



Research Paper

4 WHEEL STEERING SYSTEMS (4WAS)

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This paper is all about 4-wheel steering system rather than 2-wheel steering as in conventional vehicles running in INDIA. A 4-wheel steering is completely different from a 4-wheel drive (in which each wheel is given power rather than to 2 wheels). A 4-wheel steering system is superior to a 2-wheel steering system. It reduces the turning radius as well as the space required for turning. It also enables to change road lane while driving even at high speed. This paper is under research in a university of Egypt. In this project we want to develop an electric car with the wheel rotation up to 90° for the cause –the parking problem faced in metro cities. This car will be a special utility vehicle which can run on 2-wheel steering as well as on 4-wheel steering.

Keywords: 2 Wheel steering system, 4 Wheel steering system, Turning radius

INTRODUCTION

Four-wheel steering (or all wheel steering) is a system employed by some vehicles to improve steering response, increase vehicle stability while maneuvering at high speed, or to decrease turning radius at low speed.

In most active four-wheel steering systems, the rear wheels are steered by a computer and actuators. The rear wheels generally cannot turn as far as the front wheels. Some systems, including Delphi's Quadra steer and the system in Honda's Prelude line, allow for the rear wheels to be steered in the opposite direction as the front wheels during low speeds. This allows the

vehicle to turn in a significantly smaller radius, sometimes critical for large trucks or vehicles with trailers. An electronic four-wheel steer system is an option available on the JCB Fastrac.

HISTORY

Four wheel steering is a system that allows the rear wheels to turn for maneuvering, rather than just follow the front wheels. 4WS isn't new; you might remember it as an option on Honda Preludes in the late 1980's and early 1990's.

FEATURES OF THE FOUR WHEEL STEERING SYSTEM

The Four Wheel steering system offers a 21%

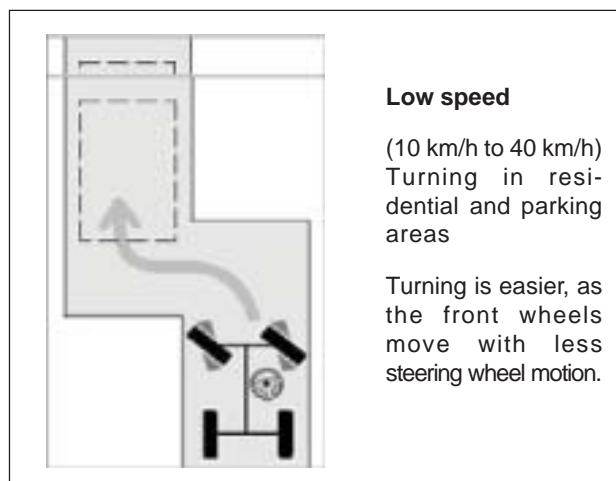
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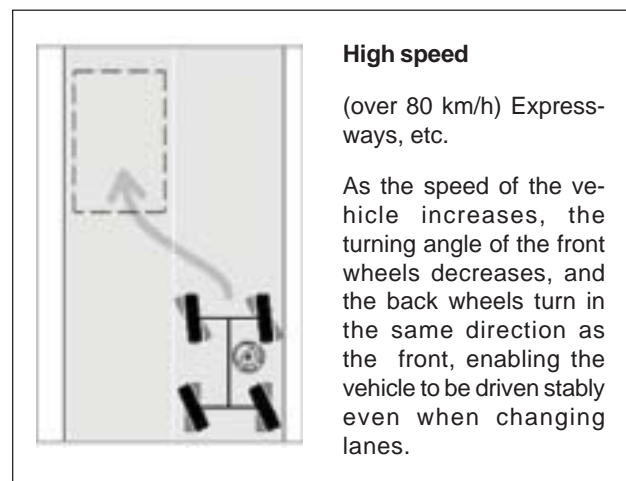
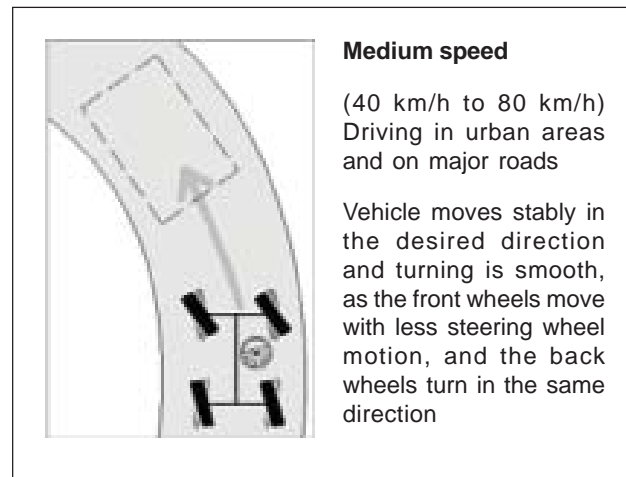
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reduction in turning radius. So if a vehicle is capable of making a U-turn in a 25-foot space. It allows the driver to do it in about 20 feet. A front wheel active steering function was added to Rear Active Steer adopted on the Fuga. By controlling the steering angle of all four wheels, this active steering system helps improve stability and response at high speed and helps reduce driver's steering workload at low speed. To achieve precise vehicle

