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Review of Design and Analysis of (Alpha) Suspension Wheel

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ABSTRACT –

A α-wheel is a component of suspension that carries different loads that affect a vehicle's suspension system. Due to various loads operating on it, α-wheel is prone to bending, torsion, and shear stresses. It will cause the material to fail and distort suddenly. The design and experimental study of a wheel made of carbon fibre are described in this project. The loop wheel is subjected to finite element analysis (FEA) under static conditions so that the stress distribution can be seen and high stress zones may be examined. Solid works model is produced in the analysis. The research compares different loading scenarios, and the study looks at the general stress distribution zones.

Keywords: Carbon Fibre, Materials, Finite Element Method, Structural Analysis.

I. INTRODUCTION

A basic kind of spring used for the suspension of wheeled vehicles is known as a "α -wheel." The concept of a uniformly strong beam serves as the foundation for the α-wheel. α-wheel can perform springing, locating, and to a lesser degree, dampening.

In the current study, an effort is made to replace the light vehicle's existing wheel switch, which is intended to analyse the behaviour of bending stress, deflection, and stress under varied loads. Weight loss of 60% is possible. after utilising a wheel made of carbon fibre composite. Growing innovation and competition in the automotive industry tend to tweak current goods or replace them with new ones made of more sophisticated materials. These advances are often used to a vehicle's suspension system as well. The weight of the car and its fuel usage are virtually directly proportionate. The use of composite materials in place of steel in traditional suspension system wheels is the major subject of this article. Automobile-sector is exhibiting an increasing interest in the field the introduction of the article should clarify the nature of the issue, past work, purpose, and the contribution of the research. Due to the high strength to weight ratio of springs made of composite material, the contents of each section may be supplied to facilitate understanding of the article. Analysis of composite material wheels has thus become crucial in demonstrating how they compare to traditional suspension systems.

II. COMPARATIVE STUDY

The projected high degree of integration of the wheel suspension system brought the authors' [4] attention to four cutting-edge off-road and light vehicle solutions. These systems (Fig. 1) all assume that elastic components of different sorts, such as bow spokes [5, loop spring elements [6, disc honeycomb structure [7], or elliptical spring elements [8,] are used to secure the wheel rim to the wheel hub.

Figure 1: many ideas for attaching the wheel disc to the suspension wheel system.

Concept of innovative suspension system

In light of the issues found, it was determined to create a new, creative solution that maintains as many benefits as possible of the ones already in use while omitting their drawbacks. The primary problem that had to be addressed was to remove the requirement of rotating the elastic-damping disc. This approach would make it possible to prevent the negative effects of disc deformation that is continually changing. The created solution's compactness and the integration of the suspension system's components were also embraced as design presumptions.

It was important to build a solution that would have all benefits of the elastic damping disc, notably inserting it in inner space of the rim, but without potential of spinning with the rim. It was chosen to apply the TRIZ approach, one of the best ideation techniques, during the conceptual stage. It turned out that the inversion approach is really helpful in the context of the produced solution. In this specific instance, the spinning part is immobilised and then pushed into motion. Up until this point, the wheel hub and rim were connected by a revolving elastic-damping disc that was mounted on the immobilised axis. While the outside portion of the shield moved relative to the inner ring and rim, the inner ring of the shield was immobile. In the method outlined, it was suggested that the outer ring be immobilised and that the inner ring be given the ability to spin with a half shaft placed in it. Fig. 2 displays the solution under discussion.

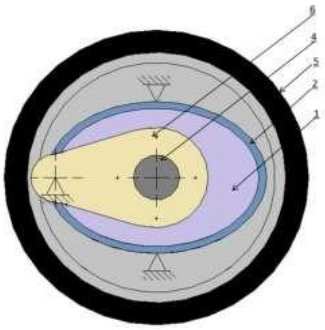

Figure 3: The concept of suspension system

The elastic-damping disc 2 is a distinct component in the suggested solution [10] and is not a part of the wheel rim 5. The inner ring of the disc is where the wheel axle is attached. The disc's outer ring is fastened to the adaptor. The adapter is also connected to the swing arm 6. The adapter makes it possible to instal the wheel to the car's frame. This method makes the suspension system extremely small. Additionally, this system is closed. It is a working system in the condition shown in Fig. 2 and does not need fastening, unlike conventional suspension systems. Wheels that are propelled or not propelled may both employ the suspension mechanism that was just stated.

