

FEA and Optimization of Boring Tool Adaptors

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Abstract:- Boring is the process of enlarging a hole that has already been drilled or cast by means of single point or multi point cutting tool. Boring is used to achieve greater accuracy of the diameter of holes and can be used to cut tapered holes. Because of the limitations on tooling design imposed by the fact that the work piece mostly surrounds the tool, boring is inherently somewhat more challenging than turning, in terms of decreased tool holding rigidly, increased clearance angle requirements. For this purpose boring adaptors are used in-order to adapt any size of the tool and obtain the accuracy.

Keywords:-- Boring adaptors, Drill Drift, Meshing structure, Deformation, Boring bars

I. INTRODUCTION

Boring operations involve rotating tools; these tools are employed to machine holes that have been prepared through methods such as castings, forgings, flame-cutting, extrusion etc. Roughing operations are performed to open up existing hole to within large tolerance and used usually to prepare for finishing. The very common size holes being bored are 30 to 100 mm diameter. Range of standard boring tools covers 23 to 550 mm for roughing and 3 to 975 mm for finishing. The maximum recommended depth of hole is four times the hole diameter. Various tools have specific maximum hole depths. For fine and rough boring of deeper holes of six times the diameter damped boring tools with tuned tool bodies should be employed.



Types of Boring:

There are various types of boring machines available. Boring bars may be supported on both ends or it may be supported to only with one end. Line boring indicates the former. Back boring is the process of reaching through an existing hole and then boring on back side of work piece.

There are two types of boring machines, each of which has several varieties that are the horizontal boring and turning mill, drilling machine and vertical boring.

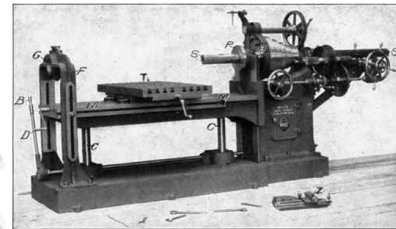


Figure2: Vertical boring machine

- ◆ Benefits of boring adaptor: .
- ◆ Production time can be minimized.
- ◆ Skilled labors not required.
- ◆ Rejection is controlled.
- ◆ In single boring adaptor multiple holes can be made.
- ◆ Cost of boring adaptor is less compared to other tools.

Drill drift

Drill Drift can Be overcome by using single point cutting tool. As shown Below Drill drift found in drills and reamers.

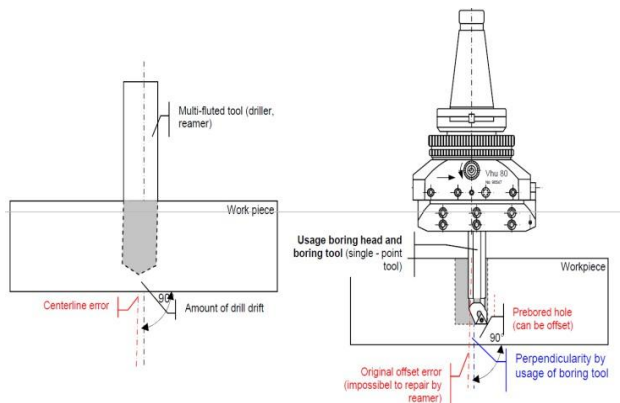


Figure 4: Drill drift operation

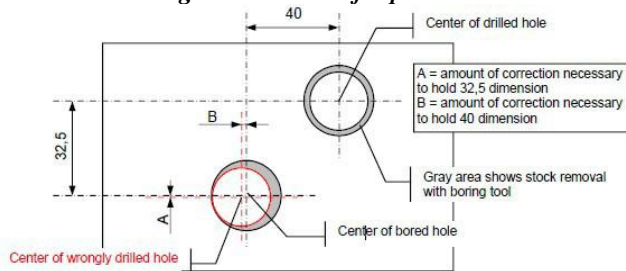


Figure 5: True position operations

True Position: A main benefit of using boring head is to have true position which will increase accuracy of bore. The above diagram shows true position operation by using boring tool.

II. LITERATURE SURVEY:

Manish Kale , D.A. Mahajan, S.Y.Gajjal has conducted study on “Design, Fabrication and analysis of special purpose machine for drilling and riveting operation. Most of manufacturing industries are going for automation to increase the productivity and to overcome shortage of labours . The main purpose of their project was to reduce cycle time by using drilling and riveting machines by attaching special purpose machines . Main concept is that the plate having different size and thickness are drill on drilling spindle first and then riveted on orbital riveting spindle. Both the operations are performed using same machine having two separate spindles. In their research paper they have covered detail information of design, fabrication and analysis of special purpose machine and compare the cycle time with conventional methods. Machine is containing automation by using pneumatic system. Modeling is done by using CAD software’s like Pro-E, Cero and analysis by FEA tool. From there study they found that the SPM is beneficial for mechanical work shop. Small scale industries can perform drilling and riveting using same machine

internally it reduces transportation and operation time and increase the efficiency. They also analyzed that by using conventional machining processes for making the hole 6 mm diameter in 8 to 10 mm thick plate. Time required for riveting and drilling operation is about 2 mins but using SPM, the time required is 1 min.

