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PRODUCTIVITY IMPROVEMENT OF AUTOMOTIVE ROD FORMING PROCESS BY SIMULTANEOUS OPERATION USING FE SIMULATION

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Abstract: Metal forming processes are the backbone of modern manufacturing processes. Connecting rods are used in automotive seats to connect recliners and achieve forward/backward movement of automobile front seats. Individual grooving, flatting and serration tools were used previously, which taking too much time for loading new die every time. The main objective of the work presented in this paper is to design a tool for simultaneous operation and simulate forming process for increasing the productivity through process optimization. Various elements of the tool are developed by calculating forming forces. Further, the forming process is simulated using finite element simulation before building of combination tool. The simulation results obtained for the stress and deformation state are discussed. The designed combination tool is fabricated and implemented successfully in one of the leading automotive component manufacturing industry. Results found are acceptable with fewer defective rods and enhancement in productivity with decrease in lead time compared to the earlier tool.

Key words: Finite element Simulation, Metal forming, Combination tool, Forming force distribution, Productivity improvement.

1. INTRODUCTION

The work is focused on designing a new combination tool and simulating the forming process to execute three processes simultanously on a rod. The recliners of driver and co driver seats are connected by the rod to accomplish movement as shown in Figure 1. Total three operations are carried out at one end and two operations at other end of the rod.

The work is intended to develop a combination tool for first three operations as grooving, flatting and serration in the sequence. Use of computer-aided engineering is very important in designing and developing a forming tool with lesser time and cost [1]. It was proven that combination tool design is optimal design, as it optimizes the process. Diamentional precision of the tool assembly should continue for the entire functioning life of the combination tool [2].

Use of forming simulation is advantages over the trial tools, as it leads to a significant reduction in both cost and time [3, 4]. Simulation of forming process has exposed new prospects due to continuous enhancement in FE simulations [5]. Simulation is important in designing metal forming process, not only for material properties and frictional conditions but also for geometric representations and computational time [6]. Simulation greatly improves the understanding of mechanics by visualizing the deformation and stress in component. FE simulation is more proficient in resolving compound design and manufacturing concerns in metal forming [7]. The accuracy of the simulation results depends on several factors: the type of finite element, the discretization of the analyzed object, the solving algorithm, etc. It helps to improve the quality with minimum product development time. The application of modelling and process simulation is highly important in metal forming, hence it must be applied at the time of design phase only. FE simulation of the complete forming process is used to gain the information about forming sequences followed for obtaining the final shape of the component according to the drawing provided by the customer.

Fig. 1. Actual application of connecting rod