle Operating Speed

The safety of infrastructure is heavily influenced by the speed of traffic and without an understanding of the operating speeds it is difficult to assess the safety performance of infrastructure at a given location. All iRAP assessments are based on vehicle operating speeds to ensure that the Star Rating is based on how the road is actively functioning, which in some cases can be above the posted speed limit. The Star Ratings are produced based on the higher value of (1) Posted speed limit, and (2) 85th percentile operating speed. The comparison of these two speeds before and after road improvement is given below.

Table 1 Posted speed limit for baseline and as built road

Posted speed limit	Baseline (% road length)	As built (% road length)
<30kmph	-	4%
40kmph	2%	42%
60kmph	25%	19%
65kmph	-	3%
80kmph	24%	32%
100kmph	49%	-

Table 2 85th percentile operating speeds for baseline and as built road

85th percentile speed	Baseline (% road length)	As built (% road length)
55kmph	19%	-
60kmph	-	12%
80kmph	81%	1%
90kmph	-	87%

The above two tables reveal that the new road has got lower posted speed limit than before however the 85th percentile speed slightly increased. The 85th percentile speed (as built road) was estimated based on the survey vehicle speed in absence of accurate speed data.

3 Star Ratings

The Star Ratings of baseline road were conducted in year 2012. A comparison of the baseline and post construction (as built) Star Ratings are shown in the table below.

Table 3 Baseline and as built road Star Ratings

Star Ratings	Vehicle Occupant		Motorcyclist		Pedestrian		Bicyclist	
	Baseline	As built	Baseline	As built	Baseline	As built	Baseline	As built
5 Stars	0%	1%	0%	0%	0%	1%	0%	0%
4 Stars	2%	6%	0%	2%	0%	3%	0%	5%
3 Stars	33%	91%	24%	78%	4%	6%	13%	47%
2 Stars	16%	2%	27%	19%	14%	56%	29%	46%
1 Star	49%	0%	49%	1%	82%	33%	59%	2%
Totals	100%	100%	100%	100%	100%	100%	100%	100%

The Star Ratings show significant improvement in the 3-star or better road length for all road users except pedestrian, however there is significant reduction in road length rated 1-star from 82% in baseline to 33%. The road sections where significant pedestrian movement is present is the urban area through which the road is passing.

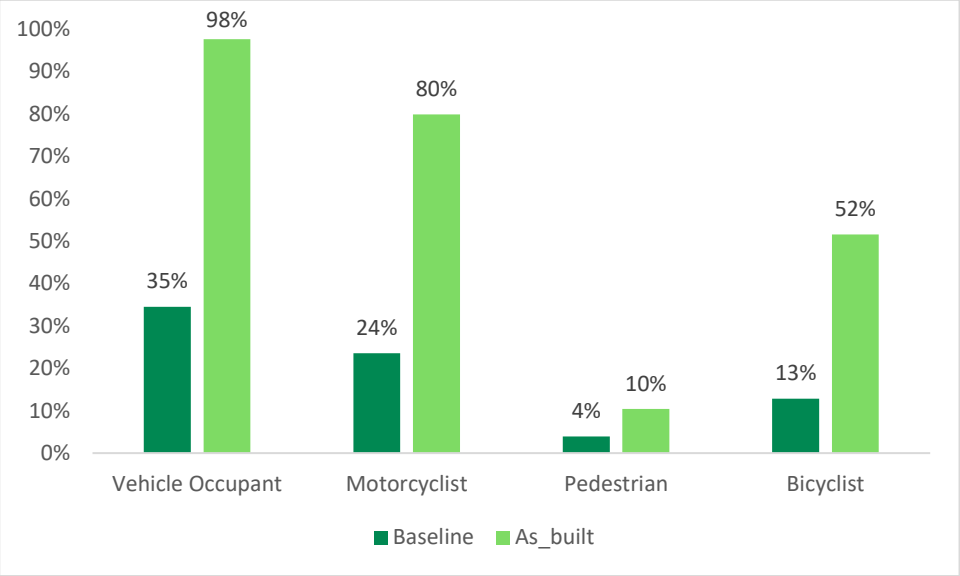

Figure 6 3-star or better road length for Mehsana-Himmatnagar SH55, Gujarat

The Star Rating maps of vehicle occupant given below compares before improvement and after improvement situation.

