Condition Assessment of State Highways Passing Through Walwa Taluka

Yadav Mahesh S[1], Prof.A.S.Thorbole[2]
[1, 2] Dept of Civil Engineering
[1, 2] Rajarambapu Institute of Technology, Rajaramnagar, Sangli

Abstract- *The deterioration of pavements can be result of various factors including traffic intensity, properties of subgrade soil, climate condition, improper drainage facilities and temperature etc. during the life span of the pavement. Deterioration causes the loss in structural and functional stability of the existing pavement and this can cause failure of pavement.*

The road pavement must provide users with comfortable, safe, and efficient service and it must possess sufficient structural capacity to support the combined effect of traffic loads and environmental conditions. We will perform visual inspection for all the state highways passing through Walwa Taluka.The pavement condition rating is calculated. Then the appropriate remedial measures are provided to increase the quality.

Keywords- Deterioration, Distress, Drainage Facilities, Temperature

I. INTRODUCTION

The complete condition and performance of a pavement is broader than just an assessment of the surface distress. Other factors, such as ride quality, structural capacity and friction are also important components. Ride quality has emerged at the national level as a primary element of pavement performance and customer satisfaction. New technologies are now available to measure other important pavement distresses at the network level.

Following are the types of distress:

- Rutting
- Cracking
  - Longitudinal
    - Fatigue cracking
    - Seasonal (frost heave) cracks
    - Joint construction cracking
    - Edge (verge) cracking
  - Transversal (thermal) cracking
  - Pattern cracks
    - Block Cracking
    - Joint Reflection Cracking
- Potholes
- Bleeding
- Raveling
- Stripping
- Corrugation and shoving
- Segregation
- Patching
- Polishing
- Depressions
- Slippage cracking
- Water bleeding and pumping

II. METHODOLOGY

We are going to perform a assessment of pavements by distress analysis. We are going to select 20% maximum deteriorated stretch of Total length for all the state highways passing through WalwaTaluka. And for this stretch we are going to do distress analysis and PCR calculations.

Total no of state highways passing through WalwaTaluka = 6 No's
Total state highway network distance passing through Walwa Taluka = 140.5 km

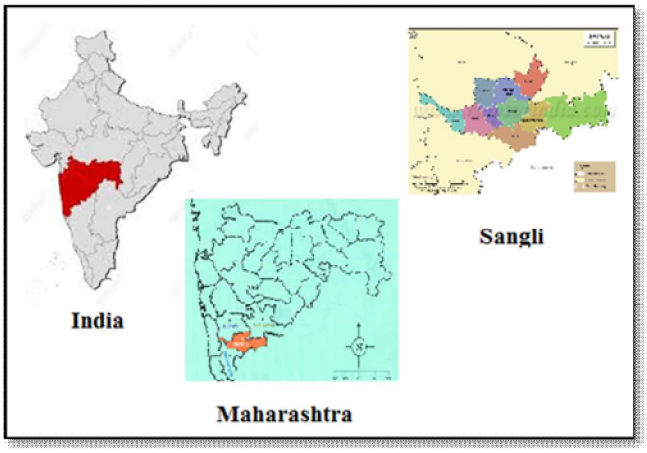


Fig. 1.1study area map

Table 1.1 State highways passing through WalwaTaluka

Sr.No.	Road Name	Road No.	Distance
1.	Khandala-Palashi-Koregaon-Rahimatpur-Karad-Kundal-Bambavdepati-Sangli-Ankali-Shirol	SH-142	12.20 km
2.	Vita-Peth-Malakapur-Oni	SH-150	14 km
3.	Top-Vadgaon-Shigaon-Ashta-Tasgaon-Bhivghat-Dighanchi-Pandharpur	SH-151	17 km
4.	Peth-Sangli-Miraj-Mhyashal	SH-152	30 km
5.	Pusesavali-Vangi-Nagathane-Walwa-Borgaon-Bahe-Tambave-Kasegaon-Wategaon	SH-158	36.5 km
6.	Mangarul-Sagaon-Mangale-Chikurde-AitavadeKhurd-Yelur-Tandulwadi-Bahadurwadi Fata Bahardurwadi-Dhavali-Bagani	SH-159	30.8 km

