文責：島根大学総合理工学部機械設計研究室教授　李　樹庭
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Design and Contact Strength Analysis of High Contact Ratio Spur Gears

By Prof. Shuting Li

1． Abstract

High-contact ratio spur gears are used to reduce vibration and noise in spur gears; however, when designing such gears, it is difficult to calculate their strength. Therefore, the author developed specialized software that uses the three-dimensional finite element method to analyze the contact problems of high-contact ratio spur gears. Since this software now enables the numerical analysis of the strength of high-tooth-contact ratio spur gears, the calculation results are briefly presented here. For details on this research, please refer to Reference [1].

2． Definition of High-Contact Ratio Gears and Development of Design Software

Figure 1 shows the definition used for high-contact ratio gears. As shown in Figure 1, the tooth addendum is defined as km. For a standard gear, k = 1, and this type of gear is called a standard gear. When k > 1, the tooth addendum is higher than that of a standard gear, so this type of gear is called a high-contact ratio gear. To facilitate the design of high-contact ratio gears, the author developed design calculation software for high-contact ratio gears, as shown in Figure 2.

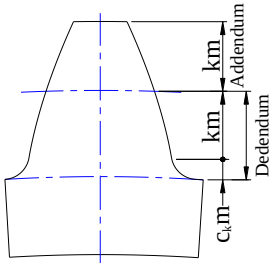

Figure 1: Definition of a high-contact ratio gear

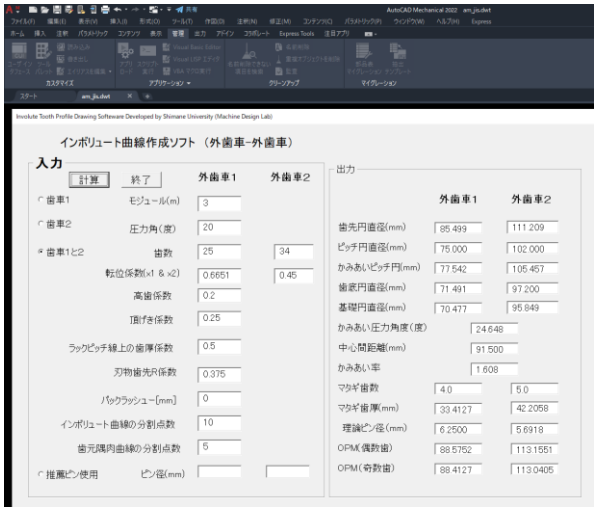

Figure 2: Design and calculation software

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3． Contact Analysis of High-Contact Ratio Gears

We analyzed the contact strength of high-contact ratio spur gears using the three-dimensional finite element method. Here, we briefly present only the analysis results; for details of the study, please refer to Reference [1].

Figures 3 and 6 show the mesh-dividing of the high-contact ratio gears under study. Figure 3 illustrates three pairs of teeth meshing simultaneously, while Figure 6 illustrates four pairs of teeth meshing simultaneously.

Figure 4 shows the tooth surface pressure (contact stress) distribution for each tooth when three pairs of teeth are meshing simultaneously, and Figure 5 shows the stress distribution in the tooth profile direction for each tooth under these conditions.

