Design, Analysis and Fabrication of Strut Stabilizer

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Abstract

Tractors are one of the most basic requirements for every farming technique, many attachments come with it to perform a specified task or to usually make it easier to use. Tractor Stabilizer bars are one of the most basic needs for any attachment of tractor [1]. It is required to prevent side to side or move up and down movement when it is in motion. Consequently, avoid the crop damage and also prevent tractor derail from its path. Design and fabrication of tractor stabilizer to increase load bearing capacity resulting in improve its efficiency by using design software is done [2]. For manufacturing purpose operations done are Shot blasting, Blanking, Turning, Drilling, Facing, Induction hardening, Tempering, Welding, Plating, and Final Inspection. Maximum stress that strut stabilizer assembly can withstand is 208.43Mpa and average working stress applied on strut stabilizer is 48.303Mpa.

Keywords

Blanking, Blasting, Hardening, Stabilizer, Tempering.

1. INTRODUCTION

Tractors are one of the most basic requirements for every farming technique, many attachments come with it to perform a specified task or to usually make it easier to use. While tractors can be used for various functions, these attachments are necessary for it to work perfectly [3].The three-point hitch (three-point linkage) is a widely used type of hitch for attaching ploughs and other implements to an agricultural or industrial tractor. The three points resemble either a triangle, or the letter A. Three-point attachment is the simplest and the only statically determinate way of joining two bodies in engineering. Tractor Stabilizer Bars are one of the most basic needs for any attachment to your tractor. It is required to make sure that the attachment you use does not sway from side to side or move up and down while it is attached and in transit [4]. This is because; it can ruin the crop and can also derail the tractor thanks to its weight.

Figure 1: Three-point linkage.

Strut stabilizer and chain stabilizer are the two types of stabilizers used in practice conventionally. Function of the stabilizer is to bear tensile and or compressive force imposed by lateral draft exerted by the implement and control lateral sway of implement. Overall length of stabilizer is adjustable, so that the lower links can be moved laterally to suit width of the implement and connect with the implement through ball joints. A strut stabilizer consists of inner and outer rectangular or circular sliding members for setting its length. Through-holes at certain pitch are provided on these members. After setting length of the stabilizer, the inner & outer members are locked in position by inserting a headed pin through these holes.

2. METHODOLOGY

The Report is concerned with Designing, Analysis and Manufacturing 0f strut stabilizer. This Strut Stabilizer has 4 main child parts, which are shown below along with the operations done on them. Shot blasting is an effective method to clean up the surface of cast iron mould. Once the

moulded product has been taken out from the sand mould, it must be removed free of grit and dirt. Even a second time treatment can also be essential to finish the surface.

Figure 2: Shot blasting

Yoke SPM machine takes 4 upper ends at a time. And the operations like Boring, Drilling and Tapping. The lead time for one part is 03:23 minutes. Facing, turning and oiling operations are done on CNC machines.

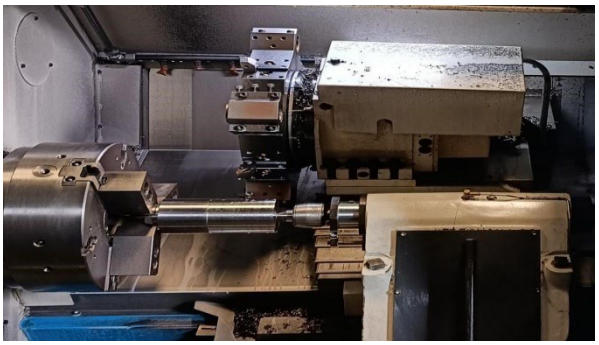


Figure 3: facing and turning operation in CNC Machine

Blanking is a metal fabrication process where the final product is removed out of the larger metal sheet, and the remaining material is discarded as scrap. When you remove a maximum amount of material from the metal sheet, blanking is more efficient.

