WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

DESIGN AND FABRICATION OF THREE AXIS MODERN TRAILER

T.Varun Kumar[1] , D. Loganathan [2], P.Soundharraj[3], N.Saravanakumar[4], R.Kavinesh[5], S.Barath[6]

Department of Mechanical Engineering, P.A College of Engineering and Technology, Pollachi, Tamil Nadu, India [1,2,3,4,5,6]

ABSTRACT:

The goal of the Three-Axis Modern Trailer project is to improve the load-handling effectiveness, stability of trailers used in heavy transportation. Weight distribution and cornering stability are frequently issues with conventional two-axle trailers, particularly on rough terrain or fast corners. In order to lessen the pressure on each wheelset and distribute weight more equally, this project presents a three-axis trailer design with an extra axle. To provide better navigation in constrained or difficult terrain, the contemporary caravan has pivot steering on the third axle, enhanced braking systems and sophisticated suspension systems. Additionally, the design has modular load support structures to accommodate various cargo kinds and hydraulic or pneumatic lifts for effective unloading. This cutting-edge trailer system is perfect for applications requiring durability, efficiency, and safety in mining, construction, and agriculture.

KEYWORDS: Three-axis trailer, Modern trailer design, Load distribution, Enhanced stability

1. INTRODUCTION

Trailers are essential for the effective carriage of cargo over a variety of terrains in the heavy-duty transportation industry. Despite being commonly utilised, traditional two-axle trailers frequently experience problems with load balance, and increased wear and tear when exposed to rough or uneven ground. The creation of a three-axis contemporary caravan offers a workable way around these restrictions.

To improve overall stability and weight distribution, a three-axis trailer has an extra axle. Along with reducing the strain on individual wheels and suspension parts, this setup enhances control and braking effectiveness in tight corners and abrupt stops. Also, the addition of new suspension systems, strengthened chassis, and sophisticated steering mechanisms results in improved performance and increased versatility in both Urbana. The project's objective is to develop and build a contemporary three-axis trailer that satisfies the expanding needs of mining, agricultural, and construction. The caravan is a sturdy and dependable option for moving bulky items in difficult conditions since it strives to provide enhanced load capacity, enhanced safety, and effective handling.

2. LITERATURE REVIEW

[1]Shyam Lal Sharma, Anant Prakash Agrawal, Chandan Kumar (2022), Design and fabrication of three direction dumping mechanism in trucks His research attempts to solve the challenges of loading and unloading materials in enterprises using a single dumping method. Material delivery is not a problem in recreational areas, but it may be challenging for the truck driver in some locations where there is not enough room for the trailer. The initiative to design and fabricate a three-directional discarding mechanism in trucks may distribute the material in three directions, including the left, right, and the typical rear region, so reducing the difficulties of the truck pilot.

[2] Francesco Sorge (2019), Motion and force analysis of slow-speed multi-trailer systems, In contrast to tractor-trailer systems used for road haulage, which have to deal with common undesirable trends like high-speed instability, over- or under-steering, and off-tracking, multi-trailer systems used for luggage transportation in airports, train stations, or warehouses operate at relatively low speeds while maneuvering around numerous obstacles. Tire cornering phenomena do not affect this kind of vehicle since the wheels are typically rigid and the speed is only modest. Therefore, the non-holonomic rolling limitation of the wheels and the steering gear installed on the trailers really control the vehicle's movement.

[3] AS Pal, AG Shahu, DP Mandaokar, RI Meshram, UT Dhanre (2017), A Review on Three Direction Dropping Dumper, A dumper is a vehicle used to transport different items from one location to another and dispose of them at a designated location. Bulk materials including gravel, sand, rubble, and rubbish are frequently transported on construction sites using a Dumperi. Dumpers are different from tipper trucks in that they are typically four-wheeled vehicles with their cab in front of the load. An open-box bed, which is hinged at the back and has hydraulic pistons to raise the front, is a standard feature of dump trucks. This allows the material inside the bed to be "dumped" on the ground behind the vehicle after delivery.