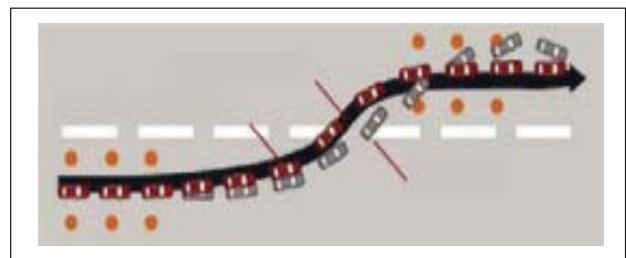
- Vehicles move smoothly and are easy to drive both in the city and on winding roads.
- Added stability means vehicles can be driven safely on expressways and when changing lanes.
- Quick and responsive control system will allow gentle steering operation.



At high speeds, the four wheel steering system avoids skidding in cars taking higher n sharper turns using ABS system. And at slow speeds, the four wheel steering system helps in reducing v turning radius by 21% which has its applications in parking etc.



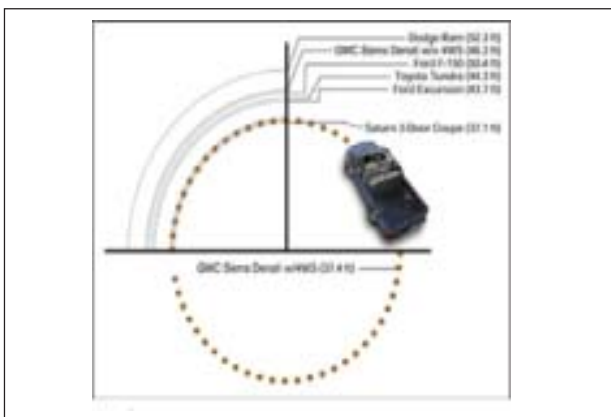
AVOIDING AN OBSTACLE DURING EXPRESSWAY DRIVING



For parking and low-speed maneuvers, the rear Wheel steer in the opposite direction of the front wheels, allowing much sharper turns. At higher speeds, the rear wheels steer in the same direction as the front wheels. The result

is more stability and less body lean during fast lane changes and turns because the front wheels don't have to drag non-steering rear wheels onto the path.

