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Design And Analysis Of Secondary Up setter Die To Correct Under filling Problem For Forged Front Axle Beam

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ABSTRACT

In recent industrial world there is a growing demand for more efficient and economic manufacturing process to improve product quality, reduce production cost, reduce lead time and increase productivity. Forging gives strength to components hence it is widely used in the industries. Forging process is divided into cold and hot forging. Hot Forging is done with the help of close die and open die forging, out of which close die forging is most commonly used. Hammer and Upsetter machines are used in closed die forging, in which several problems observed such as mismatch, crack, underfill, caving, dent mark, scalepit. Out of these underfill is one of the major problem, which damages the job permanently. Underfill occurs in process due to improper ventilation, sticking and dies wear out problem. Front axle beam is one of the most important component in automobile. Front axle beam is manufactured on hammer machine and underfill problems observed frequently on this machine. Die design optimization with computer simulation has certain benefits compared to the conventional methods like trial and error. Simulation software has been used for process optimization of forge components. Utilization of such tools reduces iterative and time consuming approach by minimizing the design parameters and cutting material weight. Iterative and time consuming approaches can be reduced by varying design parameters and billet size in simulation tool. Commercially available software FORGE11 is used for the purpose of finite element method simulation of front axle beam forging. In this 3D models of dies and preform shapes are generated and imported to FORGE11 software for simulation. The simulation trial suggests us the modifications required in the die design. This paper describes solution to resolve underfill problem in front axle beam by using simulation of dies.

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I. INTRODUCTION

Front axle is the one of the most important safety parts, and it is also the biggest and most heavy forging parts in Automobile, which request front axle to higher strength and fatigue strength. The parts are complex shape, symmetrical shapes, but big section fluctuate, especially the steel position and stopper position, its cross-section is not only deep but narrow, and it is one of the most difficulty long shaft type forging.

In forging the material is deformed applying either impact load or gradual load. Based on the type of loading, forging is classified as hammer forging or press forging. Hammer forging involves impact load, while press forging involves gradual loads. Based on the nature of material flow and constraint on flow by the die/punch, forging is classified as open die forging, impression die forging and flashless forging. Open die forging: In this, the work piece is compressed between two platens. There is no constraint to material flow in lateral direction. Upsetting is an open die forging in which the billet is subjected to lateral flow by the flat die and punch. Due to friction the material flow across the thickness is non uniform. Material adjacent to the die gets restrained from flowing, whereas, the material at center flows freely. This causes a phenomenon called barreling in upset forging.

Impression die forging both die and punch have impressions, shapes which are imparted onto the work piece.

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There is more constrained flow in this process. Moreover, the excess metal flows out of the cavity, forming flash. Flashless forging – in this the work piece is totally constrained to move within die cavity. No excess material and hence no flash forms. Flashless forging involves high level of accuracy. Designs of shape of die cavity, finished product volume are important. Following are the types of forgings, which are as follows [1-3].

I. Open die forging-

In open die forging a cylindrical billet is subjected to upsetting between a pair of flat dies or platens. Under frictionless homogeneous deformation, the height of the cylinder is reduced and its diameter is increased. Forging of shafts, disks, rings etc are performed using open die forging technique. Square cast ingots are converted into round shape by this process. Open die forging is classified into three main types, namely, cogging, fullering and edging. Fullering and Edging operations are done to reduce the cross section using convex shaped or concave shaped dies. Material gets distributed and hence gets elongated and reduction in thickness happens. Cogging operation involves sequence of compressions on cast ingots to reduce thickness and lengthen them into blooms or billets. Flat or contoured dies are used. Swaging is carried out using a pair of concave dies to obtain bars of smaller diameter.

II. Closed die forging-

It is also known as impression die forging. Impressions are made in a pair of dies. These impressions are transferred to the work piece during deformation. A small gap between the dies called flash gutter is provided so that the excess metal can flow into the gutter and form a flash. Flash has got a very important role during deformation of the work piece inside the die cavity. Due to high length to thickness ratio of the flash gutter, friction in the gap is very high. Due to this the material in the flash gap is subjected to high pressure. There is high resistance to flow. This in turn promotes effective filling of the die cavity. In hot forging, the flash cools faster as a result of it being smaller in size. This enhances the resistance of the flash material to deformation resistance. As a result of this, the bulk of work piece is forced to deform and fill the die cavity more effectively – even intricate parts of the die cavity are filled.

