

A method for suppression of defects in zigzag bending of sheet metal

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ABSTRACT

This paper clarifies cause of defects in zigzag bending of sheet metal, and proposes a method to suppress the defects. Sheet metals are often subjected to bending before being fabricated into final shapes in industry. Sheet metals are common raw materials and their products include chassis of vehicles and trains, cases of medical and other instruments, structural components in automobiles and so on. Although the mechanism of bending process is very simple, it is difficult to bend sheet metal precisely without defects. The defects include dents or scars by punch, and precision deterioration due to spring-back.

There are many research works on improvement of precision and suppression of defects in the case of simple one-place bending, such as V-bending. Imai, et al., proposed a new precise V-bending method, which bends sheet metals in two-step manner [1]. The mechanical properties are evaluated from the load and spring-back in the 1st bending, and the 2nd bending is conducted on the results of 1st bending. Shibata, et al., showed efficiency of load control in V-bending of plate for attaining high precision [2]. Koyama, et al., suppressed dent size by controlling the path of punch in L-bending [3]. However, there are few research works on multi-place bending, though it is also widely used.

The present research focuses upon multi-place bending, in particular, zigzag-shape bending for suppression of defects. This type of bending is widely used in industry for manufacturing structural parts in automobiles. It is easily conducted by press forming using an upper and a lower dies which have zigzag shape. In the research, the shape of the final target is four-place bending, which has five straight segments, and 4th and 5th segments are much shorter than the other three. The objective is to suppress dents and spring-back. A series of finite element analyses and experiments were conducted for two-place bending, which has three long segments, as a preliminary examination. The preliminary examination showed that the distance between two bending positions, which is controlled by the moving direction of upper punch, is dominant for occurrence of the dents. The dent size was able to be suppressed by selecting the optimum moving direction of the upper die so that the distance between the two bending positions might be the same to the length of the 2nd segment, because the relative travelling length of punch to the sheet metal surface became the minimum under the condition. The preliminary examination also showed that the cause of spring-back is elastic recovery of the segments instead of the bent parts against engineers' and technicians' intuition, and that a proper bending radius would be able to reduce spring-back. Finally, the knowledge obtained by the preliminary examination were applied to the four-place bending for suppression of the defects.

[Reference]

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