SURFACE GENERATION MECHANISM IN MACHINING PROCESS

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INTRODUCTION

With the numerous increases in the demand for a high precision and quality machining, the control of surface texture and finishing processes have increasingly come to a new level of accuracy. Nakajima et al. [1] examined the simulation of ground surface profile and obtained a fairly good agreement with the experimental results. Sakai et al. [2] also studied the simulation of grinding process. The surface generation mechanism of the burnishing action caused by the rubbing motion between the relief surface of cutting tool or the abrasive grains of grinding wheel and the machined surface, however, has not been clarified. In our previous report [3], the surface improvement ratio, that is, the ratio of the deformed height to the original height of asperities during burnishing action were examined under various burnishing speed and load conditions.

In this study, the surface generation mechanism upon burnishing action during machining process such as cutting or grinding was examined fundamentally. Moreover, the deformation process during burnishing action was examined theoretically based on the Hill's plastic theory (1948).

EXPERIMENT

Figure 1 illustrates the outline of experimental apparatus. As shown in the figure, the burnishing action is simplified into a two dimensional state, namely, the contact and friction condition between a cylindrical pin and one magnified triangular column test piece that models the asperity of machined surface. The 1 mm square meshes are marked on the lateral face of test piece and observed by a CCD camera in order to examine the state of deformation during burnishing action. Moreover, the experiments were also carried out by the test piece divided into two parts in order to clarify the internal deformation process of the test piece.

Figure 2 shows the comparison of the calculated plastic deformation results in the width direction based on Hill's plastic theory with experimental values in the whole contact region of the cylindrical tool and test piece at each indentation depth of tool. In this figure, as the reason why the theoretical value is larger than experimental one, the flow in the forward is not considered in the theory. Moreover, from the observation results by CCD camera and the divided test piece, it is found that the flow in the forward direction is largest in the center of test piece in every place and becomes smaller as the indentation depth becomes shallower.

REFERENCES