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Design and Manufacturing of Die

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ABSTRACT

The design and manufacturing of die is one of the most important features in sheet metal operation. The design and manufacturing are important parameters in translating the idea to a product design verification and its validation. In the current dissertation emphasis has been given to bending operation. Since during bending operations maximum rejection was observed at the die setup, which is manual and increases the setting time. The sponsored industry utilizes the 60 types of different bending operations in which total 9 types of dies are used. The current dissertation emphases on study and analysis of various parts, data, initial conceptual design, design verification and its validation. The dissertation intends to suggest multiple operation in single set up by improving the traditional design of compound die in sponsored industry.

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I. INTRODUCTION

This company is the manufacturer of assembly parts catering to automotive, vehicles business segment. They have rich experience of more than 20 years in the field of Engineering especially in Press tool Design & manufacturing. Over the years they have grown into an auto ancillary company, subassemblies. To cater to a growing demand from our customers. Vision To be the most preferred sourcing destination for Tool room works & Die making. To be an organization powered by word class technology, state of art infrastructure, providing reliable and trustworthy solutions globally in engineering business.

Problem Statement

Maximum rejection occurred during bending operation, which leads to increases in PPM count.

Problem description:

The standard procedure they followed for various types of bend. these operation leads to the continuous die setup for each bend operation, which increases die setting time thus increases the lead time for a bending operation. during the setup many parts are being waste as the setup is on the trial and error basis thus leads to increase in PPM and also due to less accurate positioning of the bend , which is due to stopper plate adjustment , the bends formed are not accurate and gets rejected during the quality inspection which is due to the inaccurate dimensions and the Taper bending. This leads to decrease in productivity, cost consumption, materials going for scarp and thus also does not fulfil costumer's satisfaction.

Objectives:

- To reduce ppm.
- To increase the productivity.
- To reduce lead time.
- To reduce setting time.

Scope:

- Reduction in number of setups can be achieved
- New setup of Die will occupy less space.
- Accuracy will be predefined.

II. LITERATURE REVIEW

2.1 Rahul A. Patil, Avinash T. Panchal [1]

The blanking die style and modelling method for sheet operations is sort of systematic and involves varied activities like checking of half style options from manufacturability purpose of read, alternative of producing operations, choice of the kind of die, choice of the press machine and choice of the size of the die elements. Compound die usually include blanking and piercing operation that square measure performed in single press stroke. There square measure many ways to style a compound die, however since there's no place for the finished half to travel throughout a compound die's operation, the half should be pushed back to the scrap net specified it will then be administered of the tool and extracted in one or another fashion later within the die cutting operation. This necessity for a separate elements extraction method is one draw back of the compound die system. blessings of a compound die system, initial and foremost being the high and best mechanical accuracy of one step method. A second advantage of a compound die discovered is its outturn. as a result of all internal and perimeter options of the half square measure created in one cycle. criterion for Die-Manufactural product Today's world places bigger and bigger demands on product and materials, from that they're created. Years ago, several designers ne'er urged out stress and strain, elasticity, fatigue, or similar values. If it stone-broke, then you simply created it two inches thicker, or three inches, or five inches, no matter you most well-liked. physical property Theories throughout the forming or deforming method, any metal material, with all its mechanical, electrical, and alternative properties, can bear a change from its elastic state to plastic. These changes square measure forced upon its structure by varied stresses, temperature changes, and speed of the forming application, among others. The changes might occur either on the plane of the very best concentration of mechanical energy, or on the plane of most shear stress. Naturally, such associate array of influences cannot fail to provide extensive changes within the part's structure and look. Some changes might are originally planned for, and for that reason these will be thought-about useful. sadly, there will be changes that square measure prejudicial to the end result of the performed operation and these lead to a defected product. In a shot to manage the material-related defects in sheet-metal forming, many theories touching on its physical property were developed. physical property of metal is that the capability to face up to the appliance of force, which, once excessive, might turn out its deformation. once this force is tiny enough to suit inside the material's yield strength limit, the deformation is just temporary, and when the discharge of the pressure, the fabric returns to its initial state. However, once the force exceeds the yield strength of that individual material, the ensuing deformation of its space lattice remains permanent and therefore the half is for good distorted, or perhaps, formed.

