

We see that there are a lot of problems with the road and Will autonomously monitor road conditions. There is a lot of manual work that goes on, all the features that could be digitized have been incorporated. All the basic analytics will take place.

<https://humraahi.netlify.app/>

Features:

**Road Profile Page :**

1. Map
2. Road Details as in DB
3. Priority
4. Construction history
5. Cost to govt over the years(graph)
6. No of complaints over the year(graph)
7. Current Complaints Active
8. Road Images
9. *Upcoming Due Repair Date*
10. *Repair cost*

**Complaint Page:**

1. Prediction of defect into *low cost, medium cost, high cost.*
- 2.

Database Design:

**Complaint**

1. Repair ID string
2. Location lat/lon
3. Is\_confirmed bool
4. Is\_verified bool
5. Is\_active bool
6. Verification Remarks string
7. Date reported on
8. Date repaired on
9. Verification Report
- 10.

**Road**

1. Road ID string
2. Road Name string
3. Construction Date string
4. Tender ID string
5. Operations Start Date datetime
6. Zone
7. Circle
8. Division
9. Sub Division
10. Road Priority Integer 1 highest
11. Category of Road
12. Start Point
13. End Point
14. Length
15. Thickness
16. Material
17. Images

1. id: "",
2. name: "",
3. start: "",
4. end: "",
5. district: "",
6. category: "",
7. zone: "",
8. length: 0,
9. material: "",
10. depth: "",
11. lvd: "",
12. mvd: "",
13. hvd: "",
14. activeMonth: 1,
15. activeYear: 2020,
16. exitPoints: "",
17. remarks: "",
18. rut: "",
19. potholes: 0,
20. crack: "",
21. long\_crack: "",
22. iri: "",
23. bridge: "",
24. mountain: "",

- 25. single\_axle\_load: "",
- 26. no\_shoulder: "",
- 27. shoulder\_width: ""

### Prediction factors (Road-quality index):

- 1. Weather.
- 2. Road type/ material.
- 3. Last repair , how many quarters back.
- 4. Average traffic density since last repair (for each type of vehicle: heavy/ med/ light).
- 5. Number of complaints since last repair.
- 6. Feedback of last inspection.
- 7. Time since last inspection.
- 8. Inspection details (like number of damages noted)
- 9. Iri 2000

### Prediction factors for road life

- 1. IRI(m/km)
- 2. Age(year) bituminous - flexible(subgrade, , wmm), concrete - rigid min 10yr
- 3. billion standard axle after 5,6
- 4. Initial IRI(m/km)
- 5. Equivalent Single Axle Load(number) (msa)
- 6. Crack(m)
- 7. Pothole(number)
- 8. Rut(mm)
- 9. Long Crack(m)
- 10. Present serviceability index (PSI)
- 11. HT\_AADT
- 12. P&L\_AADT

$$PSI = 5.03 - 1.91 \log(1+SV) - 1.38 RD2 - 0.01 (C+P)0.5$$

$$PSI = 5 * e^{-0.0041 * IRI} - 1.38 RD2 - 0.01 (C+P)0.5$$

IRI= international roughness index (in/mile)

RD= rut depth (in)

C= cracking area (ft<sup>2</sup>/1000ft<sup>2</sup>)

P= patching area (ft<sup>2</sup>/1000ft<sup>2</sup>)

$$PSI = 5 \exp(-IRI/5.5)$$

RSL = 1/b(ln(IRI/a)) - current age

a = The initial IRI value at age equal zero.

b = Measures the curvature of the performance line

Creation of performance line :-

$$Z_x = \sum_{i=1}^n (x_i \text{IRI}_i) - \frac{\sum_{i=1}^n (x_i \text{IRI}_i)}{L_s} \sum_{i=1}^n x_i \quad (1)$$

where:

$x_i$  = Length of the  $i$ th interval along the road section (100 m in this study).

$\text{IRI}_i$  = IRI of the  $i$ th interval along the road section.

$n$  = Total number of intervals along the road section.

$L_s$  = Total length of the road section being considered.

$Z_x$  = Cumulative difference value for the  $i$ th interval along the road.

Prediction for road cost

1. Total cost
2. HT\_AADT
3. P&L\_AADT
4. Age
5. AA\_Temp
6. Shoulder width(feet) ye
7. No\_shoulder(1 or 0) ye
8. Mountain(1 or 0) ye
9. Bridge(1 or 0) ye

$$\text{TotalCost} = \beta_1 (\text{HT\_AADT})^{\beta_2} (\text{P \& L\_AADT})^{\beta_3} (\text{AGE})^{\beta_4} (\text{AATEMP})^{\beta_5} (\text{SHOULDER})^{\beta_6} \dots \\ (e^{\text{NOSHoulder}})^{\beta_7} (e^{\text{MOUNTAIN}})^{\beta_8} (e^{\text{BRIDGE}})^{\beta_9} (e^{\text{MNCOLLCTR}})^{\beta_{10}} (e^{\text{DISTRICT2}})^{\beta_{11}} (e^{\text{DISTRICT11}})^{\beta_{12}}$$

- [2] <https://sci-hub.tw/https://doi.org/10.1080/10298430310001634834>  
[3] <https://www.nevadadot.com/home/showdocument?id=4044>  
[4] <https://core.ac.uk/download/pdf/55639943.pdf>  
[5] <https://www.mdpi.com/2079-9292/9/1/3/htm>

Suspension Parameters :

1. **Steering Axis**– Its the axis at which the wheel will rotate on.
2. **Scrub Radius**– The distance a tire has to rotate to make a turn. The smaller the radius the fated the turning point.
3. Camber Angle
4. Caster Angle

Type of Suspension :

1. Double Wishbone / Double-A Arm Suspension.
2. MacPherson Struts
3. Solid Axle Car Suspension
4. Trailing Control Arm
5. Panhard Rod

Suspension Degradation Modelling :

- [1] <https://www.tandfonline.com/doi/full/10.1080/21642583.2014.987359>

Section 2

Verification Tutorial:

Make sure you understand all the fields mentioned properly, if not consult the manual or contact a supervisor.

While calculation vehicle density, take several measurements, preferably 3 readings for 1 min each in 15 minute intervals.

For road quality measurements, especially include turnings, uneven segments and take multiple readings at least 25 m of gap.

When in doubt take photos/videos, so that the higher authorities can take better actions. For using road quality measuring tools, make sure the device is properly calibrated, battery is charged and the memory card is present to avoid losing any data.

In case you find additional damage which is not reported in the complaint, include that in remarks too, this would avoid double verification for the same area. However do inform the administrator regarding the same

The codes related to road defects, inspection level, and remedial methods are given in the help section on the admin portal and also in the manual, double check entries before submitting

## **Stats**

Total employees including labourers and peons = 25072

Total Employees till class 3 = 8825

Total employees that conduct inspection = 8000 approx

Total Road Length = 1,26,350 km - Better road maintenance and complaint

Total length of road per engineer = 15.79 km - Better schedule management for inspectors

Investment in road sector from 2014-2018 = 25,874 cr - Smart Management of funds

Approx 1600 km of new road projects from 2014-2018 - Better Storage

No of road accidents in gujarat = 18k approx

No of fatalities = 7k approx

No of fatalities due to potholes = 200 approx