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Design and Fabrication of Rod Straightening Machine

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Abstract— A mechanical tool called a "rod straightening machine" is used to remove bends and distortions from cylindrical metal rods. It corrects deviations from a straight line by inducing plastic deformation through the use of a roller system that provides regulated pressure. Based on the dimensions of the rod, the machine's tensioning mechanism can be adjusted to fine-tune the process. For accuracy and efficiency, an automated control system continuously monitors and modifies the straightening procedure. High-quality cylindrical metal components are produced in modern manufacturing only with the help of this machine. Using programs like SolidWorks, numerous researchers have examined its design, construction, and stress and force analysis.

Keywords—*Rod Straightening, Rollers, Design, Fabrication , Round Bar , Stresses , Forces.*

I. INTRODUCTION

A rod straightening machine is a type of specialized industrial machinery used to straighten tubes, rods, or bars composed of different materials, including plastic and metal. This machine's main goal is to eliminate any bends, twists, or deformations in the material in order to guarantee that it adheres to strict tolerances and quality requirements. This procedure is essential in sectors where precise and straight rods are needed for further production steps or final application.

Three straightening factors have been studied through an assessment of the bending and threading states of round bars between the top and bottom rolls: the roll gap, the roll skew angle, and the ratio of the rotary speed of the top roll to that of the bottom roll. [1]. The building, construction, and maritime industries use round steel bars extensively. Minor diameter (d≤12mm) in the majority [2]. Before leaving the facility, the 42CrMo bar must be straightened after rolling. Due to its straightforward design and superior production efficiency over competing bar straightening equipment, the two roller straightening machine has established itself as the industry standard for bar straightening. [3] The bar spins during the straightening operation even though the parallel-roll straightening mechanism greatly increases the straightening speed .[4] A residual stress profile is created as a result of processing. The goal of the post-drawing thermo-mechanical treatments applied to the wires is to enhance their stress relaxation behavior and durability.[5] It would be really advantageous to have a deeper understanding of how post-drawing thermomechanical treatments affect RS. Choosing a post-drawing treatment that creates an appropriate RS field in the wire can enhance its mechanical qualities and durability. [5]

This paper presents the critical review of the work done by other researchers in the field of rod straightening machine. This paper is reviewed in terms of diagrams and graphs. The reviews are discussed under the design, analysis and fabrication of rod straightening machine.

II. LITERATURE REVIEW

The ability to straighten is achieved by the curve gap between the concave and convex curve rollers in a two roller straightening machine. The rotation principle has produced homogeneous elastic-plastic deformation in the bar during the straightening process.[1]

The six components of the bar two roll straightening apparatus are the convex and concave rollers, front guide sleeves, front guide plates, back guide sleeves and back guide plates. Figure displays these parts' combining form.[1]

Bar stock is advanced through pairs of horizontal and vertical rollers in the first and second halves of the machine, respectively, by three power-driven vertical feed rolls.[2]

Using ANSYS, a finite element analysis programme, the total deformation, stress, and equivalent strain that developed in the bar were determined.[2]

According to the analysis, there was very little bar deformation during the straightening process, preventing bar

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damage. The generated stress and strain are within permitted bounds.[2]

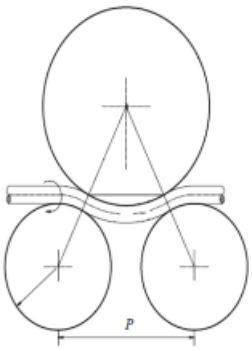

Fig : Deformation system

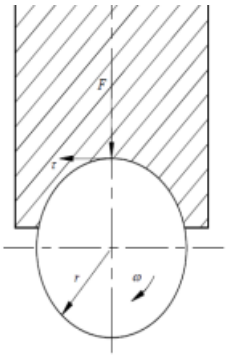

Fig: Force diagram of bar and rollers

Eutectoid steel wires and rods have excellent mechanical properties, including high strength and elastic limit combined with suitable ductility, which account for their wide range of structural applications.[3]

The outcomes demonstrate how well the post-drawing treatment works to reduce the residual stresses caused by drawing, particularly in the rods' surface area. This explains why the "stabilised" samples show improved stress relaxation and stress corrosion behaviour.[3]

An examination of the bending and threading states of round bars between the top and bottom rolls has been used to study three straightening factors: the roll gap, the roll skew angle, and the ratio of the top roll's rotary speed to the bottom roll's rotary speed.

