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# A STUDY ON ADVANCED OPTIMIZATION TECHNIQUES USED TO OPTIMIZE JIGS FOR VARIOUS APPLICATIONS

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**Abstract:**
Tool configuration is the way toward designing and developing the tools, strategies, and procedures important to enhance fabricating efficiency and productivity. The principle targets of hardware configuration are to bring down the assembling cost while keeping up the quality and expanded creation by chopping down time between machining operations. Different parameters that structures the fundamental standard in the apparatus configuration are giving straightforward, simple to-work devices for greatest proficiency, lessening of assembling costs by delivering parts at the most reduced conceivable cost, plan of Tools which reliably create parts of high caliber, expanding the rate of generation with existing machine devices, outline of hardware to influence it to trick proof and avoid uncalled for utilize, determination of materials that will give satisfactory device life Tooling alludes to the equipment important to deliver a specific segment. Tooling comprises of an immense range of cutting gadgets, dances, apparatuses, jigs, fixtures, dies and gauges utilized as a part of typical generation. A unique endeavour has been made to build up a flexible kind of penetrate shrub, which can improve for the holding of work piece with variable measurement.
**KEYWORDS**: Tool Design, jig and fixture.

## 1.0 Introduction:

Jigging is a procedure of metal focus did in any liquid whose viability relies upon contrasts in particular gravity of granular mineral particles. It comprises of partition of the particles into layers of various particular gravities took after by the expulsion of the isolated layers. Jig fixation is not the same as different sorts of gravity focus, for example, substantial media division, where the partition is done specifically. Stratification of bed particles in a Jig focus is accomplished bit by bit, and the partition into items is acknowledged after a specific time.Many of the jigging factors are inherently controllable (manipulated variables), but some uncontrollable factors (disturbance variables) associated with the ore to be treated also play an important role in the separation process. The basic factors that affect on jig performance were reviewedA jig, however, guides the cutting tool. A fixture references the cutting tool. The differentiation between these types of work holders is in their relation to the cutting tool.

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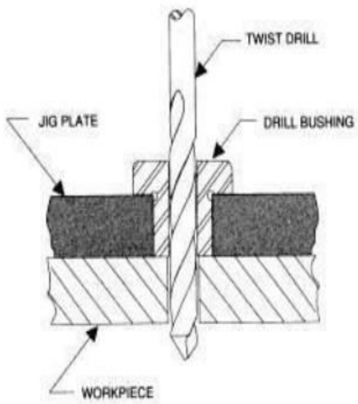


Jigs are the most-widely used form of ig. Drill jigs are used for drilling, tapping, reaming, chamfering, counter boring, countersinking, and similar operations. Jigs are further identified by their basic construction. The two common forms of jigs are open and closed. Open jigs carry out operations on only one, or sometimes two, sides of a work piece

## STATEMENT OF PROBLEM:

To design single sided expanding component to hold workpiece for machining on VMC with 4th axis( Rotary table with face plate support). Material of the workpiece is Aluminum Die Casting Alloy. The operations to be carried out are drilling and tapping. The fixture is rotary (4 axis) which is to be used with VMC machine. As shown in the **Error! Reference source not found.**, the reference dimension of the internal hole is 23.875 mm with symmetric tolerance of 0.125 mm. This diameter is to be used to hold the workpiece using expanding component. Thus the component should hold the workpiece using this hole with consideration of the tolerance. Operations to be carried out are drilling and tapping on two sides of the workpiece as shown in **Error! Reference source not found** and **Error!**

## SCOPE OF THE WORK:

It is only used for small size components. Forces causing deflection may come from handling. Initial investment is high. There is no special way to remove the chips produced by drilling, so it requires separate time also time consumption while changing the diameter of the drill bit.

## OBJECTIVES:

- High-performance, accurate and long lasting components represent a crucial ingredient of a well-functioning, reliable fixture
- A 3D model has been created and a solution for fixture placements was selected.
- By creating a modular fixture costs have been saved and production cycle improved.
- Next step is machining simulation and its optimization.

## 2.LITERATURE REVIEW:

- **M.Janardhan et al. [1]** proposed that in cylindrical grinding metal removal rate and surface finish are the important responses. The Experiments were conducted on CNC cylindrical grinding machine using EN8 material (BHN-30- 35) and he found that the feed rate played vital role on responses surface roughness and metal removal rate than other process parameters
- **M.A. Kamely et al. [2]** have been developed a mathematical model of the surface roughness by using response surface methodology

(RSM) in grinding of AISI D2 cold work tool steels.