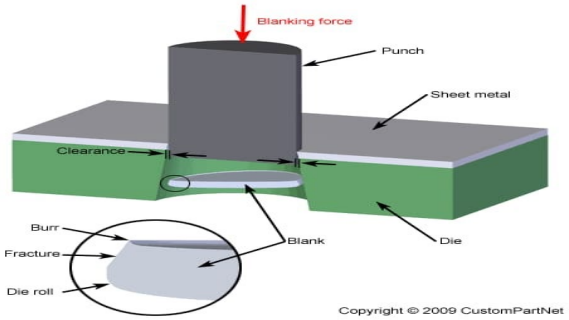


Fig4: Blanking Operation

Hardening treatment will result in an improvement of the mechanical properties, as well as an increase in the level of hardness, producing a tougher, more durable item. Alloys are heated above the critical temperature for the material, then cooled rapidly enough to cause the soft initial material to transform to a much harder, stronger structure [5]. Tempering is a process of heat treating, which

is used to increase the toughness of iron-based alloys. Tempering is usually performed after hardening, to reduce some of the excess hardness, and is done by heating the metal to some temperature below the critical point for a certain period of time, then allowing it to cool in still air.

Fig5: Hardening and Tempering

Vertical drilling machine a drilling machine with a vertical arrangement of spindles. The vertical drilling machine can feed automatically, and its power and mechanical strength allow the use of higher cutting consumption and a fixed center position, referred to as a vertical drilling.

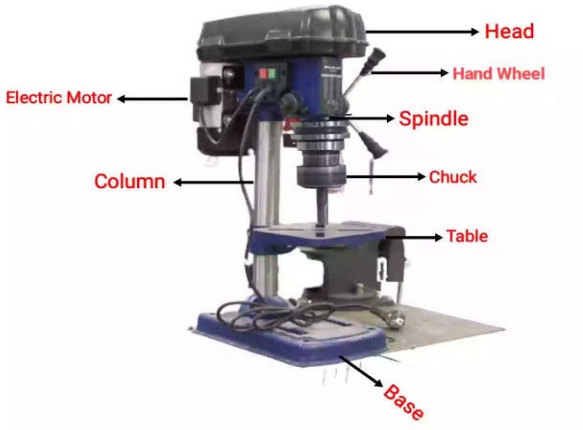


Figure 6: Vertical drilling machine

Tapping is a machining process for producing internal threads. A tap is a cylindrical or conical thread-cutting tool having threads of a desired form on the periphery. Combining rotary motion with axial motion, the tap cuts or forms the internal thread.

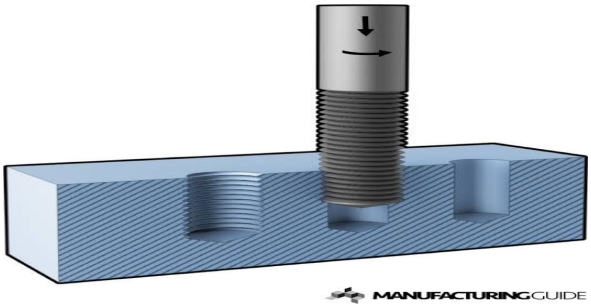
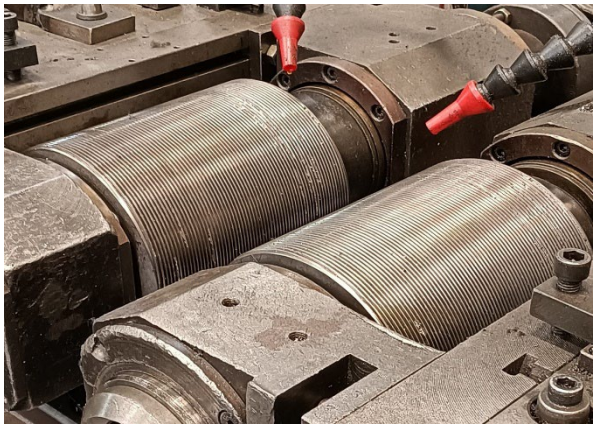


Figure 7: Tapping

Welding is a fabrication process whereby two or more parts are fused together by means of heat, pressure or both forming a join as the parts cool. Thread rolling is a metal forging process that forms threads into the mirror image of a roller die. The process is different from metal cutting, grinding,



and chasing because it does not remove any metal from the work piece. Instead, thread rolling uses hardened steel dies to displace and mould ductile metals.