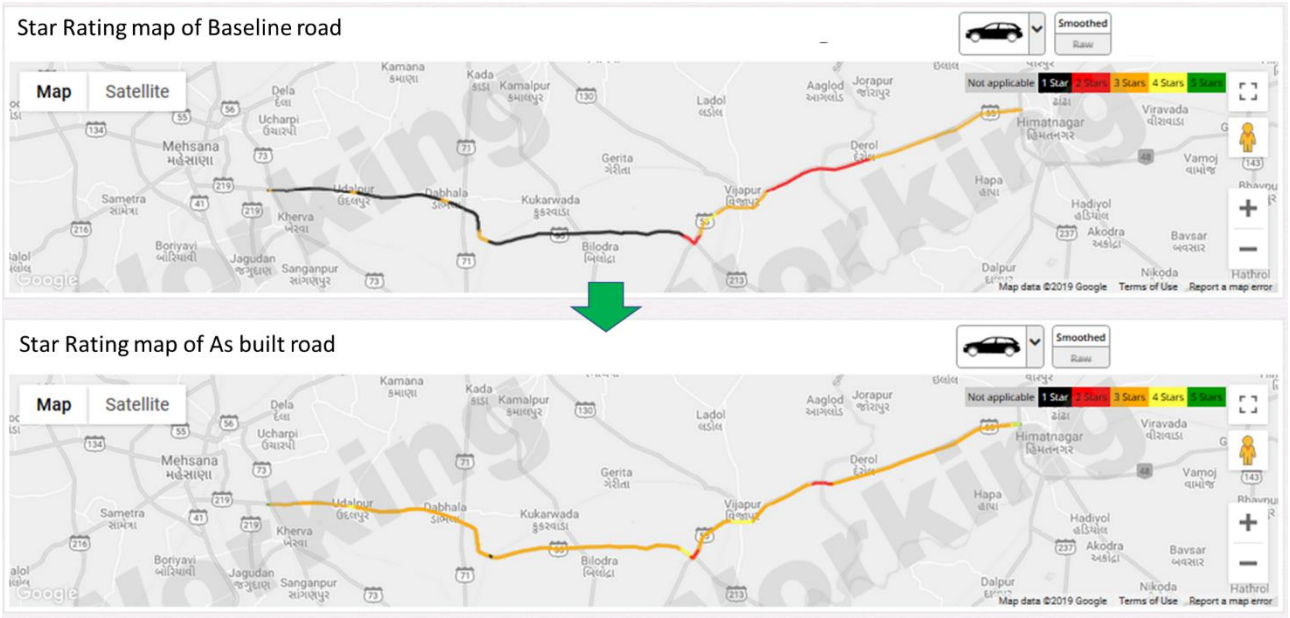

Figure 7 Star Rating map of baseline and as built road for vehicle occupant

As the major pedestrian movement is restricted to urban area it is important to provide safe infrastructure and manage speeds in such areas. The map given below for Star Rating for pedestrian in the urban area of Vijapur shows significant improvement for pedestrian through provision of footpath, pedestrian fence, crossing facilities at intersections and traffic calming measures.

