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5. Problems Encountered in Highway Construction in Flood Prone Areas- A Review

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Abstract:

A network of good roads directly affects the economy of the country. Roads are veins and arteries of the nation, which help to transform the pace of development and ensure that prosperity reaches the farthest corners of our nation. Deterioration of roads because of flooding causes huge amount of expenditure on our already struggling economy. Hence, there is an urgent requirement for better and more sustainable road system in the flood prone regions specially. This review paper is based on such regions of India and discusses some of the major problems faced.

Keywords: Flood, Embankments, Soil properties, Highway statistics.

5.1 Introduction:

India, owing to its topographical and climatic conditions, is among the most vulnerable countries to natural disasters in the world. It is hit by some major calamity almost every year. High Powered Committee on Disaster Management identified 33 different types of disasters affecting various parts of India, out of which flood was the major and the most hazardous one. Floods are a very common phenomenon here.

Over 8% Indian area, i.e. 40 million hectares is prone to floods and the average area affected by floods annually is over 8 million hectares [1].

These floods cause immense loss of life and property, pose serious health issues and social trauma and are a predominant cause of disruption to the transport section. It gets worsened when the connectivity (road-rail network) fails as these roads are built using the conventional methods majorly and cannot stand such calamities. In many cases it is seen that the major sections of the roads are completely washed off.

5.2 Major Flood Prone Areas in India:

The total area affected by floods in India is between 7.5 million hectares and 10 million hectares annually. India Meteorological Department (IMD) has divided the contiguous Indian area into 33 meteorologically homogeneous sub-divisions mostly on the basis of rainfall.

Based on the amount of rainfall received and types of flooding situations, the regions have been sub-categorized into the following areas:

2.1 Bihar, Chhattisgarh, Jharkhand and Orissa
2.2 Assam and other eastern state
2.3 Kerala, Tamil Nadu and parts of Mumbai
2.4 Uttarakhand - (floods of 2013)

As of NHAI 2018-19 records, the average road construction rate was 29 Km/day but in these regions it stooped to as low as 1.5 Km/day which was only 0.6 Km/day in 2009-14.

Ministry of road transport and highways, NHAI and BRO are already working to improve these numbers but there are many challenges due to the climatic and topographical conditions.

Figure 5.1a: flood hazard map highlighting areas most prone to flooding [1].

Every year these floods cause huge damages in the subcontinent. On an average, 8 million hectares of land gets covered with water per year and INR 5431Cr of property is ruined with includes the damage to roads, crops, public buildings and houses.