Table No 1

Descriptions	Conventional machines	SPM
Total time required for producing one job	120 seconds (2 mins)	65 sec
Job/Hour	30 Jobs/Hour	55 Jobs /Hour
Job/Hour	30 Jobs/Hour	55 Jobs /Hour
Jobs / Day	720 Jobs /day	1320 Job/Day
Jobs/ Month	21600 Jobs /Month	39600 Jobs /month
Jobs /Year	259200 Jobs/year	475200 Jobs /year

Amol Rabade and his team members have conducted study on “Design and Development of SPM for face milling and two hole boring of a CR-22 block”. Now a days special purpose machines are widely used for special kind of operations. These are not economical on conventional machines .It is designed for getting higher accuracy at desired condition. Through their study they have concluded that the SPM is fabricated and satisfactorily commissioned. Savings done due to use of advance manufacturing technique directly contributes to net profit of the product and to the company. The SPM is able to complete the 400 jobs per day. Hence it is successfully increases the production rate up to 5 times as compared to normal production. Also it has improved repeatability, less rejections, accuracy due to accurate automation. Use of SPM causes less human interaction drastic reduction in work load through SPM which helps in less operator figure. This in-turn reduces labour costs . Hence it increase production rate.[11]

Prof. P.R. Sawant and Mr. R.A.Barawade conducted study on design and development on SPM-A and they have prepared case study for the Multi drilling and tapping machine. They have made a comparison of components

using special purpose machine for drilling, tapping operations and conventional radial drilling machine. Through their study they have defined that special purpose machines used for 8 drilling operation, angular tapping operation and linear tapping operations. Following studies are carried out through their case study.

1. Time can be saved by component handling using hydraulic clamping
2. Productivity increases
3. Less manpower, reduction in operation fatigue
4. Rejection are less due to automatic control

V COMPANY PROFIT INCREASE.

At the end of paper they have concluded that Special Purpose Machine are in Continuous developing process and this type of machines are multi tasking machines. This is one of the new approaches to increase productivity of the any organization.

Methodology:

Aims and Objectives of the project.

- ◆ Preparing detailed 2D drawing as per the specifications.
- ◆ 3D modeling of the boring tool adaptor in solid works.
- ◆ Analysis of 3D model using solid work simulation.
- ◆ Interpretation & Optimization.

1st stage: The dimensions of Boring tool adaptor are finalized by the design.

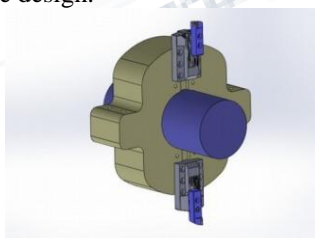


Figure6: Shows Model view of 3D Boring Tool Adaptor

2nd Stage Taking the dimensions from the AutoCAD model the boring tool Adaptor is modeled in Solid Works. Material properties such as modulus of elasticity, Density independent of geometry. Property may be linear, nonlinear, isotropic, anisotropic, etc. For this analysis the material properties are isotropic. Specifications are given below:

Material used for manufacturing the machine: Structural Steel

3rd Stage:- Structural analysis: Application of load and boundary conditions is very important aspect and also difficult task for the designer. For this purpose understanding the problem Is very much necessary.

Density: 7300Kg/m³

The boundary conditions (or the constraints) applied for Boring Tool Adaptor. The maximum load available on the Boring Tool Adaptor is 2982.2N is made to act on the Boring Tool Adaptor and Structural analysis is carried out to know stress and deflection

4th Stage: The results obtained from the analysis are interpreted & checked for their validity.

5th Stage: - Optimization, Flowchart to Indicate Stages of the Project Yield strength: 275 N/m² 2 Young's modulus: 190000 N/mm Poisson's ratio: 0.27.

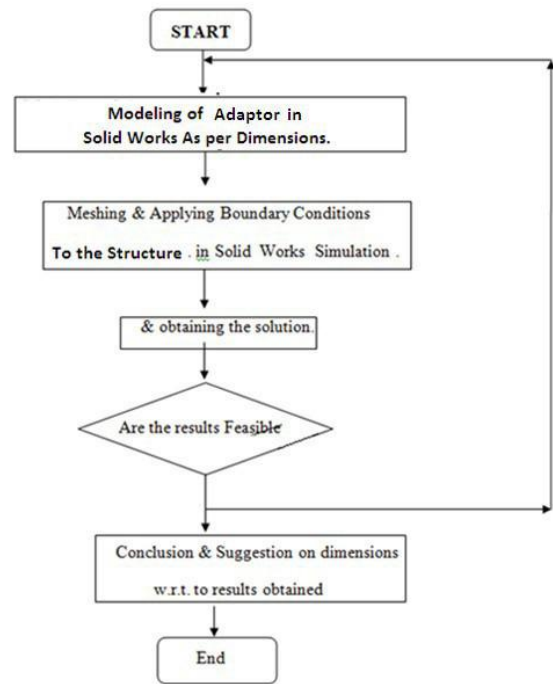


Table No 2:Results From Calculations

TANGENTIAL CUTTING FORCE (F) :	2985.24 N
MATERIAL REMOVAL RATE (V) :	0.072 mm ³ /min
TIME REQUIRED TO COMPLETE 1 JOB (T) :	50 min
SHEAR STRESS (τ) :	1.6 N/mm ²
BENDING STRESS IN ADAPTOR (σ) :	0.48 N/mm ²

The Boring tool adaptors.

