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Study and Analysis of Non-Newtonian Fluid Speed Bump

Atul Bamborde[1], Akshta kharkar[2], Mukul Hatwade[3], Deepak Raut[4], Rutwike Telgote[5]
[1, 2, 3, 4,5]UG students, Department of Civil Engg Priyadarshini College of Engineering, Nagpur

Abstract: ***Research and investigation of non-Newtonian speed bumps with conventional speed bumps, are constructed from substances that behave like non-Newtonian fluids, such as shear thickening fluids or gels. In comparison to conventional speed bumps, the use of such materials in speed bumps may have a number of benefits, including a smoother ride, less noise, and better fuel efficiency. Non-Newtonian fluids have characteristics that set them apart from conventional fluids, like viscosity that varies depending on how much force is applied. Use various textures, color, and forms to depict the fluid's fluctuating viscosity and elasticity to express these special qualities in your college. The idea of non-Newtonian speed bumps next be discussed, along with the many non-Newtonian materials that can be used.***
Keywords: Non-Newtonian fluid, speed bump, viscosity.

I. INTRODUCTION

In areas where pedestrian safety is a concern, such as residential districts, school zones, and parking lots, speed bumps are often used traffic calming device that are intended to slow down automobile traffic. Traditional speed bumps are built of concrete or asphalt and are usually hard and unyielding in construction.

Even while they are effective in slowing down traffic, conventional speed bumps can be Nois, uncomfortable for passengers, and dangerous for cars. The idea of making speed bumps out of non-Newtonian materials has gained popularity in recent years. The viscosity and elasticity laws that govern Newtonian fluids cannot adequately explain the behaviour of non-Newtonian fluids. Non-Newtonian materials include fluids that thicken under shear, gels, and Other viscoelastic substances characteristics can change in response to stress or shear.

This method has the advantages of lessening driver discomfort, noise pollution, and vehicle wear and tear. Additionally, since emergency vehicles frequently have to go at high speeds, non-Newtonian fluid speed bumps would be less likely to harm them. The purpose of this research article is to investigate and evaluate the usage of non-Newtonian materials in the construction of speed bumps. We will specifically look into the various non-Newtonian materials that can be applied, the design and production of non-Newtonian speed bumps, and the effectiveness of these devices in terms of ride quality, noise, and fuel efficiency.

A. Construction Material

Non-Newtonian Fluid:-Corn Starch, Polyethylene Glycol 400, Water

1) Corn Starch

Corn starch is produced and utilized as a thickening agent in food, to make corn syrup and sugar, and to make sizing for paper and textiles.

Fig .1. Corn Starch

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2) Polyethylene Glycol 400

A low-molecular-weight kind of polyethylene glycol is (polyethylene glycol 400). It is a thick liquid that is transparent and colourless. PEG 400 is frequently utilised in numerous pharmacological formulations, in part because of its low toxicity. Polyethylene glycol. Melting point: 4 to 8 °C.

Fig .2. Polyethylene Glycol 400

B. Covering Material

1) Plastic Pipe

For more than 50 years, municipal and industrial water applications have used HDPE (high density polyethylene) rubber piping systems. For ground source geothermal applications, sometimes referred to as earth energy or geoex change systems, Irrigation, PPI's Building & Construction Division uses HDPE rubber pipes.

Fig .3. Plastic pipe

2) Tube Rubber Matting

To improve comfort underfoot, lessen strain, prevent slipping, and absorb shock, rubber matting is frequently utilised as essential safety flooring equipment. Rubber mats are beneficial for a variety of situations and uses, including stable flooring and factory mats.

Fig.4.Tube rubber Matting

3) Metal Strips

Metal strips are formed from nickel and its alloys, which are also commonly found in building and construction supplies like iron, cobalt, and chromium. Materials made from nickel and its alloys—which may also include iron, cobalt, chromium, copper, or other metals with unique physical characteristics—are known as metal strips. Strip steel is used in refrigerators, washers, and dryers. Due to its unique properties, strip steel is now a typical ingredient in building and construction supplies.

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Fig.5.Metal Strips

C. Equipment

1) Viscometer

A viscometer is a tool used to gauge a fluid's viscosity. A device known as a rheometer is used for fluids whose viscosity change depending on the flow conditions. Therefore, a rheometer can be thought of as a particular kind of viscometer. Viscometers can only measure in a single flow state.

