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Design of a Drilling Fixture for Nylon-66 33% Glass Filled, Automobile Component to Produce an Internal Hole

Sowrabh Kugunavar*
M.Tech in Tool engineering
GT&TC-Mysore, India

L.G Sannamani
Dept of PG Studies
GT&TC-Mysore, India

Abstract:- Certain polymers are reinforced with glass fibres, carbon fibres and other additives in order to enhance their properties. The enhancement in the mechanical properties of any polymer will tend to a favourable condition of its machinability like any other alloys. This article focuses on the design of drilling fixture to produce a recess that is an internal feature, that could not be incorporated in the injection moulding tool. To design any fixture there are fundamental concepts that are to be followed, but to avoid the error in dimensions or in the tolerances or the design itself, computer aided fixture design is one of the best ways to develop the fixtures. This allows the manufacturers to virtually simulate, minimize errors and ensure human safety as well.

Keywords:- *Design, Drilling Fixture, Nylon-66, Virtually Simulate, Injection Moulding, Fool-Proofing, Fits.*

I. INTRODUCTION

In the fast-growing material science and technology, the materials used in engineering application are myriad. The various materials used may be metals, alloys, aerogels, composite materials polymers etc… Each of these materials have different manufacturing technologies involved to convert the raw materials into finished products. It is no longer a myth that even plastics can be machined like any other metals or alloys. Composites are the mixture of various materials such as polymer, glass fibres, carbon fibres and other filler materials[1]. Polymers are reinforced with glass fibres to enhance their strength and other mechanical thermal and chemical properties for their application. In this article one such material specified is nylon 66 with 33% glass filled for an automobile application.

The component is majorly manufactured with the plastic injection moulding process. With the complexity of the part design an internal feature could not be incorporated within the injection moulding tool. Therefore, it had to be processed with a traditional machining method. In this article drilling fixture for the component material polyamide 66 with 33% glass filled polymer is designed. Fixtures are the work holding devices, they are necessary for any machining operation in order to locate the workpiece at at the desired location[2].

Studies show that 40% of the parts that are rejected is due to the poor fixture design. The problem when addressed, has a stronger desire towards computer aided fixture design for the better quality of the fixtures with respect to its dimensioning and tolerances[3].

II. METHODOLOGY

The design the fixture involves following steps.

- The first step is to study the component or the part.
- The clamping technique must be incorporated such that the forces acting on the component by clamps do not damage the part.
- Care must be taken about the loading of the component as well as unloading of the component.
- The fixture assembly must be able to withstand the cutting forces generated during the machining operation.
- Provision must be made for the chip removal.
- There must be a precise relation between the cutter and the component location[4].
- Fastening of fixture must be taken care to mount the fixture to the machine table.
- The design must be fool-proofing.

III. FIXTURE DESIGN

A. The component model is as shown in the *fig. 1.* The component is studied and can be inferred that the machining operation to be performed is drilling 2mm diameter hole to a depth of 3.1mm. it is also noted that there is a recess that exists on the surface of the component which cuts down the need of guiding bush for the drill bit to perform the drilling operation.

Fig 1:- CAD model of the component

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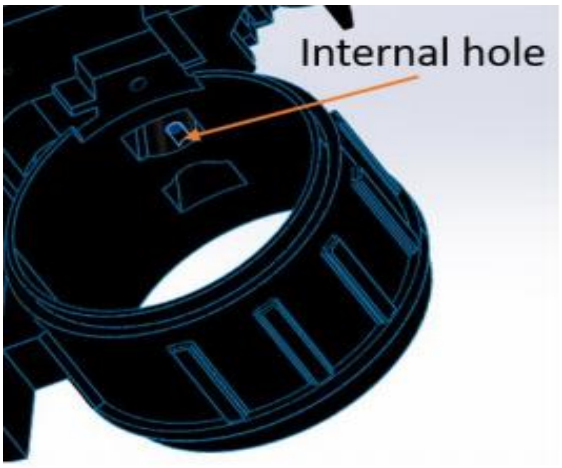

Fig 2:- Zoomed area, where the drilling operation has to be performed

B. The fixture does not require any external clamp to hold the component in position as the operation performed is vertical drilling, as well as the rotational motion of the component is arrested during the machining operation by the hardened locating pin therefore, the locating pin arrests the degree of freedom (rotational motion) and locate the part by making it fool-proof. The locating pin is as shown in the *Fig. 3*.