2.2 VivekD.Barhate1, Dr. Sachin G. Mahakalkar, Dr. A. V. Kale [2]

The die that performs 2 or additional operation afterwards during a single stroke is thought as a progressive die. This die is employed for manufacturing a end half during a single stroke. Compound die is additionally use for this; however its construction additional sophisticated than progressive die. In progressive die the strip is feed from one finish and end half eliminate from another finish. There the strip passes over completely different workstations and therefore the connected operations ar performed there over. during this paper the progressive die has 2 work stations. 1st digital computer performs piercing operation and other performs the blanking operation. initially station in piercing there 2 holes ar cut there. These holes ar used for locating the strip at the blanking operation. For locating the strip there locating pins ar used on die surface and pilot pins ar used on punch surface. Main objective of this paper is to style a progressive die, prepare a model of die. Basic Die style and Die-Work Influencing Factors Grain Direction of the fabric. The present grain of fabric should be taken into thought 1st. Unless completely necessary, it shouldn't seem aboard a bend, a joggle, or the other deflection and elevation within the part's surface. each sheet-metal material behaves otherwise aboard the grain line and across it. Forming, drawing, and even straightforward punching could typically show variations within the size and form of the opening once evaluated for the grain influence. associate extruded gap, shown in illustrates this claim. By cutting across the grain line, the fabric behaves nearly as if perpetually in tension, which, once forcibly removed by the cutting method, causes the fabric to backpedal. If a bracket like the one shown in. 1-17a are turned 90° and positioned on the strip with its bends on the grain line, these flanges could typically crack in forming or maybe abundant later, in service, afterward. For that reason, where the matter of multiple bends happens and there's no probability of avoiding their placement aboard the grain line, associate angular positioning on the strip or sheet, ought to be thought-about. Such a grain-line pattern ought to be used quite routinely with materials of the 6061-T4 (T6) atomic number 13 cluster, as they're at risk of cracking. particularly if, for a few reason, elements ar belt-sanded in flat before bending, their disposition to cracking are increased. A larger bend radius, likewise as moving sanding, or belt-sanding beneath associate angle, could facilitate to alleviate the matter to a degree. In elements with many shaped sections, the shear strength and resistance to columnar stress of their flanges can vary with their variation from the material's grain, as shown in. 1-18. ought to a force A, parallel with the grain line, be applied to the bend-up section, the best shear strength are encountered. However, we have a tendency to already grasp that bends running parallel with the bend line ar at risk of cracking in forming and aren't counseled. Intermediate shear strength are encountered within the direction of the C force line in. 1-18a, whereas the B force line can show the smallest amount shear strength, because the projection could tend to bend under that. Whenever a bent-up projection is acted upon by a secondary bending force, it's a bent to follow that force's direction provided that in keeping with the initial movement of the projection in forming. A force applied against the direction of bending won't flatten the fabric, however can Pritam B. Bhawar, Shubhangi break it2.3 А Dongare, Shubham R Bhamare, Ajinkya B Padul, Shubham V. Shirsath[3]

Abstract Progressive die performs a series of operations in an exceedingly single die at 2 or a lot of workstations. there's given end half at every stroke of press machine. style and development of progressive die is one in every of the vital phases in sheet producing. the little error at any work station will induce serious producing losses through die failure, half pure mathematics distortion and production risk. This analysis deals with coming up with a progressive die, simulating the blanking and piercing method. By victimization this die we will manufacture correct element. during this work authors have designed a progressive die that have 2 work stations. the previous operation is piercing and is followed by blanking. it's the fabric removing tool. This progressive die is intended for Seva Engineers Pvt. Ltd. that is additional utilized in agricultural sector. Close-Tolerance Dimensions management of The

