ABSTRACT

Nowadays, the every vehicle existed mostly still using the two wheel steering system to control the movement of the vehicle whether it is front wheel drive, rear wheel drive or all wheel drive. But due to the awareness of safety, four wheel steering vehicles are being used increasingly due to high performance and stability that they bring to the vehicles. A Four Wheel steering (4WS) System named as “Quadra Steering System”. Here in this System both front as well as rear wheels can be steered according to space available for turning. If a car could automatically compensate for an under steer/Over steer problem, the driver would enjoy nearly neutral steering under varying operating conditions. Four-wheel steering is a serious effort on the part of automotive design engineers to provide near-neutral steering. For parking and low-speed manoeuvres, the rear Wheel steer in the opposite direction of the front wheels, allowing much sharper turns. At higher speeds, the rest 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. Quadra steer is system that gives full size vehicles greater ease while driving at low speed, and improves stability, handling and control at higher speed. The scope includes commonly used methods found in practice as well as some theoretical methods found in various literatures from other areas of research. A multi-functional four-wheel steering system could improve directional stability, sharp turning performance, and parking performance of a vehicle. From concept validation and controller design of the active pinion, the models have been proven effective to explain dynamic phenomena related to Quadra Steering systems.

CONCEPTUAL MODELS

PARTS OF SYSTEM

[Images of gear, rack, bevel gear, spur gear, cylinders]
ASSEMBLY OF DESIGN

Calculation:

1. NORMAL MODE:

Gravitational acceleration (G) = 9.81 m/s.
Gross Weight (m) = 1350 kg.
Weight of vehicle (W) = m * g = 13243.5 N
Radius of Wheel (r_W) = 0.3556 m.
Radius of curvature (R) = 3 m.
Width of Track (x) = 1.295 m.
Wheel Base (b) = 1.295 m.
Distance of C.G. vertically above the road surface (h) = 0.55 m.
Distance of C.G. horizontally from rear wheel axle (l) = 0.963 m.
Linear velocity (V) = 26 Km/hr.
Mass moment of inertia of wheel (I_W) = 0.8 Nm².
Mass moment of inertia of rotating parts of engine (I_w) = 13.5 Nm².
Angular velocity of wheels or velocity of spin (w_ψ) = 20.8902 rad/s.
Gear ratio (G) = 4
Angular velocity of rotating parts of engine (ω_e) = 83.561 rad/s.
Velocity of precession (ω_ψ) = 51.42214 rad/s.
Angular velocity of wheels or velocity of spin (ω_ψ) = 12.8554 rad/s.
Gear ratio (G) = 4
Angular velocity of rotating parts of engine (ω_e) = 51.42214 rad/s.

Gravitational acceleration (G) = 9.81 m/s².

Gross Weight (m) = 1350 kg.
Weight of vehicle (W) = m * g = 13243.5 N
Radius of Wheel (r_w) = 0.3556 m.
Radius of curvature (R) = 1.7868 m.
Width of Track(x) = 1.295 m.
Wheel Base (b) = 1.295 m.
Distance of C.G. vertically above the road surface (h) = 0.55 m.
Distance of C.G. horizontally from rear wheel axle (l) = 0.963 m.

Linear velocity (V) = 16 m/s.
Mass moment of inertia of wheel (I_w) = 0.8 Nm².

Cross Steer Mode: Radius of curvature (R) = 3 m.

Normal Steer Mode: Radius of curvature (R) = 1.7868 m.

%Reduction = \frac{3 - 1.7868}{3} \times 100 = 40.44 \%

3. CRAB MODE:
Gravitational acceleration (G) = 9.81 m/s².
Gross Weight (m) = 1350 kg.
Weight of vehicle (W) = m * g = 13243.5 N
Radius of Wheel (r_w) = 0.3556 m.
Width of Track(x) = 1.295 m.
Wheel Base (b) = 1.295 m.
Distance of C.G. vertically above the road surface (h) = 0.55 m.

Fig: Radious Vs Maximum Speed.

2. CROSS MODE:

Gravitational acceleration (G) = 9.81 m/s².

Fig: Radious Vs Maximum Speed.
Distance of C.G. horizontally from rear wheel axle (l) = 0.963 m.
Linear velocity (V) = 95 km/hr.
Mass moment of inertia of wheel (Iw) = 0.8 Nm².
Mass moment of inertia of rotating parts of engine (Ie) = 13.5 Nm².
Angular velocity of wheels or velocity of spin (ωw) = 76.3294 rad/s.
Gear ratio (G) = 4
Angular velocity of rotating parts of engine (ωe) = 305.3189 rad/s.

Cw = 544.2551824 Nm.
Ce = 4121.806203 Nm.
W/2 = 6621.75 N.
P/2 = C/2x = 1685.737987 N.
R₁ = 3238.857488 N.
R₂ = 11.41653844 N.
R₃ = 6610.333462 N.
R₄ = 6610.333462 N.

4. ZERO STEER MODE:

CONCLUSION

There are three modes in 4-wheel steering each of which is individually implemented in most of the 4 wheel steering cars. Each one has its own disadvantage like use of crab mode increases the turning radius which is turn decreases the ease of maneuvering the vehicle at sharp bends, similarly rear steer mode decreases the turning radius to a greater extent, thus increases the risk of toppling of the vehicle at high speed.
Hence to overcome these problems, both the modes have been introduced together in a locomotive and its performance has been simulated and shown.

REFERENCES
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