Table 1.2 Area under test for State highways

Sr.No.	Road Name	Chainage No.	Stretch distance
1.	SH-142	Km 119/600 to 131/800	3 km
2.	SH-150	Km 30/000 to 45/000	3 km
3.	SH-151	Km 12/00 to 29/00	3.5 km
4.	SH-152	Km 0/000 to 30/000	6 km
5.	SH-158	Km 67/000 to 104/000	7 km
6.	SH-159	Km 38/800 to 68/800	6 km

III. DISTRESS TYPES

1. Rutting

- **Description:** Surface depression in the wheel path. Pavement uplift (shearing) may occur along the sides of the rut. Ruts are particularly evident after a rain when they are filled with water.
- **Problem:** Ruts filled with water can cause vehicle hydroplaning, can be hazardous because ruts tend to pull a vehicle towards the rut path as it is steered across the rut.
- **Possible Causes:** Permanent deformation in any of a pavement's layers or subgrade usually caused by consolidation or lateral movement of the materials due to traffic loading. Specific causes of rutting can be:
  - Insufficient compaction of pavement layers during construction.
  - Compression of unbound layers (base course, sub base)
  - Subgrade rutting (e.g., as a result of inadequate pavement structure)
- **Repair**: A heavily rutted pavement should be investigated to determine the root cause of failure (e.g. insufficient compaction, subgrade rutting, poor mix design or studded tire wear). Slight ruts (< 8 mm deep) can generally be left untreated. Pavement with deeper ruts should be leveled and overlaid.

2. Fatigue Cracking

- **Description:** Series of interconnected cracks caused by fatigue failure of the HMA surface (or stabilized base) under repeated traffic loading. In thin pavements, cracking initiates at the bottom of the HMA layer where the tensile stress is the highest then propagates to the surface as one or more longitudinal cracks.
- **Problem:** Indicator of structural failure, cracks allow moisture infiltration, roughness, may further deteriorate to a pothole.
- **Possible Causes:** Inadequate structural support, which can be caused by a number of things. A few of the more common ones are listed here:
  - Loss of base, sub base or subgrade support (e.g., poor drainage or spring thaw resulting in a less stiff base).
  - Increase in loading (e.g., more or heavier loads than anticipated in design)
  - Inadequate structural design
  - Poor construction (e.g., inadequate compaction)
- **Repair**: A fatigue cracked pavement should be investigated to determine the root cause of failure. Any investigation should involve digging a pit or coring the pavement to determine the pavement's structural makeup as well as determining whether or not subsurface moisture is a contributing factor. Once the characteristic alligator pattern is apparent, repair by crack sealing is generally ineffective. Fatigue crack repair generally falls into one of two categories:

3. Transversal (thermal) cracking:

- **Description:** Cracks perpendicular to the pavement's centerline or lay-down direction. Usually type of thermal cracking.
- **Problem:** Allows moisture infiltration, roughness.
- **Possible Causes:** Several including:
  - Shrinkage of the HMA surface due to low temperatures or asphalt binder hardening.
  - Reflective crack caused by cracks beneath the surface HMA layer.

- Top-down cracking.

- **Repair**: Strategies depend upon the severity and extent of the cracking:
  - *Low severity cracks (< 12 mm wide and infrequent cracks).* Crack seal to prevent (1) entry of moisture into the pavement through the cracks and (2) further raveling of the crack edges.
  - *High severity cracks (> 12 mm wide and numerous cracks).* Remove and replace the cracked pavement layer with an overlay.

4. Frost heave/thaw (action) cracking:

- Frost action can be quite detrimental to pavements and refers to two separate but related processes:
  - Frost heave. An upward movement of the subgrade resulting from the expansion of accumulated soil moisture as it freezes.
  - Thaw weakening. A weakened subgrade condition resulting from soil saturation as ice within the soil melts.

