



Predefined Height Measurement of the Slab in Plate Mill

Monika Kulshrestha¹, Jaya Misra²

¹M.Tech Student, ²Assistant Professor

Shri Shankaracharya Technical Campus, Bhilai, Chhatisgarh, India

ABSTRACT

In the past 20 years, we can see various changes in the rate of production in industries. This has been achieved with the help of advanced technologies which leads to the growth of industries. The challenging problem of height measurement of the slab in plate mill as well as in rail mill is an active field of research in automation. The reheating furnace and the rolling mill can be considered as two main process in a plate mill. Reheating is thermal process while rolling is mechanical process. Reheating furnace is used for heating iron blocks, which is the raw material for the plate mill and the rolling mill is used for turning the steel block to the plate by making it wider, thinner and longer. The main feature of interest in the operation of furnace is the production capacity, measurement of the dimension of the block and display it to the seven segment display board using microcontroller. The production capacity of plate mill affects by the operation of the process and to obtain proper production, dimension should be accurate. That's why before entering of bloom between the rollers, there will be a display system which will give the exact dimension of the block.

Keywords: Measurement, reheating furnace, rolling mill, seven segment display, plate mill

1. INTRODUCTION

1.1 Overview

In the process of the plate mill, moulding plays an important role in the process of continuous casting of liquid steel or alloy. Through this process, the liquid form of the alloy can be solidify into various shapes as per requirement. There is difference in the method of solidification and continuous casting as in casting, there is steady state nature relative to an outside observer in a laboratory frame of reference. The

molten metal solidify into container. According to research paper [1], the solidified molten steel into semi finished steel, it can be done with the help of Secondary Cooling Zone (SCZ).

1.2 Problem Identification

This is a common problem sometime facing in plate mill section that while entering the bloom between the rollers for pre-pressing for converting into plate, it seems like initially from the blast furnace, the bloom are transferred to the plate mill through overhead crane. Before entering to the plate mill, there is pre-heating section which maintains the temperature of the bloom at 1800 degree centigrade and feed to the plate mill press roller. As per the plate mill section of Bhilai steel plant (BSP) that the initial roller operator doesn't get actual measurement of pressed bloom. The length and breadth are primarily accurate after passing from blast furnace but height cannot be accurate as after the method of casting, the liquid alloy will take shape of the container, but height may be less or more than predefined height. If the measured height of bloom is not accurate, the slab may struck between the roller and it will consume time to release and production rate will decrease.

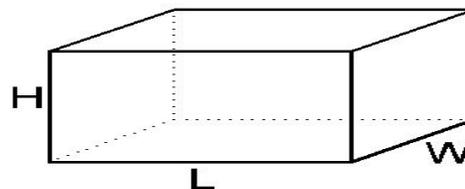


Figure1. Rectangular slab with dimensions

Here, L = Length of the slab

W = Width of the slab

H = height of the slab

2. LITERATURE REVIEW

Nowadays for any industry, main motto is to get vast production with more accurate quality in less time. The production should be done under economic deadlines to prevent loss in industry. The supply chains in the manufacturing industry are facing increasingly changeable market in terms of demand; at the same time, expectations to meet in shorter delivery time, to be more flexible, and to keep with customer-oriented solutions, Several research is being done to increase the production. In order to maintain their competitive position, or even to enhance it, they have to respond quickly, in terms of both volume and product mix. The chain has to be in a position to supply smaller series at lower cost.

In [1], Dr. S. k. Sonpimple (2016) has examined in “Stress analysis of rolling mill roller” that due to the weight of slab, the portion from where it rolls gets deformed. Due to which breakage and cracks on its surface occurs due to multiple passes or overdraft.

Fei Zhang ,Beijing (2014) , [2] “ Research and application of thickness Control Strategies in Steel Plate Rolling” has proposed various method for measurement of gap between rollers in the steel plate rolling section .The thickness of plate depends on the automatic gauge control (AGC) in the plate mill area. Modern technology has implemented to make quick and accurate modifications to make quick and accurate modifications to both control loops and tuning constants. The gap control can be done by controlling in top mounted variable speed synchronous motor and to the bottom mounted servo controlled by hydraulic cylinders. While measuring thickness, there is chance of error i.e. strip thickness error and roll gap error which needs to be eliminated .Two methods were used ,In first , the position of roll and force measurement at rolling mill stand. The value is converted into accurate transfer function .This method is also known as gaugemeter or BISRA (British iron and steel research association).In second method , the gauge is placed at the exit of the roller and feed forward system are implemented . M. Saito, Japan in [3] paper “High accuracy plate thickness control” consider that the accuracy of measurement through gaugemeter is more than that of roll force model.

According to the gauge meter principle,

$$\begin{aligned} \text{Plate thickness} &= \text{roll opening} + \text{mill} \\ &\text{Stretch (function of roll force)} \\ \text{In most mills, the roll expansion and} \\ &\text{Wear model is to be consider.} \end{aligned}$$

In the paper [4] by Maklakova E. A.(2015) “The work roll bending control system of the hot plate rolling mill .” the quality of final sheet after production depends on its thickness deviation .This can be applied for thick , thin , hot and cold sheets . Two types of thickness has considered, which are longitudinal and transverse. The author in [5] by Voronin SS, (2015) considered energy - power parameters. The hot plates in industries has variety of applications like shipbuilding , tube production ,construction industries for which the mathematical models whose energy and power parameters is to be consider .It include the torque of rolling and the total force of rolling. This can be done by screw down mechanism and the main electric drives. A case study [6] of the effectiveness of rolling process to manufacture the strip of leaf spring .Various types of defects in industries is discussed like seam, piping , lapping , edge cutting ,roll mark , etc. The main focussed of author in this paper is customer satisfaction should be satisfied. Pareto diagram, brain stroming, cause and effect analysis, data collection and data analysis. In this case raw material which is strip of SUP 11 is manufactured under rolling process.