The mechanism due to which the rear wheels turn one way at low speeds and another direction at high speeds can be controlled electronically or hydraulically too. The Japanese automakers have come up with an astonishing variety of technological solutions. Example: Mazda's 626 four-door sedan turns its rear wheels electronically. Sensors monitor the car's speed and its front-wheel angle and pass the information to an onboard computer, which determines in what direction the back wheels should turn. At speeds less than 22 mph, the rear wheels counter steer; at more than 22 mph, their turn version is simpler but more limited. On its four-wheel steer, some models, now available in Japan, the rear wheels are incapable of counter steering, but they can turn with the front wheels in the same direction as the front wheels. Mitsubishi's Galant at high speeds, the action is controlled hydraulically. The higher the oil pressure, the more sharply the rear wheels turn.



The 2002 Sierra Denali's turning radius is almost 10 feet smaller than the 2001 Sierra C3.

RECENT APPLICATION

Four-wheel steering found its most widespread use in monster trucks, where maneuverability in small arenas is critical, and it is also popular in large farm vehicles and trucks.

General Motors offers Delphi's Quadra steer in their consumer Silverado/Sierra and Suburban/Yukon. However, only 16,500 vehicles have been sold with this system since its introduction in 2002 through 2004. Due to this low demand, GM will not offer the technology on the 2007 update to these vehicles.

Previously, Honda had four-wheel steering as an option in their 1987-2000 Prelude, and Mazda also offered four-wheel steering on the 626 and MX6 in 1988.

A new "Active Drive" system is introduced on the 2008 version of the Renault Laguna line. It was designed as one of several measures to increase security and stability. The Active Drive should lower the effects of under steer and decrease the chances of spinning by diverting part of the G-forces generated in a turn from the front to the rear tires. At low speeds the turning circle can be tightened so parking and maneuvering is easier.

PRODUCTION CARS WITH ACTIVE FOUR WHEEL STEERING

Exhibit	
<ul style="list-style-type: none"> • BMW 850CSi (optional) • Efini MS-9 (high and low speed) • GMC Sierra (2002) (high and low speed) • Honda Prelude (high and low speed, fully mechanical from 1987 to 1993) • Honda Accord (1991) (high and low speed, mechanical) • Infiniti G35 Sedan (option on Sport models) (2007-Present) (high speed only?) • Infiniti G35 Coupe (option on Sport models) (2006-Present) (high speed only) [2] • Infiniti J30t (touring package) (1993-1994) • Infiniti M35 (option on Sport models) (2006-Present) (high speed only?) • Infiniti M45 (option on Sport models) (2006-Present) (high speed only?) • Infiniti Q45t (1989-1994) (high speed only?) 	<ul style="list-style-type: none"> • Mitsubishi Galant/Sigma (high speed only) • Mitsubishi GTO (also sold as the Mitsubishi 3000GT and the Dodge Stealth) (high speed only) • Nissan Cefiro (A31) (high speed only) • Nissan 240SX/Silvia (option on SE models) (high speed only) • Nissan 300ZX (all Twin-Turbo Z32 models) (high speed only) • Nissan Laurel (later versions) (high speed only) • Nissan Fuga/Infiniti M (high speed only) • Nissan Silvia (option on all S13 models) (high speed only) • Nissan Skyline GTS, GTS-R, GTS-X (1986) (high speed only) • Mazda 626 (1988) (high and low speed) • Nissan Skyline GT-R (high and low speed) • Renault Laguna (only in GT version of 3rd generation which was launched October 2007, GT launched on April 2008) • Subaru SVX JDM (1991-1996) (Japanese version: "L-CDX" only) (high speed only) • Toyota Aristo (1997) (high and low speed?) • Toyota Camry JDM 1991 Camry Prominent 2.0 L V6[citation needed] • Toyota Celica (option on 5th and 6th generation, 1990-1993 ST183 and 1994-1997 ST203) (Dual-mode, high and low speed)

NEW ACTIVE DRIVE WITH FOUR-WHEEL STEERING FOR NEW RENAULT LAGUNA GT AT GENEVA MOTOR SHOW

- New high-performance GT versions of New Laguna Hatch and Sport Tourer available to order in the UK from 9 May 2008
- Featuring innovative Active Drive chassis with four-wheel steering for the ultimate in handling and response
- Exclusively available with 205hp two-litre turbo petrol engine or 180hp two-litre turbo diesel – both making their debut in New Laguna