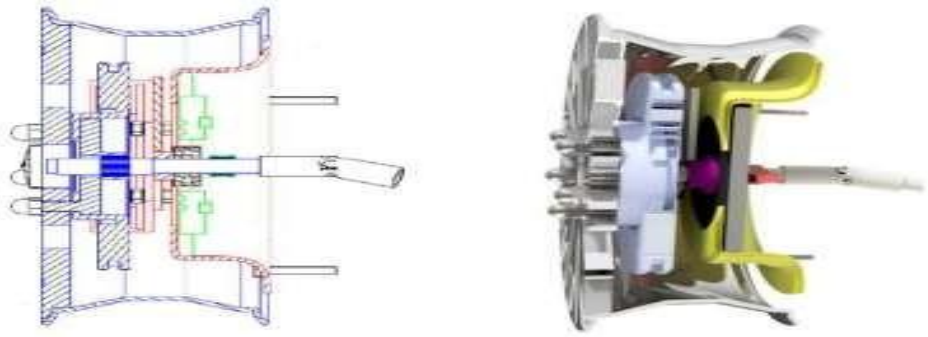

Figure 3. Detailed concept of suspension system b. The model of suspension system with composite disc

A thorough representation of the suspension notion is shown in Figure 3a. A disc with elastic-damping properties and flexibility in one direction makes up the suspension system. The disc is fastened to the ring, which serves as the system's anchor point against the car's frame. The elastic-damping disc's

hole has a bearing unit integrated into it through which the wheel axle travels. The rocker arm attached to the ring's components holds the wheel axle in place. The wheel only has rotation around its own axis and vertical motion as degrees of freedom as a result.

Figure 3b shows the physical models of the idea as given, but with several elastic-damping disc solutions. A complete composite disc with the necessary material characteristics is part of the elastic-damping element. Figure 5a depicts a model in which the honeycomb structure, which was used in the prior solution [7] and was enhanced for use in energy-efficient applications [10], [2], serves as the elastic-damping element.

The hub is attached to the elastic-damping element, which is a disc made of rolled-up elastic strips that can dampen and absorb stress. The answer is similar to that offered in the loopweel design [6], although it has been much enhanced [10]. The examined solutions are ideal for the advancement of the generative modelling techniques now being employed in vehicle design [11].

As weight significantly influences how efficiently a car operates. Steel wheel rims, which are often utilised and relatively hefty since they contribute for 10–20% of the spring weight borne on their own, are one of the prospective items for weight reduction in vehicles. The application of carbon fibre wheels in place of traditional steel wheels is the major emphasis of this effort in order to decrease product weight and increase safety, comfort, and durability.

For 3-D modelling of solid structures, utilise Tetra element: SOLID185. Four nodes that each have three degrees of freedom—translations in the nodal x, y, and z directions—define the element.

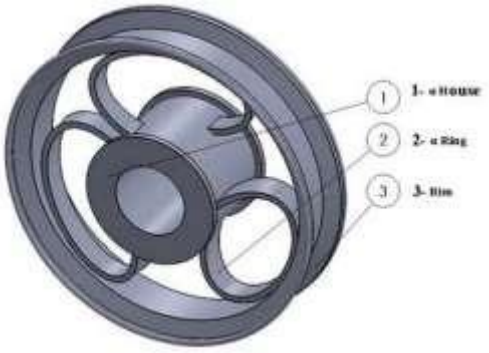

Figure 4: Design of Alpha Wheel

Four nodes and the isotropic material characteristics characterise the element. Global directions serve as the element coordinate system by default. ANSYS may be used to construct an element coordinate system, which serves as the foundation for isotropic material directions.