3. SOLUTION

In order to overcome the wastage of time , a system has been implemented for measuring height primarily after output of pre heater by a system of slide lifter over conveyor belt with magnetic induction sensor . This can be sensed by magnetic induction sensor whose output will programmed by microcontroller and the output of microcontroller will show into seven segment LED display. The operator who is operating closing and opening of the roller can see the display from far and according to dimensions , gap between roller can be maintained .By this process , the production level get increase , financial stagnancy can be released .

4. IMPLEMENTATION

- The block diagram of our project is shown in figure 1. It is an outline description of how we have implemented our project and various steps involved in it.
- Here the main task is that the slab whose height has been measured will be displayed on the seven segment display board (made up of LEDS).
- The height will be measured with the help of magnetic induction sensor .There is slide lifting mechanism .Before , the entering of slab into the rollers , the slider lifts up whenever the bloom

after preheating passes through conveyor belt and the slider lifts up as the bloom goes below the slider . The sensor which is kept per measurement whenever the magnet comes in contact of sensor.

- The output of sensor may be high or low depends on the output of microcontroller. At a time only one sensor goes high.
- A permanent magnet is fixed over the slider and the sensor sense the position of the permanent magnet. In this way, by software program commands to operates the microcontroller and the four digit value will display on seven segment display board.

Magnetic Induction Sensor

It is also called as magnetic reed switch. It is made up of two iron reeds in a small glass like enveloped. It is just like a switch in which opening and closing can be controlled. It can also act like bridge, gate, relay. There are types , ‘ normally open (NO) ’ and ‘ normally close (NC) ’ .It works on the principle of electromagnetic induction , in which the electric supply will induce magnetic field inside it and the contact from NO to NC .The output of magnetic sensor will be given to the microcontroller.

Circuit Representation

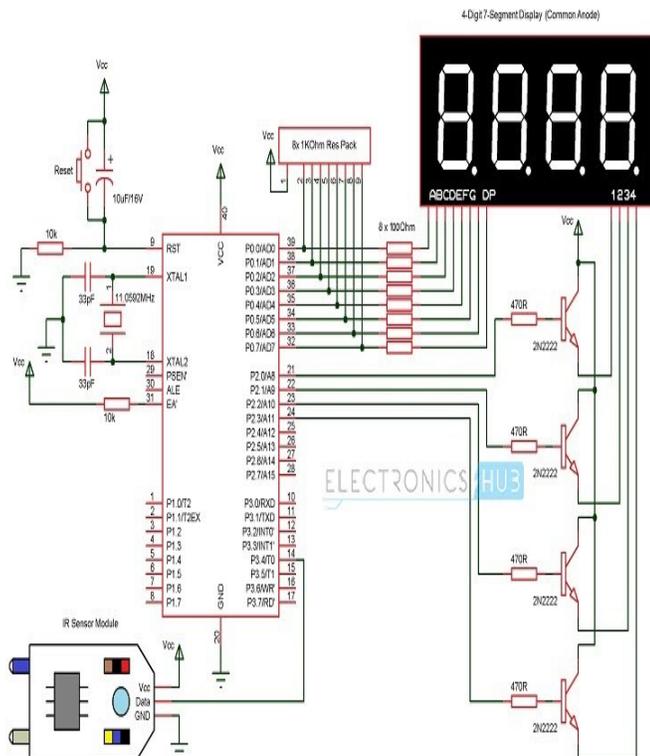


Figure2. Interfacing microcontroller with LED display

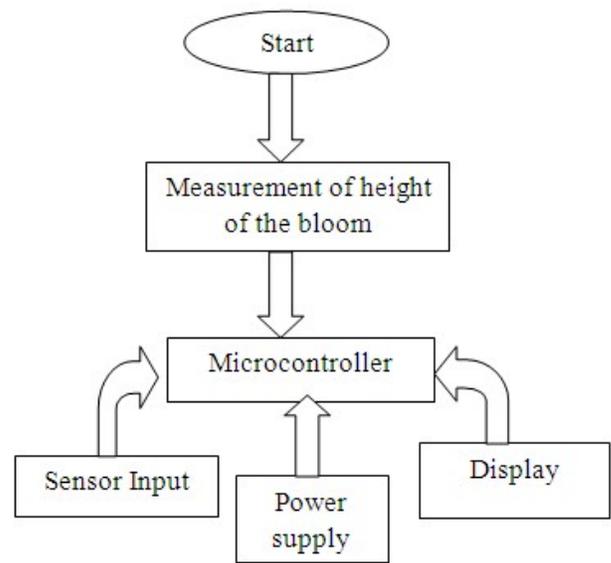


Figure3. Block representation of the hardware system

5. RESULT

An automated system is developed in the hope of tracking with the problem of variation in dimension of the slab in plate mill. In this hardware implementation, seven segment LED display is shown.

5.1 Actual height is less than predefined height

When the actual height is less than predefined height, the microcontroller will compare it with reference value, perform arithmetic operation internally and the actual dimension will get display on LED board .There will be three sensor placed in series vertically on the slider, as actual dimension is less than reference, so the lower sensor will activate, a display on the LED board.

5.2 Actual height is more than predefined height

If the actual height is more than the reference height, top sensor will activate, and the signal directly goes to the microcontroller and the size of the block will be displayed accordingly.



Figure4. LED display (LEDs on PCB board)



Figure4. LED display (LEDS on PCB board) interfaced with microcontroller

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