

Experimental Investigation of a Non-Newtonian Fluid-Based Speed Breaker for Road Safety Enhancement

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Abstract— This research paper presents the design and analysis of a non-Newtonian fluid-based speed breaker as an innovative alternative to conventional speed breakers. Traditional speed breakers made of concrete or asphalt often cause discomfort, noise, and vehicle damage. The proposed system uses a non-Newtonian fluid (Oobleck), which exhibits shear-thickening behavior. At low speeds, the fluid behaves like a liquid, allowing smooth vehicle movement, whereas at high speeds it becomes rigid and resists motion.

Experimental results show that the proposed system reduces noise, improves ride comfort, and minimizes vehicle damage. It is also cost-effective and requires less maintenance. This study concludes that non-Newtonian speed breakers are an efficient and eco-friendly solution for modern traffic management.

Index Terms— Non-Newtonian Fluid, Speed Breaker, Oobleck, Traffic Control, Shear Thickening, Road Safety.

I. INTRODUCTION

Road safety is a major concern in modern transportation systems. Over-speeding in hospital areas, school zones, and narrow roads leads to accidents. Conventional speed breakers, although effective, create problems such as discomfort and vehicle damage.

To overcome these limitations, non-Newtonian fluid-based speed breakers are introduced. These fluids change viscosity with applied force. At low speed, they act like liquids; at high speed, they behave like solids. This adaptive property makes them suitable for smart traffic control systems.

II. OBJECTIVE

To understand how the fluid reacts when force is applied. It helps to observe changes in its flow and thickness. This study shows how the fluid behaves differently at low and high pressure.

III. LITERATURE REVIEW

Many researchers have studied non-Newtonian fluid speed breakers as a better alternative to normal speed breakers.

Mr. Shoeb S. Sutar, February 2025, had study, researchers prepared a non-Newtonian fluid by mixing corn starch and water in different ratios. They tested it by placing it on the road and passing vehicles over it. [2] They found that the fluid gives less resistance at low speed and more resistance at high speed, which helps in controlling speed.

Haari Babu, June-2021, had study designed a speed breaker using a metal plate and rubber. [1] The non-Newtonian fluid (Oobleck) was filled inside it. When vehicles passed over it, the speed reduced effectively without causing much discomfort or noise.

Mr. Nishant Balashankar, March 2025, had research, a model speed breaker was made using simple materials like plastic pipe, rubber mat, and metal strips. [3] The fluid was filled inside and tested with vehicles. The results showed better ride comfort, less noise, and good speed control compared to traditional speed breakers.

Overall, all studies show that non-Newtonian fluid speed breakers are more comfortable, reduce vehicle damage, and improve road safety. They are also cost-effective and suitable for modern traffic control systems.

IV. METHODOLOGY

1. Study

First, we study about non-Newtonian fluids and speed breakers from books, internet, and research papers. This helps us understand how the fluid works and how we can use it in a speed breaker.

2. Selecting Materials

Next, we choose the materials needed for the project:

- Corn starch
- Water
- Polyethylene glycol
- Rubber sheet
- Steel or plastic plate

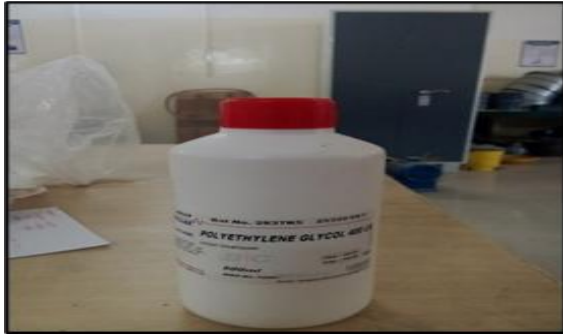


Fig 1.1 Polyethylene glycol

3. Making the Fluid (Oobleck)

We mix corn starch and water in the correct ratio.
 Mix well so that there are no lumps
 When pressed fast → it becomes hard
 When touched slowly → it feels like liquid



Fig 1.2 Mixed fluid

4. Designing the Speed Breaker

We design the speed breaker structure carefully for proper working. A strong base is provided at the bottom to support the load of vehicles. A hollow space is created inside to store the non-Newtonian fluid. A rubber layer is placed on top for flexibility and protection. This design helps the speed breaker work effectively at different speeds.