3. PROBLEM IDENTIFICATION

Conventional two-axle trailers, which are frequently utilised for moving large loads in sectors like mining, construction, and agricultural, have serious drawbacks with regard to stability, and load distribution. The axles of these trailers frequently endure unequal weight stress, which causes tires and suspension parts to deteriorate quickly. Additionally, they provide little control while negotiating steep curves or traversing difficult or uneven terrain, which raises the possibility of mishaps and cargo damage. The ineffective unloading procedure in traditional trailers is another significant issue. Particularly in large-scale operations, manual unloading and single-direction tipping devices are labour intensive and time-consuming.

4. PROBLEM RECTIFICATION

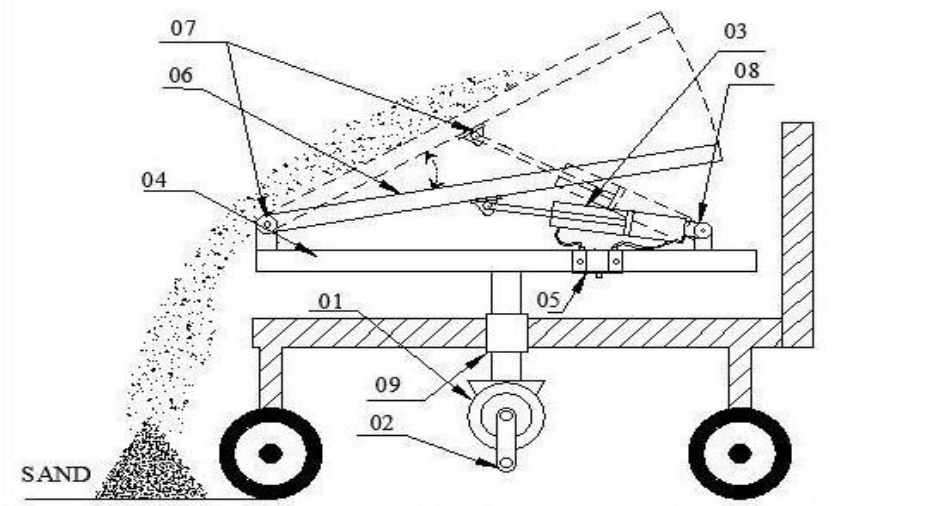
A three-axis contemporary trailer design is suggested as a solution to the drawbacks of conventional two-axle trailers. Longer service life and increased road safety result from the installation of a third axle, which helps distribute the weight more uniformly and lessens the strain on individual axles and tires. The trailer's stability is greatly improved by this arrangement, particularly while making fast bends, travelling over uneven ground, or towing large or imbalanced cargo. The design incorporates pivot steering or self-steering axles to overcome more control in confined situations and smoother corners. Incorporating sophisticated suspension systems, such air or hydraulic suspension, guarantees a more comfortable ride and reduces vibrations, safeguarding the cargo and the trailer's construction.

5. LIST OF COMPONENTS

S.NO	NAME OF THE COMPONENTS	QUANTITY NO
1	Frame & Shaft	1
2	Pneumatic Cylinder	1
3	Solenoid Valve	1
4	Pevel Gear	1
5	Handle	1
6	Bearing	2

6. DESIGN DIAGRAM

6.1 MODEL



S.NO	PART NAME	S.NO	PART NAME	S.NO	PART NAME
01	BEVEL GEAR ARRANGEMENT	04	ROTATING PLATE	07	HINGED SUPPORT
02	HANDLE	05	SOLENOID VALVE	08	BEARING
03	PNEUMATIC CYLINDER	06	LIFTING PLATE		

MODEL

WORKING PRINICIPLE

Bevel gears are used to transfer rotational motion between crossing shafts, frequently at a 90-degree angle, in a three-axis contemporary caravan that runs on a mechanical gearbox system. Bevel gears can be included into the axle or steering system of these trailers to improve provide smooth torque distribution, particularly when guiding the rear axles or running hydraulic systems. Tilting beds, movable axles, and side-opening mechanisms are examples of mechanical components that the bevel gear arrangement helps operate when it is coupled to a power source, such as the truck's Power Take-Off. This configuration guarantees effective power transfer with low energy loss, which makes it perfect for contemporary heavy-duty applications needing load management, precise movement, and trailer component synchronisation.