The paper explains how the three straightening factors work in concert as well as the practical applications of the clarified straightening conditions.[4]

Reinforced bar is pre-straightened during the straightening process, and as it moves through the three-roll large deformation, its residual error decreases. The reinforced bar is guaranteed not to rotate when the deformation reaches equivalent curvature. [5]

During the straightening processes, the three-roll large-deformation technology in this straightening system can prevent the bar from rotating around its own axis, ensuring that two--dimensional straightening is achieved and the two orthogonal levelling planes remain unchanged. As the curvature residual of the identical bar approaches equivalent curvature, the accuracy of the bar's straightening is ensured[5]

III. GENERAL DESIGNING

SolidWorks is a leading computer-aided design (CAD) programme that is widely used in many different industries because of Dassault Systèmes' strong 3D modelling, simulation, and technical documentation capabilities. SolidWorks is an assembly design tool that makes it easier to create complex assemblies by providing tools for motion analysis, interference detection, and mate creation. In addition, it provides simulation features to evaluate fluid, thermal, and structural flow behaviours, which helps with design optimisation and validation before physical prototyping.

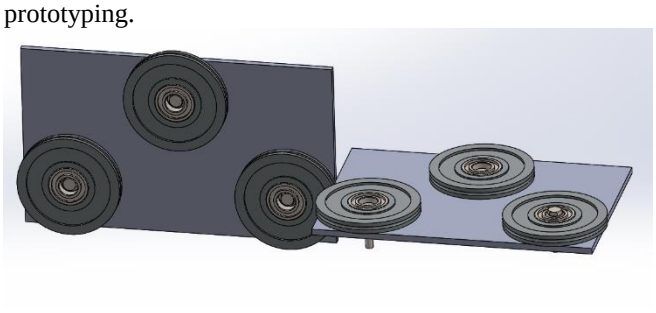

Fig. Vertical and Horizontal roller assembly view of rod straightening machine

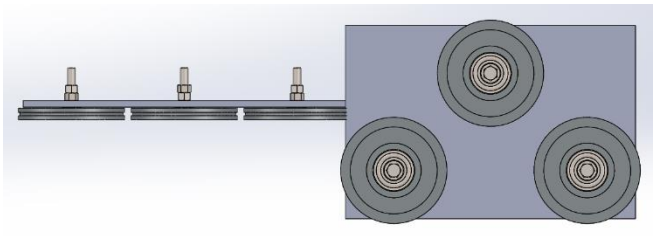

Fig. Top View of roller assembly

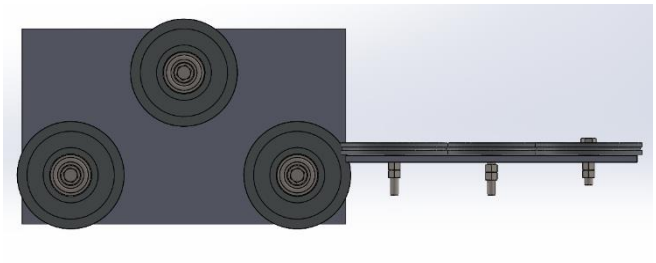

Fig. Front View of roller assembly

S.no	Components	Specification
1)	Base	1000x600 mm
2)	Bearing	Radial Ball Bearing 6312
3)	Roller	Dia. 290 mm
4)	Bolts	DIN 6914 M24 X 130
5)	Nuts	Hexagon Nut ISO 4033 M24

Table:- Design Component Specification

IV. METHODOLOGY

The objective and main goal of this project is to design and fabricate manually operated rod straightening machine which ensures efficiency and safety of process of rod straightening.