Fig 1.3 Tube rubber Matting

5. Making the Model

First, the wooden plate is cut to the required size. Then, the frame is fixed using strips or bolts to give proper support. A rubber sheet is placed on top for flexibility and protection. After that, a hollow space (chamber) is created inside the structure, and the prepared fluid is filled into it. Finally, the setup is sealed properly to prevent any leakage of the fluid.

6. Placing the Model

The speed breaker model is placed on a flat surface or road area and fixed properly

7. Testing the Model

Vehicles like bicycle or bike are passed over it:
 At slow speed → smooth movement.
 At high speed → it becomes hard and slows the vehicle.

8. Collecting Data

We noted down:
 Speed before crossing.
 Speed after crossing.
 Comfort level.
 Noise and vibration.

9. Checking Results (Analysis)

We study the data to see:
 How much speed is reduced.
 Whether it is comfortable.
 Comparison with normal speed breakers.

10. Final Result

Table 1.1 Result

No. of testing	Speed before impact	Speed after impact	Speed before impact	Speed after impact	Speed before impact	Speed after impact
1	30km/hr	24km/hr	40km/hr	30km/hr	45km/hr	33km/hr
2	30km/hr	25km/hr	40km/hr	32km/hr	45km/hr	32km/hr

3	30km/hr	27km/hr	40km/hr	31km/hr	45km/hr	31km/hr
4	30km/hr	26km/hr	40km/hr	33km/hr	45km/hr	30km/hr
5	30km/hr	25km/hr	40km/hr	29km/hr	45km/hr	28km/hr
Total Average speed	30km/hr	24.4 km/hr	40km/hr	31km/hr	45km/hr	30.8 km/hr
Percentage of speed reduction	18.67%		22.5%		31.55%	

V. DESIGN AND WORKING PRINCIPLE

1. Design Components
2. Base Plate (0.45m x 0.91m)
3. Rubber Layer (3mm thickness)
4. Metal or plastic Frame
5. Fluid Chamber

Working Principle:

The system works on shear-thickening property:

Low Speed: Fluid behaves like liquid → smooth ride

High Speed: Fluid becomes solid → resists motion

VI. DISCUSSION

The proposed system shows significant effectiveness, with speed reduction observed up to 60–65%, ensuring better control of vehicles. It also helps in reducing noise and vibration, which improves the overall driving experience and minimizes disturbance in surrounding areas. The design provides improved ride comfort and causes less damage to vehicles compared to traditional speed breakers. Additionally, it is cost-effective, with an estimated cost of ₹5200 compared to ₹5800 for conventional systems. The system also demonstrates good thermal stability, functioning efficiently even at temperatures up to 60°C.

VII. APPLICATIONS

Non-Newtonian fluid speed breakers are used in residential areas, school zones, and hospital areas to control vehicle speed. They are also used in parking areas and smart traffic systems to improve safety and reduce accidents.

1. Hospitals and emergency routes
2. Parking areas
3. Industrial zones
4. Rural areas

VIII. ADVANTAGES

It reduces vehicle damage and noise while providing a smooth and comfortable ride. It helps in controlling vehicle speed effectively, which improves overall road safety. In addition, it requires less maintenance compared to conventional speed breakers, making it more efficient and economical.

1. Reduces vehicle damage
2. Low maintenance cost
3. More effective in controlling speed

IX. CONCLUSION

The Fluid speed breaker changes its behaviour based on vehicle speed, which makes it safe and comfortable. Compared to normal speed breakers, it works better, needs less maintenance, and improves road safety. So, it is a good solution for future smart roads.

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