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Design and Drawing Software Developments of Helical Gears

By Prof. Shuting Li

1． Abstract

In order to enable the rapid design of external and internal helical gears (hereinafter referred to as “helical gears”) and to allow the contact strength of designed helical gears to be analyzed using commercial CAE software, it is necessary to develop software for the design and drafting of helical gears. The author has developed software required for the design and calculation of a pair of helical gears, as well as software that visualizes how these helical gears mesh at any given position. The detailed functions of this software are described below.

2． Features of the design software developed for a pair of helical gears

Figure 1 shows the main screen of the design calculation software for a pair of helical gears developed by the author. The helical gears are designed using the tooth-perpendicular method and are drawn in a cross-section perpendicular to the axis. As shown in Figure 1, the user enters the helical gear specifications in the “Input” section of the software. Upon pressing the “Calculate” command, the results—including the basic dimensions of the helical gear, the tooth thickness, the over-pin diameter, and the tooth engagement ratio—are immediately displayed in the “Output” section. This software also allows the user to check whether undercut is present. Furthermore, as shown in Figure 2, the designed helical gear is immediately plotted onto an AutoCAD drafting template, allowing for immediate visual verification of the designed helical gear. Since this software allows helical gears to mesh at any meshing position, including the worst-load meshing position, it is possible to create a 3D model in SolidWorks when a pair of helical gears meshes at the worst-load position and analyze the gear strength using CAE analysis.

Figure 3 shows the main screen of the design and calculation software developed for a pair of external and internal helical gears, and Figure 4 shows the meshing parameters of the external and internal helical gears designed and calculated using this software, plotted on an AutoCAD drafting template.

3． Creation of a 3D Model of a Helical Gear Using SolidWorks and FEM Analysis of Contact Strength

Figure 5 shows the front view of a helical gear generated in AutoCAD as it appears when imported into SolidWorks. As shown in Figure 5, since the precise geometry was imported into SolidWorks, the 3D model of the helical gear created from this geometry (Figure 6) also has precise geometry. Figure 7 shows a component breakdown view created in SolidWorks of a pair of helical gears meshing at the worst-load meshing position. Figure 8 shows the tooth surface pressure of the helical gears, analyzed using SolidWorks’ Simulation.

As described above, without design and automatic drafting software for helical gears, it is impossible to

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create a 3D model of a helical gear, which in turn makes it impossible to perform CAE analysis of the gear's contact strength.

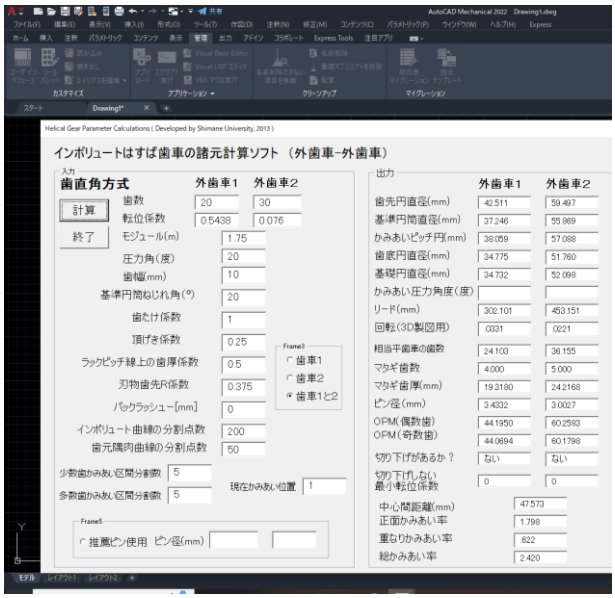

Figure 1: Screen shot of the design calculation software

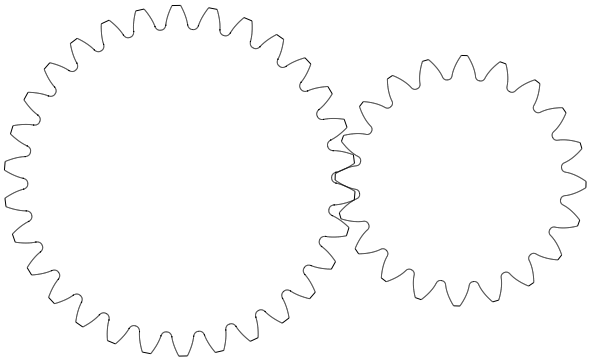

Figure 2: Meshing of a pair of external helical gears (drawn using AutoCAD software)