- This problem occurs primarily in soils containing fine particles (often termed "frost susceptible" soils), while clean sands and gravels (small amounts of fine particles) are non-frost susceptible (NFS). Thus, the degree of frost susceptibility is mainly a function of the percentage of fine particles within the soil.

5. Block cracking:

- **Description:** Interconnected cracks that divide the pavement up into rectangular pieces. Blocks range in size from approximately 0.1 m2 to 9 m2. Block cracking normally occurs over a large portion of pavement area.
- **Problem:** Roughness, Allows moisture infiltration.
- **Possible Causes:** HMA shrinkage and daily temperature cycling. Typically caused by an inability of asphalt binder to expand and contract with temperature cycles because of asphalt binder aging.
  - Poor choice of asphalt binder in the mix design

• **Repair**: Strategies depend upon the severity and extent of the block cracking:
– *Low severity cracks (< 12 mm wide).* Crack seal to prevent (1) entry of moisture into the structure through the cracks and (2) further raveling of the crack edges. HMA can provide years of satisfactory service after developing small cracks if they are kept sealed.
– *High severity cracks (> 12 mm wide and cracks with raveled edges).* Remove and replace the cracked pavement layer with an overlay.

6. Potholes:

• **Description:** Small, bowl-shaped depressions in the pavement surface that penetrate all the way through the HMA layer down to the base course. They generally have sharp edges and vertical sides near the top of the hole. Potholes are most likely to occur on roads with thin HMA surfaces (25 to 50 mm) and seldom occur on roads with 100 mm or deeper HMA surfaces.

• **Problem:** Roughness (serious vehicular damage can result from driving across potholes at higher speeds), moisture infiltration.

• **Possible Causes:** Generally, potholes are the end result of alligator cracking. As alligator cracking becomes severe, the interconnected cracks create small chunks of pavement, which can be dislodged as vehicles drive over them. The remaining hole after the pavement chunk is dislodged is called a pothole.
• **Repair**: Patching.

7. Joint Reflection Cracking:

• **Description:** Cracks in a flexible overlay of a rigid pavement. The cracks occur directly over the underlying rigid pavement joints. Joint reflection cracking does not include reflection cracks that occur away from an underlying joint or from any other type of base (e.g., cement or lime stabilized).
• **Problem:** Allows moisture infiltration, roughness.
• **Possible Causes:** Movement of the PCC slab beneath the HMA surface because of thermal and moisture changes. Generally not load initiated, however loading can hasten deterioration.
• **Repair**: Strategies depend upon the severity and extent of the cracking:
– *Low severity cracks (< 12 mm wide and infrequent cracks).* Crack seal to prevent (1) entry of moisture into the pavement structure through the cracks and (2) further raveling of the crack edges.
– *High severity cracks (> 12 mm wide and numerous cracks).* Remove and replace the cracked pavement layer with an overlay.

8. Corrugation and shoving:

• **Description:** A form of plastic movement typified by ripples (corrugation) or an abrupt wave (shoving) across the pavement surface. The distortion is perpendicular to the traffic direction.

Usually occurs at points where traffic starts and stops (corrugation) or areas where HMA abuts a rigid object (shoving).

• **Problem:** Roughness

• **Possible Causes:** Usually caused by traffic action (starting and stopping) combined with:

– An unstable (i.e. low stiffness) HMA layer (caused by mix contamination, poor mix design, poor HMA manufacturing, or lack of aeration of liquid asphalt emulsions)

– Excessive moisture in the pavement structure

• **Repair**: A heavily corrugated or shoved pavement should be investigated to determine the root cause of failure. Repair strategies generally fall into one of two categories:

– *Small, localized areas of corrugation or shoving.* Remove the distorted pavement and patch.

– *Large corrugated or shoved areas indicative of general HMA failure*. Remove the damaged pavement and overlay.

