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Study on Repairing of Potholes

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Abstract : After the onset of monsoons, development of potholes on roads and streets of India is a common phenomenon. Quite often, potholes are repaired with antiquated techniques such as placing soil or bare aggregate in the pothole because no hot mix asphalt is available during monsoons. But techniques are not reliable these days because they require large amount of time and the quality of repairing is also not up to the mark. Traditional pothole filling techniques take a lot of manpower and a lot of heavy machinery, which is an expensive process. Due to non-repairing of potholes on time many of accidents and traffic congestion takes place every year. In 2016, nearly 1,50,000 deaths were caused by road accidents in India. Out of these, 2,424 deaths in road accidents were caused by potholes. Apart from deaths, they cause several accidents leading to major and minor injuries, and delay in travel time. Pothole is a failure in an asphalt pavement when there is water present in the underlying soil which weakens the supporting soil, and then traffic around affected area fatigues and breaks the asphalt surface. Failure in pavements takes place because of shearing, loading and deflection of materials. Which is the result of the action of traffic, poor support, and adverse atmospheric condition. In this paper different methods which are used for repairing potholes are described and best suitable method is selected based on the costing and quality parameters.

Keywords – Asphalt, Pothole, Pavement, Shearing, Traffic.

I. INTRODUCTION

A hole in a road surface that result from gradual damage caused by traffic or weather. A pothole is a hole in the roadway pavement that vary in size and shape. A deep natural underground cave formed by the erosion of rock, especially by the action of water or a depression or hollow in a road surface caused by wear or subsidence. Introduction to potholes in India is very common due to poor drainage system & poor quality of materials been used to repair it. The structural failure in pavement is mainly because of water below the structure of roads. Once the crack is developed water may enter it and deteriorate the materials of pavement. Quite often, potholes are repaired with antiquated techniques such as placing soil or bare aggregate, bitumen in the pothole because no hot mix asphalt is available during monsoons. Nowadays, the most common method is the pothole filling truck. This truck is equipped with a roller at its rear end and a hole in its base, which supplies the asphalt-aggregate mixture for filling the pothole.



Fig no.1:- Potholes on Indian road

Potholes are surrounded by cracks; these cracks are called crocodile cracks. This is the initial stage of asphalt pavement failure. These cracks, when subjected to heavy loads, tear apart and create a small hole. This

hole becomes larger and larger with heavy traffic and stops growing until the whole water-weakened region is turned into a pothole.

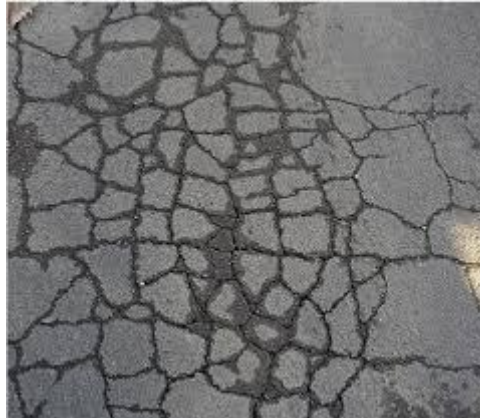


Fig no. 2:- Crocodile crack

II. POTHOLES

Development of potholes on Indian roads and streets after the onset of monsoons is a common phenomenon. Every year there is a public outcry and newspapers are full of pictures showing potholed road pavements. Hot mix asphalt plants are usually shut down during monsoons and no hot bituminous mix is available for filling potholes. Therefore, many potholes are either not repaired or repaired with antiquated techniques. The unprecedented development of potholes during the 2009/2010 summer rainfall season on particularly the Indian provincial and metropolitan roads with bituminous surfacing led to widespread concern among road users and significant media reporting.

III. EFFECT OF POTHOLES

These are the serious effects of potholes, the accident rate is increased, the appearance of road is also affected, speed of vehicle will decrease so the travel time will increase, so it is need to repair this potholes and for that government is wasting so much money for it but it needs proper method to be repaired. The major cause of road accidents in India are potholes which has claimed 3,597 lives in the year 2017 which is significant increase from the year 2016 i.e., more than 50% increase in the number of deaths was reported in the Times of India article.