APPLICATIONS

- large Load Transportation: Used in sectors such as mining, construction, and logistics to transport bulk items, large machines, or materials with better load distribution and stability.
- Automatic Tipping Mechanisms: In tipper trailers, bevel gears power hydraulic mechanisms that tilt or lift the trailer bed to facilitate the dumping of waste and sand.
- Steerable Axles: Used in rear axle steering systems to improve manoeuvrability in confined places, particularly for long trailers.
- Agricultural Transport: Provides improved control and power transfer while moving equipment or produce over difficult terrain in agricultural trailers.
- Container Carriers: These are used to transport intermodal containers and have bevel gear-powered lifting and locking systems built in.

FUTURE SCOPE

The potential of three-axis contemporary trailers is bright, since innovations are concentrated on sustainability, efficiency, and automation. By combining telematics and smart sensors, it will be possible to monitor load, tyre pressure and brake conditions in real time, increasing safety and lowering maintenance costs. Caravan technologies, such self-powered axles, can reduce pollutants and improve fuel efficiency by implementing electric and hybrid powertrains. Semi- or completely self-driving trailers might be a result of autonomous driving technology, particularly in regulated settings like ports and logistics centres. Aerodynamic designs and lightweight materials will also help to maximise fuel efficiency and load capacity, meeting the increasing need for sophisticated and environmentally friendly transportation systems.

FINAL ASSEMBLY

SIDE VIEW

FRONT VIEW

CONCLUSION

When combined with bevel gear mechanisms, the three-axis contemporary trailer is a major development in load-handling and transportation systems. Stability, safety, and efficiency are all improved by its ability to distribute weight equally over three axles, which makes it perfect for heavy-duty applications. By facilitating smooth and accurate power transfer, bevel gears offer features including multidirectional tilting and efficient mechanical component performance. As businesses transition to automation and intelligent transport systems, these trailers have the potential to significantly improve operational efficiency, decrease human labour, and boost the overall productivity of industrial and logistical processes.

REFERENCES

1. Mungmode, D. P., & Lanjewar, P. (n.d.). *Modification and fabrication of three axis modern trailer for industrial application*. International Research Journal of Engineering and Technology, 4(5), 3543–3546. Retrieved from https://www.irjet.net/archives/V4/i5/IRJET-V4I5678.pdf
2. Ramachandran, M. (n.d.). *Three axis pneumatic modern trailer by using single cylinder*. International Journal of Recent Research in Civil and Mechanical Engineering, 2(2), 111–126. Retrieved from https://www.paperpublications.org/upload/book/Three%20Axis%20Pneumatic-624.pdf
3. Chime, R. O., & Okonkwo, U. C. (2016). *Design, modeling, application and analysis of bevel gears*. International Journal of Engineering Research and Applications, 6(4), 44–52. Retrieved from https://www.ijera.com/papers/Vol6_issue4/Part%20-%203/H060403044052.pdf
4. Bhandari, V. B. (2015). *Design of machine elements* (3rd ed.). McGraw-Hill Education.
5. Patil, A. V., & Patil, R. B. (2014). *Investigation of bending strength of bevel gear by FEM*. International Journal of Innovative Research in Advanced Engineering, 1(6), 1–6.
6. Prasad, B. V., Nagaraja, K., Arali, M., Thippeswamy, P. S., & Thippeswamy, R. (n.d.). *Springless suspension system for automobiles*. Journal of Emerging Technologies and Innovative Research, 10(12), 107–112. Retrieved from https://www.jetir.org/papers/JETIR2305940.pdf
7. Ambade, R. S., Navghare, S. D., & Kamatkar, B. S. (n.d.). *Development and fabrication of three directional modern trailer using pneumatic system.* International Journal of Scientific & Engineering Research, 8(5), 887–891. Retrieved from https://www.ijser.org/researchpaper/Development-and-Fabrication-of-Three-Directional-Modern-Trailer-Using-Pneumatic-System.pdf
8. Bruzhas, V. V., & et al. (2015). *Development of solid state models for the apparatuses of various geometry*. Procedia Engineering, 129, 369–373
9. Jadeja, R. M., & et al. (2013). *Bending stress analysis of bevel gears*. International Journal of Innovative Research in Science, Engineering and Technology, 2(7), 3041–3046.
10. Chime, R. O., & et al. (n.d.). *Design, modeling, application and analysis of bevel gears*. International Journal of Engineering Research and Applications, 6(4), 44–52