

# Impact of Rains on Road Transport

<sup>1</sup> Parshant Rana, <sup>2</sup> Dr. R.R. Singh

<sup>1</sup> Student of M.E Transportation, <sup>2</sup> Professor & Head  
Civil Engineering Department

Punjab Engineering College (Deemed to be University), Chandigarh

**Abstract -** There are various factors which cause deterioration of roads. The objective of our paper is to study the effects of rain during monsoon season in India. In India, there is a big problem of destruction of roads during monsoon season due to heavy raining. The roads investigated experienced severe failure like cracking, potholes, etc. there are impacts also on road transport system, accident is the major problem due to wet surface and widening of potholes. Here, objective of this paper is to study how the roads can be prevented from destruction and road users from accident due to raining. The study involved different reasons having impact on road transport and their mitigation measures during raining mainly in North West monsoon season in India. Various factors including poor drainage, expansive subgrade soil and use of inferior material are common causes of destruction and wet roads, widened cracks and potholes etc. The rains can reduce the speed of vehicle and capacity of roads by 3-16 percent and 10-30 percent respectively. Hence, rains lead to delays on high extent and impacting transport by road. Accidents due to rain, fog, sleet, wet pavement etc. come under the category of weather related accidents. In 2016 there were 36594 accidents happened during rainy weather that is 27 percent of total weather related accidents (135084) (according to Ministry of road transport and highways transport research wing New Delhi). Essential objective is to reduce the accidents caused due to rain. Broadly, the study includes identification of impacts caused by rain to transport system and their remedies.

**Keywords -** Deterioration, Rain, Road Transport, Drainage, Accidents, Wet Roads, Destruction of Roads

## Introduction

The road network plays a vital role in economic development of a country like agriculture and industrialisation, specially the developing country like India. That is why many countries invest huge amount on road networks. The road network of India, which has approx. 5472150 kms. Generate convenience for road users to travel from one place to other. But importance given to maintenance of roads is not as what required. Hence during each monsoon in India there is problem of deterioration of pavement structure due to penetration of water. The north east monsoon, a boon to the city, continues to be a bane for city roads in India. Low intensity rainfall for a long period is more disastrous than high intensity for small duration. Deterioration of the road affect the serviceability, riding quality and safety of road up to a high extent. During monsoon season or rainy season, the road pavement deteriorates due to various factors like poor drainage, low quality of pavement materials let the rain water to penetrate through the pavement due to which various distresses like cracks, potholes, depressions, rutting, ravelling etc. take place. These stresses may cause premature failure and traffic hazards. Due to these failures and hazards delays in transporting freight and passengers occur which causes retardation of process of social and economic development of country because 90 percent of Indian passengers travel by road and 65 percent of goods also transported by using road transportation. During rainy season road crashes also increased as compared to normal days which may also lead to death of person. Road accidents may be happened due to different parameters like road, vehicle, environment or human causes. Skidding of vehicle is major cause of accidents, which may be due to lack of tyre to road friction. This paper aims to analyse the wet road related issues like destruction of pavement and road crashes.

## Issues and challenges

There are various issues and challenges to protect roads from climatic conditions. First issue is to know the proper gradation of materials for different kind of climates. India is a country where variations are there in weather from place to place. Hence proper knowledge of material is important. Then maintenance during the rains is a big challenge to labours and engineers as well. Grants given by the government for maintenance work is not appropriate sometimes because less concentration toward maintenance. Increasing vehicle load and change in climate due to various environmental issues also leading to problems in keeping of roads safe and defect free. Because there are abrupt changes in environment now a days like recent flood in Kerala which was not expected, it destroyed a major portion of infrastructure there including roads of the state. Corrupt nature of some engineers may also be an issue in case of roads maintenance and construction which results in poor gradation of materials and hence the low quality roads.

## Impacts on pavement

In rainy season pavement, destruction takes place in various forms like widening of potholes and cracks

- **Widening of potholes and cracks**

If there are existing potholes in roads due to heavy traffic or any other reason and rain is there, then the water accumulate in pot hole and weakened the pavement due to which the potholes become wide and produce resistance to the vehicles moving on road.