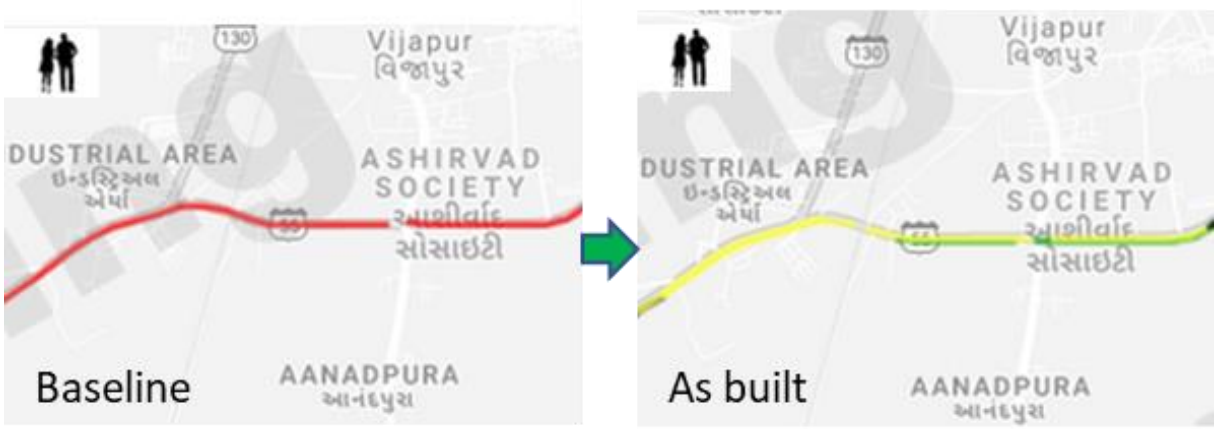

Figure 8 Pedestrian Star Rating map in urban area of Vijapur town

A Star Rating Score (SRS) was calculated for each 100metre segment of SH20 for vehicles occupants, motorcyclists, pedestrians and bicyclists. These scores were then allocated to Star Rating bands to determine the Star Rating for each 100metre of road. However, for the purposes of producing a network level map showing Star Ratings, 100metre is too much detail. Hence, Star Ratings were smoothed (or averaged) over longer lengths in order to produce more meaningful results. The chart (risk worm) with smoothed SRS for vehicle occupant before and after road improvement is given below which shows significant reduction in risk after road improvement.

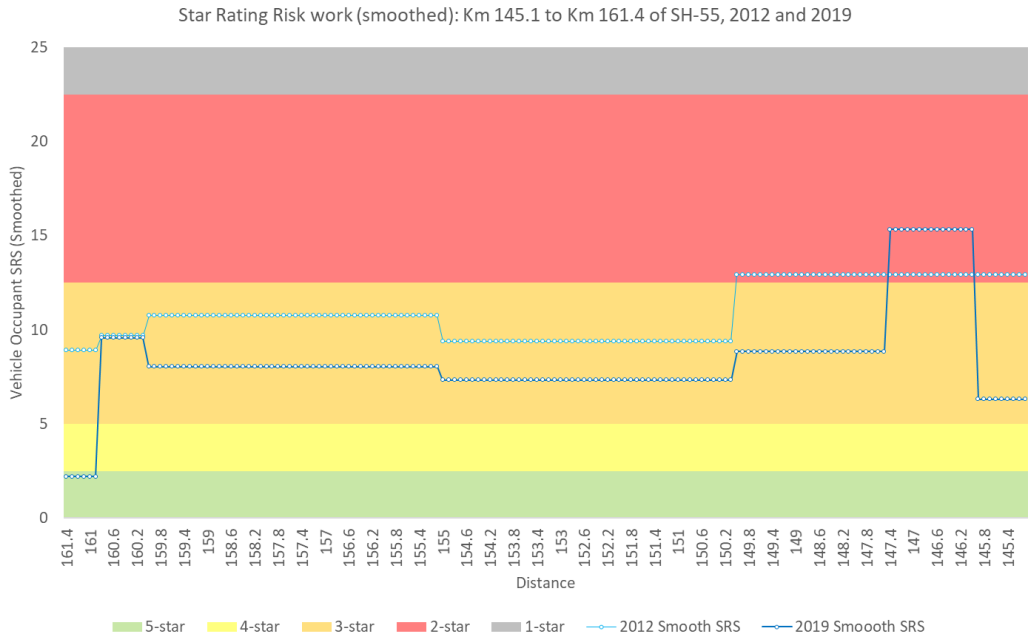

Figure 9 Risk work showing Star Rating Score for vehicle occupant before and after road improvement