- **M.N. Dhavlikar et al. [3]** have done a project on Combined Taguchi and dual response method for optimization of a centerless operation. This paper presents a successful application of combined Taguchi and dual response methodology to determine robust condition for minimization of out of roundness error of work pieces for center less grinding operation. From the confirmation runs, it was observed that this approach led to successful identification of optimum process parameter values. The application of combined Taguchi and dual response methodology has resulted in a solution, which has led to almost zero defect situation for the centerless grinding process.
- **S. Shaji et al. [4]** studied with the analysis of the process parameters such as speed, feed, infeed and mode of dressing as influential factors, on the force components and surface finish developed based on Taguchi's experimental design methods. Taguchi's tools such as orthogonal array, signal-tonoise ratio, factor effect analysis, ANOVA, etc. have been used for this purpose and an optimal condition has been found out. The results have been compared with the results obtained in the conventional coolant grinding. It has been observed that, with the graphite application, the tangential force and surface roughness are lower and normal force is higher compared to those in the conventional grinding.
- **Jae-Seob Kwak [5]** applied Taguchi and response surface methodologies for geometric error in surface grinding process. The effect of grinding parameters on the geometric error was evaluated and optimum grinding conditions for minimizing the geometric error were determined. A second-order response model for the geometric error was developed and the utilization of the response surface model was evaluated with constraints of the surface roughness and the material removal rate.
- **Suleyman Neseli et al [6]** applied combined response surface methodology (RSM) and Taguchi methodology (TM) to determine optimum parameters for minimum surface roughness (Ra) and vibration (Vb) in external cylindrical grinding.
- **Külekcý [7]** aims Analysis of process parameters for a surface Grinding process based on the Taguchi method. In this study the wheel speed (V), the rate of feed (F) and the depth of cut (D) were selected as variable parameters. Other process parameters were fixed.
- **Deepak Pal et al [8]** aims at Optimization of Grinding Parameters for Minimum Surface Roughness by Taguchi Parametric Optimization Technique. In this study, experiments are conducted on universal tool and cutter grinding

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machine with L9 Orthogonal array with input machining variables as work speed, grinding wheel grades and hardness of material.

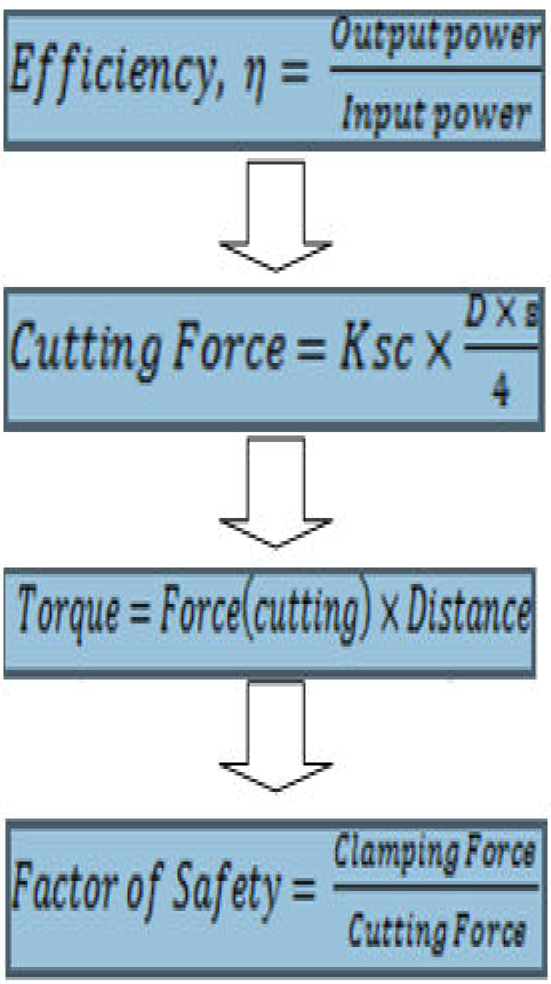
## 3.0 METHODOLOGY:

### ESSENTIAL FEATURES OF JIGS:

The jigs must satisfy the following condition:

