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Transverse Behavior of Frictional Flat Belt Driven by Tapered Pulley - Change of Transverse Force Under Driving State–

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Abstract : A skew is one of important problems for designing the conveyor and transmission with frictional flat belt, in which running belt is deviated in width direction due to the transverse force applied to the belt. The skew often not only degrades the stability of the path of belt but also causes some damages of the belt and auxiliary machines. However, the transverse behavior such as the skew has not been discussed quantitatively in detail for frictional belts. The objective of this study is to clarify the transverse behavior of frictional flat belt driven by tapered pulley. Commercially available rubber flat belt reinforced by polyamide film was prepared as the test belt where the thickness and length were 1.25 mm and 630 mm, respectively. Test belt was driven between two pulleys made of aluminum alloy, where diameter and inter-axial length were 50 mm and 150 mm, respectively. Some tapered pulleys were applied where tapered angles were 0 deg (for comparison), 2 deg, 4 deg, and 6 deg. In order to alternatively investigate the transverse behavior, the transverse force applied to the belt was measured when the skew was constrained at the string under driving state. The transverse force was measured by a load cell having free rollers contacting on the side surface of the belt when the displacement in the belt width direction was constrained. The conditions of observed bending stiffness in-plane of the belt were changed by preparing three types of belts (the width of the belt was 20, 30, and 40 mm) where their observed stiffnesses were changed. The contributions of the bending stiffness in-plane of belt and initial inter-axial force to the transverse were discussed in experiments. The inter-axial force was also changed by setting a distance (about 240 mm) between the two pulleys. Influence of observed bending stiffness in-plane of the belt and initial inter-axial force on the transverse force were investigated. The experimental results showed that the transverse force was increased with an increase of observed bending stiffness in-plane of the belt and initial inter-axial force. The transverse force acting on the belt running on the tapered pulley was classified into multiple components. Those were components of forces applied with the deflection of the inter-axial force according to the change of taper angle, the resultant force by the bending moment applied on the belt winding around the tapered pulley, and the reaction force applied due to the shearing deformation. The calculation result of the transverse force was almost agreed with experimental data when those components were formulated. It was also shown that the most contribution was specified to be the shearing deformation, regardless of the test conditions. This study found that transverse behavior of frictional flat belt driven by tapered pulley was explained by the summation of those components of forces.

Keywords : skew, frictional flat belt, transverse force, tapered pulley
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