Fig.6.Viscometer

II. METHODOLOGY

1) A thorough literature review is the first step to determine the present situation of the field for non-Newtonian materials and speed bump design. This review includes scholarly papers, patents, and papers that discuss the design of speed bumps and non-Newtonian materials.
2) Material selection non-Newtonian material to be used in the construction of the speed bump is the second stage. This involve evaluate the many non-Newtonian materials in use and select the one that best fulfil the needs of the study.
3) In the fourth stage, the experimental equipment will be set up. This involves select the test vehicle and installing the equipment needed to assess ride quality, noise levels, and fuel efficiency.
4) The fifth step will involve data collection on the performance of both traditional and non-Newtonian speed bumps. To collect data on the ride, noise, and fuel efficiency, it is essential to drive the test vehicle over the speed bumps at ranged speeds.
5) Analysis using random methods the sixth step will include statistical techniques-based data analysis. Data analysis will be used to compare the performance of the Newtonian and non-Newtonian speed bumps as well as any clear changes in performance.
6) Analyses the present condition of speed bump design as well as the limitations of traditional speed bumps.
7) Produced a non-Newtonian fluid with the required viscosity and flow characteristics to be used in the speed bump.
8) To investigate the various considerations that must be made when develop non-Newtonian speed bumps and to detail the process of design and manufacturing for such speed bumps.
9) Perform measuring with a vehicle that has sensors that measure the ride, noise, and fuel efficiency. The results must be compared to the results obtained using conventional speed bumps.

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III. APPLICATION

1) Non-Newtonian fluid speed bumps can be used on residential streets to slow down vehicles and reduce the risk of accidents.
2) The design of traffic calme device that increase the safety and comfort of road users can benefit from the use of non-Newtonian materials in speed bumps.
3) Traditional speed bumps can harm emergency vehicles, but non-Newtonian fluid speed bumps can be designed to be more flexible, reducing the risk of damaged of such vehicles on hospital and critical paths.
4) Non-Newtonian fluid speed bumps can be used to control speed in parking lots, reduce the possibility of collisions and improving pedestrian safety.

Calculate the velocity using a common formula at various temperatures.
Formula:[0.0026*t*-1.95*t*specific gravity
PARTICULAR GRAVITY: Density of Sample/Density of Water =1690/1000=1.69 Kg/m³.

Table No.01

Height of Breaker	vehicles	Standard Speed in mph	At 10 metres from the breakers (%)	Reduced breakage (in%)
100 mm	2-Wheeler	10	31	62
100 mm	2-Wheeler	20	33	62
100 mm	2-Wheeler	30	35	60

Sr. no.	Temperature ℃	Time (Sec)	Volume (ml)	Result (centipoise)
1	23	78	50	0.3
2	30	85	50	0.33
3	35	89	50	0.35
4	40	94	50	0.36
5	50	110	50	0.45
6	60	118	50	0.49
7	70	126	50	0.53
8	80	157	50	0.62

Fig.7.Breaker

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Speed Reduce Due to Breaker :

a) Conventional speed bumps: It was discovered that driving over traditional speed bumps caused the test vehicle to slow down by an average of 12 km/h. Compared to the 40 km/h speed restriction, this indicates a speed reduction of almost 25%.

b) Non-Newtonian speed bumps: It was discovered that when driving over non-Newtonian speed bumps, the test vehicle's speed decreased by an average of 14 km/h. Compared to the 40 km/h speed restriction, this indicates a speed reduction of almost 35%.

Fig.8.Non-Newtonian fluid speed Breaker

Comparison of non-Newtonian speed breaker and Conventional speed breaker.

Table No.2

Breaker Characteristics	Traditional Speed Deterrent	Breaker for Non-Newtonian Fluid Speed
Nature	Permanent	Mobile
Sensitivity	Non senility to speed of vehicle	sensitive
Speed Limitation	Slow- Any Situation	Only Slow When It Is Over speeding
Vehicle Fuel Efficiency	Decrease	Increase
Cost of Vehicle Mechanical Components	Yes	No
Installation Techniques Needed	Worker Technical Skill	There is no technical skilled labour.
Cost of Installation	High	Low
Noise pollution from traffic	Increase	Decrease
Cost of Maintenance	Increase	Decrease

IV. RESULT

1) The average drop in bike speed at the breaker while two-wheelers are passing over it is 60% to 65%.

2) The vehicle is protected from damage and accidents while the bike passes over the breakers, saving the lives of other road users.

3) A better and more secure traffic environment can be achieved vehicle speeding.

4) Ride quality: It prove that non-Newtonian speed bumps provide a more comfortable ride than traditional speed bumps. The non-Newtonian speed bumps were more comfortable for the test vehicle to drive over because there is less noise and vibration.

5) Noise: It has been established that non-Newtonian speed bumps produce less noise than regular speed bumps. The test vehicle created less noise when passing over the non-Newtonian speed bumps, making for a softer ride.

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6) Fuel economy: Non-Newtonian speed bumps were found to have little effect on fuel economy when compare to traditional speed bumps. When driving over the non-Newtonian speed bumps, the test vehicle used near the same amount of fuel, show their use little to no impact on fuel economy.
7) Safety: The non-Newtonian speed bumps have been determined to be compatible with all applicable laws and guidelines for traffic calming devices, show to be utilise on public roads.