- Reduction of Idle Time
- Provision for Coolant
- Hardened Surfaces
- Safety
- Fool Proof
- Indexing Type of Jig

**Chart of Calculations:**




Modelling of the component:

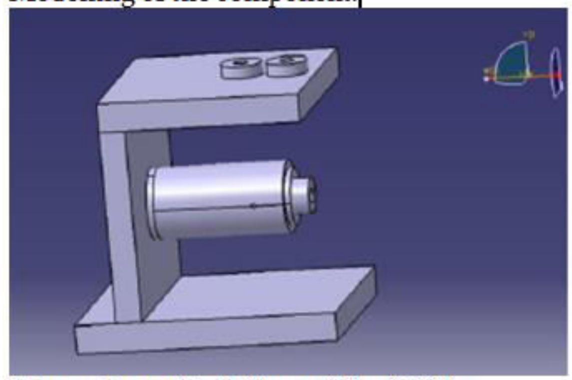
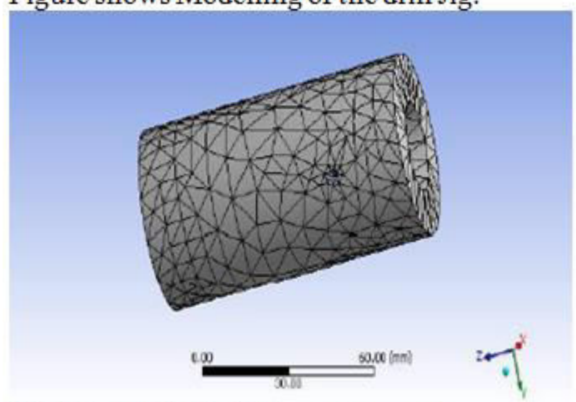
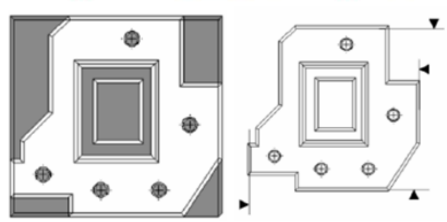


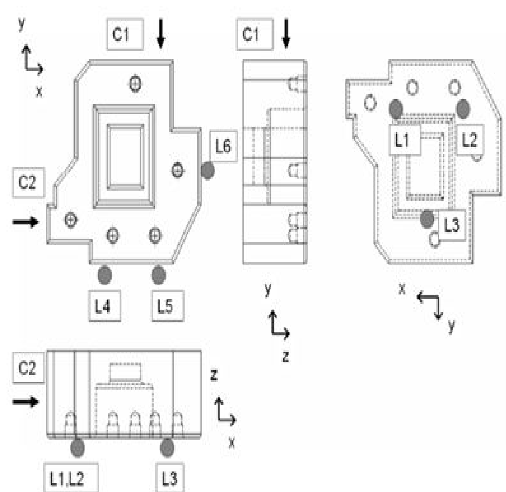
Figure shows Modelling of the drill Jig.




Meshing of the Drill Jig component



Work piece surfaces that are not machined are selected for positioning




Selection of ideal positions for locating and clamping

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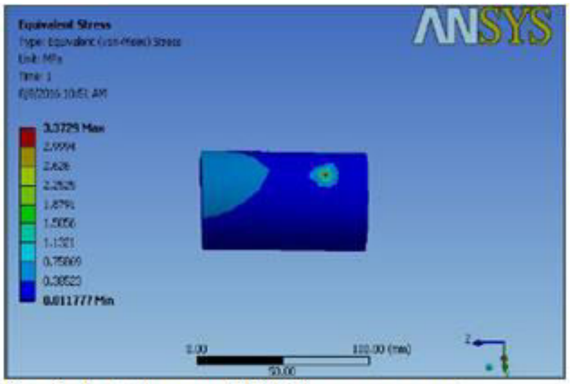
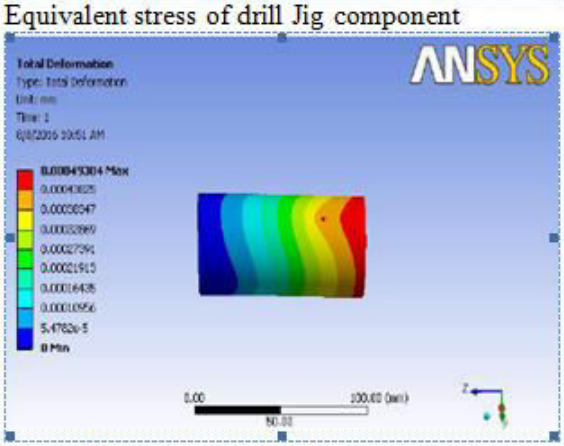
**Table shows the variables and levels factorial design for jigging process**