Figure 8: Thread Rolling

Plating is a process in which a thin layer of metal coats a substrate. This can be achieved through electric plating.

Figure 9: Plating process

After completion of all necessary operations on the child parts, Assembly of the child parts is done in this order Upper-end assembly to the tube. Lower-end assembly to the tube. Linch pin assembly to the tube and lower-end.

MATERIALS

Cast iron is used to manufacture the parts of strut stabilizer there are yolk end, tube, linch pin and eye bolt. The composition of cast iron used having 2 - 4% of carbon, 1- 3% of silicon,1- 1.5% of manganese, 0.05% of sulphur and small amount of other chemicals.

Cast iron have more carbon, which results in distinct qualities such as high strength and hardness levels as compared to iron [6]. This alloy is particularly machinable due to its low carbon content. It can be cut, machined, and shaped into complex shapes without introducing proportionate stresses to the work piece. It also aids in greater weldability.

3. DESIGN AND ANALYSIS

Design software used is NX, formerly known as "uni-graphics", is an advanced high-end CAD/CAM/CAE, which has been owned since 2007 by Siemens Digital Industries Software. For analysis ANSYS Workbench is used.

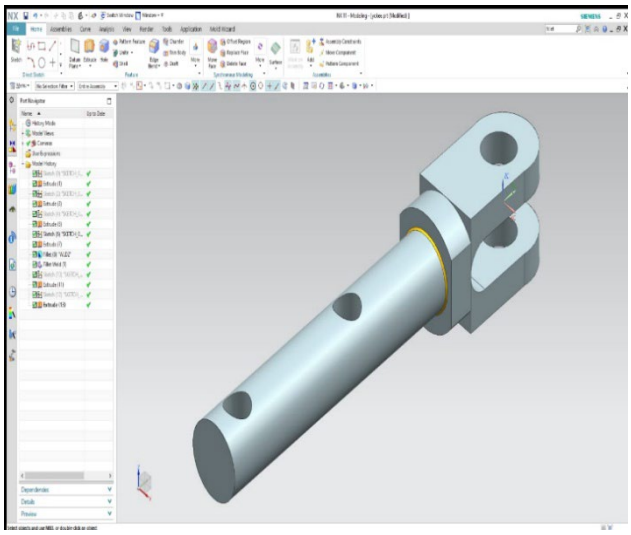


Fig10: 3D Sketch of Yoke end

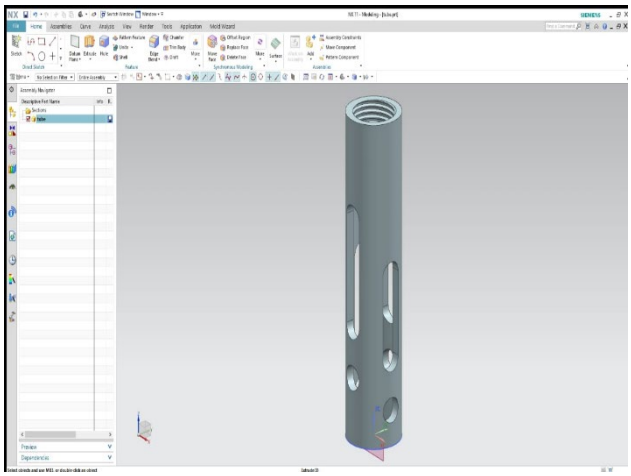


Fig11: 3D sketch of Tube

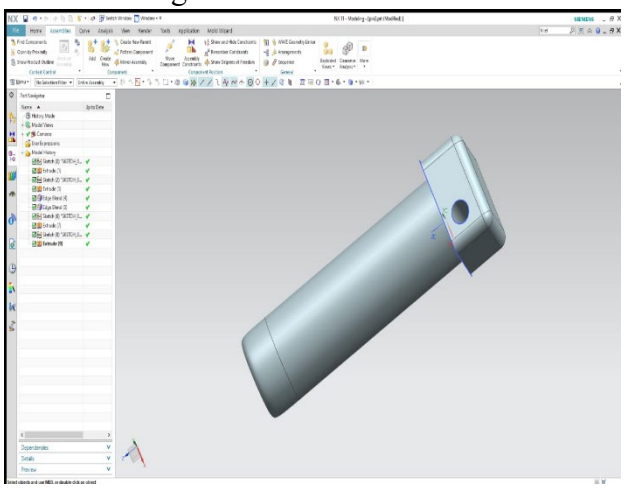


Fig12: 3D sketch of Linch pin

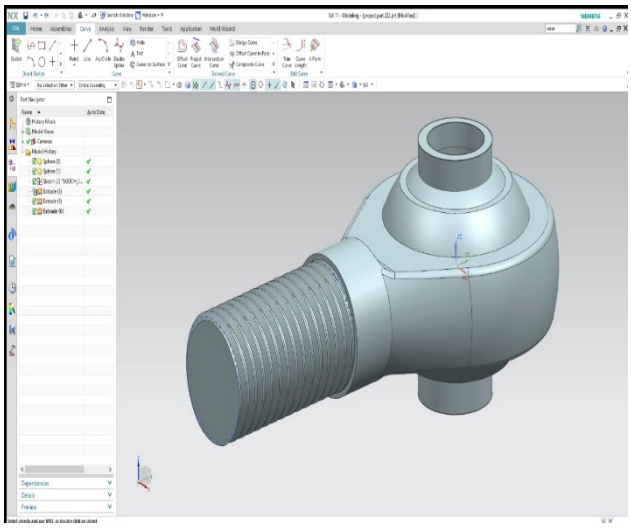


Fig13: 3D sketch of Eye bolt with bearing

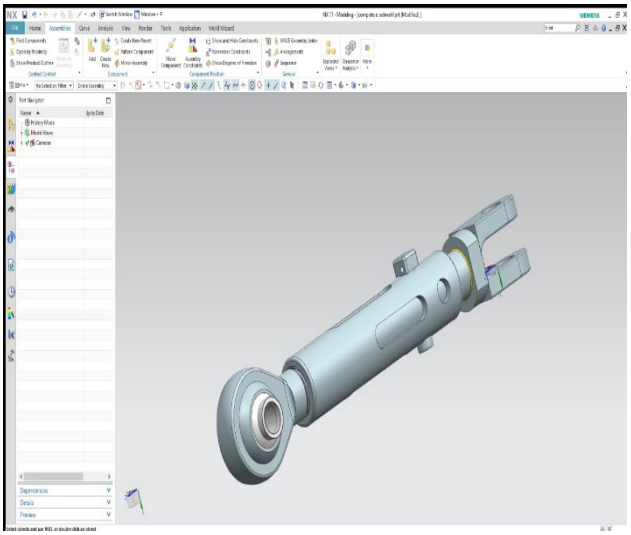


Fig14: Assembly of strut stabilizer using Siemens NX

Ansys develops and markets CAE, multi-physics engineering simulation software for product design, testing and operation. Structural analysis is done on Strut stabilizer.

