



Implementation of designed jigs and fixtures for hand operated press in production of mainframe for paddy-weeder

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Abstract

The main purpose of paddy weeder is to dislocate the weeds present in paddy fields. The operation, when done manually causes drudgery in workers, which in turn reduces their efficiency in fields. Paddy weeder proved to be efficient enough to perform the work manually with less efforts & time consumed. The product was being manufactured by traditional methods, i.e. without implementation of jigs & fixtures. The paper presents a procedure for inclusion of designed & developed jigs and fixtures in the production of paddy weeder, and hence fulfills the need of mass production. The designed jigs proved quite efficient & were helpful in reduction of 50 % in welding operations performed. Hence, it is helpful in enabling mass production.

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1. Introduction

Weeds are the plants which grow, in a region where they are not desired. Paddy weeder is agricultural equipment used to remove weeds from a desired area. One of the major laborious and time consuming operations in rice cultivation is weeding. The concept of weed control is as old as agriculture itself. The global figure for crop yield loss is accepted as 10% of actual yield [1]. To get the full benefit of mechanization it is very necessary to use proper weeding implements, which will reduce drudgery and cost of cultivation [2]. Study was conducted by [3] to evaluate and compare the inputs of manual energy only and manual-cum-mechanical energy in the production of ground-nuts. Study revealed that weeding had the most energy requirement (45% and 52% of the mean total energy inputs) in ground-nut cultivation. The human labour output capacity is increased by 8 – 10 times in weeding by the use of mechanical weeder [4].

Jig is a special tool used for locating and firmly holding work piece in the proper position during the manufacturing or assembly operation. It also guides the tool or work piece during the operation. Jig is designed to increase the productivity of operation assisting worker to do job easier, faster and more comfortable [5]. Fixtures are mechanism used to rapidly, accurately, and securely position workpiece

during machining such that all machined parts fall within the design specifications. This accuracy facilitates the interchangeability of parts. The goal of research was to find appropriate systematic approach to quality improvement in the production preparation, within the frame of metal production. Starting from the main principles and methodologies of manufacturing process quality improvement, in the paper are identified possibilities of integration of methods and tools in an operational model of quality improvement in the process of production preparation [6].

The implementation of power press into the production operation was not a feasible alternative, as the pressure developed by it would be way too much. As the desired outcome was just to get a bend of 90° on MS plates of 6mm thickness, its implementation would lead towards more time consumption in the process, with added quantity of scrap.

2. Problem Statement

Keeping an eye on the huge demand of the paddy weeder in the present scenario, and on the other hand workers presently operating without jigs and fixtures, the parts were welded using visual observations which resulted in in-accuracy in dimensions, and poor workmanship & lack of interchangeability. Jigs to serve for the sole purpose has been designed and developed at Faculty of Agricultural Engineering workshop. Mass production aims at high productivity to reduce unit cost and interchangeability to facilitate easy assembly. This necessitates production devices to increase the rate of manufacture and inspection device to speed-up inspection procedure. Nowadays new machine tools, high-performance cutting tools, and modern manufacturing processes enable industries to produce parts faster and better than ever before. To counterbalance the need and production, implementation of jigs and fixtures in the production line is extremely important to produce good parts with low cost and high quality.

When changes in a manufacturing method are proposed, it is first necessary to assess the extent of the change. Similarly, in consideration of paddy weeder the change should be within the limits defined for the parameters of manufacturing process. In this case, since the whole process had been demonstrated to yield product that meets the design intent, change within the process can be allowed with no further process validation. Based on this evaluation, it was found that there were processes that need upgrading for enabling mass-production with less time consumed and material wastage with higher accuracy. Since there were a lot of parameters that needed the attention, hence the need to design the jigs for the processes emerged. Jig is one of the most important components in the processes for manufacturing precision parts in mass production. Both the material costs and manufacturing time will be decreased in many of the process involved in manufacturing steps, this means the cost of these steps would be reduced as a result as well.

3. Materials and Methods

Considerations while designing jigs and fixtures

Designing of jigs and fixtures depends upon so many factors. These factors are analyzed to get design inputs for jigs and fixtures. The list of such factors is mentioned below-

(a) Study of work piece and finished component size and geometry.

- (b) Type and capacity of the machine, its extent of automation.
- (c) Provision of locating devices in the machine.
- (d) Available clamping arrangements in the machine.
- (e) Available indexing devices, their accuracy.
- (f) Evaluation of variability in the performance results of the machine.
- (g) Rigidity and of the machine tool under consideration.
- (h) Study of ejecting devices, safety devices, etc.
- (i) Required level of the accuracy in the work and quality to be produced.