Similarly, risk worm prepared for pedestrian shows significant reduction in the risk for pedestrian after improvement of the road given below. Both the charts of vehicle occupant and pedestrian show significant reduction in risk for most of the length. In some road section, the risk tend to increase in the as built road as compared to the baseline which is due to a different smoothing section than baseline.

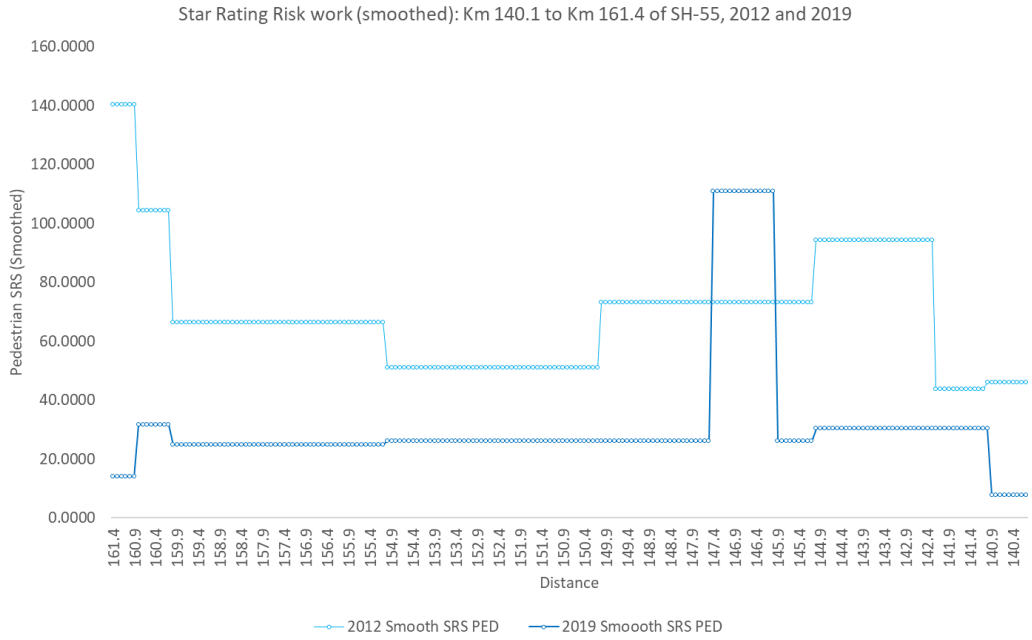

Figure 10 Risk worm showing Star Rating Score for pedestrian before and after road improvement

4 Before and after road images

Select images of the baseline road (year 2012) and post-construction (year 2019) with Star Ratings are given in this section.

Figure 11 Before and after improvement road image, Km 118.3

The new improved road facility is 4-lane wide road with concrete barrier in the median which eliminates the risk of head-on collision. The improved road has got adequate delineation (road markings and signages), paved shoulders and earthern shoulders which reduces the run-off crash risk.

Figure 12 Before and after improvement image of intersection, Km 126.9

The four-leg intersection shown in the above image has been replaced by a well-designed roundabout with splitter islands and crossing facility for pedestrian. The roundabout is safe treatment for an intersection as it reduces the vehicle-vehicle conflict points and also the vehicles approaching a roundabout need to slowdown. The roundabouts on this road are provided with streetlights and blinkers to catch attention of approaching drivers.