9. Depressions

- **Description:** Localized pavement surface areas with slightly lower elevations than the surrounding pavement. Depressions are very noticeable after a rain when they fill with water.
- **Problem:** Roughness, depressions filled with substantial water can cause vehicle hydroplaning.
- **Possible Causes:** Irregular frost heave or subgrade settlement resulting from inadequate compaction during construction or poor quality (soft) subgrade.
- **Repair**: By definition, depressions are small localized areas. A pavement depression should be investigated to determine the root cause of failure (i.e., subgrade settlement or frost heave). Depressions should be repaired by removing the affected pavement then digging out and replacing the area of poor subgrade. Patch over the repaired subgrade.

10. Patching

- **Description:** An area of pavement that has been replaced with new material to repair the existing pavement. A patch is considered a defect no matter how well it performs.
- **Problem:** Roughness.
- **Possible Causes:** Previous localized pavement deterioration that has been removed and patched.
- **Repair**: Patches are themselves a repair action. The only way they can be removed from a pavement's surface is by new either overlay.

11. Polishing (polished aggregates):

- **Description:** Areas of HMA pavement where the portion of aggregate extending above the asphalt binder is either very small or there are no rough or angular aggregate particles.
- **Problem:** Decreased skid resistance.
- **Possible Causes:** Repeated traffic applications. Generally, as a pavement ages the protruding rough, angular particles become polished. This can occur quicker if the aggregate is susceptible to abrasion or subject to excessive studded tire wear.
- **Repair**: Apply a skid-resistant slurry seal or BST or overlay.

12. Raveling:

- **Description:** The progressive disintegration of an HMA layer from the surface downward as a result of the dislodgement of aggregate particles.
- **Problem:** Loose debris on the pavement, roughness, water collecting in the raveled locations resulting in vehicle hydroplaning, loss of skid resistance.
- **Possible Causes:** Several including:
  - Loss of bond between aggregate particles and the asphalt binder as a result of:
  - A dust coating on the aggregate particles that forces the asphalt binder to bond with the dust rather than the aggregate
  - Aggregate Segregation. If fine particles are missing from the aggregate matrix, then the asphalt binder is only able to bind the remaining coarse particles at their relatively few contact points.
  - Inadequate compaction during construction. High density is required to develop sufficient cohesion within the HMA (paving in cold weather).
  - Mechanical dislodging by certain types of traffic (studded tires, snowplow blades or tracked vehicles).
- **Repair**: A raveled pavement should be investigated to determine the root cause of failure. Repair strategies generally fall into one of two categories:
  - *Small, localized areas of raveling*. Remove the raveled pavement and patch.
  - *Large raveled areas indicative of general HMA failure*. Remove the damaged pavement and overlay.

13. Stripping:

- **Description:** The loss of bond between aggregates and asphalt binder that typically begins at the bottom of the HMA layer and progresses upward. When stripping begins at the surface and progresses downward it is

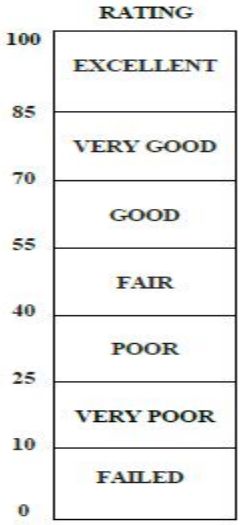
usually called raveling. The third photo show the surface effects of underlying stripping.

- **Problem:** Decreased structural support, rutting, shoving/corrugation, raveling, or cracking (alligator and longitudinal).
- **Possible Causes:** Bottom-up stripping is very difficult to recognize because it manifests itself on the pavement surface as other forms of distress including rutting, shoving/corrugations, raveling, or cracking. Typically, a core must be taken to positively identify stripping as a pavement distress.
  - Poor aggregate surface chemistry.
  - Water in the HMA causing moisture damage
- **Repair**: A stripped pavement should be investigated to determine the root cause of failure (i.e., how did the moisture get in?). Generally, the stripped pavement needs to be removed and replaced after correction of any subsurface drainage issues.