4. RESULTS AND DISCUSSIONS

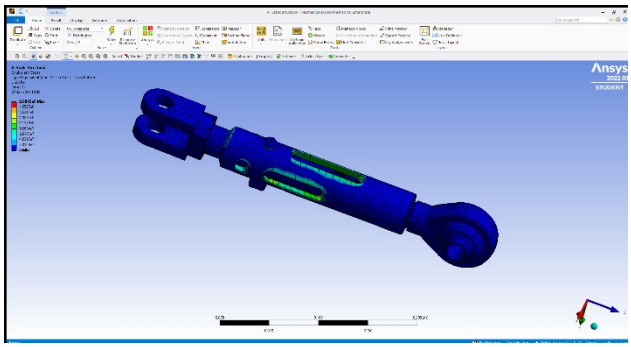


Fig15: Structural analysis of strut stabilizer

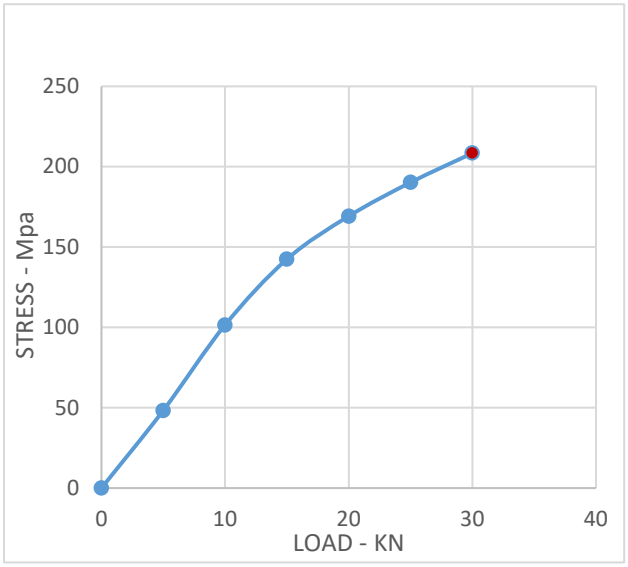


Fig16: Stress and load curve for strut stabilizer

- Design of strut stabilizer parts like yoke end, tube, linch pin and eye bolt are completed in Siemens-NX.
- Assembly of individual parts is also done using Siemens NX.
- By using above manufacturing processes the final product obtained contains high mechanical properties.
- Structural analysis for strut stabilizer assembly is done in Ansys.
- Static structural analysis of strut stabilizer with equivalent stresses are obtained.
- Average stress applied on strut stabilizer is 48.303Mpa.
- Maximum stress that a strut stabilizer assembly can withstand is 208.43Mpa

FUTURE SCOPE

If implemented, it will greatly contribute to prevent side to side or move up and down movement of hitching equipment when it is in motion. Consequently, avoid the crop damage and also prevent tractor deflect from its path by reducing high impacts on tractor. Thus increases work efficiency.

CONCLUSION

The three-point hitch is a widely used type of hitch for attaching ploughs and other implements to an agricultural or industrial tractor. Three-point attachment is the simplest and the only statically determinate way of joining two bodies in engineering. The parts of strut stabilizer undergo different manufacturing processes like shot blasting, facing, turning, drilling, blanking, tapping, welding, hardening, tempering and plating. These individual parts go through some inspection processes like income quality inspection, in-process inspection and microstructure inspection. Therefore, manufactured products can withstand several attributes like high stress, temperature, pressure and strain. It can assemble and disassemble easily. Since, product is manufactured using cast iron it can withstand high load conditions. Average loading conditions on strut stabilizer is 48.303Mpa. Maximum stress that strut stabilizer assembly can withstand is 208.43Mpa. Therefore, strut stabilizer helps the tractor by increasing its stability while working and helps in better outcomes.

REFERENCES

1. Kise M and Zhang Q. Investigated sensor in the loop tractor stability control: look ahead attitude prediction and field tests. Computer Electron Agriculture 2006; 52:107.
2. Gialamas T, Koutsofitis Z et al performed testing bench for stability determination of agricultural machinery. In: Proceedings of 3d national conference of agricultural engineering. Thessaloniki; 2003 [in Greek with English abstract].
3. Liu J and Ayers PD studied about Off-road vehicle stability mapping integrating GPS/GIS and video technology. An ASAE meeting presentation; 1999.
4. Liu J and Ayers PD investigated Technology for measuring tractor stability on-site. ASAE paper 965034; 1996.
5. Yisa MG, Terao H et al. studied Stability criteria for tractor-implement operation on slopes. J Terramechanics 1998;35:1–19.
6. Spencer H and Gilfillan G performed An approach to the assessment of tractor stability on rough sloping ground. J Agricultural Engineering Res 1976;21169–76.