Figure 13 Before and after improvement image of curvature, Km 133.7

All horizontal curvatures, as shown in the image above, have been provided with better delineation. The chevron signs provided on the outer edge and improved road markings reduces risk of run-off crash on such curvatures. The concrete barrier in the median eliminates head-on risk thus minimizing overall risk on road sections having such curvatures.

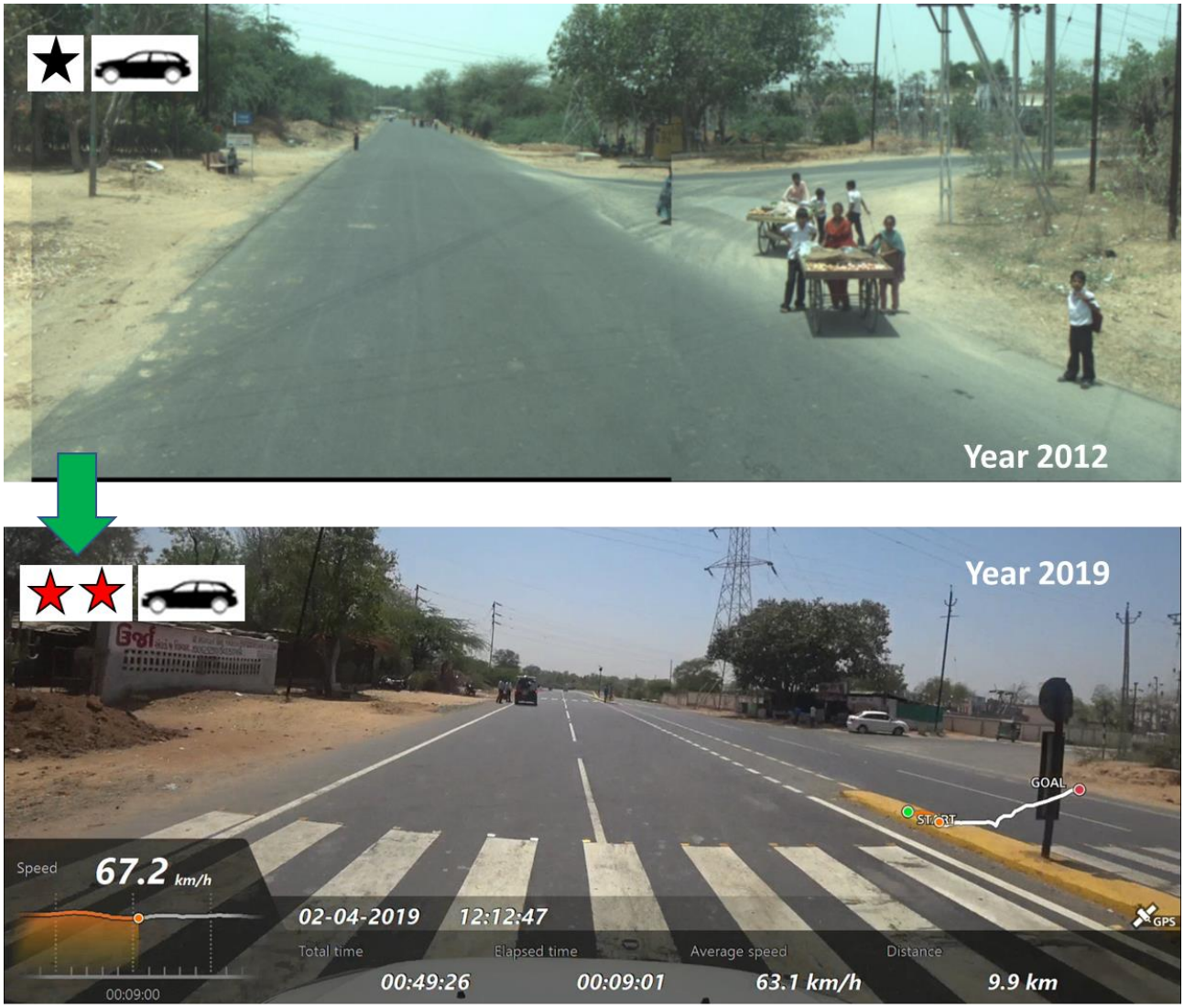

Figure 14 Before and after improvement image of intersection, Km 119.3

Three-leg and four-leg intersections have been improved with lane markings and signages. The major intersections have been provided with streetlights. The image above shows the improved intersection still gets 2-star which is result of narrow median and having no turn-lane for right turning vehicle. On such intersection, there is risk of waiting vehicle being hit from rear.