management of dimensions in die work continues to be incomparable by alternative producing processes. Already the actual fact that a fast-moving strip may be quickly and exactly positioned with the help of pilots, stops, guides, and alternative locating components simply before the press comes down, speaks volumes regarding productivity and effectiveness. the likelihood of staging varied operations in order that one doesn't have an effect on the opposite, the wide selection of operations that may be performed in an exceedingly die, the flexibility of this tooling approach is simply few among several benefits the metal-stamping field presents. cluster of closely-spaced b openings, serving as a start line for a few rather correct orienting. The spacing between the teams would be jeopardized if a wrong sequence of die work were used. this is often as a result of such closely spaced piercing produces a distortion of the fabric structure, which ends in its enlargement therein explicit space, usually to the purpose of bulging on top of the remaining surface. This condition may be controlled to a degree with Specially formed punches, Special cutting conditions, Staggered cutting, of these techniques ar mentioned well later. At now, the sequence of operations and their disbursement in an exceedingly single progressive die are mentioned. Method No. one utilizes the subsequent scenario: one. Pierce the cluster of tiny b openings by staggering the cuts as shown (two stations, every with a special cluster-punch needed) two. Pilot on the 2 opposite holes, c1 and c2 for additional strip advancement three. Flatten the half within the die if required or if advantageous four. Pierce the 2 massive holes, a1 and a3, either side five. Pierce the center massive hole, a2, both sides. Die-Produced components to switch alternative product, like Castings, Forgings, or Plastics several die-stamped components ar wont to replace castings, forgings, and components created by varied alternative methodology as a result of die production is quicker, a lot of precise, and consistent. Dimensions ar simply controlled and infrequently no succeeding grinding, drilling, metal removal, and alternative intensive finishing is needed. Lately, however, the trend is to switch some sheet-metal components with plastics usually to the disadvantage of the client. Everything has its time and place, and plastic materials despite the fact that displaying several admirable properties, typically simply don't live up to. sheet is unquestionably sturdier and nevertheless versatile, the impact of its aging is a lot of negligible, and also the weathering impact has no influence thereon if properly coated.2.4 Gaurav C. Rathod, Dr. D. N. Raut [4] Abstract: Press tools square measure wont to turn out a selected part in great quantity, out of sheet metals wherever specific part achieved depends upon press tool construction and its configuration. completely different|the various} styles of press tool constructions result in different operations specifically blanking, bending, piercing, forming, drawing, separating, parting off, embossing, coining, notching, shaving, lancing, dinking, perforating, trimming, curling etc. Generally, metals having thickness but 6mm is taken into account as strip. Metals having thickness bigger than 6mm is taken into account as plate. In Piercing and notching the specified form bound iscut within the work piece material. The press tool used is for Piercing operation is termed as Piercing tool. the appliance of press operations is wide utilized in several industries like food process, packing, defines, textile, automobile, craft and plenty of aside from producing trade. during this association an effort

is created on to find out the press tool style, materials, producing used for press tool and calculations concerned in it. during this work, a true time style of an easy piercing press tool and producing of a model is created in conjunction with static analysis of punch wherever the output may be a Pierce hole and notch hole. The press machine is of mechanical style of 200ton. Here the matter statement of project 2/is 2} mix these two piercing and notching operations. that is currently producing severally i.e. 2 piercing by one punch and 2 notching operation with another punch. Metal forming is one in every of the producing processes that square measure nearly chip less. These operations square measure in the main administered by the assistance of presses and press tools. These operations embody deformation of metal work items to the required size and form by applying pressure or force. Presses and press tools facilitate production work. These square measure thought of quickest and most effective thanks to type a sheet into finished product. Here the matter statement of project 2/is 2} mix these two piercing and notching operations. that is currently producing severally i.e. 2 piercing by one punch and 2 notching operation with another punch. The cutting of sheet in press work is cutting method. Punch is same form of the die gap however the gap between the punch and die known as as clearance. As punch apply pressure on metal strip then material enters into die cavity at that point material is subjected to each tensile and compressive stresses once it crosses elastic limit then once 1/3rd (one third) of fabric thickness then this material get fracture this solely attainable by providing optimum clearance between punch and die .If there's no optimum clearance then rather than fracture material can get bend. So, there's have to be compelled to give optimum clearance between punch and die. sheet and Its Behaviour in Metal Stamping method The metal stamping method will alter the sheet-metal material in some ways. elements could also be blanked, pierced, drawn, formed, or brocaded, simply to call many basic operations. every of those processes exerts its influence upon the structure of the material: that of the half which of the scrap. Often, a full piercing will cause stresses that may turn out a rise in space measurements of that exact section, that is termed bulging, or tin effect(from oilcan's snapping back and forth). Forming or drawing, on the opposite hand, will turn out wrinkling, tearing, ironing, or undesirable folding of metal.

2.5 Ivana suchy, hand book of die design, 2nd edition, McGraw-Hill [5] During straightforward bending, sheetmetal material remains uniform and isotropous. No stress residues stay at intervals its mass on termination of a straightforward bending method. typically speaking, there square measure numerous bending ways, that embody stretch forming, conjointly referred to as wrap forming, roll forming, forming with high pressures, rubber forming, to call however some. In die work, majority of bending operations will be divided into four types: • V-die bending • U-shape bending • Wipe bending • Rotary bending. V-die bending is shown in. the primary example is that of a daily V-die bending, with bottoming at the stroke of the press. At that moment, the fabric is ideally forced to fill the gap between the punch and also the die and it appears that except for spring back nothing will alter an ideal bend. Actually, like each producing method, there square measure several variables concerned, every of them capable of rendering such optimistic expectations wrong. there's the