According to an article in Hindustan times, the Supreme Court Thursday expressed concern over 14,926 people being killed in road accidents due to potholes in last five years and termed it “unacceptable”. A bench headed by Justice Madan B Lokur said the large number of deaths caused due to potholes across the country was “probably more than those killed on border or by the terrorists”. The bench, also comprising justices Deepak Gupta and Hemant Gupta, said the number of deaths from 2013 to 2017 in accidents due to potholes indicated that the authorities concerned were not maintaining the roads. The most extensive types of damage that have been caused by potholes on vehicles are alignment problems, damages to the under carriage, mufflers, shocks, axles, tires, and rims. At low speeds, hitting a deep pothole can cause damage to tires, wheels and steering alignment but the cost of repair probably would not justify an insurance claim. At higher speeds, can cause severe damage and risks loss of control of the vehicle which could result in impact with other vehicles, the curb or roadside objects.

IV. REPAIRING OF POTHOLES

Pothole repair operations can usually be divided into two distinct periods. The first period is winter repairs, when temperatures are low, base material is frozen, and additional moisture and freeze-thaw cycles are expected before the spring thaw. The second period is spring repairs, when base material is wet and soft, and few additional freeze-thaw cycles are expected. Regardless of the climatic conditions, the potential safety and rideability problems that could result from the unrepaired distress must be considered when deciding whether a pothole should be patched. A highway agency must repair potentially hazardous potholes as soon as it becomes aware of them. The decision to patch potholes is influenced by many factors: The level of traffic. The time until scheduled rehabilitation or overlay. The availability of personnel, equipment, and materials.

The two main elements of quality pothole patching are material selection and repair procedures. For every combination of these two factors, the cost-effectiveness of the overall patching operation will be affected by material, labor, and equipment costs. The combinations of materials and procedures that will produce optimum cost-effectiveness vary from agency to agency. There are generally two types of patch mixtures used for pothole filling: hot and cold. Cold mixture is used when the traffic cannot be halted. It takes around 3 minutes for the cold mixture to set. On the other hand, hot mixture requires some time to set. Use of hot or cold mixture depends upon

the cost and the level of traffic. Hot mixture is cheaper in cost than the cold mixture, and cold mixture provides a ready-to-go, durable, and effective repair than the hot mixture.

V. MATERIALS

Most agencies have three types of cold mixes available to them. The first of these is cold mix produced by a local asphalt plant, using the available aggregate and binder, usually without an opportunity to consider compatibility or expected performance. The second type is cold mix produced according to specifications set by the agency that will use the mix. The specifications normally include the acceptable types of aggregate and asphalt, as well as acceptance criteria for the agency to purchase the material. The third type is proprietary cold mix. A local asphalt plant generally produces this material using specially formulated binders. These binders are produced by companies that test the local aggregate, design the mixes, and monitor production to ensure the quality of the product.

VI. REPAIR TECHNIQUES

Many maintenance agencies use the throw-and-go method for repairing potholes. Although not considered the best way to patch potholes, it is the most commonly used method because of its high rate of production.

6.1 Throw and Roll

Throw-and-roll method is one of the oldest and simplest pothole repairing method. It is a temporary repair and done where the conditions are unfavourable: wintry or watery conditions. It can be performed on wet potholes but has a better repairing effect when done on dry potholes. It is used very commonly in India because of its speed and simplicity. Hot or cold patch material is placed in the pothole, and then the patch is compacted with a roller. Throw-and-roll method is cost effective and quick but it doesn't provide a longlasting repair. One difference between this method and the traditional throw-and-go method is that some effort is made to compact the patches. Compaction provides a tighter patch for traffic than simply leaving loose material. The extra time to compact the patches (generally 1 to 2 additional minutes per patch) will not significantly affect productivity. This is especially true if the areas to be patched are separated by long distances and most of the time is spent traveling between potholes.



Fig. no.03:- Throw and roll

6.2 Spray Injection Repair method

Spray-injection repair is a semi-permanent repair. It uses a spray gun to fill potholes. It is one of the best methods to repair a pothole. This procedure includes the following steps: 1. Remove water and debris from the pothole. 2. Square-up the sides of the patch area until vertical sides exist in reasonably sound pavement. 3. Place the mix. 4. Compact with a device smaller than the patch area. (Single-drum vibratory rollers and vibratory plate compactors work best.) 5. Open the repaired section to traffic as soon as maintenance workers and equipment are cleared from the area. This repair procedure provides a sound area for patches to be compacted against and results in very tightly compacted patches. However, it requires more workers and equipment and has a lower productivity rate than either the throw-and-roll or the spray-injection procedure.