Flash is subsequently trimmed off in order to obtain the required dimension on the forged part. Often multiple steps are required in closed die forging. Flash is to be properly designed so that the metal could flow and fill the intricate parts of the die cavity. A thin flash with larger width requires higher forging loads. Before getting forged to intermediate shape inside the primary die set called blocking die, the billet is fullered and edged. This is called preforming. Subsequently, it is forged to final shape and dimensions in the finishing die. Closer dimensional accuracy is possible in closed die forging. However, higher forging loads are required. Parts with wider and thinner ribs, or webs are difficult to forge as they require higher forming loads. Impression dies are usually provided with taper called draft of 5o in order to facilitate easy removal of the finished part. Die preheating may be required to prevent the die chilling effect which may increase the flow stress on the periphery of the billet. As a result, incomplete filling or cracking of the preform may occur.

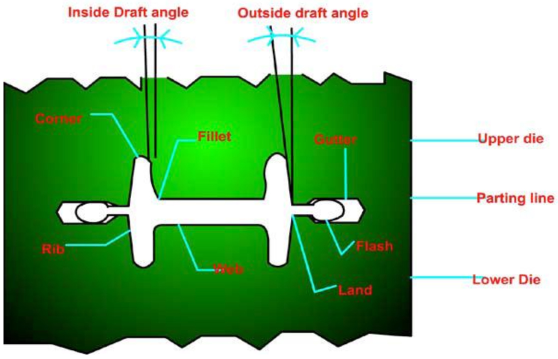

Fig. 1 Parameters of impression die forging

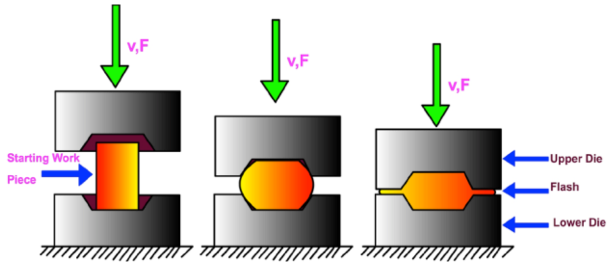

Fig. 2 Stages of closed die forging process

Secondary die is the different from the primary one which is using for forging of front axle beam. Secondary die are using for to eliminate the under fill problem. Upsetter is the machine which is different from Hammer. In upsetter we can use only round material for forging. Upsetter is having fixed die, moving die and holder which contain punch. In upsetter, there may be 2 pass, 3 pass, 4 pass or 5 pass in die. Application of this upsetter is we can forge job which is having the impression on the front side of cutting material. That is, we forged material which is having space to locate tong on one end of material during forging.

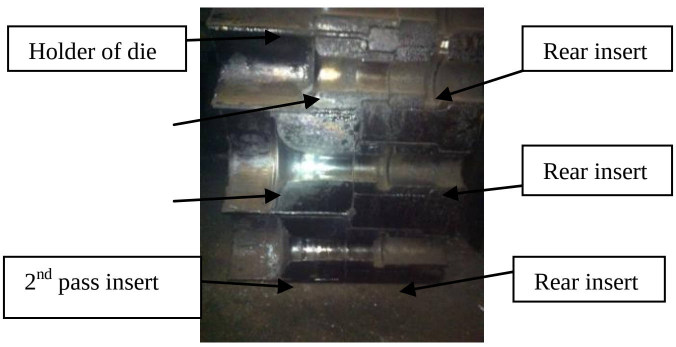

Fig. 3 Upsetter die

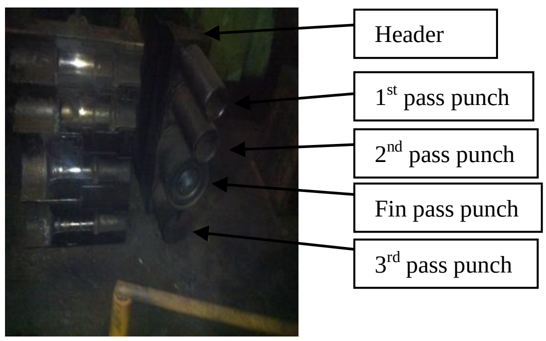

Fig. 4 Upsetter die and header

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II. SPECIFICATION OF FRONT AXLE BEAM

Tata motors used this front axle beam in his 207 vehicle, whose specification is as follows.

Sr No	Parameters	Value
1.	Material	40Cr4TYPE B
2.	Weight (Kg)	28.80
3.	Total length (mm)	1370.0
4.	Pad thickness	15.0

Fig. 5 Front axle beam

III. MODEL BUILDING

The geometric model of spring is created in Unigraphics NX software.

Following are the general step has been followed while creating the CAD model;

- Draw sketch of semi-elliptical curve
- Draw sketches of variable cross section at specified points.
- Insert swept along the curve through variable cross-section.
- Unite the parts.
- Draw sketch of eye ends.
- Extrude the sketch of eye ends.
- Export file to IGES format.