14. Bleeding:

- **Description:** A film of asphalt binder on the pavement surface. It usually creates a shiny, glass-like reflecting surface that can become quite sticky.
- **Problem:** Loss of skid resistance skid (when wet).
- **Possible Causes:** Bleeding occurs when asphalt binder fills the aggregate voids during hot weather and then expands onto the pavement surface. Since bleeding is not reversible during cold weather, asphalt binder will accumulate on the pavement surface over time. This can be caused by one or a combination of the following:
  - Excessive asphalt binder in the HMA (either due to mix design or manufacturing)
  - Excessive application of asphalt binder during BST application (as in the above figures)
  - Low HMA air void content (e.g., not enough room for the asphalt to expand into during hot weather)
- **Repair**: The following repair measures may eliminate or reduce the asphalt binder film on the pavement's surface but may not correct the underlying problem that caused the bleeding:
  - Minor bleeding can often be corrected by applying coarse sand to blot up the excess asphalt binder.

Fig.1.2 Pavement Condition Rating Scale



IV. RESULT

Table 1.3 Showing results of visual inspection

Sr. No	Road Name	Pavement Condition Index	Pavement Condition Rating
1.	SH-142		
	Stretch A	55.3	Good
	Stretch B	42.4	Fair
	Stretch C	48.2	Fair
2.	SH-150		
	Stretch A	50.3	Fair
	Stretch B	57.6	Good
	Stretch C	37.5	Poor
3.	SH-151		
	Stretch A	42.3	Fair
	Stretch B	37.9	Poor
	Stretch C	59.7	Good
	Stretch D	27.8	Poor
4.	SH-152		
	Stretch A	7	Failed
	Stretch B	42.4	Fair
	Stretch C	53.8	Fair
	Stretch D	22.4	Very Poor
	Stretch E	38.4	Poor
	Stretch F	18.3	Very poor
5.	SH-158		
	Stretch A	25.4	Poor
	Stretch B	46.4	Fair
	Stretch C	14.8	Very Poor
	Stretch D	52.8	Fair
	Stretch E	41.2	Fair
	Stretch F	9.7	Failed
	Stretch G	57.8	Good
6.	SH-159		
	Stretch A	38.4	Poor
	Stretch B	43.8	Fair
	Stretch C	31.4	Poor
	Stretch D	29.4	Poor
	Stretch E	53.6	Fair
	Stretch F	17.6	Very Poor

V. CONCLUSION

From above results it is found that major part of state highways passing through Walwa Taluka is not in good condition. Axle load limitations are not maintained during service of road. Due to this they require maintenance in the form of increase in depth for various layers.

SH-142 this road having fair condition so requires maintenance.
SH-150 It has average condition so requires maintenance.
SH-151 this road also has a poor condition so it requires immediate maintenance.
SH-152 Very fair condition exists at this road. So it requires immediate action of construction new road.
SH- 158 some part of this road is in good condition. This road is passing through black cotton soil belt. This is at average level.
SH- 159 It seems to be poor so it require new construction of road.

REFERENCES

[1] E.J.Yoder, “Flexible Pavement deflections- Methods of analysis and interpretation” (1962)
[2] IRC:81-1997, “Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique” (1997)
[3] J.H.DeFoe, “Benkelman beam testing of shoulder and pavement recycling projects” (1983)
[4] New York State Department of Transportation, “Pavement Condition Assessment” (2010)
[5] IRC:81-1997, “Guidelines For Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique” (1997)
[6] ARA,Inc. ERES Consultants division 505 west university Avenue Champaign Illinois, “Evaluation of existing pavement for rehabilitation” (2004)
[7] Kathryn A. Zimmerman, P.E. and Marshall Stivers, “A Guide to Maintenance Condition Assessment Systems” (2007)