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Road Pavement Failure of Flexible Pavement from Sanat-Nagar to Pantha-Chowk

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Abstract
The road pavement from sanat nagar to pantha-chowk is the main road in the Srinagar which connects the north Kashmir to the Jammu. It also connects the south Kashmir to the international airport Srinagar and also the railway station at Srinagar. The load on the roads is increased day by day very rapid rate and if the road conditions are also so bad it will also effects on traffic jam much more. This road also connects the Jammu to kargil and leh.

Keywords
Road Failure, Fatigue Cracking, Potholes, Block Cracking

INTRODUCTION
My project is related to the failure of the flexible pavement stretch of road from Sanat-Nagar to Pantha-Chowk Srinagar Jammu and Kashmir India. In my project, I will study the various pavement failures which have occurred on flexible pavement mainly due to rains, snow and recent floods. This road stretch is located on NH-1A and is 8.5 km in length. It is a four lane two way divided carriageway. It is 18 m wide (7.5+7.5+3.0).

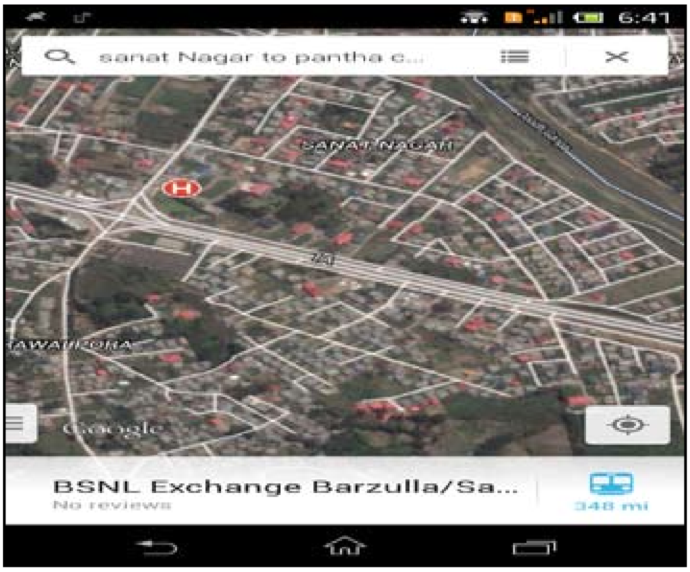

Fig. Satellite view of the road from Sanat-Nagar to Pantha-Chowk

What is a failure of a pavement?

- Failure of typical civil engineering structures is defined as break or fracture. This usually happens when applied load exceeds the maximum allowable value.
- The applied loading on pavements are usually much smaller than the strength of the material. Therefore one load application does not fail the pavement, but causes as infinitesimal amount of deterioration. This deterioration gradually increases until it reaches an unacceptable level.
- Surface distress is “Any indication of poor or unfavourable pavement performance or signs of impending failure; any unsatisfactory performance of a pavement short of failure”

Type of failure modes

- Rutting
- Cracking
  – Longitudinal
- Fatigue cracking
  – Single crack in the wheel path
  – Alligator cracking
- Seasonal (frost heave) cracks
- Joint construction cracking
- Edge (verge) cracking
  – Transversal (thermal) cracking
  – Pattern cracks
- Block Cracking
- Joint Reflection Cracking
- Potholes
- Bleeding
- Ravelling
- Stripping
- Corrugation and shoving
- Segregation
- Patching
- Polishing
- Depressions
- Slippage cracking
- Water bleeding and pumping

Fatigue Cracking

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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. This is commonly referred to as “bottom-up” or “classical” fatigue cracking. In thick pavements, the cracks most likely initiate from the top in areas of high localized tensile stresses resulting from tire-pavement interaction and asphalt binder aging (top down cracking). After repeated loading, the longitudinal cracks connect forming many-sided sharp-angled pieces that develop into a pattern resembling the back of an alligator or crocodile.

• **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, subbase or subgrade support (e.g., poor drainage or spring thaw resulting in a less stiff base).
– Stripping on the bottom of the HMA layer (the stripped portion contributes little to pavement strength so the effective HMA thickness decreases)
– 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:

– *Small, localized fatigue cracking indicative of a loss of subgrade support*. Remove the cracked pavement area then dig out and replace the area of poor subgrade and improve the drainage of that area if necessary. Patch over the repaired subgrade.
– *Large fatigue cracked areas indicative of general structural failure*. Place an HMA overlay over the entire pavement surface. This overlay must be strong enough structurally to carry the anticipated loading because the underlying fatigue cracked pavement most likely contributes little or no strength.

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.

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 ravelling 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 ravelled edges)*. Remove and replace the cracked pavement layer with an overlay.

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.

Conclusions

Failures of flexible pavements (bituminous roads) have been prevalent in many states in India, a trend causing concern to both the road users and the roads authorities. In this regard, it was found necessary that an investigation be initiated to determine the possible causes of such failures, due to rain, snow & resent flood and a case study was carried out on sanat-nagar to pantha-chowk Highway in Jammu and Kashmir, India. The investigations were conducted in several categories to determine the pavement characteristics such as structural strength by Benkelman Beam Deflection Test (BBDT). Traffic loading by Axle load measurements, Traffic volumes by traffic counting and ageing characteristics of the type of the bitumen used by cutting cores and extracting the bitumen for the standard tests, such as penetration, ductility, bitumen content, air voids, softening point and CBR using the Light Drop Weight Tester (LDWT). The visual inspection of the pavement showed that due to the hardening of the bitumen and overloading, cracks and potholes were very common for the whole stretch of the road. Axle load data revealed that, there has been a tendency to exceed the maximum allowed axle load limits, after that the enforcement of axle load limits was tightened. This fact together with the revelation that the road is a very busy one as depicted in the traffic counts, could be one of the major causes of the road's fast deterioration.

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