Same in case of cracks is there. Cracks get widened due to seepage of water through them and pavement disintegration get accelerated. Here main reason is hydrophobic nature of bitumen due to which water breaks the bond between bitumen and aggregates. Another reason of failure is low speed of vehicles during rain as when vehicle move with slow speed impact on road is more.

Various other types of defect, which get accelerate due to rain

- Ravelling
- Rutting
- Patch deterioration

### Various causes of destruction

#### • Poor drainage

The drainage system of various cities like Delhi in India is not adequate as population is increased dramatically but drainage system is still old due to which the sewers become unable to handle the rain water and water flows over roads which penetrate through pavement and make it weaker. The drainage may also be hampered by lack of maintenance or blockage due to some plastic or other wastes.

According to investigations by N.D Little and R.D Jones the moisture content, which increases during rain due to improper drainage causes deterioration of asphalt roads. They found that cohesion of asphalt layer lost due to which strength and durability of pavement affected.

#### • Construction with inferior quality material

The roads constructed of inferior materials get affected predominantly by the rain water or moisture. Here with low quality we mean improper grading of aggregate, weak subgrade, substandard base material or poor quality asphalt. Rain water weaken the pavement and flowing vehicle during rain destruct it. Due to failure of surface layer the water penetrates to base layer as well and if there is high fine content in base material the loss of strength is inevitable and load bearing capacity reduced upon wetting.

#### • Expansive subgrade soil

An expansive soil subgrade is made up of soil which get expand volumetrically when comes to contact with moisture. During rainfall moisture content increased and due to which the subgrade volume increase and cracks appear on pavement of flexible road. In India we have region having clay soil like Gujarat and Maharashtra, which is very expansive and create problems in transportation system.

### Preventive measures

#### • Maintenance

Proper Maintenance of road is very important to prevent its destruction. If there are existing cracks, then it is important fill otherwise water penetrates during rain and produce hazards for the road.

#### • Types of maintenance

routine maintenance  
periodic maintenance  
special repairs

#### • Routine maintenance

- ✓ Repairs to pot holes cracks and other minor defects comes under routine maintenance
- ✓ Cleaning of drains and culverts
- ✓ Upkeep of carriageway

### Periodic maintenance

This is the periodic renewal of existing surface to preserve pavement from wear and tear caused by weathering and traffic.

Various repairs include

- ✓ Thin mix seal surfacing
- ✓ Improving drains
- ✓ Thin premix carpet

### Special repairs

These are the maintenance at which major rehabilitation such as overlay is needed.

### Problems during maintenance

- Geological problems such as landslides, flash flood etc. in hilly region and shifting sand dunes in desert. Similarly snow clearance in high altitude areas etc.
- Damage to subgrade due seepage of water into subgrade
- Poor quality control during construction stage
- Lack of equipment skilled laboured and modern technology and lack of updated guideline norms and standards.
- Subgrade stability decreased due to adverse moisture condition.

### Good quality control

During the construction, quality control should be very good there. The material used in construction should be according to the standard set by highway authorities. If area is lying in heavy rainfall region special guidelines should be there for construction materials. Various lab testings should be done to with regarding climatic condition of the area so that particle size analysis, atterberg limits, swelling, CBR etc. can be known properly and a good asphalt or aggregates can be used to construct the road.

### Stabilisation of subgrade

There are various regions in country having expansive soil. In those areas it is necessary to stabilise the soil to improve strength of subgrade. If soil is expansive then it expands when moisture is there in atmosphere due to rains which causes cracks and other defects in pavement. There are various methods of soil stabilisation which are

- ✓ Mechanical stabilisation: compaction, blending, geosynthetics
- ✓ Chemical stabilisation: by using lime, cement, fly ash etc.

### Impact on road accidents

road accidents must be a strategic issue for any country because it can lead to a growth crisis if not addressed properly. 9.6 percent of total fatal accidents in world occurred in India. One person dies at every 4.6 minutes for road accident in India. Rainfall increases the rate of accidents and many researchers proved proportionality of road accidents with rainfall. Gothie, M said that twice the road accidents take place in wet conditions as compared to dry. These accidents take place due to lack of visibility during heavy rain and less friction on wet pavement. In 2016 there were 36594 accidents happened during rainy weather in India that is 27 percent of total weather related accidents (135084) (according to Ministry of road transport and highways transport research wing New Delhi).