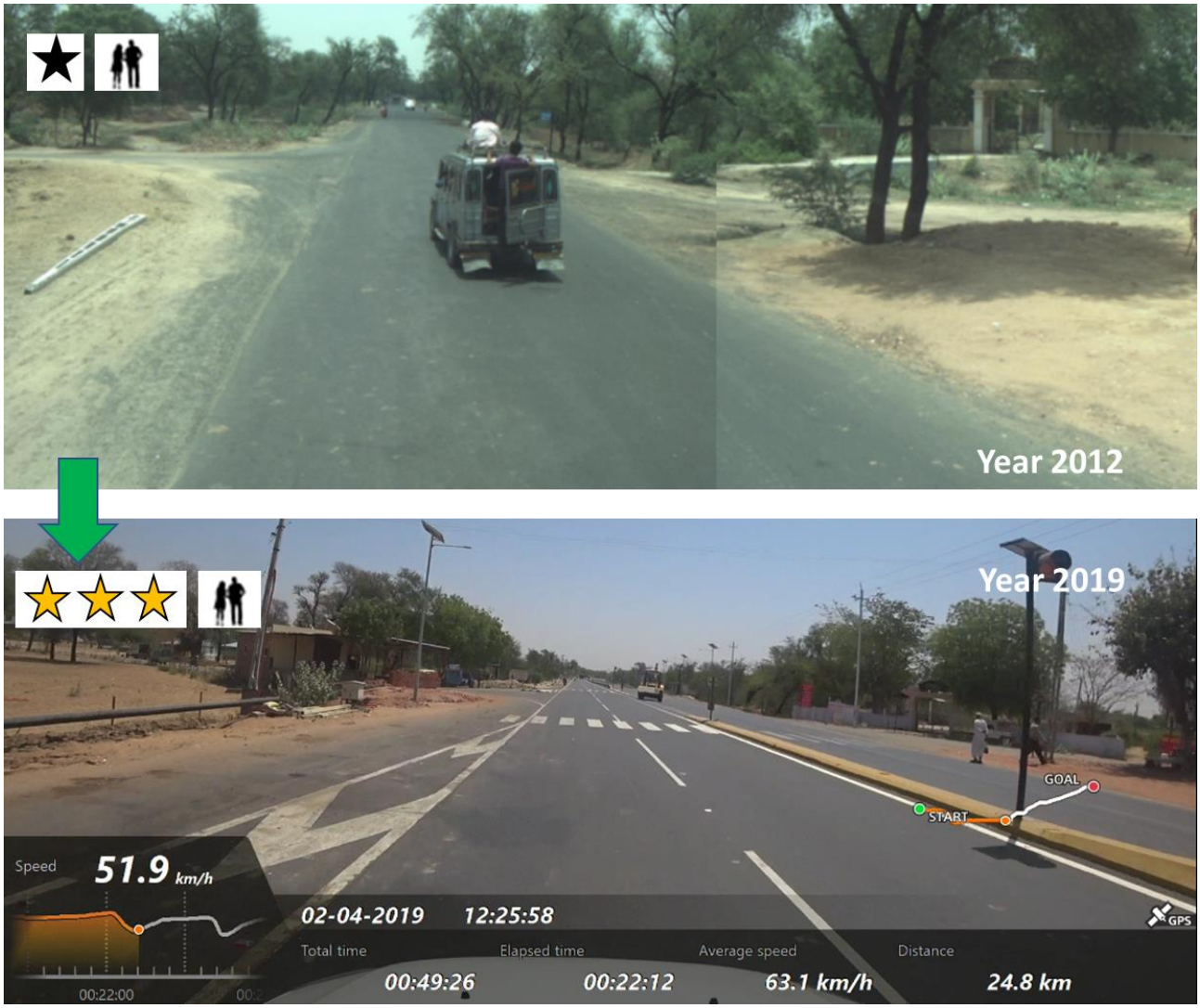

Figure 15 Before and after improvement image of pedestrian facilities, Km 134.2

The above image shows improved facility for pedestrian at an intersection. All such intersections are provided with marked pedestrian crossing with median refuge and streetlights which reduces the risk of pedestrian being hit by vehicle while crossing the road. Bus bays and thermoplastic painted strips as traffic calming measure are also provided few meters before such intersections on both carriageways of the road.

5 Smooth and Raw Star Ratings

A Star Rating Score (SRS) is calculated for each 100metre segment of road for vehicles occupants, motorcyclists, pedestrians and bicyclists. These scores are then allocated to Star Rating bands to determine the Star Rating for each 100metre of road. However, for the purposes of producing a network level map showing Star Ratings, 100metre segment is too much detail. Hence, Star Ratings are smoothed (or averaged) over longer lengths in order to produce more meaningful results. The effect of smoothing is illustrated in the chart below, which shows risk-worm for Section-3 of Mehsana-Himmatnagar road. The raw Star Rating Scores (SRS) are shown in light blue and smoothed SRS in dark blue colour.