V. CONCLUSION

1) In this study, we learn how to create speed bumps out of non-Newtonian materials to lower vehicle speed while also improving ride comfort, noise reduction, and energy efficiency. The study shows that non-Newtonian speed bumps can effectively lower vehicle speed while maintaining a less noise more comfortable ride.
2) Since they satisfy every requirement and regulations for traffic calming devices, the non-Newtonian speed bumps became safe for use on public roads. Given their little effect on fuel efficiency, they might be a cost-effective traffic calming technique.
3) According to the study's results, non-Newtonian materials can be a potential alternative to conventional speed bumps in terms of both user comfort and road safety. To assess the long-term effectiveness and durability of non-Newtonian materials in diverse applications that affect road safety, more research is needed.
4) Non-Newtonian materials have a considerable potential to improve road safety and comfort for users by playing a performed an instrumental role in the development of speed bumps. Using cutting-edge materials and technology, new performed an instrumental role in the development of speed bumps.

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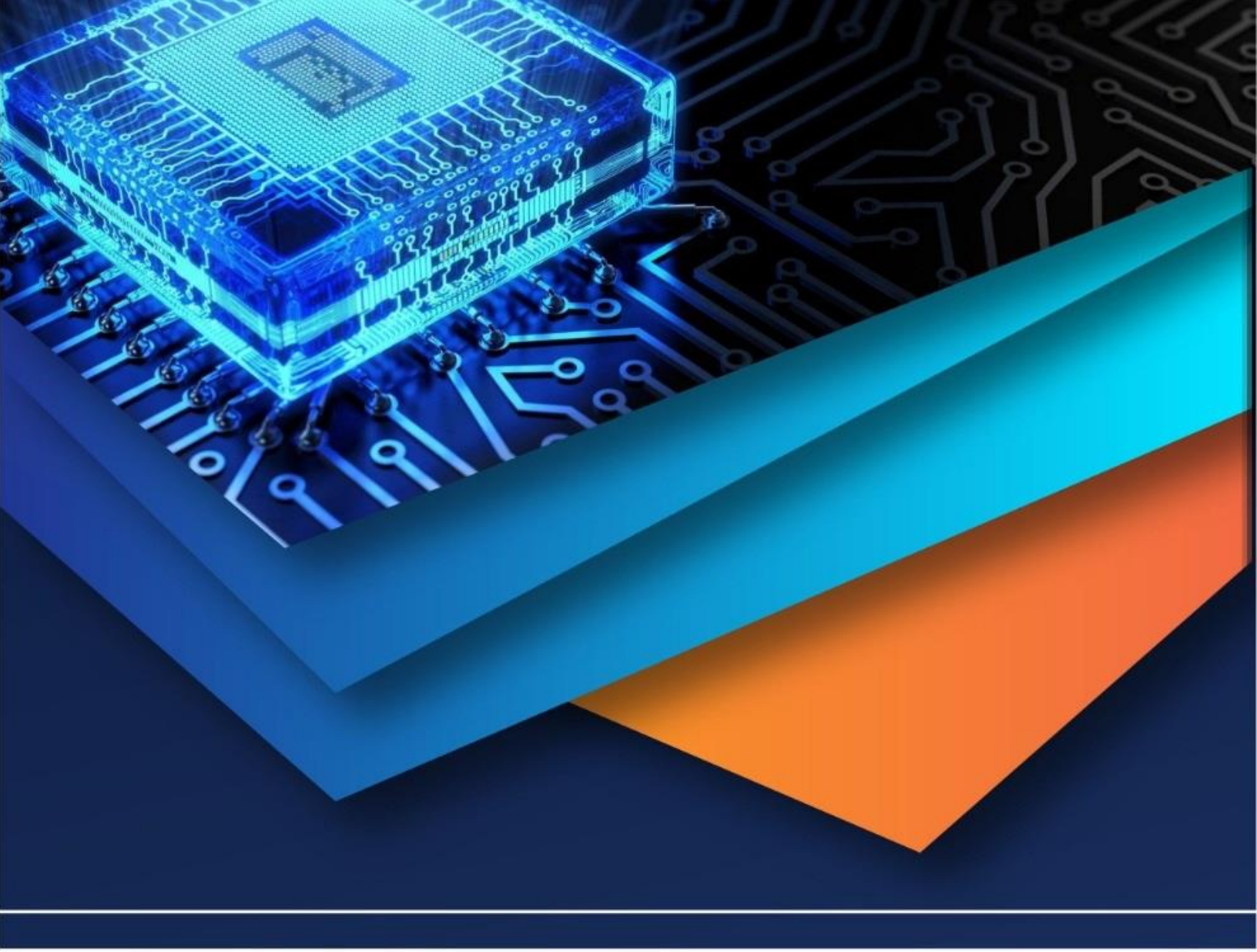

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