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STRUCTURAL SHAPE ROLLING

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ABSTRACT:

The purpose of this project is to learn the manufacturing process of structural steel (channels, angels, flats, column, round bars, etc…) which are manufactured in hot rolling mills and hot re-rolling mills. These structures form the basic pillars for construction and it is a very huge business market.

Through this project we shall be able to know how to manufacture, materials used, why they are used and much more. All the results and details obtained will be revealed and discussed.

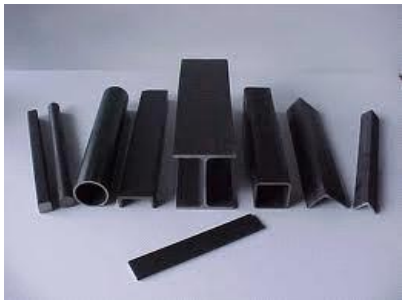

Fig. Structural elements

INTRODUCTION OF STRUCTURAL SHAPE ROLLING:-

Raw Materials:

In this rolling mainly uses three types of raw materials, such as

1. Billets

2. Blooms

3. Ingots

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Billets:

The ingots and billets are almost similar but billets have better finish and there is less chance of blow holes being present inside within and fulfils the customer requirement. The final product obtained by using billets have better finish when compared to the ingots. Billets are more refined raw material which has less chance of blow holes and smooth surface finish.

Bloom:

Bloom is of rough surface finished, whereas ingot is of rough surface as well as tapered cross-se2ction. Some initial preparation is needed for bloom and ingot, whereas billets can be used directly. That is the reason the plant mainly uses billets.

Ingot:

The ingots have a structure similar to a trapezoid. It is like a cuboids structure but with
A little taper included at the sides. This makes the area of one side of ingot bigger than the other end. These ingots are manufactured by casting process with either iron ore or iron scrap at a furnace plant..

The Billet

The Blooms

The Ingots

Inspection of Raw materials:

The incoming material is inspected visually at the initial stage before it unloaded. The QA person tags yellow ribbon to the material which indicates the material is for inspection. After inspection based on the C% the respected Ribbon colors will be issued. The stacked is done based on the color Code. The ingots are identified by lot number, color Code is issued based on the C%.Billets don't have any standard color coding but they are tested and coding is done bythe company itself.

There is a **heat number** mentioned on Billets which is evidenced to the chemical composition in Supplier TC. Before feeding there is a procedure of inspection where there is a series of chemical tests done which determines the percentage of **Carbon, Sulphur, Phosphorous and Manganese.**

1. The presence of carbon affects the strength where 0.23% is the maximum.
2. The presence of Sulphur and phosphorous gives more strength where the maximum allowable level is 0.045%.

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THE FURNACE

Coal Fired Reheating Furnace:

The main function of a reheating furnace is to raise the temperature of a piece of steel, typically to between 900°C and 1200°C, until it is plastic enough to be pressed or rolled to the desired section, size or shape.

Normally rated to produce 270 tons/hr, improvements in efficiency and some sacrifice in slab temperature uniformity enable extended production rates 25% above the design. Heating this much steel from room temperature to 1150 to 1170°C consumes much coal.

There are also have side burners enhances the preheating. The exhaust gases preheats the incoming air to over to 1000°C the massive heat exchangers. Conversely, in the heating zone the steel is primarily heated by the glowing-hot furnace walls.

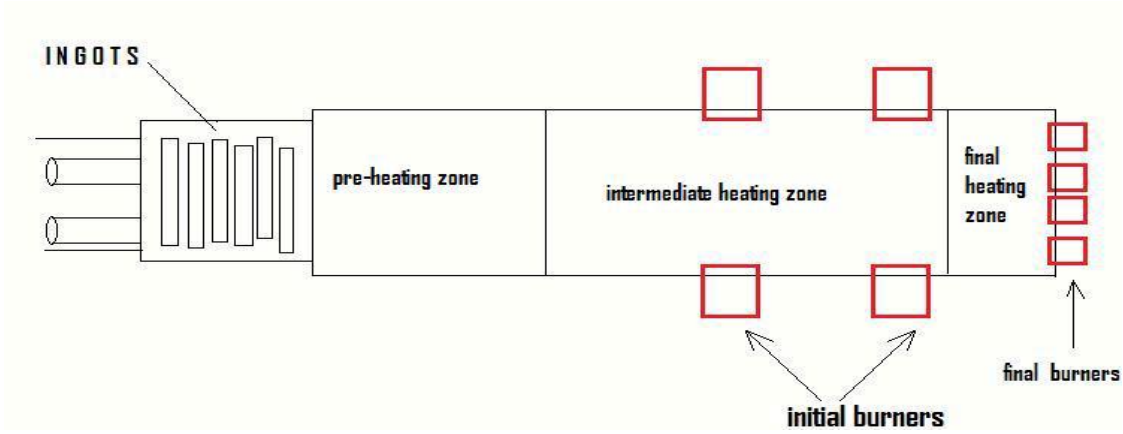

Fig. An Overview of furnace

The processes in furnace:

1. Feeding
2. Heating
3. Ejection

Mechanism used for feeding billets:

In the below figure, the entrance of the furnace can be seen and the feeding bed and the pusher are ready to operate. This type of operation decreases lead time and is comfortable while starting the plant again.