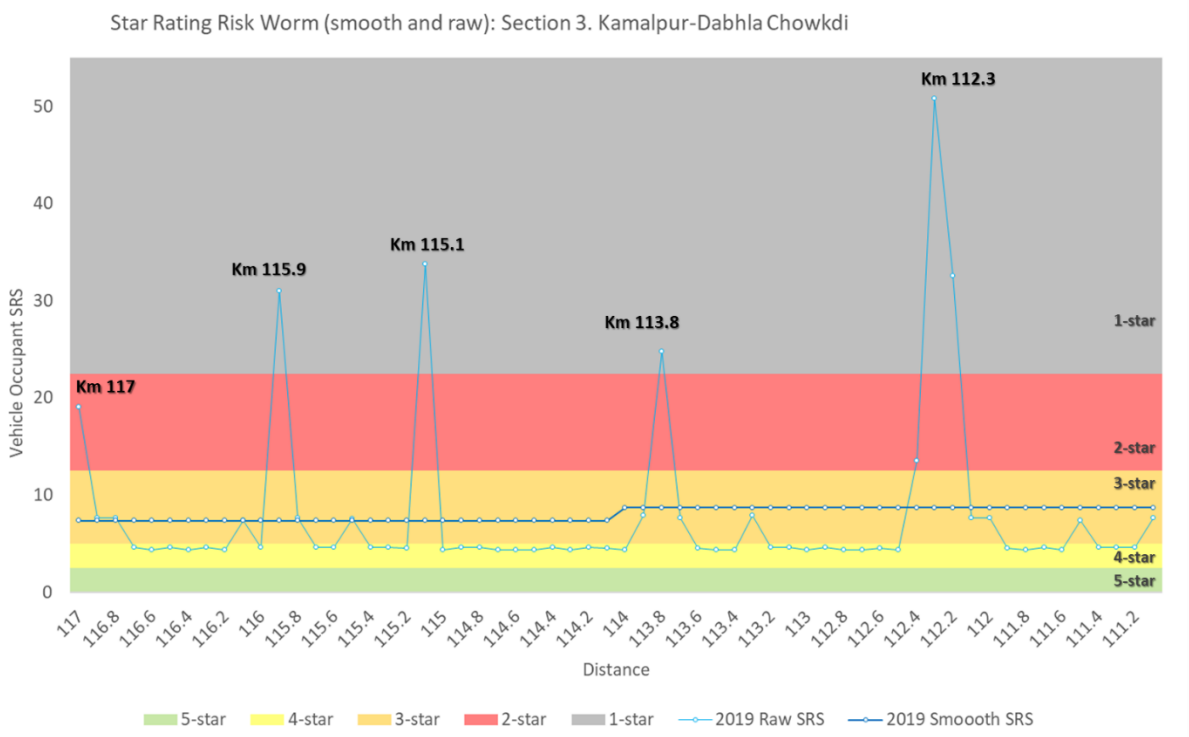

Figure 16 Risk worm showing smooth and raw SRS for Section-3 of Mehsana-Himmatnagar road

The spikes with raw SRS indicate road segments where the risk is higher. The first such spike is Km 117 which is 2-star location and other four such spikes are 1-star locations. These are intersections and the image given below for 3-leg intersection at Km 112.3 shows the road has narrow median and lack of right turning lane increases the risk of rear-end collision for vehicles waiting to turn.

Figure 17 Three-leg intersection without turn-lane, Km 112.3

The road has been widened from 2-lane to 4-lane with limited Right-of-way hence the median has been kept as narrow as possible hence none of the intersection are provided with turn-lanes. This results into such intersection getting 1-or 2-star. However, the average risk of each road section is lower hence the smooth Star Rating tends to be 3-star or better as shown in the risk worm above. This is resulting into majority of road length getting 3-star or better for vehicle occupant and motorcyclist.

6 Summary

The upgraded road Mehsana-Himmatnagar SH55 eliminates head-on collision risk between the opposite flow of traffic as the road has been converted to dual carriageway (except a bridge and two railway crossings) with provision of concrete barrier in the median. The quality of intersections has been improved, the geometry of existing roundabouts has been improved, some intersections have been converted to roundabouts which reduces the risk of intersection related crashes. However, the narrow median barrier at intersections are still a concern for safety as it poses high risk of vehicles, waiting to take turn, being hit from rear as shown in a sample image of such intersection.

Narrow median width is hazardous for vehicles taking turn. The motorcyclist waiting in the median may hit by any vehicle from the rear or side.