Fig. no.04:- Spray Injection

6.3 Edge Seal

The edge seal method consists of the following steps: 1. Place the material into a pothole (which may or may not be filled with water or debris). 2. Compact the patch using truck tires. 3. Verify that the compacted patch has some crown (between 3 and 6 mm). 4. Move on to the next pothole. 5. Once the repaired section has dried, place a ribbon of asphaltic tack material on top of the patch edge (tack material should be placed on both patch and pavement surfaces). 6. Place a layer of sand on the tack material to prevent tracking by vehicle tires. 7. Open the repaired section to traffic as soon as maintenance workers and equipment are cleared from the area. This procedure may require a second visit to the repaired section by the crew to allow water to dry before placing the tack. Although this does reduce the productivity of the procedure, the placement of the tack material prevents water from getting through the edge of the patch and can glue together pieces of the surrounding pavement, improving support for the patch.

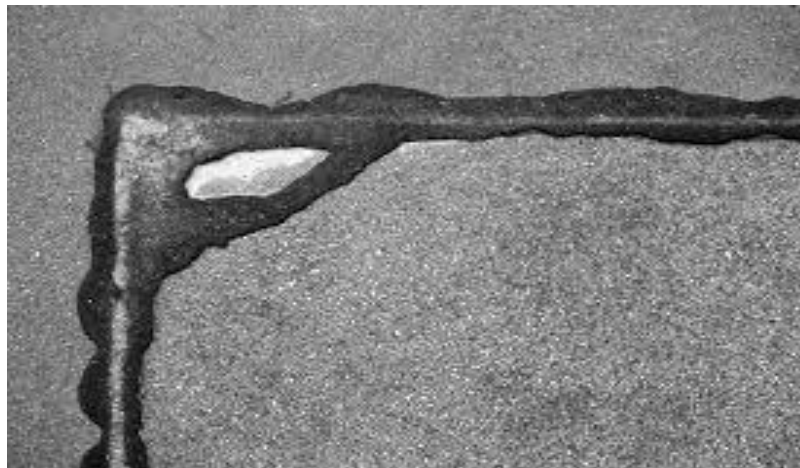


Fig no.05:- Edge Seal method

VII. MODERN ADVANCEMENT

Nowadays many advancements are found both in materials & methods for repairing of potholes. Earlier only some of the limited materials were used like sand, bitumen, asphalt etc. for filling of potholes, but now geosynthetics are also finding a way in repairing materials. Geosynthetic is basically used as sheet for the repair with non-newtonian fluid inside sheet. As of for methods or equipments modified pothole filler truck is used for better filling of potholes.

7.1 Use of Non-Newtonian fluid to fill Potholes

A system and technique to fill cracks and voids; potholes caused thanks to deterioration of roads. This technique employs filling the chuckhole by putting a versatile instrumentality, principally a bag that is filled by a strategy is Non-Newtonian fluid that has shear thickening properties. the economical, comparatively less heavy than typical strategies of repairing potholes. it's conjointly environment friendly because the fluid is organic. the target is to produce a superior and mobile answer to an extended standing and infrequently unheeded downside of potholes.

7.1.1 “Application of Non-Newtonian Fluid to Fix Potholes”, Mitali Kandalgaonkar, Ruturaj Mane (ICGTI) March 2017:- From test perform it can be concluded that Cornstarch + water (2:1) can be used to fix potholes. This method can be used where hot mix method is inefficient especially during monsoon season. The life span of the material is 30-40 days. Hence it is a temporary method to fix pothole. With further study and research the life span can be increased by adding admixtures to the material. According to gazette published by ministry of road transport government of India the maximum axial load permitted on Indian roads is 35.7 tons. Hence this method can be used for all vehicle loading conditions.

7.1.2 “Use of Non-Newtonian Fluid To fill Potholes” Deepak Vishwakarma, Rahul Yadav, Sameer Mehdi (International Journal Of Research In Science And Engineering) 3rd March 2017:- In most cases non-Newtonian characteristics square measure ascertained within the therefore known as structured fluids, however there's an on the spot link between the kind and extent of non-Newtonian fluid behavior and therefore the influence of the outwardly applied stress on the state of the structure. Therefore, the activity of non-Newtonian characteristics is often accustomed ascertain the state of structure in a very fluid. Conversely, one will engineer the structure of a sub-stance to impart the required rheologic properties to a product. However, before examining the role of structure, it's helpful to review 2 key assumptions inherent the thought of shear or elongation or complicated viscousness.

