ISSN: 2582-4686 SJIF 2021-3.261,SJIF 2022-2.889,
2024-6.875 ResearchBib IF: 8.848 / 2024

THE MULTIDISCIPLINARY JOURNAL OF SCIENCE AND TECHNOLOGY

VOLUME-4, ISSUE-12

EXPLORING THE IMPACT OF CROWNING AND MODIFICATIONS IN SPIRAL, PRESSURE AND TORSION ANGLES OF TEETH

Ishmuratov Hikmat Kakharovich
PhD., Associate Professor, Tashkent State Technical University
Abdurakhmanov Azamat Erkinovich
Senior Lecturer, Tashkent State Technical University

Abstract. Bevel gears are essential components in mechanical systems that require precise motion transmission and load distribution. However, under heavy loads, these gears can suffer from deformations and localized contact pressures that negatively affect their performance and longevity. This paper investigates the effect of crowning modifications on bevel gear teeth, particularly in relation to profile and flank adjustments, as well as changes in the spiral, pressure, and torsion angles. By examining these modifications, the study aims to improve the contact distribution, reduce localized stresses, and enhance the overall performance of bevel gears under load.

Аннотация. Конические зубчатые колеса являются важными компонентами в механических системах, которые требуют точной передачи движения и распределения нагрузки. Однако под тяжелыми нагрузками эти колеса могут подвергаться деформациям и локализованным контактным давлениям, что негативно влияет на их эксплуатационные характеристики и долговечность. В данной статье исследуется влияние модификаций профиля и фланцев на зубья конических колес, а также изменения углов спирали, давления и кручения. Изучив эти модификации, работа направлена на улучшение распределения контакта, уменьшение локализованных напряжений и повышение общей эффективности работы конических колес при нагрузке.

Keywords. Crowning, bevel gears, profile modifications, flank modifications, spiral angle, pressure angle, torsion angle, load distribution, contact pressures, gear performance.

Ключевые слова. Модификация профиля, конические зубчатые колеса, модификация фланцев, угол спирали, угол давления, угол кручения, распределение нагрузки, контактные давления.

Introduction. Bevel gears are widely used in mechanical systems for transferring rotational motion between intersecting shafts. However, bevel gears often face challenges related to load-induced deformations, which can lead to premature wear and efficiency loss. To mitigate these issues, engineers apply various corrective modifications to the gear teeth, such as crowning, to optimize their performance.

Crowning is a crucial modification that adjusts the tooth profile or flank to compensate for load-induced deformations and to control contact pressures between the pinion and the crown. Additionally, modifying the spiral, pressure, and torsion angles of the teeth plays a significant role in the effective distribution of forces and ensuring proper engagement. This paper explores the impact of these modifications on the geometry and performance of bevel gears.

ISSN: 2582-4686 SJIF 2021-3.261,SJIF 2022-2.889,
2024-6.875 ResearchBib IF: 8.848 / 2024

THE MULTIDISCIPLINARY JOURNAL OF SCIENCE AND TECHNOLOGY

VOLUME-4, ISSUE-12

Materials and Methods. **The study utilizes theoretical models and computational simulations to evaluate the impact of crowning and angle modifications on bevel gear performance. The modifications considered in this study include:**

- **Profile Crowning:** Modification of the tooth profile to compensate for deformations caused by load.
- **Flank Crowning:** Adjustment of the tooth flank to localize the contact area and reduce edge contact.
- **Spiral Angle Modification:** Adjustment of the spiral angle to optimize the engagement and distribution of forces.
- **Pressure Angle Modification:** Modification of the pressure angle to ensure smooth contact and load distribution.
- **Torsion Angle Modification:** Adjustments to the torsion angle to enhance gear stiffness under load.

These modifications are implemented through theoretical calculations and finite element analysis (FEA) to model the effects of load and deformation on the gears.

Results. Crowning Modifications. Crowning modifications play a critical role in reducing localized contact pressures and improving the load distribution between the pinion and the crown. The profile crowning compensates for the flexing of the teeth under load by adjusting the theoretical tooth profile. As shown in Figure 1 a, b, the profile crowning focuses on concentrating the contact area at the center of the teeth, minimizing premature wear at the tip of the pinion tooth.