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To operate one must check the rods for flaws, bends, or irregularities that might interfere with the straightening process.
The rods are positioned for feeding into the machine, usually by hand, after being inspected. Operators must make sure the rods are properly aligned as they are fed into the straightening machine in order to avoid jams or misalignments during the straightening process. This could entail guiding the rods manually as they enter the machine or modifying the feed mechanism.
Operators keep a close eye on the rods' condition and the machine's performance throughout the straightening process. To attain the intended outcomes without endangering the rods, they can modify the machine's settings, such as the straightening pressure.
Operators carefully remove the straightened rods from the machine, being cautious not to cause any damage or re-bending while handling them. The straightened rods might go through additional processing or inspection depending on the application before moving on to the next phase of production.
Operators are required to follow safety procedures and guidelines the entire time in order to avoid mishaps or injuries. This entails keeping a tidy and orderly work area, adhering to machine operating instructions, and donning the proper personal protective equipment.

V. FABRICATION

An important stage in the product development process is prototype fabrication, which offers a chance to test and validate design concepts prior to large-scale production. Early in the development cycle, it enables engineers and designers to assess functioning, spot possible problems, and make the required changes, lowering the possibility of expensive mistakes and guaranteeing the finished product performs as intended.
Cutting the chosen materials in line with the requirements of the design. To form the frame, rollers, and other parts to the necessary dimensions, use tools like saws, shears, or plasma cutters.
Use welding techniques to assemble the frame and other structural elements. For stability and durability, make sure the alignment and reinforcement are correct. Adhering to safety precautions is necessary when welding.
putting together the straightening rollers that will be utilised to make the rods straight. To protect the rods, these rollers are meticulously machined to guarantee that they are smooth and precisely cylindrical. The lathe machine is used to turn in groves on the rollers; the grove's arc measures 11 mm, including tolerance.
Utilising half axels, bearings, and nut bolts to secure the straightening rollers to the frame for smooth rotation, assemble the machine. Install any extra parts you may need, like handles or hand-operated mechanisms for adjustment.
To ensure that the rod is straightened effectively, ensure that all the parts are positioned correctly. To attain the required degree of precision in straightening, adjust the machine's calibration as necessary.
Made certain that the machine is operating efficiently by thoroughly testing it. To confirm its functionality under various circumstances, test it using rods of varying diameters and materials.
Finishing touches, like painting or coating, are necessary to prevent corrosion and enhance the machine's appearance.
Prioritise worker safety during the fabrication process by donning the proper PPE and using tools and materials according to recommended procedures.

Image:- Rod Straightening Machine

S.no	Components
1)	Roller
2)	Bearing
3)	Half Axel
4)	Nut/Bolt
5)	Base
6)	Roller base

Table:- Components used in fabrication

VI. CONCLUSION

This article describes how the development and testing of a manual rod straightening machine that uses two plates—one vertical and one horizontal—each with three rollers and one more horizontal plate with two rollers initially placed has shown promise in addressing the need for precise and effective rod straightening in industrial applications. A rigorous design approach comprising conceptualization, detailed design, prototype fabrication, experimental testing, and performance evaluation was used to evaluate the effectiveness of the proposed roller configuration. The trial

results showed that within permissible tolerances, the manual rod straightening machine could straighten rods with varying diameters and initial defects to a satisfactory degree. By delivering consistent and predictable straightening performance, the roller design on the vertical and horizontal plates proved the system's practicality and effectiveness.

VII. FUTURE SCOPE

In the end, the manual rod straightening machine project will look into automation integration, complex roller setups, and multi-stage straightening processes.

By using automation technology like control systems and sensors, the straightening process can be made more efficient and productive.

Additional investigation into alternative roller configurations and evaluations of material compatibility can enhance the effectiveness of straightening and increase its flexibility to different types of rods and alloys.

Researching multi-stage straightening methods can also reduce residual stresses and improve rod straightness, both of which will improve overall performance in industrial applications.

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