7.2 Modified Pothole Filler Truck

On Indian roads, conventional pothole filler trucks can be made efficient by making few modifications in the trucks. Apart from a hole in its base and a roller at its rear, two mixer blades are added and can provide a good quality mixture of asphalt and aggregate. Pothole filling truck works on the throw-and-roll method. The only difference: manual throwing of patch material is replaced by filling the pothole with a truck directly, by the hole provided in its base. It can also be automated by using ultrasonic sensors to detect the irregularities on the surface of the road, and of those irregular surfaces, the ones with high difference with mean level of the road can be detected and filled automatically. The quantity of the patch material can also be governed with the help of sensors.



Fig.no.06:- Modified Pothole filler truck

VIII. COMPARISON

THROW & ROLL	SPRAY INJECTION	EDGE SEAL
It is most basic method of filling conventional pothole by placing materials in pothole and driving heavy truck over it.	It is similar to semi-permanent one but requires special equipment.	It involves using throw & repair and then filling potholes. Further it is compacted by heavy duty truck.
It provides temporary pothole relief.	In this method water needs to be blown out first and then spray injection is used to apply asphalt and aggregate to it.	In this method after compaction asphalt ribbon is placed along the edge so it overlaps patch and pavement.
It has high failure rate and only used in case of absence of other choices.	Once the solution is applied no need to compact the materials.	It can be open to traffic as soon as it is done and equipments are cleared.

IX. SUMMARY

In India, the method which is using to repair the potholes does not give durability, because, the portion which is repaired gets seepage through the base and top surface gets water entry from sources like rain, ice. Which will again damage the work and bonding would reduce thus durability will reduce and again we have to apply same method to repair it. The application of geo sheet in potholes repairing work gives durability to the work. After applying it, the seepage through base will reduce which will improve the durability of repaired pothole. Same as for epoxy it gives well resistant for water entry from the top surface. Modified pothole filling trucks are better than ordinary pothole filling trucks when they are compared, in reference to Indian conditions. They can work well for both hot and cold mixtures. A better-quality mixture of emulsified asphalt and aggregate from the modified pothole filling truck will result in cost-effective yet stronger repairing material for the pothole filling.

REFERENCES

- [1] Damein Gayle and Myank Saxena: "Prototype of Non-Newtonian Fluid To Fix Potholes", Case Western University Cleveland, Ohio,(ScienceMag) U.S.A.(Published 12th March 2012) volume : 5 Issue : 1.
- [2] Deepak Vishwakarma, Rahul Yadav,Sameer Mehdi. "Use of Non-Newtonian Fluid To fill Potholes",Journal Name-International Journal Of Research In Science And Engineering(IJRIS) 3rd March 2017. Volume : 2 Issue : 3
- [3] N.Naveen ,S Malleesh Yadav, " A study on potholes and its effect on vehicular traffics" ,IJCRT 2018 . Volume : 6 Issue : 1
- [4] Anderson, D.A., et al. 1988. More Effective Cold, WetWeather Patching Materials for Asphalt Pavements, Federal Highway Administration, Report No. FHWA-RD88-001.
- [5] Smith, K.L., et al. 1991. Innovative Materials and Equipment for Pavement Surface Repairs—Final Report, National Research Council, Strategic Highway Research Program, Contract No. SHRP-M/UFR-91-504
- [6] Timothy Geary "Pot Hole Repair Patch and Method of Installation" Camarillo, Ca (U S) In June 2013
Wilson, T.P. 1998. Long-Term Monitoring of Pavement Maintenance Materials Test Sites, Final Report, Publication No. FHWA-RD-98-073, Federal Highway Administration, McLean, Virginia
- [7] Ransome J Wyman "Roadway Repair and Maintenance" Palmas, Laguna Niguela Ca (Us) 92677 In April 2009.
- [8] [Dr. Umesh Sharma, Er. Abhishek Kanoungo, Study of causes of Potholes on bituminous. Roads – A Case Study.
- [9] [Chhabra, R.P. (2006). Bubbles, Drops, and Particles in Non-Newtonian Fluids (2nd ed.). Hoboken: Taylor & Francis Ltd. pp. 9–10. ISBN 1420015389
- [10] Journal of Pothole Identification, Assessment and Repair Guidelines, Clifton associates ltd, August 2012.
- [11] Evans, L.D., et al. 1993. Materials and Procedures for Pavement Repairs—Final Report, National Research Council, Strategic Highway Research Program, Contract SHRP-89-H106.