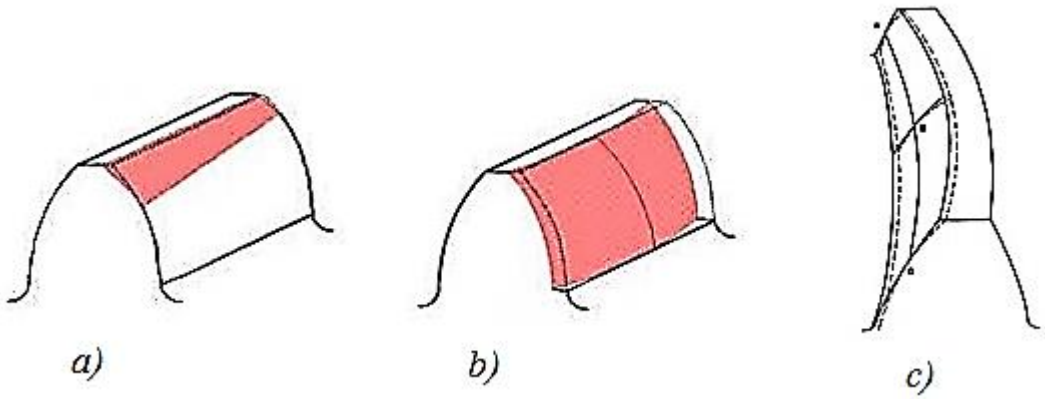


Figure 1. Profile modification

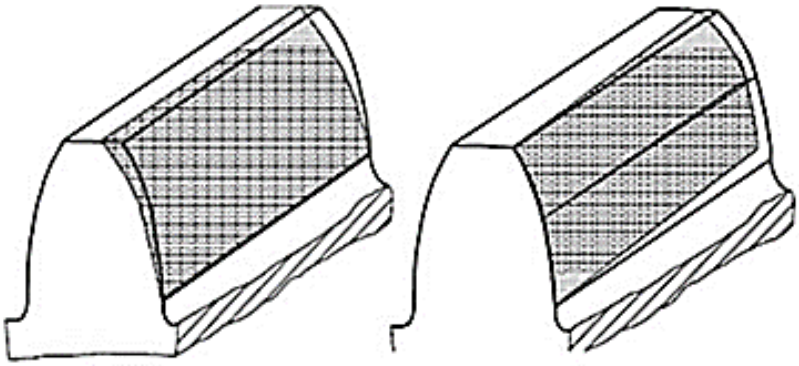
Similarly, flank crowning ensures that the contact area remains concentrated in the central region of the tooth, avoiding excessive stress at the tip or heel. The modifications also prevent edge contact, which can lead to wear and efficiency loss. Figure 1b illustrates the changes in tooth flank geometry due to flank crowning.

ISSN: 2582-4686 SJIF 2021-3.261,SJIF 2022-2.889,
2024-6.875 ResearchBib IF: 8.848 / 2024

THE MULTIDISCIPLINARY JOURNAL OF SCIENCE AND TECHNOLOGY

VOLUME-4, ISSUE-12

Spiral, Pressure, and Torsion Angle Modifications. ***The study also considers modifications to the spiral, pressure, and torsion angles. These angles significantly affect the meshing behavior and load distribution between bevel gears. The spiral angle modification, as***



shown in Figure 2, optimizes the gear's engagement and ensures smooth force transmission. By adjusting the spiral angle, the forces are distributed more evenly, reducing localized pressure points that could otherwise lead to gear failure.

Figure 2. Changes in the pressure and spiral angles

Similarly, modifying the pressure angle helps distribute the forces more effectively along the tooth profile. This modification reduces the risk of high localized contact pressures and minimizes wear. The torsion angle modification, although less commonly applied, provides additional stiffness to the gear teeth, preventing excessive deformation under heavy loads.

Discussion. **The results of this study highlight the importance of crowning and angle modifications in improving the performance of bevel gears. Profile crowning compensates for tooth flexing and helps maintain consistent contact during operation. Flank crowning ensures that the central region of the tooth carries the load, reducing the risk of edge contact and wear.**

Modifications to the spiral, pressure, and torsion angles also contribute to improved load distribution and smoother engagement of the gear teeth. These changes prevent localized contact stresses and help extend the service life of bevel gears. However, it is crucial to strike a balance between the extent of the modifications and the potential for increased curvature at the tooth flanks, which could lead to higher contact pressures if overdone.

ISSN: 2582-4686 SJIF 2021-3.261,SJIF 2022-2.889,
2024-6.875 ResearchBib IF: 8.848 / 2024

THE MULTIDISCIPLINARY JOURNAL OF SCIENCE AND TECHNOLOGY

VOLUME-4, ISSUE-12

Conclusion. In conclusion, crowning modifications and adjustments to the spiral, pressure, and torsion angles of bevel gear teeth are essential for optimizing their performance under load. By carefully implementing these modifications, engineers can improve load distribution, reduce localized contact pressures, and enhance the overall durability and efficiency of bevel gears. Future research should focus on experimental validation of these modifications and further optimization techniques to ensure the reliability of bevel gears in high-load applications.

REFERENCES

1. Ishmuratov H.K., Irgashev B.A. Assessment of the Wear Resistance for Gearwheel Teeth in an Open Toothed Gear under the Conditions of a High Level of Dust. Journal of Friction and Wear. Volume 41, Issue 1, 1 January 2020, P. 85-90.

2. Goldfarb, V.I. Experimental studies of low-speed heavy-loaded spiroidal reducers / V.I. Goldfarb, E.S. Trubachev, A.S. Kuznetsov, A.A. Kornilov // Intelligent Systems in Production. - Izhevsk: Izhevsk State Technical University, 2014 - No.1. - C. 31-41.

3. Ishmuratov H.K. Wear resistance of open gears of gear teeth. // Vestnik TashGTU, - Tashkent, 2019. №2.-C.175-182.