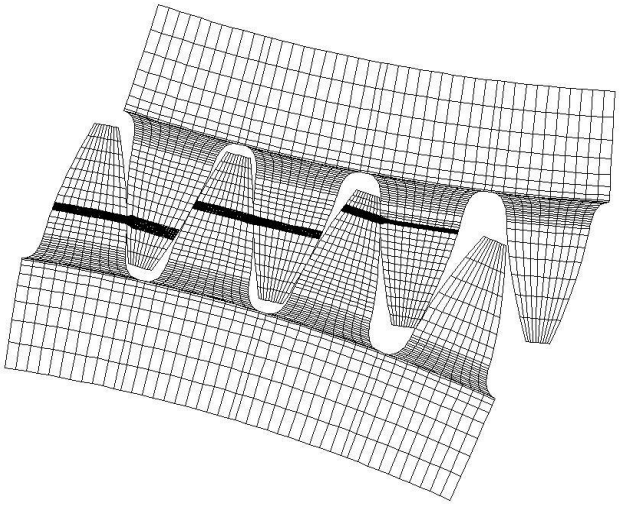

Figure 3: FEM mesh-dividing

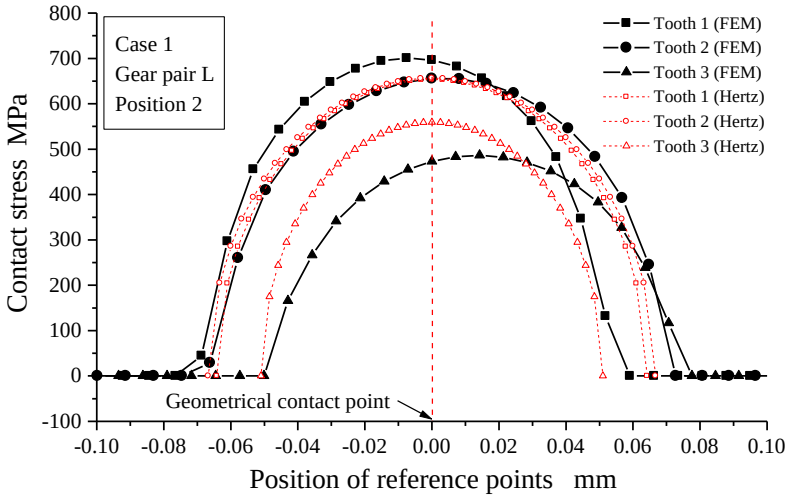

Figure 4: Contact stress distribution on each tooth

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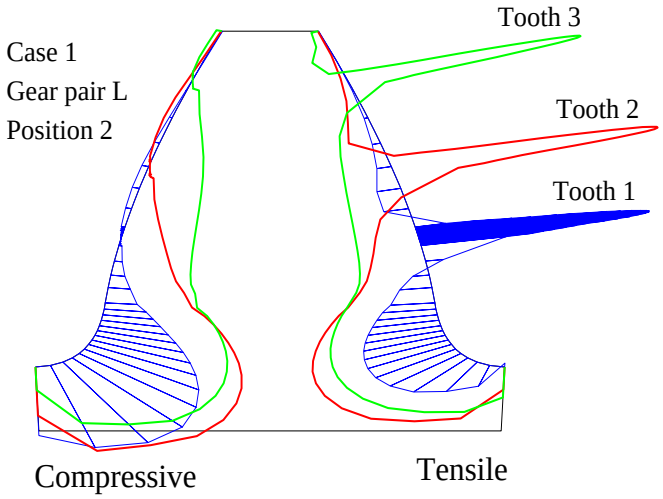

Figure 5: Surface stresses along the tooth profiles

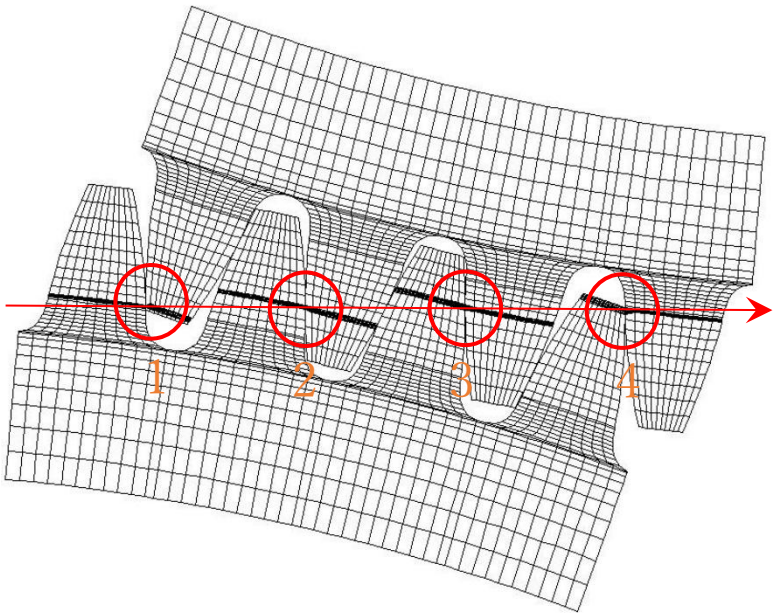

Figure 6: FEM mesh-dividing

Figure 7 shows the distribution of surface pressure (contact stress) on each tooth when four pairs of teeth are in simultaneous mesh, and Figure 8 shows the stress distribution along the tooth profile direction for each tooth under these conditions.

Figure 9 shows the relationship between the tooth addendum coefficient k of a high-contact ratio gear and the maximum relative slip rate. Figure 10 shows the relationship between the gear meshing ratio and the load sharing ratio.