Main-frame

The main frame of the paddy weeder consists of two metal plates of 205mm each, one plate of 125mm, are weld together at 90⁰ (Fig. 1).



Fig. 1: Frame manufactured traditionally.

A different metal plate is taken with dimensions 405mm, and was bent with the help of a handmade fixture (Fig.2). The part is called float, as it skids over the fields so as to facilitate proper working of equipment.



Fig. 2 Hand-made jig for bending float

Table 1 shows the amount of welding operations being performed, while manufacturing the equipment's frame traditionally.

Table 1: Welding operation for traditional method

S. No.	Name of part	No. of welding operations
1	Weeder frame	02
2	Joining frame with float	02
	Total	04

Design of jigs & fixtures

To facilitate the fast manufacturing process for the production, jigs and fixtures were designed on designing software solid works 2012.

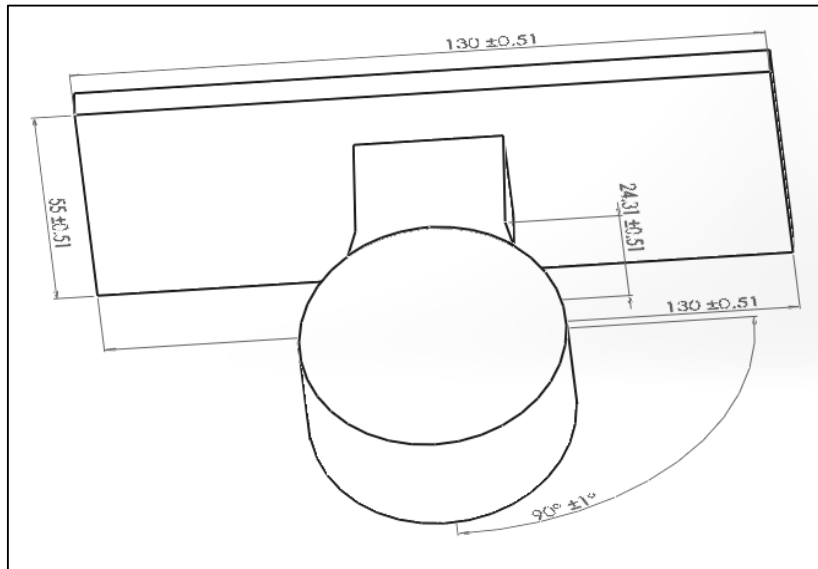


Fig.3(a) Fixture be fixed on bending machine

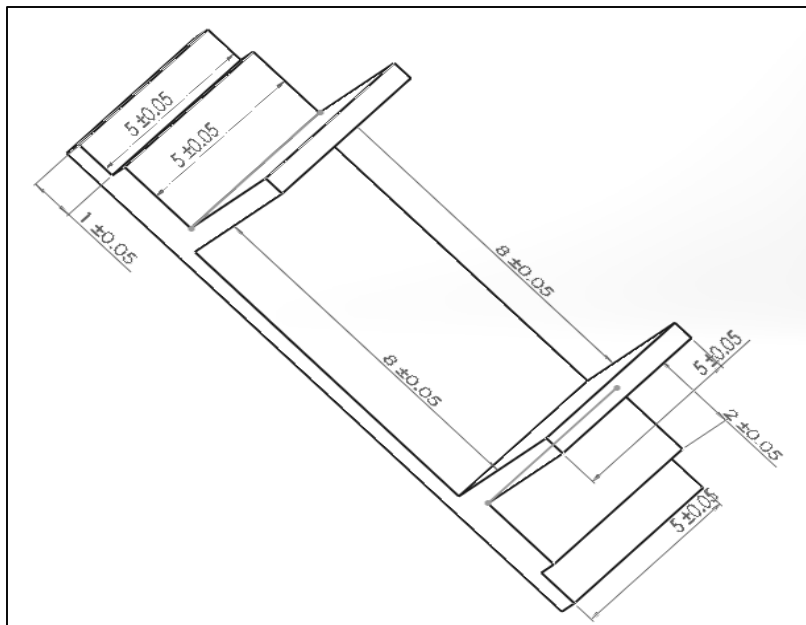


Fig. 3 (b) Jig for bending float

For bending float, set of jigs & fixtures were developed to facilitate the bending of float, the MS plates cut after the marking operation were placed on the elevated corners (Fig. 3(a)) and the other fixture was made to be fixed on the bending machine (Fig. 3(b)), with the help of nuts and bolts.

