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Design and application an integrated element selection model for press automation line

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Abstract

There are many things that make useful automatic line systems for metalworking machinery. Press automation systems have been widely used in the industry for sheet metal processing. This paper presents a new approach towards elements selection of an automatic line for sheet metal forming. Automation line element selection is a complex, tedious task, and there are few tools other than checklists to assist engineers in the selection of appropriate, cost-effective elements. It has been described as an integrated press automation line elements selection system called press automation elements selection advisor (PAESA) model in this study. The PAESA has incorporated 10 stages of integrated factors such as property profile of possible elements, defining of developed elements, firm research, company contact and costumer service, specification of requirements, driver mechanisms, environmental selection and cost, system accuracy, product strategy and fine selection.

Keywords: Automation; Press; Sheet metal Strip; Dies; Decoiler; Straightener; Feeder

1. Introduction

A typical automatic line for sheet metal forming processes consists of six elements which are: 1. decoiler, 2. straightener, 3. feeder, 4. the press, 5. die and 6. sheet metal strip, as shown in Fig. 1. For thin metal strips, the distance between the straightener and the feeder is selected by experimentation, which later serves the industrial practitioners sufficiently well. Generally, different feeders such as a roll feeder, a clamp feeder, a hydraulic/pneumatic feeder and an electronic (servo control) feeder are used practically in the industry. There are many things that make element successful in the workshop. Many different methods for materials selection and design have been presented over the last couple of decades. A method was reported by Edwards that brings an approach to a materials selection model that is an integral part, in an integrated product development model, in which both physical and metaphysical properties are analysed for different types of products [1].

The minimisation problem for the weight of the entire bottom structure under static load conditions, including stiffness, strength and buckling constraints, is formulated and solved for each material application, mass and materials' price used for selection of elements, the assessment of an environmental impact of materials-candidates during the entire life cycle of the structure is considered [2]. The introduction of new, or modified or alternative materials and processes for a given application is dependent on satisfying a lot of different factors [3]. Design aspects and examples of methods to fulfil demands for manufacturing, assembly, disassembly, service, recycling, etc., are also presented as well as environmental friendly solutions for product development [4]. Achieving the match with design requirements

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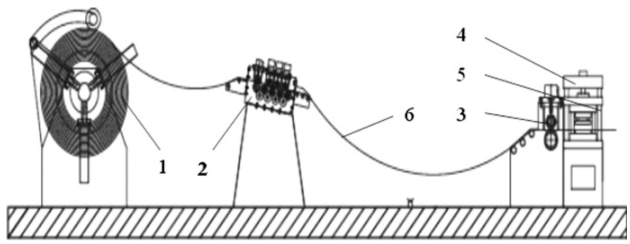

Fig. 1. A typical automatic line elements for sheet metal forming (EAE machinery) 1 – decoiler, 2 – straightener, 3 – feeder, 4 – press, 5 – die, 6 – sheet metal strip.

involves the following steps: translating design requirements, a procedure for screening out, a scheme for ranking the surviving materials and process, a way of searching for supporting information about the top-ranked candidates, giving as much background information about their strengths, weaknesses, history of use and future potential as possible [5]. In the design of dies casting as cheaply and rapidly as possible, suitable die size, locations of gating system, and selection of an appropriate die casting machine, shortened lead-time in designing a new die for new product, cooling time, cooling channel locations, and flow rates relations are estimated and presented [6]. Process selection involves three steps which are the 'menu' of all available processes, lowest cost and safety with environmental issues [7]. The materials profiles information is structured on the basis of: what they are, design notes, typical uses, competing materials, environmental aspects and technical notes, and the materials processes [8].

A procedure for the selection of cutting tools is capable of cutting conditions and estimates component cost, based on the properties of the work piece material and features attributes, which include surface finish and tolerances, as well as using a number of production criteria such as material removal rate, tool life, machining time, and cost [9]. Such a methodology was developed defining the requirements of the design and identifying the attributes of the relevant subset of processes, an evaluation of a design considering both technical viability (including the product quality during processing and in the finished part), and economic viability [10]. A case study involving design limitations and performance requirements in cost estimation is presented to illustrate the use of the integrated approach [11]. Comparative information on the performance and properties of the engineering materials under consideration; the influence of total cost on the selection of the optimum material is discussed [12]. The purpose of this article is to provide a straightforward selection procedure. It will become apparent that a much wider choice of feeder than drive is available: the underlying reason appears to be that power matching is required for an efficient feeder. The classes of elements studied here are detailed for the press automation system.

2. Automation line and its elements

2.1. Automation

The term automation has many definitions. Apparently, it was first used in the early 1950s to mean automatic handling of materials, particularly equipment used to unload and load stamping equipment [13]. It has now become a general term referring to services performed, products manufactured and inspected, information handling, materials handling, and assembly, all done automatically (i.e., as an automatic operation). Amber and Amber's yardstick for automation was presented in 1962 [13]. A portion of chart that they developed has been updated and is included here as Table 1. Abbreviated form is that each level of automation, in which no human attribute that is begin replaced (mechanised or automated) by the machine.

Automation as we know it today begins with the A (3) level in Table 1. Self-adjusting and measuring machines are of the A (4) level, replacing human adjustment and allowing these machines to be self corrected. At the A (5) level, the system would detect the increase in deflection due to increased forces (due to the tool's dulling) and reduce the feed to reduce the force. The A (6) level reflects the beginning of artificial intelligence, in which the control software is infected with elements (subroutines) that permit some thinking on the pan of the software. In a metal working machinery, multiple die sets are mounted side by side along the slide. After the completion of each stroke, a continuous coil or individual work pieces are automatically and progressively advanced to the next station by a mechanism.

2.2. Presses

Many types of presses have been developed to perform the various cold-working operations. When selecting a press for a given application, consideration should be given to the capacity required, the type of power (manual, mechanical, or hydraulic), the number of slides or drives, the type of drive, the stroke length for each drive, and the type of frame or construction. Table 2 lists some of the major types of presses, in general, mechanical drives provide faster motion and more positive control of displacement. The available force usually varies with position, so mechanical presses are preferred for operations that require the maximum pressure near the bottom of the stroke, such as cutting, shallow forming and drawing and progressive and transfer die operations. In contrast, hydraulic presses produce motion as a result of piston movement, and longer or variable-length strokes can be programmed within the limitations of the cylinder. Hydraulic presses are preferred for operations requiring a steady pressure throughout a substantial stroke (such as deep drawing), operations requiring wide