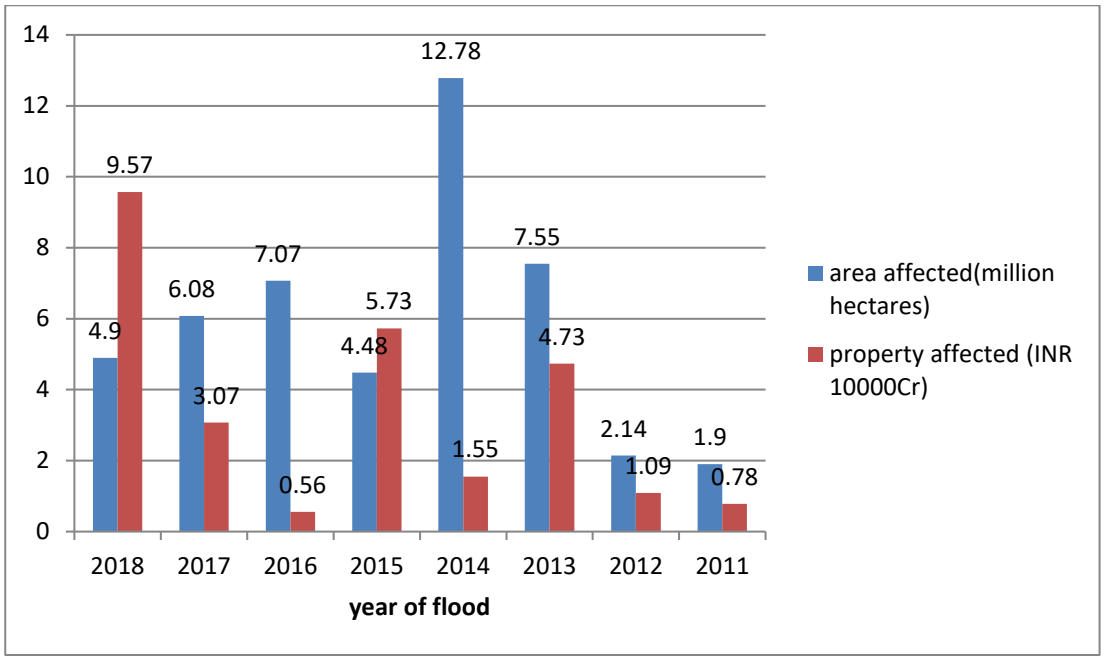

Fig. 5.1b: flood damage statistics over the years

5.3 Various Problems in Road Construction:

There are many reasons that directly or indirectly affect the construction works, pose problems in rehabilitation work and other factors that cause degradation of the soil quality. The factors discussed here are:

5.4 Flashing Floods:

- Major characteristics: loosening of subsoil, Prone to landslides

The high velocity running water sweeps away the subsoil leaving the structure hanging above hollowness making it vulnerable to cuts, cracks and even landslides. Heavy flood damage was inflicted during the monsoon of 1955, 1971, 1973, 1977, 1978, 1980, 1984, 1988, 1989, 1998, 2001 and 2004 and not to forget the most hazardous case of 2013.[4]. During flashfloods of **Uttarakhand-2013**, due to the cloud outburst, the high velocity rain water swept away the subsoil and the structure above causing immense landslides in the area and also making it difficult for rehabilitation works. The roads were seriously damaged more than 450 places. A total of 1,936.36 km of major roads and 8,099 km of rural roads were damaged. A total of 2,217.36 km of major roads were damaged. “Close to 50 percent of the state’s area is above the tolerance limit of 11.2 tons per hectare per year of soil loss,” Mahapatra, Principal Scientist, ICAR-National Bureau of Soil Survey and Land Use Planning, told in one of his statements.

Indian scientists have been trying to reach the root cause of this problem. They have developed a soil loss map of Uttarakhand that will help pinpoint the most affected areas where further tests and data collection will be done. Also, a three-tier wall is being built to save the town from any flood in the future.

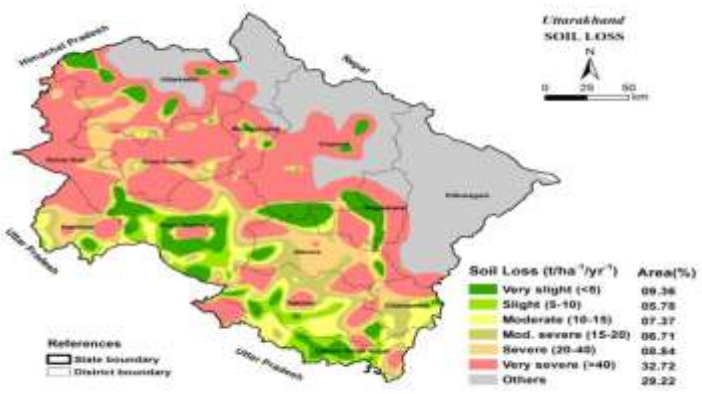

Figure 5.2: A soil loss map of Uttarakhand. Photo by SK Mahapatra. [8]

Figure 5.3: a three tier wall-ongoing project in Uttarakhand. [9]

5.5 Alternate Wet Dry Conditions:

- Major characteristics: -The cohesion property of soil is affected that indirectly reduces the shear strength of the soil leading to its erosion.

The alternate wet and dry weather conditions corrode the soil quality and promote the chances of its erosion making the construction works more challenging. Odisha faced this issue while constructing its 163km long Rourkela-Sambalpur toll-way road extension project. The project is along the state highway SH-10, extending the original two lanes to four lanes. The embankment slope lengths were as long as 16 meters with a slope gradient of 2H: 1V. Such slopes are susceptible to erosion due to rainwater run-off and progressive attrition can compromise the stability of the vital earth structure. [10**]**

Figure 5.4: Section of State Highway SH-10[10]

Stone pitching is a conventional erosion control technique for embankment slope but it is highly labor intensive. With these factors and the new government policies emphasizing green highways with low carbon footprint, the Strata Web system is the best option.

The Strata Web innovative solution for side-slope protection is cost-effective, technically-sound, long-lasting and eco-friendly.