fabric thickness to catch up on, the speed of the operation, the tactic of edges' interrupt and also the ensuing development of cracks, the radius of the punch, breakage of tooling, and alternative agents of influence. wherever the strip is just too slender a shift throughout the downward stroke is feasible. This typically happens at the instant the fabric can't be radio-controlled by virtually any suggests that however pins, as after all, wherever pins square measure wont to restrain the half in its location, the fabric will definitely pull on them; that must be anticipated. In V-die bending with alleged bottoming, the fabric doesn't have to be compelled to affect within the space of bend radius. Actually, a pointy corner within the die, as shown in Fig. 2-16a, or maybe a relief slot will be of advantage there. Anyway, the shaped material can invariably wrap round the punch and don't have any tendency some to fill that sharp corner. Actually, to feature a corner radius to the Vdie could also be quite harmful, because the distance between its surface which of the radius of the punch becomes crucial to the result of bending. a small deviation within the material thickness, or a small build abreast of the punch or die, and also the bend could find yourself in a very failure. Coining that will occur in such a state of affairs may additionally be extremely prejudicial to the tooling. The second version of V-die bending is alleged air bending. The term air bending refers to the actual fact that the punch doesn't bottom with the stroke of the press. Such bending offers the advantage of a variation of the bend angle, as well as the likelihood of overbending. The bend angle is controlled bythe length of the punch travel. Bends made by this method could suffer from a rather bigger spring back. Also, the slender body of the punch is additional liable to harm. each kinds of V-die bending leave overbending, which implies that the bends underneath 90° will be made. this can be gettable by creating the angle of the punch tip chiseler, typically in conjunction with a corresponding angle of inclination applied to the die wherever boltoming is needed. Habitually, the V-die punch tip for 90° bends is made with a 88° to 89° angle, that is what, within the majority of cases, the spring back most frequently amounts to.

Zone chin lien [6] believes in style new professional and learning system for coming up with new bending die. The professional system any divided into 3 varieties. The sheet bending content uses the rule of expertise to regulate system flow chart. The sheet bending knowledge base sort uses to avoid wasting qualitative knowledge like pressure, spring back quantity which may applied to rules for content. {the style|the planning|the look} expertise content of sheet bending uses for saving previous style expertise to use in future design and learning. Learning system square measure of 2 types' committal to memory and construct learning. consistent with construct learning, connected modules square measure classified. Sing committal to memory all input data and changes memorized into production rule. this method additionally follows Martin's law, that defines learning as adding of already nonheritable data. The professional system possess versatile developing capabilities convergency sheet bending style. victimization this method one will cut back used memory of your time for coming up with bending die and increase speed of execution. By victimization learning and committal to memory, automatic rule addition is finished that is extremely helpful for coming up with new bending die.

Satyandra k gupta [7] ,develop rule for setup coming up with that set of components and capable shared setup of production of each half in given set of components, if it's possible .in low amount producing , the most downside is frequent modification in setup for numerous half production , to supply value effective little batches of product . we've got to use new technique to cut back no of setup changes. In actual method, time taken for method is Vol-4 Issue-3 2018 IJARIIE-ISSN(O)-2395-4396 8562 WWW.ijariie.com 1176 considerably less compared to time taken for tool modification and setup. The given rule delineate as an area formation rule and mixed whole number family programming based mostly single setup generation rule. The rule uses, bottom up approach for generate half families. This rule makes use of mixed whole number programming formulation for generating setup of every half family. The approach is predicated on mixed whole number programming and supply 2 blessings. Moderate size downside, it hostile approximate answer and finds optimum setup. Opposing to minimizing range of stages, and conjointly permits to reduce total stage length. The rule gift improvement over previous work. The half fail formation to NPhard probable; it's much smart to develop rule generating instead of best answer.

Apurv Kumar [8], the finite part methodology is employed to see totally different optimum style still as method variables foe manufacturing half while not defect .in common analytical at totally different section of operation all the result of friction ,thinking of sheet & botching result is neglected .in fem actual method is simulated therefore time &money for trial & error methodology shared .process variables ,material property &design parameter play a crucial role in bending of flat solid .punch nose radius ,die corner radius ,punch angle &length of stroke area unit style parameter .the optimum condescend make sure that the bent flat solid half free from cracking &necking the punch nose radius Associate in Nursing effect on} the inner curvature radius of bent still as an residual stressed .by victimisation fem ,crack free bent give up uniform thickness &minimum variable stress of die & punch style.