Loads & Boundary Conditions

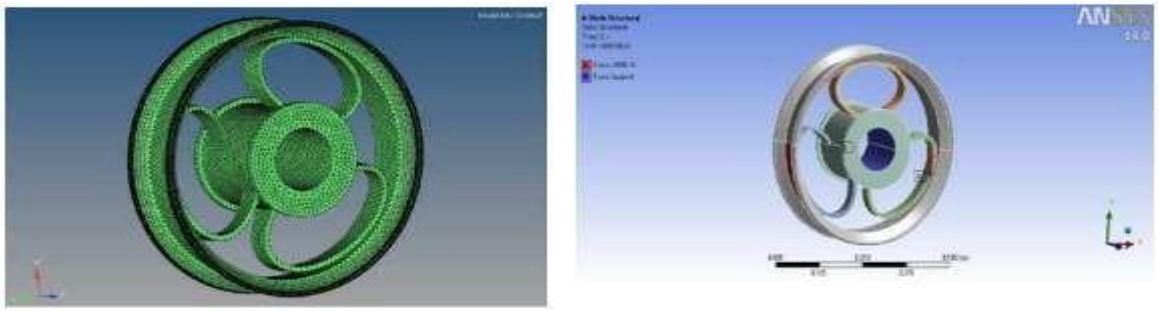

Figure 5: Load Applied on wheel rim

- Figure 3 depicts the alpha wheels' boundary conditions.
- The hub's inner face is restrained in all directions.
- The crowd is stopped so it can spin in Uz.
- The magnitude of the static load is specified as -1000N, - 1500N, and -2000N in Uy, respectively.