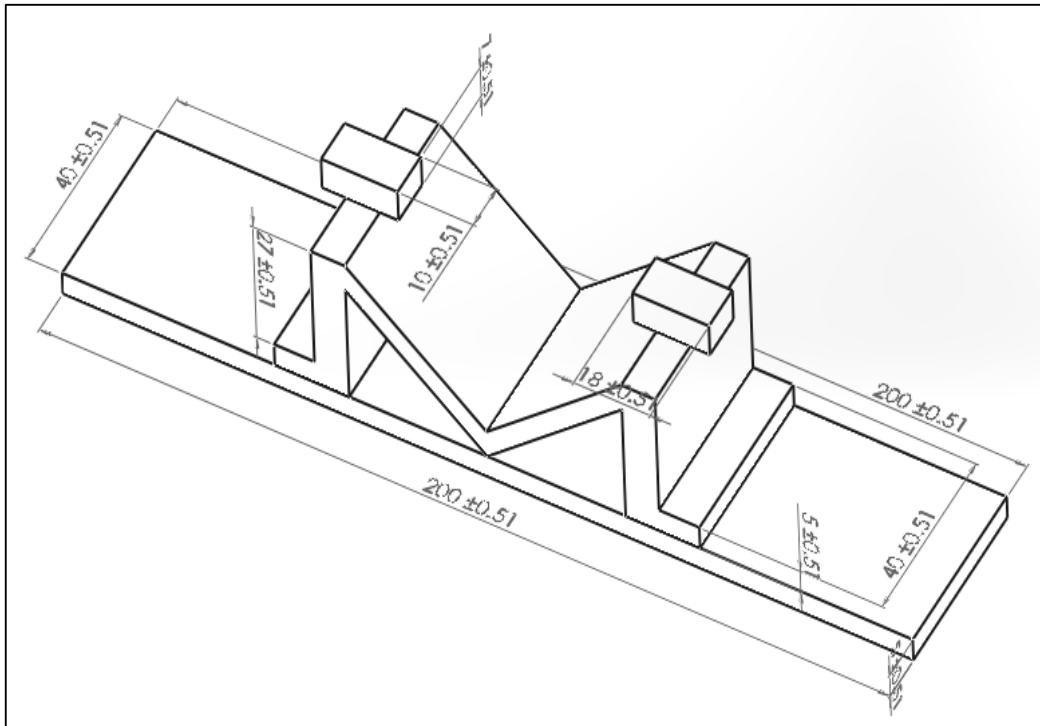


Fig. 4: Designed jig for bending at right angles.

A solution was needed for replacing welding with the bending operation and hence a jig was designed to serve for this purpose. The plates were bent with the help of a set of jigs and fixtures, plates were placed on the elevated surface (Fig. 4), and were pressed with the help of bending machine and hence creating a bend of 90° , and eliminating the need of welding operation to remarkable extent.

4. Results and Discussion

Hand operated press

The jigs and fixtures designed for the weeder were developed and were made to serve the sole purpose of reducing the time consumed in the production with less efforts to be laid for operations (Fig. 5). Hand operated press was used instead of power press, to reduce the complexity of operation and to ensure the mobility of operation.



Fig. 5 Hand operated press

Developed jigs & fixtures

The purpose of designing a jig for paddy weeder was to eliminate the time consumption in process and increase the quality of the product. The jig and fixture designed for bending the float was hence developed (Fig.6 & 7) in accordance with the design produced.



Fig. 6 Developed fixture for bending the float



Fig. 7 Developed jig for bending float.

The jig and fixture developed for producing frame (Fig.8) with minimum number of welding operations involved, desired the plates to be bent at an angle of 90° .



Fig. 8 Developed jig for bending plates

Fig.9 shows the jig and fixture setup on the bending machine, which uses mechanical force to create bends. The jigs were designed so as to reduce the welding operation.



Fig. 9 Set of jig & fixture for manufacturing frame

The new developed jigs and equipments helped in reducing the number of welding operations to half, i.e. two (Fig.10)



Fig. 10 Frame manufactured by jigs & fixtures

5. Conclusion

The developed jigs & fixtures according to the designs generated, proved helpful in reducing the time elapsed in manufacturing by reducing the number of times an operation was being performed to achieve the goal. The reduction in operations to half, proved helpful in reducing the time consumed in manufacturing operation. Hence, the goal of enabling mass-production was achieved.

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