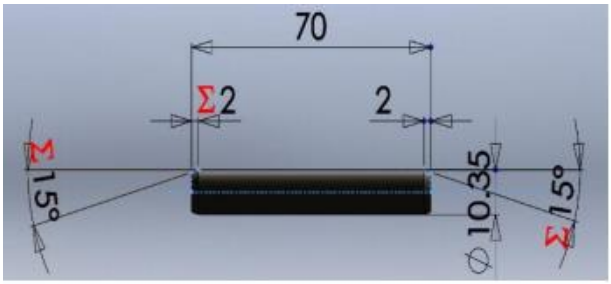

Fig 3:- Locating pin with dimension

C. The fixture assembly consists of main base plate on which the other parts are assembled, cylindrical base and locating pin. The main base is 250x150x15mm overall dimension made of Mild steel material as shown in the figure *fig. 4.*

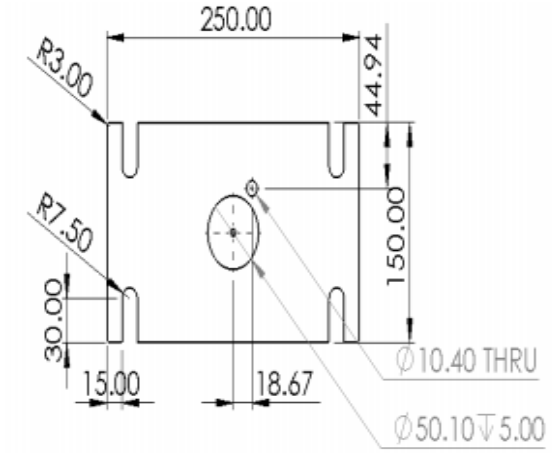

Fig 4:- Detailed view of main base plate

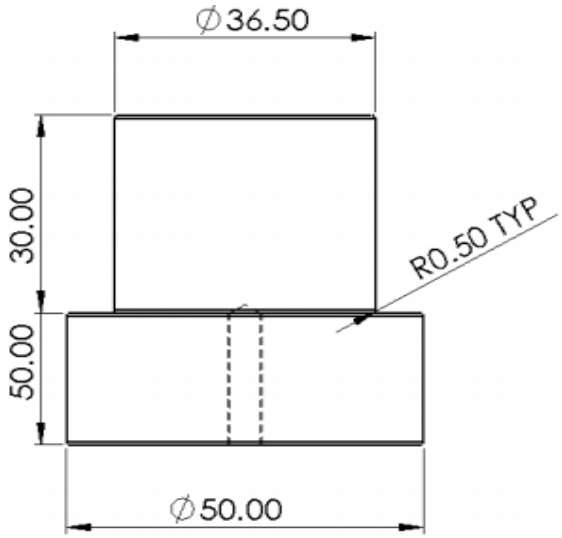

Fig 5:- Detailed view of cylindrical base

D. The cylindrical base is fastened at 5mm depth of the main base centre. The component is slid on the circumference of the cylindrical base with respect to the locating pin's position. This base is as shown in the *Fig. 5*. Care is taken that one of the faces of the component is parallel to the main base, when the component is placed in position, it can be witnessed in the *Fig. 6.*

