

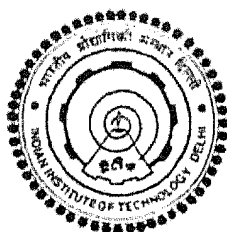
A CONTRIBUTION TO CAD OF STAMPING LAYOUTS AND INTELLIGENT SELECTION OF DIE COMPONENTS

by

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submitted
in fulfilment of the requirements for the Degree of
DOCTOR OF PHILOSOPHY

to the



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CERTIFICATE

This is to certify that the thesis entitled "**A Contribution to CAD of Stamping Layouts and Intelligent Selection of Die Components**" being submitted by Mr. Rajender Singh for the award of the degree of **DOCTOR OF PHILOSOPHY**, is a record of the original bonafide research work carried out by him. He has worked under my guidance and supervision and has fulfilled the requirements for the submission of this thesis. The results presented in this thesis have not been submitted in part or full to any other University or Institute for award of any degree/diploma.



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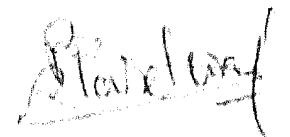
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(Rajender Singh)

ABSTRACT

The aim of the present work is to contribute to the growing body of knowledge in the field of computer aided planning of sheet metal operations. The investigation has three facets, namely the development of a low cost modeller for strip layouts, formulation of a computerized technique for comparative evaluation of strip layout alternatives and creation of a knowledge based system for checking manufacturability of the part, choice of manufacturing operations and intelligent selection of press machine and die components for single stage piercing and blanking operations.

A low cost modeller has been developed for two dimensional metal stamping layouts. The AutoCAD and AutoLISP based software is capable of modelling circular, polygonal and other components. The proposed modeller generates optimal layouts and presents them graphically. The modeller is interactive in nature and enables quick design and visualization of good quality stamping layouts.

A strip-layout selection methodology for metal stamping work has been formulated. The method is based on a computerized diagraph and matrix approach. Factors affecting the cost of production of stampings from raw stock to the finished stage are identified. A strip-layout diagraph is used to model both the individual and relative importances of the above factors. Based on this diagraph, so-called permanent matrices are set up. Expressions are developed for a selectivity index to help rank a given set of strip-layout alternatives. Test examples show that the recommended layouts are very close to what an expert, using the conventional approach, would obtain after spending relatively much longer time.

The problem of testing the manufacturability of a given part, choice of manufacturing operations and selection of dies, tools, press machine and die components for piercing and blanking operations is tackled through the expert system approach. The proposed system comprises of a data base on press machines,

tools, jigs, fixtures, gauges and die components. The knowledge base comprises of more than 210 production rules of the IF-THEN variety. The rules are contained in fourteen modules. Each module generates user-friendly prompts for entering job-related data. The output from the modules includes recommendations on suitability of geometrical features of the part, required manufacturing operations, the kind of die and tool needed for the job, the alternative machines on the shop floor which can handle the given job, identification of the most economical of the above machines, optimal die dimensions, appropriate die land, die angle, tolerances on die and punch, the die and punch clearances, the stripper and punch details, the recommended type of the die set, precision class of the die set and its dimensions, the diameter of dowels and bolts, and the kind of the pilot. The expert system is coded in the autoLISP language and loaded into the prompt area of AutoCAD. This arrangement facilitates automation of the drafting process. In the present study, a special purpose AutoLISP program has been developed for automating the drafting of die components and die assembly for single stage dies. The proposed knowledge based system has been designed as a special purpose low cost tool for planners working in small scale industry. The knowledge base of the proposed system can be modified depending upon the capabilities of a specific shop floor.

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