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Design and Development of Non- Newtonian Fluid Speed Breaker

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Abstract*: Speed bumps, as traffic calming devices, have been extensively used to reduce traffic speed on local streets. This study represents a unique application of Non-Newtonian fluid as Speed Bump. This technical paper relates to a device that reduces the speed of any over speeding vehicles travelling on a roadway. It is formed by a flexible material which consist of Non-Newtonian fluid in it i.e. each receptacle is impregnated with a dilatants shear thickening fluid. The material is placed under compression during impact when the vehicle strikes it and the fluid itself acts as means for controlling the resistance to deformation of the strip. Thus, if the vehicle travels at a low speed the fluid has a low viscosity and the strip is easily deformed, whereas if the speed of the vehicle is high the viscosity of the fluid is high and as a result has great resistance to deformation, thus forming a rigid obstacle to the passage of the vehicle. Drivers must always slow down when driving over the conventional speed breakers to prevent damage to their vehicle. However, the Non-Newtonian fluid Speed Breaker is sensitive to the speed of the vehicle. The vehicle needs to slow down only if it is over speed.*

Keywords: Bumps, Non-newtonian Fluid ,Viscosity, Speed Breaker, Flexible Material, Rigid obstacle, Shear Thickening Fluid

I. INTRODUCTION

Road safety is a critical concern worldwide, particularly in urban and suburban areas with heavy traffic flow. One of the major contributors to road accidents is over-speeding, which accounts for a significant proportion of injuries and fatalities. To mitigate these risks, various traffic-calming measures, such as traditional speed breakers, have been deployed. However, these methods often have limitations, including discomfort to vehicle occupants, increased vehicle wear and tear, and noise pollution.

In response to these challenges, engineers and scientists have developed **Non-** Newtonian Fluid Speed Breakers, which represent a significant leap in traffic management technology. Unlike traditional speed breakers that impose a fixed mechanical barrier, these innovative systems adapt dynamically to the speed and weight of the approaching vehicle. The unique properties of non-Newtonian fluids make this possible, offering a smarter, safer, and more sustainable approach to controlling vehicle speeds.

II. LITERATURE REVIEW

Teja Tallam and Jyothi Makkena (2017) aims to find the variation of speeds of different class of vehicles at speed breakers and to develop a model for finding the bump height that should be provided at that particular road for a given safe speed limits of different types of vehicles on that road section. To achieve this, three locations were selected and Volume counts for the above roads were observed for every 15 -minute intervals. The video was recorded during peak hours and the variation of speeds before and after 10 m from speed breakers were calculated at these locations. The average reduction in speed of vehicles with respect to the approaching speed at the distance of 10 m from bump is 52.69%.

Geetham Tiwari (2009) the main conclusion of his studies is that there is an urgent need for Traffic Calming measures in Indian cities. The co DE2`nclusion from this is that "standardised Traffic Calming measures", primarily by introducing humps at both entrances and exits to intersections and to introduce raised footpaths in all corners to see to it to make the

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approaches for pedestrians as comfortable and safe as possible by preventing cars from being able to use that space **3.S. Revathi and A. Senthil Kumar (2020)** Compared to the state before the speed bumps were installed, statistically significant speed reducing was achieved. The values of the measured speeds became lower asthe speed bumps height raises. At locations where larger pedestrian presence is expected, speed bumps can successfully reduce the speeds of vehicles. The implementation of traffic calming measures, such as speed bumps, significantly contributes to the safety of pedestrians. 4. **Sahoo p.k** (2009) he discussed about geometric design of speed control breakers. Dimensions of most speed- control humps are determined from the engineering judgment of design engineers or past experience of the highway agency concerned. Guidelines for analytical design of hump geometry for speed control are studied. A rational approach is presented in which the geometric dimensions of a hump selected are dependent on the choice of a hump-crossing speed and a peak vertical acceleration that governs driver's choice of hump-crossing speeds. **5. Ndhlovu Pardon and Chigwenya Average** (2013) they aims to study the effectiveness in terms of speed reduction of three type of traffic calming measures: speed table, chicane, and road narrowing. The speed analyses regard a series of traffic calming measures located in urban contexts of Catania Province (Italy). For each of these traffic calming measures, experimental investigations were carried out relating to the measurement of speed. The study has shown that the speed tables represent the measure of traffic calming that guarantees the greatest conditioning on speed. Even the chicanes have a significant impact on reducing speed, as well as the speed tables (average speed is reduced by up to 50%), while road narrowing allows maximum reductions in average speed of around 35%. Furthermore, all three traffic calming measures have resulted in a reduction of accidents always greater than 30%. In the case of speed tables, the reduction in accidents exceeds even 40%a mainstream road safety solution

III. RESEARCH GAP

There are gaps in research on how well non-Newtonian fluid speed breakers last in different weather conditions and how they can be scaled for various traffic needs. Studies on their cost, potential environmental issues like leaks, and how they handle heavy vehicles are limited. Also, there hasnat been enough focus on adding smart systems, testing them in real traffic conditions, or fully understanding their safety for all road users.