### Impact on capacity of road

When there is raining, capacity of the road also gets hampered means it decreases. In this study data considered is the data of a roads of Virginia, with guidance of highway capacity manuals. The findings are

- Light rain (intensity of 0.01 to 0.25 inches/hour) decreases freeway capacity by 4 to 10%
- Heavy rain (intensity of 0.25 inches/hour or greater) decreases freeway capacity by 25 to 30%.
- The presence of rain, regardless of intensity, results in approximately a 5.0 to 6.5% average decrease in operating speeds.

As the data is from Virginia but in India also situation will be similar with some changes in data because of volume of traffics or topography or drainage system etc. but there will be decrease in capacity of road it is sure. Lamm, Choueiri, and Mailaender concluded in their research that wet pavements do not affect the operating speed until the visibility is hampered due to rain that's why heavy rainfall hamper the speed not light rainfall. Ibrahim and Hall in their research provided quantitative information for impact of heavy rain and light on operating speed as well as maximum observed flow rates. In case of light rain, according to manual, there is 1.2 mile per hour reduction in operating speed during free flow conditions and during 2400 vehicle per hour flow it is 4 to 8 mile per hour. According to manual there is 14-15% reduction in capacity during heavy rain.

By following the method collecting data by Virginia researchers, various surveying agencies collected data for different roads in India. The average of all the data is concluded in the given table as approximate reduction in flow of traffic on Indian roads

Weather condition	Avg. speed	capacity
Light rain	5-15%	6-14%
Heavy rain	6-18%	12-34%

### Conclusion

After going through various researches the conclusion is that the weather impact on road transport is a major problem means rain affects transportation and there is need of identification of problems and their rectifying. The study shows that there is impact of rainfall on subgrade strength of road, pavement, shoulders, drainage etc. which causes failure of road and road transport also influenced. It was also find out that knowing the cause of pavement destruction during rain will significantly help in adopting proper maintenance techniques and preventive measures results in better road life and transportation. The productivity of highway management also influenced because of increase in cost of operating and maintenance of road during rainfall generally in high rainfall areas. Rainfall also reduces mobility of traffic on roads and accidents may also occur due to invisibility during heavy rainfall. Flow rate of the traffic reduced and capacity of road reduced which hampered the transport by roads.

### References

- [1] A.S. Harischandra, Identification of road defects, causes of road deterioration and relationship among them for bitumen penetration macadam roads in Sri Lanka. Master Thesis at the University of Moratuwa, Sri Lanka, 2004.
- [2] D.Y. PatilAbhijit, Y.B. PatilPrathisthan's, and A. Patil Polytechnic, Effects of Bad Drainage on Roads, Civil and Environmental Research, Vol. 1, No.1, 2011.
- [3] N.D. Little, and R.D. Jones, Chemical and Mechanical Processes of Moisture Damage in Hot-Mix Asphalt Pavements, Moisture Sensitivity of Asphalt Pavements- A National Seminar, February 4-6, 2003 San Diego, California. Transportation Research Board of the National Academics, 2003.
- [4] K.D. Stuart, Moisture Damage in Asphalt Mixtures- A State-of-Art Report, FHWARD-90-019, Federal Highway Administration, U.S Department of Transportation, Washington, D.C., 20001., 1990.
- [5] Kordi, Nurul Elma, EndutIntanRohani, and BaharomBahardin, "Types of Damages on Flexible Pavement for Malaysian Federal Road." Malaysian University Transportation Research Forum and Conferences (978-967-5770-08-1): pp.421-432, 2010.
- [6] TRB. *Highway Capacity Manual* 2000. Transportation Research Board, 2000.
- [7] Lamm, R., Choueiri, E.M., and Mailaender T. Comparison of Operating Speeds on Dry and Wet Pavements of Two-Lane Rural Highways. In *Transportation Research Record 1280*, Transportation Research Board, National Research Council, Washington DC, 1990, pp 199-207.

- [8] Jones, E. R., and Goolsby, M. E. The Environmental Influence of Rain on Freeway Capacity. In *Highway Research Record* 321. Transportation Research Board, National Research Council, Washington DC, 1970, pp. 74-82.