The technically advanced solution leaves a low carbon footprint and lush greenery along the highway embankment slope, besides protecting the slopes against erosion. It provides a stable layer of vegetation over the slope surface. Roots of the vegetation further prevent erosion.

Figure 5.5: Stone Pitching on side slopes of highways [10]

5.6 River Line Flooding:

- Major characteristics- Water logging makes subsoil saturated; Bearing capacity of soil is reduced.

A River line flood occurs when the water level in a river, lake or stream rises and overflows onto the surrounding banks, shores and neighbouring land. The water level rise could be due to excessive rain or snowmelt. river line Flooding leads to water logging in already moisture laden land making it swampy in texture.

Thus it loses its bearing capacity and becomes unfit for direct construction. . When roads are inundated for a long time or repeatedly, the materials in each layer of road structure become saturated, and the original condition of subgrade soils will be compromised. The excessive water can drain into the foundation reducing its load bearing efficiency.

The increased river discharge in **the coastal regions of Kerala** leads to slow flooding that causes tremendous damage to roads and is terribly expensive.

Figure 5.6: River line flooding in Kerala [2]

The most probable solutions that can be provided for this case can include-

Protecting embankments, soft armoring and reinforced vegetation.

5.7 Immediate Requirements:

In India we are still following the conventional techniques of construction in most areas. Some of them have even become outdated and cannot provide the necessary stability and strength in such regions.

Hence new reforms are a need of the hour. Some of them include:- Properly implemented flood risk management system; better road designs; use of proper embankments; Use of skilled laborers and modern machinery(for clearing muck); imbibing modern construction techniques; Strict inspection by the concerned authorities

The bottom line is that though there are many issues and the process is quite challenging due to terrain, climatic and other reasons. But on the brighter side the authorities are working on these and soon will overcome these problems.

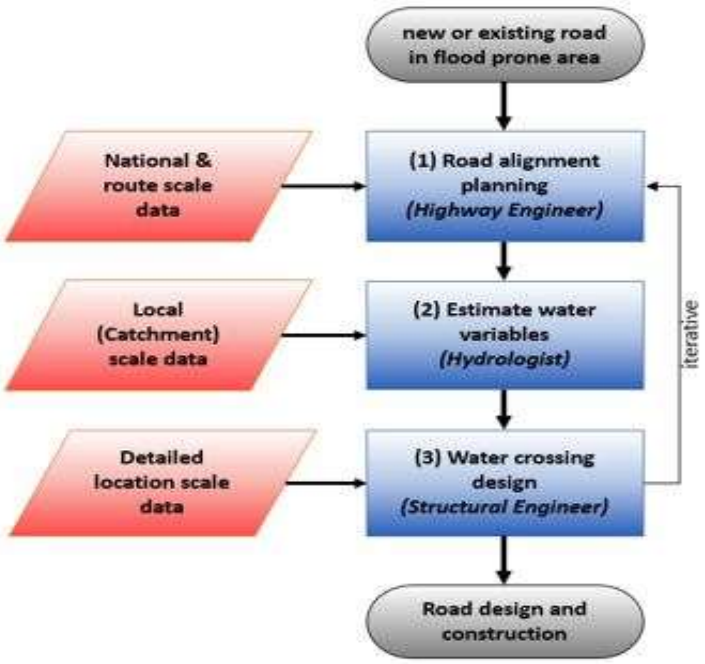

Figure 5.7: Modern Road Design plan [5]

5.8 Current and Upcoming Projects:

A network of stronger, safer, all weather roads is being built, in the State over the past four years.

Till 2014, the length of National Highways was 2,509 km. In 2018, NH length has reached 3,492 km.

The completion of the Delhi-Meerut Expressway and Delhi Saharanpur Highway will result in greater savings in time, cost and fuel for Uttarakhand bound vehicles.

Over Rs. 5,000 Cr will be invested to build 983 km of new National Highways.

Work is in progress on 66 projects worth Rs. 12,300 Cr, spanning a length of 800 km. Under Chardhamprogramme, 37 projects of 633 km length, worth a total cost of Rs. 8,500 Cr have been sanctioned.

Out of these 23 projects of 385 km length worth Rs. 4,100 Cr are ongoing and the remaining ones are at tender/award stage.

A total of Rs. 30,000 Cr worth investments will be made towards road development in the State. [3]

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