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IV. MANUFACTURING AND ASSEMBLY PROCESS

The manufacturing and assembly of the non-Newtonian fluid speed breaker followed a structured approach to ensure functionality, durability, and reproducibility. The outer shell was fabricated using a 3–5 mm thick silicone sheet, chosen for its UV resistance, flexibility, and weatherproofing properties. The inner container, designed to encapsulate the shear-thickening fluid, was constructed from a 2–3 mm thick low-density polyethylene (LDPE) sheet, cut into rectangular panels and heat-sealed to form a leak-proof compartment. A galvanized steel sheet (5–6 mm thick) served as the base plate, providing structural stability and anchorage to the road surface. Stainless steel screws and nuts (M10 size) were used to secure the assembly.

The non-Newtonian fluid was synthesized by mixing corn starch (60%), glycerine (30%), and water (10%) by weight. Glycerine was incorporated to delay fluid evaporation, while water activated the shear-thickening behavior. The mixture was homogenized mechanically to eliminate lumps, and its rheological properties were validated using a rheometer to confirm viscosity increases under high shear rates. The LDPE container was filled with the fluid through a dedicated port, which was later sealed using heat or epoxy adhesive.

Assembly began by layering the galvanized steel base plate, LDPE fluid container, and silicone outer shell. The silicone sheet was pre-molded into a convex shape using vacuum-forming to ensure an ergonomic design and then bonded to the base plate using silicone adhesive, with clamps applied for 24 hours to achieve a watertight seal. Finally, the speed breaker was anchored to the road by drilling holes into the asphalt, aligning them with the base plate's pre-drilled holes, and securing the structure with stainless steel screws and nuts torqued to 30–40 Nm.

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Fig: Non – Newtonian fluid speed breaker

Fig: Non-Newtonian Fluid Fig : Construction of Outer Shell

V. RESULT

The non-Newtonian fluid speed breaker was tested in real-world conditions by passing vehicles over it at different speeds, with outcomes observed visually. At low speeds (below 20 km/h), the breaker remained soft and flexible, allowing vehicles to pass smoothly without significant discomfort. However, when vehicles approached at higher speeds (above 40 km/h), the corn starch-glycerine-water mixture inside stiffened instantly, creating a rigid barrier that forced drivers to reduce speed. After couples trials with cars and motorcycles, the silicone outer shell and LDPE inner container showed no visible cracks, leaks, or wear, demonstrating robust durability. Drivers reported a noticeable difference in ride comfort compared to traditional concrete speed breakers, particularly appreciating the smoother transition at safe speeds. The fluid retained its shear-thickening properties throughout testing, with no separation or drying despite exposure to sunlight and light rain. While the design successfully encouraged speed reduction and proved adaptable to real-world conditions, testing was limited to light vehicles, and long-term durability under extreme weather or heavy traffic remains unverified. This pilot test confirms the concept's practicality as a low-cost, eco-friendly traffic solution, though future work should explore scalability and enhancements like reflective markings for nighttime visibility.

VI. CONCLUSION

The non-Newtonian fluid speed breaker, crafted from silicone, LDPE, and a corn starch-glycerine-water mixture, successfully demonstrated its ability to adapt to vehicle speeds during real-world testing. At safe speeds, the breaker remained soft and flexible, offering a smoother ride compared to rigid concrete models, while high-speed impacts triggered instant stiffening, effectively encouraging drivers to slow down. The simple, low-cost design proved durable under repeated vehicular stress, with no visible damage to materials or fluid leakage observed.

This project highlights the potential of shear-thickening fluids in smart traffic management, combining eco-friendliness (biodegradable materials) with user-centric functionality. However, limitations such as untested performance under extreme weather, heavy trucks, and long-term wear warrant further investigation. Future improvements could include temperature-stabilizing additives, reflective coatings for visibility, or integration with sensors for data collection. Overall, the prototype offers a promising, innovative alternative to traditional speed breakers, prioritizing safety, comfort, and sustainability.

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REFERENCES

[1]. International Journal of Advances in Engineering and Management (IJAEM), Design and Working of Non-Newtonian Fluid Speed Bumps Published: Volume 3, Issue 6, June 2021, https://ijaem.net/issue_dcp/No Newtonian%20Fluid%20Speed%20Breaker.pdf

[2]. International Research Journal of Engineering and Technology (IRJET) Application of Shear Thickening Fluids in Speed Breakers Published: Volume 9, Issue 5, May 2022, https://www.irjet.net/archives/V9/i5/IRJET-V9I5274.pdf

[3]. ScienceGate, Research on: Dynamic Behavior of Shear Thickening Fluids in Traffic Applications https://www.sciencegate.app/document/10.22214/ijraset.2021.35250

[4]. A Study on the Behavior of Speed Breakers using Non-Newtonian Fluid and Comparison with Conventional Speed Breakers Published in International Journal of Engineering, Research & Technology (IJERT), June 2021

[5]. https://www.ijert.org/research/a-study-on-the-behavior-of-speed-breakers-using-non- newtonian-fluid-and-comparison-with-conventional-speed-breakers-IJERTV10IS060470.pdf

[6]. Non-Newtonian Fluid Speed Breakers: An Alternative Traffic Calming Measure", Published in International Research Journal of Engineering and Technology (IRJET), May 2022, https://www.irjet.net/archives/V9/i5/IRJET-V9I5274.pdf