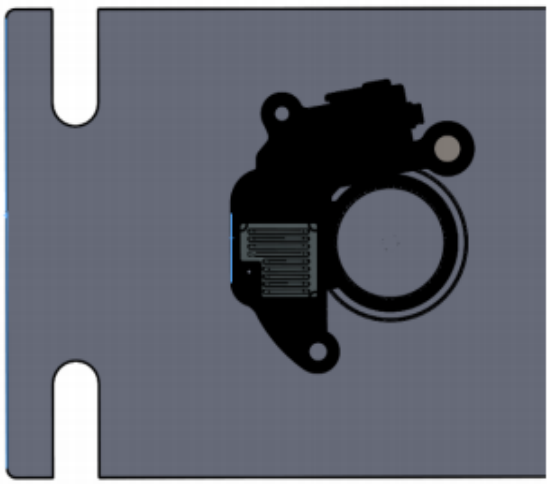

Fig 6:- Parallel faces

E. Various views of the fixture assembly with the part positioned is as shown in the *Fig. 7, Fig. 8 and Fig. 9.* For precision the locating pin's dimension is maintained to press fit (H7p6) with respect to the hole made in the base plate. The fit between the cylindrical base circumference and the component (inner circumference) is sliding fit(H7g6).

The base plate is provided with oblongs to mount the fixture assembly on to the machine bed.

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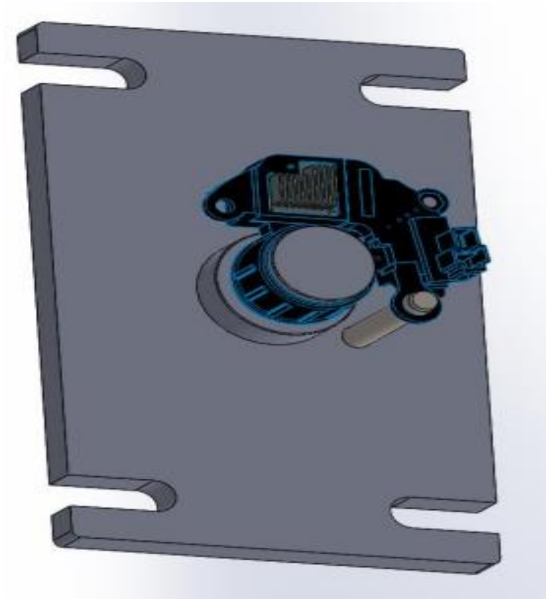

Fig 7:- Fixture assembly view (a)

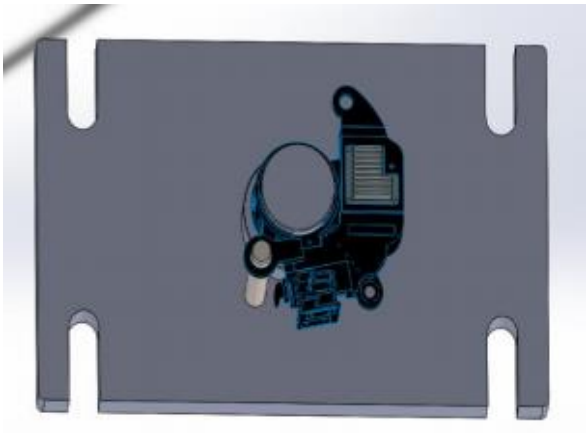

Fig 8:- Fixture assembly view (b)

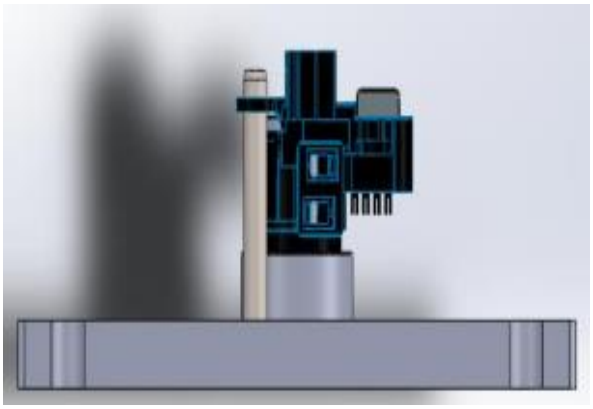

Fig 9:- Fixture assembly view (c)

IV. CONCLUSION

The drilling fixture for the nylon 66 reinforced with 33% glass fibre component is designed by considering the fundamental concepts of fixture design. After the drilling operation is completed the component is removed from the fixture and the swarf is blown away with the help of safety air gun.

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