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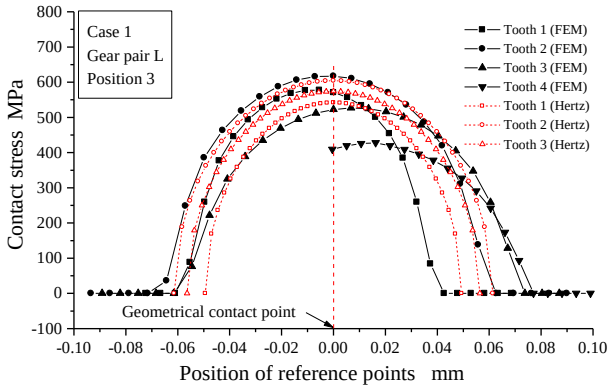

Figure 7: Contact stress distribution on each tooth

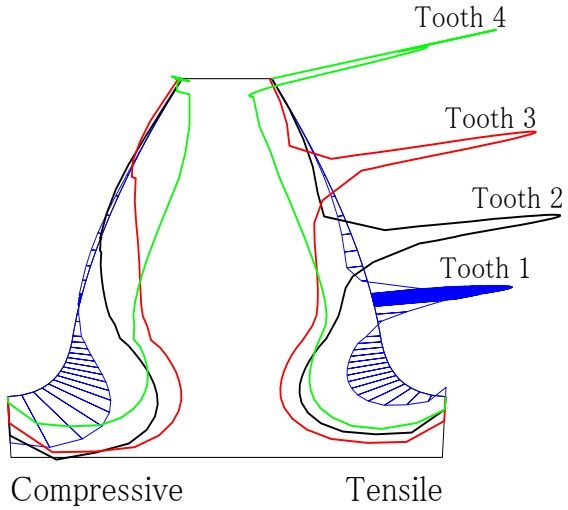

Figure 8: Surface stresses along the tooth profiles

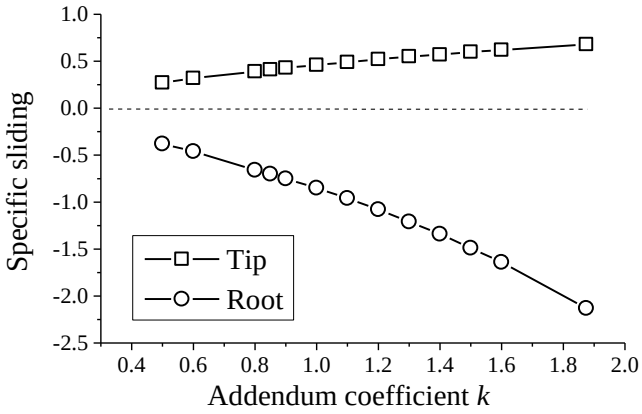

Figure 9: Tooth addendum coefficient vs. the maximum relative slip rate

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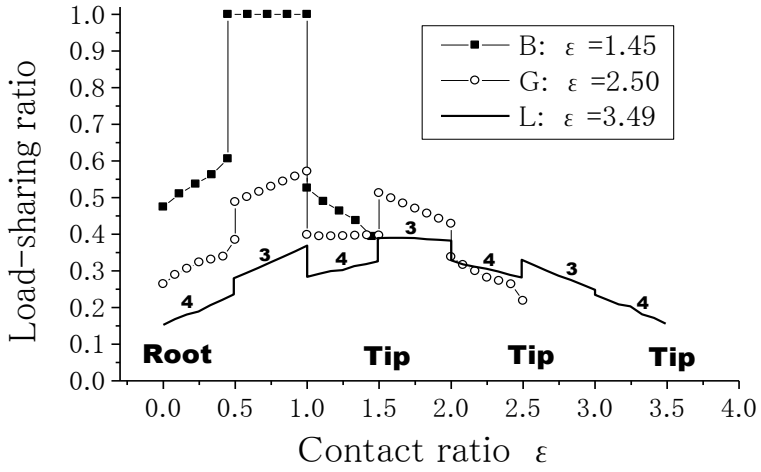

Figure 10: Relationship between contact ratio and load sharing ratio

References：

(1) Shuting Li, “Effect of addendum on contact strength, bending strength and basic performance parameters of a pair of spur gears”, **Mechanism and Machine Theory**, Elsevier Press, Vol.43, Issue 12, pp.1557-1584, 2008.