Figure 3: Screen shot of the design calculation software developed for a pair of external and internal helical gears

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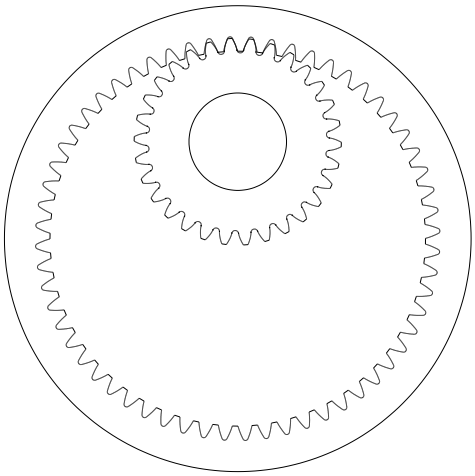

Figure 4: Engagement of the internal helical gears (drawn by AutoCAD software)

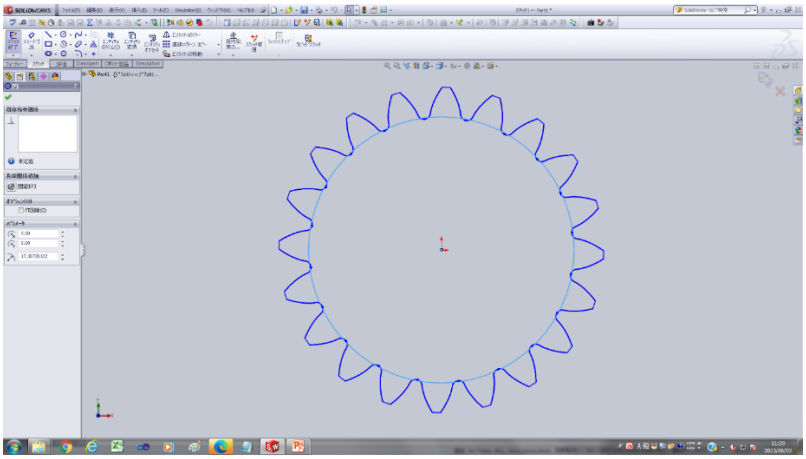

Figure 5: Front view of a helical gear generated
by AutoCAD, as it appears after being imported into Solidworks

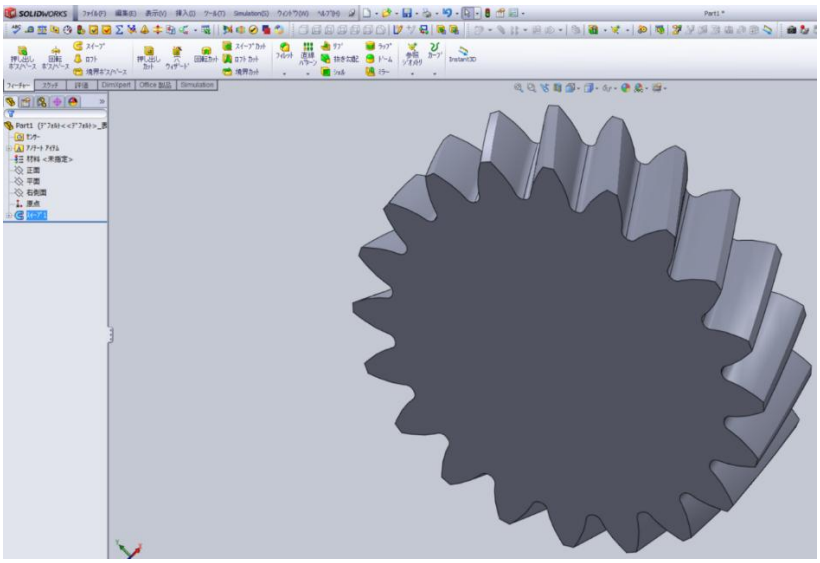

Figure 6: 3D model of a helical gear created in Solidworks (for CAE analysis)