| Variables | Code | Low level(-1) | Base level(0) | High level(+) | Step size |
|---|---|---|---|---|---|
| Particle size (mm) | $X_1$ | 1.425 | 4.288 | 7.150 | 2.863 |
| Bed thickness (cm) | $X_2$ | 1.570 | 2.415 | 03.26 | 0.845 |
| Water level (cm) | $X_3$ | 03.10 | 4.175 | 05.25 | 1.075 |
| Number of strokes (rpm) | $X_4$ | 151.1 | 200.5 | 249.9 | 49.40 |

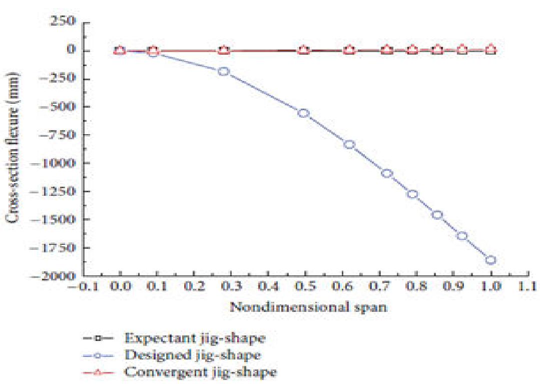
## 4.0 RESULTS AND DISCUSSION:



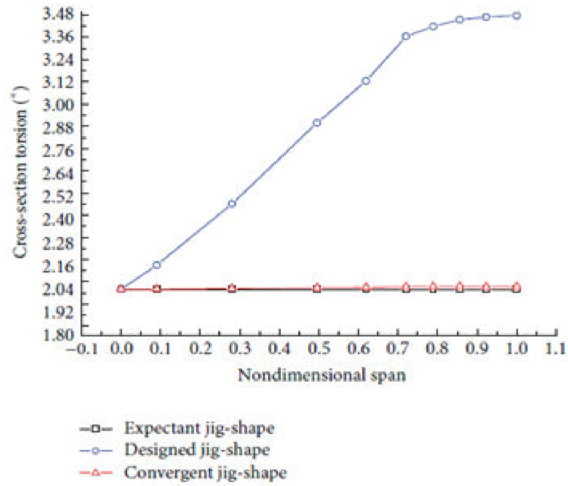
Equivalent stress of drill Jig component



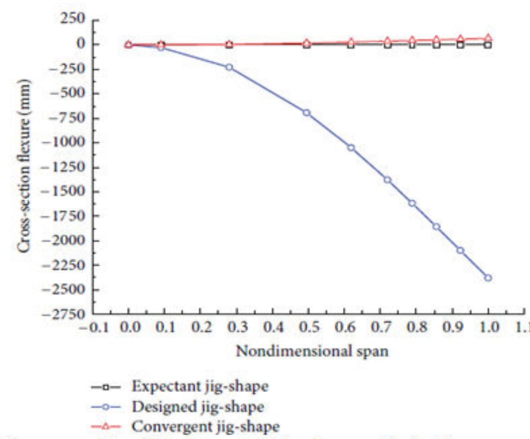
Total deformation of drill Jig component



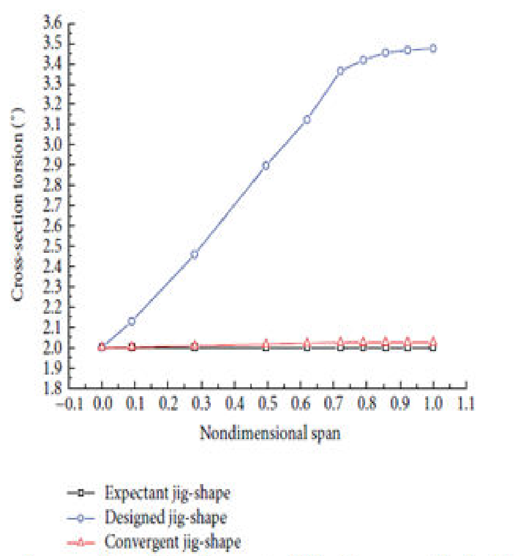
Independent flexure optimization results