The length of road having 3-star or better increased significantly for vehicle occupant (98%), motorcyclist (82%), and bicyclist (52%). Provision of pedestrian crossings, footpath and streetlights in urban area on SH55 have reduced the risk of pedestrian being involved in a crash. As the road has been improved less than a year ago, meaningful crash data isn't available yet for before-after comparison.

Given below are the suggestions to sustain this achievement.

Road maintenance: The road must undergo continuous maintenance to keep the road markings and other safety devices in good condition.

Night-time delineation: The painted rumble strips in the intersection area and other road markings must be maintained for better visibility during the night-time. The streetlights must be maintained and lit during evening/night-time. Major intersections and urban areas must have working streetlights.

Intersection improvement: As described above, the narrow width of median at intersections may become hazard. Ways to widen the median in intersection area (e.g. to have additional width of 1.5m on both sides by widening the road on outer side in the intersection area – that makes the median 3m wide) must be explored.

More pedestrian friendly treatments: There could be more pedestrian friendly treatments like raised pedestrian crossings and footpath where pedestrians are present e.g. rural intersections with bus stops or other commercial/residential land use and in the urban area. This will help to increase the % road length with 3-star or better rating for pedestrian.

'Hold your Stars high': The Mehsana-Himmatnagar SH55 has been improved with safe road treatments. The increase in road length with 3-star or better ratings is a big achievement and must continue with proper maintenance of the safety features. The post-construction Star Ratings shows significant improvement and a continuous monitoring (say every year) is recommended. It is also recommended that the road crash data to be continuously collected and monitored so that reactive actions may be taken if the trend shows any increment in the road crashes or fall in the 3-star or better road length.

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