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DEPARTMENT OF AUTOMOBILE ENGINEERING

**COURSE NAME : 23AUT101 – ELEMENTS OF
AUTOMOTIVE SYSTEM**

I YEAR /II SEMESTER

**Unit 4 – Rigid Axle Suspension System & Independent
suspension system**



Suspension system



- Suspension is the system of tires, tire air, springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the two. Suspension systems must support both road holding/handling and ride quality, which are at odds with each other.

Principle of suspension system

- A suspension is essentially a damped spring producing opposing force when being compressed. Springs sustain the weight of the vehicle. Dampers oppose the spring movement, dissipating their energy and preventing them to bounce without control.



Rigid Axle Suspension System



- The rigid axle suspension system is the oldest system used in automotive cars. It is rigidly fixed to the car's frame so it's called a rigid axle suspension system.
- This is the oldest and best system used in most of the vehicles. This is also known as a solid axle suspension system. It is specially used in trucks, SUVs, and off-road vehicles. In this system, a single axle connects the wheels on either side of the vehicle.
- Unlike an independent suspension system, where each wheel can move independently, a rigid axle suspension means that the movement of one wheel is directly linked to the movement of the other wheel on the same axle.



Rigid Axle Suspension System



- The rigid axle itself is a single, solid beam or tube that spans the width of the vehicle and is connected to both wheels.
- The axle is typically supported by leaf springs, coil springs, or other types of suspension components.
- The entire axle assembly moves as a single unit, providing a simpler and often more robust design, especially suitable for heavy-duty applications.



RIGID AXLE SUSPENSION



Independent Suspension System



- An independent suspension system is a mechanical setup in cars that allows each wheel to move independently of the others.
- Unlike traditional solid axle suspensions, where the movement of one wheel affects the others, independent suspension provides individual control and movement, enhancing stability and ride quality.
- Independent suspension works by using components such as control arms, ball joints, and shock absorbers to isolate each wheel's movement. When one wheel encounters a bump or irregularity on the road, its movement does not directly impact the other wheels, ensuring a smoother ride and improved handling.



Types of Independent Suspension System



Different types of independent suspension systems exist, each offering unique characteristics, four common types are:

- **Double Wishbone Suspension:** This system uses two wishbone-shaped arms to control the wheel's vertical motion while maintaining stability during cornering.
- **Multi-Link Suspension:** Employing multiple links and bushings, this setup provides precise control over the wheel's movement, enhancing handling and comfort.
- **McPherson Strut:** Combining a shock absorber and a coil spring in a single unit, McPherson struts are simpler in design and widely used in front-wheel-drive cars.
- **Air Suspension:** Air suspension systems offer adjustable ride height and a luxurious driving experience using air springs instead of traditional coil or leaf springs.



Advantages of Independent Suspension System



Better Handling: Independent suspension setups enable individual wheel movement, enhancing manoeuvrability and stability, which is especially beneficial for car drivers navigating sharp corners and sudden directional changes.

Elevated Comfort: Independent suspension configurations offer a smoother ride by effectively absorbing road imperfections, reducing jolts and providing a more comfortable driving experience, particularly noticeable on uneven surfaces.

Increased Traction: It enhances traction by ensuring continuous contact between each wheel and the road, even when encountering obstacles or uneven terrain. This is crucial for cars tackling challenging off-road conditions.



Advantages of Independent Suspension System



Improved Braking: Independent suspension systems enhance braking efficiency by allowing each wheel to brake independently, resulting in shorter stopping distances and more precise control during braking manoeuvres, prioritising safety.

Enhanced Customisation: Its setups can be tailored to match various car types and driving preferences, optimising performance and delivering a personalised driving experience, particularly advantageous in high-performance driving scenarios.



Disadvantages of Independent Suspension System



Elevated Expenses: Independent suspension systems in cars often come with higher expenses for design, manufacturing, repair, and maintenance, potentially limiting accessibility and usage in certain cars.

Increased Complexity: Independent suspension setups are more intricate, with high number of components that are prone to wear and breakdown, leading to complex and costly repair and replacement procedures.

Decreased Load Capacity: Despite offering improved handling and comfort, independent suspension systems may have reduced load-bearing capacity, making them less suitable for heavy-duty cars or those carrying heavy loads.

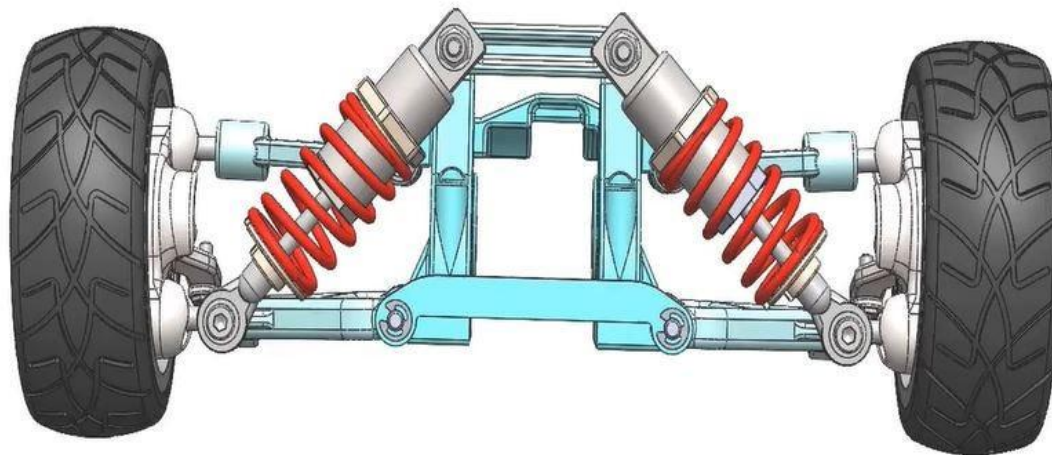


Disadvantages of Independent Suspension System

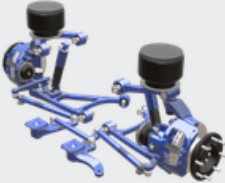



Less Durable: The complexity and abundance of moving parts in independent suspension systems may decrease longevity compared to other suspension types, necessitating more frequent repairs or replacements.

Lower Fuel Efficiency: Independent suspension systems may contribute to lower fuel efficiency due to their added weight and energy requirements, posing concerns for drivers aiming to minimise fuel costs or environmental impact.





| |  <p>Independent Suspension</p> |  <p>Rigid Axle</p> |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Weight | Lighter | Heavier |
| Comfort & Dynamic | Top level performance | Standard level performance |
| Width Flexibility | Customizable vehicle width | No customization flexibility |
| Turning Flexibility | Customizable in design phase | No customization flexibility |
| Fit to Electric Vehicles | Good for electric vehicles built with pure electric vehicle design mindset, considering lightweight, and flexibility to build a new vehicle family with same axles | Good for replacement market having its traditional versions built on rigid axle suspensions |
| Tender Strategy | Might be strategic to meet the tender requirements | Might result missing tenders with independent suspension requirements |
| Unit Cost | Reasonable level of unit cost | Lower cost solution, especially if used with leaf springs |