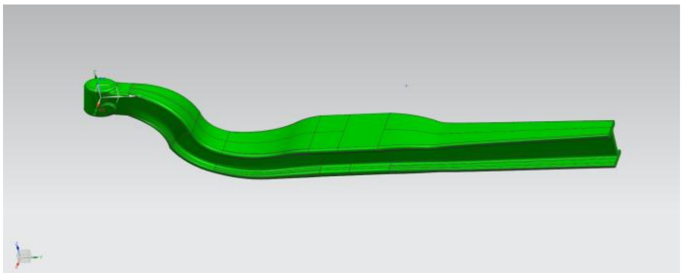

Fig. 6 Model of Front axle beam

To understand that underfill problem on front axle beam we created a upsetter die model for simulation, after simulation we understand that what parameters is to be controlled to solved the underfilling problem of forged front axle beam.

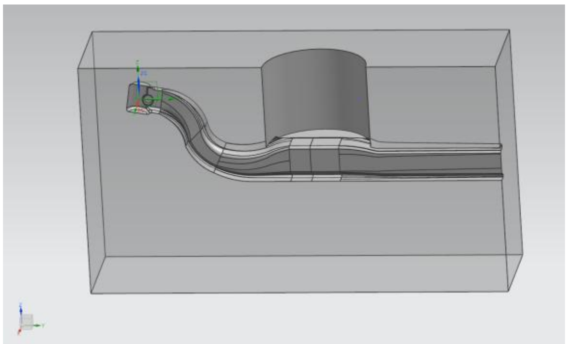

Fig. 6 Upsetter dies Model of Front axle beam

IV. MODEL SIMULATION OF UPSETTER DIE

In this simulation we will get the solution for underfill problem.

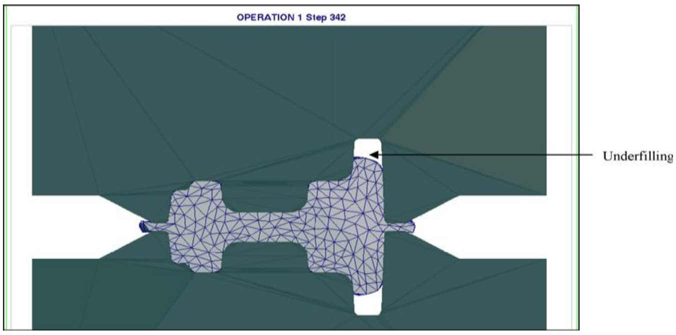

Fig. 6 Upsetter die simulation 1

In above figure 6, it shows that underfill occur in die which is not accepted. Again we simulation of dies done to get job completely filled.

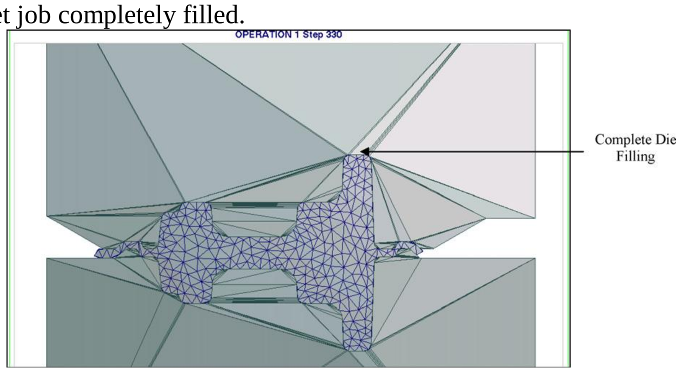

Fig. 7 Upsetter die simulation 2

In figure 7 we get completely filled by using simulation of dies. In this material is heated at 1150 Degree celcious and pressed at pad thickness to get completely filled.

V. CONCLUDING REMARK

UNDERFILL PROBLEM IS ONE OF THE MAJOR PROBLEM IN FORGING. THIS IS ONE OF THE DIFFERENT METHODS FOR CORRECTING UNDERFILL PROBLEM OF FRONT AXLE BEAM WITH THE HELP OF UPSETTER DIE. WE ARE DESIGNING A NEW DIE FOR REWORK OF FORGED FRONT AXLE BEAM ON UPSETTER MACHINE, WHICH IS DIFFERENT THAN FORGING DIE OF FRONT AXLE BEAM. THAT REGULAR DIE IS USED IN

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HAMMER MACHINE. WITH THE HELP OF THIS UPSETTER DIE THE REJECTION FOR FRONT AXLE BEAM FOR UNDERFILL PROBLEM WILL BE 0 TO 1%.

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