Vivek D.Bharad [9] the all a part of bending die doesn't would like high involve in direct operation of press tool. Die ,punch & touching ar the foremost vital a part of die set therefore needed strengthen material .the principle for choice of fabric for 3 half ar 1) Material having additional wear, adhesive or abrasive resistance than half material 2) The friction force & hardness ought to be quite half material 3) Compressive strength, shear &fatigue strength ought to be plastic &elastic deformation strength ought to be less.

Ketan, Kapse [10] has studied metal bending operation ar wide performed on press machine. the quantity of operations ar performed in press machine like, bending, drawing, dip drawing, etc. The tool used for producing the part have a high accuracy and it's in giant numbers. This paper shows the look of bending die that is use for manufacturing the rib. This paper focused in style of various part of blanking tool, 2nd and 3D modelling of elements. This modelling part was dispensed on solid works.

III. METHODOLOGY

Process Study:

The first day of company was about induction of company. There we came to know about the overall company scenario www.ierjournal.org

about press machines, types of sheet metal operation, welding operation, inspection and many more. we study about process flow of the company and what standards are maintained. We had basic training of all the department. So that we can find our problem statement or project in it. In the beginning we did induction in company we came to know that in many sheet metal working enterprises they face many more problem such as time limit, maintaining quality, gaining customer, etc. While studying available data we find major issues like rejection of final product, so we decide to do Root cause analysis of it.

Collection of data: We collected all data about the rejection of parts by observation and deep studying about all the process. At the end of the study, reasons of rejection can be classified such as Dimensional, Aesthetic, shifting of holes, Blank cut, Bending, Profile not ok, etc. Collected data which are:

Root cause analysis: Collected data analysed and we reach to identified the main cause of rejection of the final product by bending issues So, we came to know the major issues are due to all bending operations in company.

Selection of problem: From the above data we came to know the root cause or we can say maximum rejection is due to bending therefore we conclude that maximum rejection can be solve if bending issues are solved.

Conceptual design: After selection of problem we decided to make conceptual bending design in suitable software for more understanding and visualization.



Fig 1. Process Flow

IV. INTRODUCTION TO DIE AND PUNCH BASICS:

A die and punch assembly may be a metal operating method. that's convert staple (sheet metal) into parts. And additionally die may be a tool to producing of components and part from flat solid. The Compound die, combination die, and progressive sorts of dies area unit created in production quickly. The die placed on a press. once the press moves upward direction and die is opened. because the press is captive down and die is closed. The flat solid move through die that is open and fed into the die a particular quantity with every press The die may be a closed along, the die performed work on the metal and end components area unit ejected from the die. The die flat solid operation such how like as punching, bending and coining. Die secret is product of alloy steel to resist high shock load, sharp cutting of edge and resist the abrasive forces involves.

Our project style die pictures area unit below:

Die no 1



Die no 2







V. REFERENCES

1. Rahul A. Patil, Design of Die for Industrial Part, ResearchGate march 2018, pp. 140.

2. Pritam B. bhawar, Shubhangi A Dongare,Shubham R Bhamare, Design and Manufacturing of Progressive Die Design of Die for Industrial Part, IJNTR, april 2017, pp. 81-82.

3. Gaurav C. Rathod, Dr. D. N. Raut., Study and Analysis of Press Tool Design, IJERT, July 2017, pp. 40-43. 4. A. K. Chitale and R. C. Gupta, Product design and manufacturing,6th edition 2013,pp. 334-336.

5. Karl T. Ulrich, Steven D. Eppinger, Anita. Goyal, Product design and development, 13th edition 2015, pp. 97-99.

6. P.C. Sharma, S. Chand, Production engineering, 1st edition 1982,pp. 69-78.

7. Zone-Ching Lin, An investigation of an expert system for sheet-metal bending design, JMPT, Vol. 4 Issue 1, October 19994, pp. 165-176

8. Satyandra k gupta, sheet metal bending: part families for generating shared press-break setup, JMS, Vol. 2, issue 3, march 2002, pp. 329-350

9. Apurv Kumar et. al. design of dies in V- bending using finite element simulation IJRCT, vol. 1, issue 1, Dec. 2004 pp. 202-210

10. Vivek D. Bharad et. al. design and analysis of progressive die for an industrial part IJSR, vol. 6 issue 3, Oct. 2011 pp. 110-121

11. Ketan kapse, ajinkya jadhav Design of blanking die for stiffening rib: A case study IJRSET Vol.6,Issue 2, February 2017, pp. 1725-1735