Boring Tool Adaptor Modeling: - The Boring Tool adaptor is modeled in Solid works as per 2D Drawings. And Analysis carried out in Solid Works simulation.

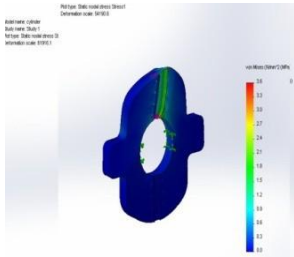


Figure 7 :Shows the Deformation induced in Boring Tool Adaptor.

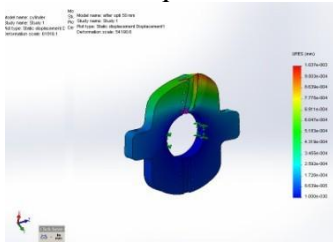


Figure8: Shows the Stress induced in Boring Tool Adaptor

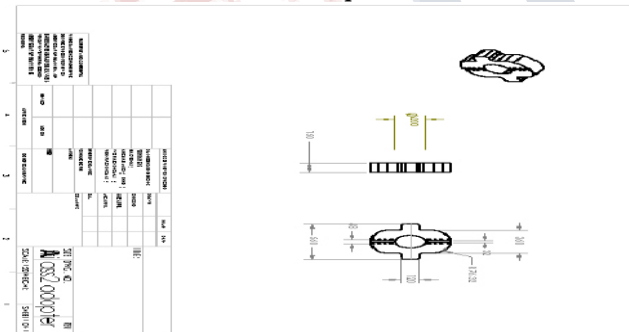


Figure9: Shows Model view of 2D Boring Tool Adaptor

Results of Analysis: - The Max stress Obtained = 3.6 MPa
The Max Deformation = 0.001 mm

The Max stress found in the Boring Tool Adaptor. (2.5MPa) is lower than yield stress of

S.G iron i.e 350 Mpa. As stress induced far below yield 0.001 to 0.002 so optimization.

The Boring Bar: The Cylinder Modeling: - The boring bar modeled in Solid works as per 2D Drawings. And Analysis carried out in Solid Works Simulation.

Stress and Deformation of tool: -

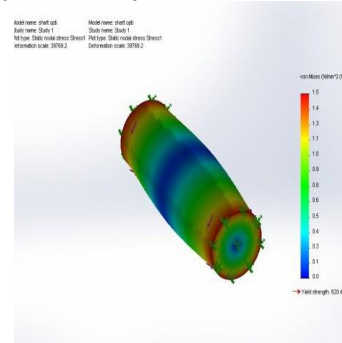


Figure10: Shows the Stress induced in boring.

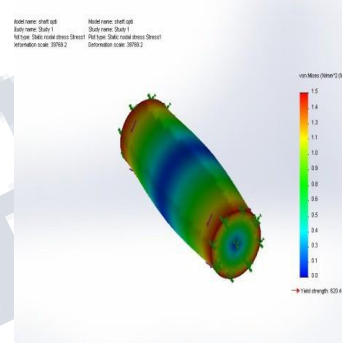


Figure11: Shows the Stress induced in boring

Results of Analysis: - The Max stress Obtained = 1.5 MPa.
The Max Deformation = 0.00125 mm
The Maximum stresses found in the Boring Tool Adaptor. (2.5MPa) is lower than yield stress of S.G iron i.e 350 Mpa. As stress induced far below yield stress and deformation is required is 0.001 to 0.002 so optimization is done.

Table No 3: Total cost Saved after optimization

Sl No	Part	Weight Before Optimization in Grams	Weight After Optimization in Grams	Total weight Saved in KG
1	Boring Adaptor	168957.73	54949.46	114.00827
2	Boring Bar	15707.96	8835.73	6.87223

Table: Total cost Saved after optimization

Total	120.8805
Cost per kg	100
Total cost saved in Rs	12088.05

V. CONCLUSION

An attempt was made to Design and Analysis the Boring Tool Adaptor. And is Been done using Solid works software also Optimized to reduce the cost.

The project work carried out is successfully designed to meet the requirements as per the constraints. The Boring tool adaptor is carefully designed and cross checked where it the requirements. With reference to the assumptions made above the maximum Deformation induced in Boring Tool Adaptor and Boring Bar 0.00079mm, 0.0005335mm After Optimization in the Boring Tool Adaptor and Boring Bar is 0.001037mm, 0.001257 mm. With the further reduction in thickness and diameter of boring bar causes higher deformation and stresses. Making it unsafe. Cost of Boring Tool Adaptor reduced by Rs 12088.05 by Optimization.

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