- Prices start from £21,050 for the Hatch and £22,000 for Sport Tourer
- New versions feature numerous sport styling touches, including: lateral air-intakes and larger front grille, new 18-inch alloy wheels, smoked rear light clusters and black background to the headlamps
- Inside, the new models boast GT-embossed leather/alcantara sports seats, drilled aluminium pedals, aluminium gear knob and GT steering wheel

DISADVANTAGES OF 4WS VEHICLES

1. Significantly increase in work load for front tyres.

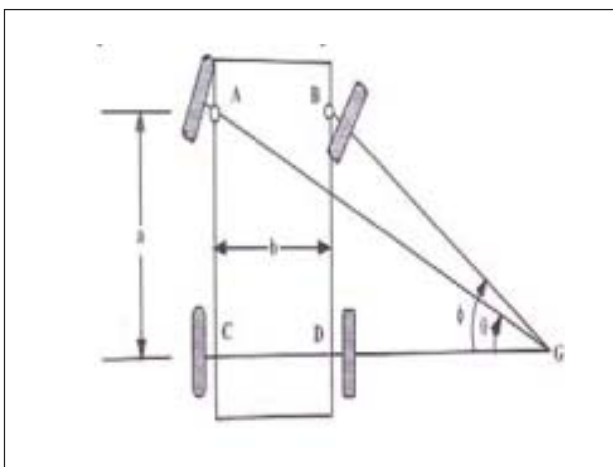
2. Large amount of left/right weight transfer seen in 4ws vehicle.
3. Uneven tyres wear of front and rear wheels.

Geometrically Correct Steering

a the wheelbase, b the distance between the Steering pivot axes

$$\cot \theta - \cot \Phi = b/a$$

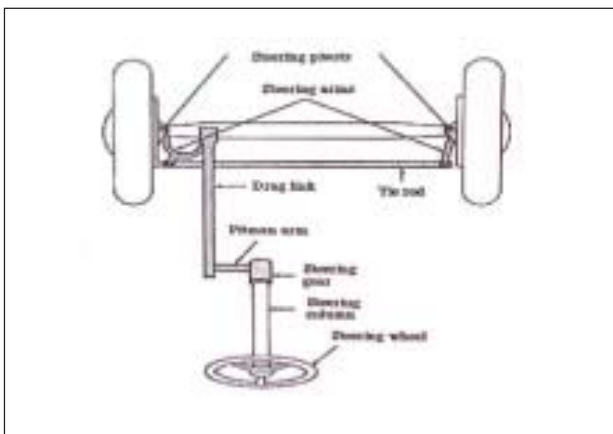
$$\Gamma = |\theta_{\text{corr}} - \theta_{\text{actual}}|$$



Four Wheel Steering Arrangement

Steering input is fed into the system through the steering wheel.

Steering gear multiplies the steering effort applied to the steering wheel by the driver. It also converts the turning motion of the steering wheel into a linear motion.



The steering linkage transmits motion from the steering gear to the wheels and regulates the relative positions of the wheels.

ADVANTAGE

1. Computer-controlled Quadra steer can be switched on and off and has an effective trailer towing mode.
2. A computer determines how much and in which direction the rear wheels should move, and whether the rear wheels should turn the same direction as the front wheels or in the opposite direction. The movement is variable up to a couple of inches.
3. At slow speeds, the rear wheels move the opposite direction of the front wheels. This makes for easier parking and maneuvering.
4. At highway speeds, the rear wheels move in the same direction as the front wheels for easier lane changing. If you're pulling a trailer you'll really appreciate this feature, since it allows your vehicle to change lanes without the snaking-effect you'd normally experience.
5. In order to accommodate the steering mechanism and wheel movement, the Sierra Denali's track and fender width are wider than its conventional counterpart, but it's not as wide as the rear of a dually pickup.

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