Independent torsion optimization results



Flexure results of the integrated jig-shape optimization



Torsion results of the integrated jig-shape optimization

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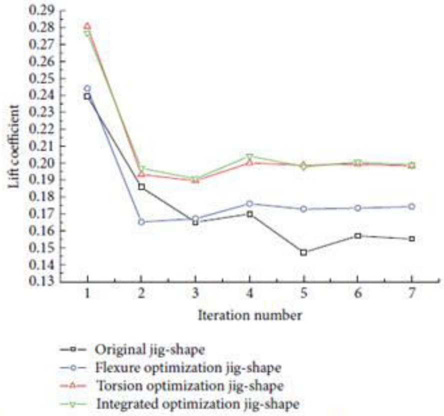
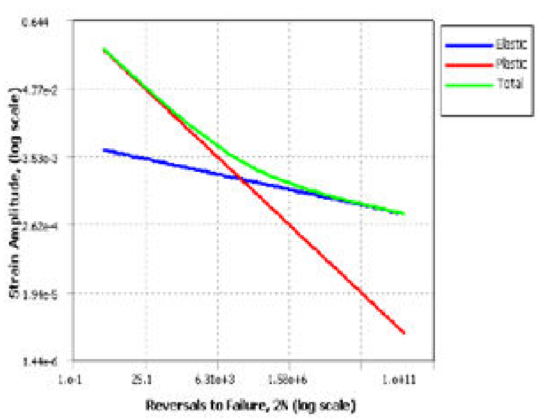
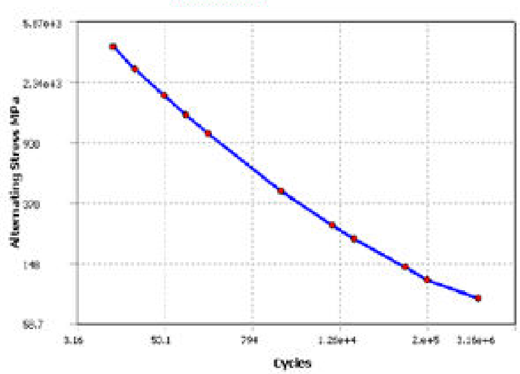



Lifts coefficient iterative processes of different jig-shape wings

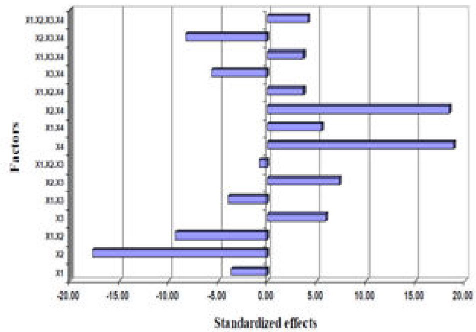
| Object Name | Equivalent Stress | Total Deformation |
|---|---|---|
| State | Solved | |
| Scope | | |
| Geometry | All Bodies | |
| Definition | | |
| Type | Equivalent (von-mises) Stress | Total Deformation |
| Display time | End time | |
| Results | | |
| Minimum | 1.77e-002 MPa | 0 mm |
| Maximum | 3.3729 Mpa | 4.9304e-004 mm |




Strain life of the mandril




Alternating Stress Cycle Behaviour of Mandrel




Pareto chart of the standardized effects for quartz recovery

## 5.0 CONCLUSION:

Report deals with the design and fabrication of drill jig and the detailed drawing of the component and assembly. The project carried out by us made an impressing task in drilling works. It is very useful industries for mass production of identical parts. Jigs are used to hold and locate the work piece that positions and guides or controls the cutting tool. In jigs, drill bush is used to guide the tool. In conventional jigs we can't change the diameter of drill bush. Main objective of this project is to vary the diameter of the drill bush based upon the application. Drill jig is used to ensure a hole to be drilled, tapped or reamed in the work piece at proper place. Jigs are generally used for mass production. Jig reduces operators fatigue and increases productivity. Jig consists of locating, clamping and tool guiding elements.

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