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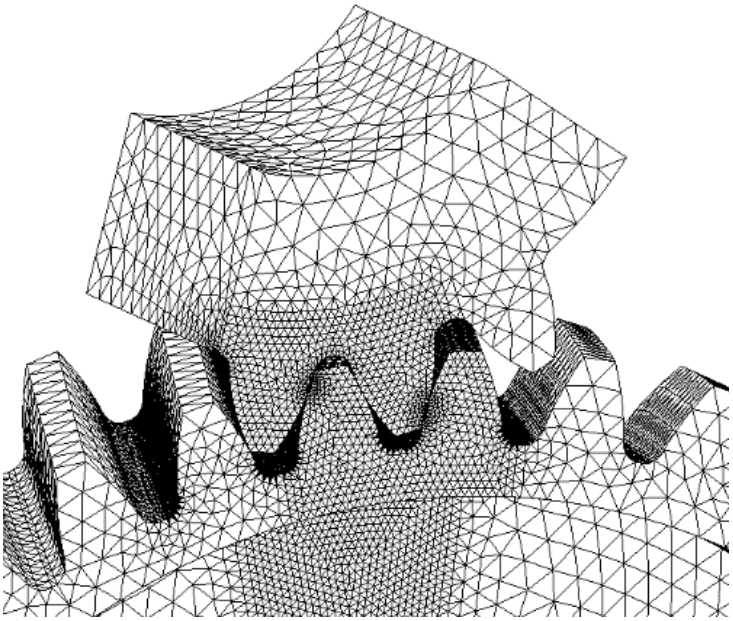

Figure 7: FEM model for contact analysis of a pair of helical gears

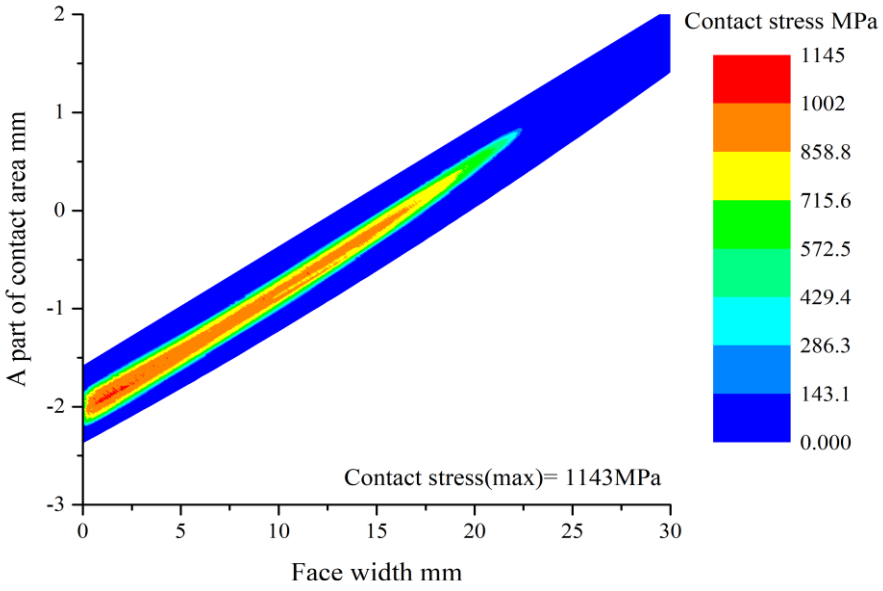

Figure 8: Tooth surface pressure distribution for a helical gear