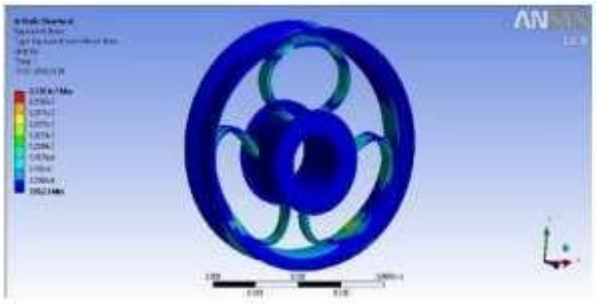

Figure 6: Load vs. Deflection for 1000N load

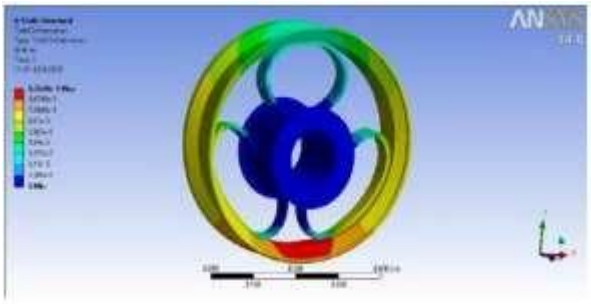

Figure 7: Shear Stress at load of 1000 N

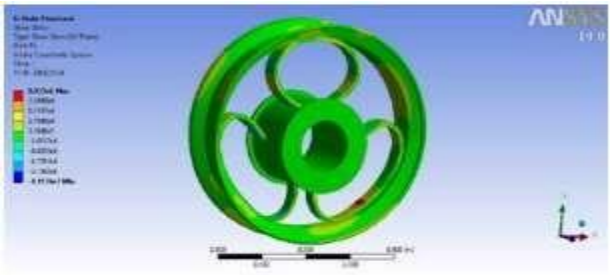

Figure 8: Von Misses Stress at load of 1500 N

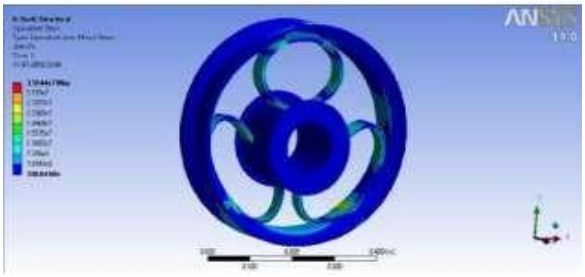

Figure 9: Load vs. Deflection for 1500N load

III. CONCLUSION

This paper we describe the new concept of alpha wheel which work as wheel rim as well as suspension system. This is best solution for light vehicles and off road vehicles like racing vehicle. Many researcher works on this concept. Alpha wheel is also known as supplementary suspension system. In further research we design and analysis the alpha wheel for various load condition.

REFERENCES

[1] W. Skarka, Reducing the Energy Consumption of Electric Vehicles, Advances in Transdisciplinary Engineering, Vol. 2, IOS Press, Amsterdam, 2015, pp. 500-509.

[2] T.Pabian, W.Skarka, An optimization approach for an ultra-efficient electric racing vehicle's supporting system based on composite shell elements. EngOpt 2018. Proceedings of the 6th International Conference on Engineering Optimization, September 17-19, 2018, Lisbon, Portugal. Eds.: H. C. Rodrigues, J. Herskovits, C. M. Mota Soares, A. L. Araujo, J. M. Guedes, J. O. Folgado, F. Moleiro, J. F. A. Madeira. Springer, Cham, 2019, pp. 1061-1072.

[3] W. Skarka, Methodology for the optimization of an energy efficient electric vehicle, Proceedings of the 6th International Conference on Integrity-Reliability-Failure. IRF2018, Lisbon/Portugal, 22-26 July 2018. Eds.: J. F. Silva Gomes, Shaker A. Meguid. [Porto] : FEUP-INEGI, 2018, pp. 415-422

[4] W. Kocoń and W. Skarka, Hybrid wheel innovative suspension system. Advances in Transdisciplinary Engineering, Vol. 7, IOS Press, Amsterdam, 2018, pp. 496-505.

[5] T. Berman, ShockWheel: A Revolutionary Wheel Technology With Bow-Spokes, Interesting Engineering, 15th January 2017, https://interestingengineering.com/shockwheel-a-revolutionary-wheeltechnology-with-bow-spokes, Accessed July 8, 2019.

[6] Loopwheel, 2018, Loopwheel.com, http://www.goesbike.com/articles/2400/1/Loopwheel-ban-sepedadengan-suspensi-sendiri.html, Accessed: Jan 19, 2018.

[7] Q. Zhang, X. Yang, P. Li, G. Huang, S. Feng, Ch. Shen, Bioinspired engineering of honeycomb structure – Using nature to inspire human innovation, Progress in Materials Science, 2015, Vol. 74, pp. 332-400.

[8] D. Cardile, N Viola, S. Chiesa and A. Rougier, Applied design methodology for lunar rover elastic wheel, Acta Astronautica, 2012, Vol. 81, pp. 1–11.

[9] TRIZ https://en.wikipedia.org/wiki/TRIZ

[10] W. Skarka, R.Skoberla: Vehicle wheel suspension system - Application for patent P. 429743 pending.

[11] A.Jałowiecki, W. Skarka, Generative modeling in ultra-efficient vehicle design. Advances in Transdisciplinary Engineering, Vol. 4, IOS Press, Amsterdam, 2016, pp. 999-1008.

[12] M.John, A.John, W.Skarka, The influence of the geometrical parameters on the mechanical properties of honeycomb structure. MECHANIKA, 2017, Vol. 23, Issue: 3, pp. 359-364.

[13] M. Targosz, W. Skarka and P. Przystałka, Model-Based Optimization of Velocity Strategy for Lightweight Electric Racing Cars, Journal of Advanced Transportation, Volume 2018, Article ID 3614025, 20 pages https://doi.org/10.1155/2018/3614025