Heating Chamber:-

The Heating Chamber or furnace is the chamber where the ingots are made molten, which makes it feasible to pass it through the rollers. The furnace is a fuel consuming chamber which works on coal gas. The furnace has a total of 8 burners. There is a pre-heating zone, which leads to the intermediate zone ultimately leading to the final zone.

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The above picture shows the structure of the furnace. Several pipelines can be seen at the entrance of the furnace, for exhaust. The pipes present near the burners consist of the gas fuel pipeline. The doors or gates present at the side are used for inspection or to replace the refractory bricks during maintenance.

The 8 burners balance the heat such that there is uniform temperature. In usual practice the last 4 burners are usually varied. The above figure shows the four burners placed inline. And the pipes are the carriers of coal gas. Usually during maintenance the pipes are cleaned and the soot is removed.

Entire Feeding Process

The Furnace Burners

Furnace exit:

After heating, the ingot is ready for the roughing mill. Authorized personnel are stationed at various nodal points to navigate the heated raw material from the furnace to the roughing mill. The exit door is opened by the person who removes the ingot.

The furnace exit is shown in the above figure. The gate opens when an ingot is ready to be rolled and the rollers in the path provided, carry the heated ingot onto the roughing mill.

Conveyor System:

A conveyor system is a common piece of mechanical handling equipment that moves materials from one place another. Conveyors are especially useful in application involving the transportation of heavy or bulky materials.

The Furnace exit

The Conveyor system

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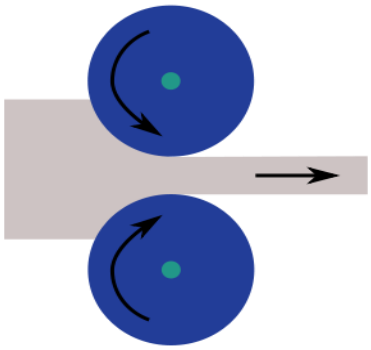
STRUCTURAL SHAPE ROLLING:

Structural shape rolling, also known as **shape rolling** and **profile rolling**, is a metal forming process where structural shapes are passed through rollers to bend or deform the work piece to a desired shape while maintaining a constant cross-section. Structural shapes that can be rolled include: I-beams, H-beams, T-beams, U-beams, angle iron, channels, bar stock, and rail road rails. The most commonly rolled material is structural steel, however other include metals, plastic, paper, and glass. Common applications include: railroads, bridges, roller coasters, art, and architectural applications. It is a cost-effective way of bending this kind of material because the process requires less set-up time and uses pre-made dies that are changed out according to the shape and dimension of the work piece.



ROUGHING MILL:

The roughing mill has 47 inch wide rolls for rolling 'broadside' to make a slab wider. A 800hp motor drives 12'' diameter work rolls through 28:1 gears to reduce the slab's thickness by $2^1/_2$''. The last four roughing mills each incorporate edges for width control and roll the billet into 5 to 6'' incrementally down to around an inch and a quarter, depending upon customer's ordered width, gauge and steel grade. The 3rd and 5th mills each have high pressure de scaling headers operating at 1,500psi. The individual roughing mills are spaced increasingly further apart to accommodate the lengthening of transfer bars as they are rolled thinner and thinner.

FINISHING MILL:

SIL-IV's Hot Roll Mill includes finishing mills, which reduces the thickness of the transfer angles down to the gauge required by the customer or the next process. The rolling speed is set to allow the last strand to perform the final reduction at the finishing temperature, between 900^{o}C to 950^{o}C, specified to reach certain mechanical properties.

The hot steel is quite fragile as it is rolled and tension between the finishing mill strands must be closely controlled at every low level in order to avoid stretching or tearing the roll. Prior to the finishing roll operation, the

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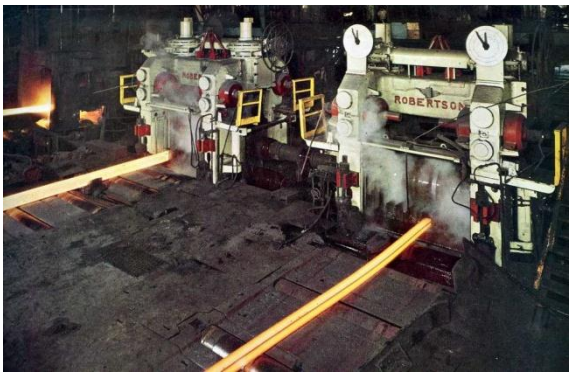
head and tail end of the transfer bar will be sheared to square them up and avoid fishtail at both ends. A finish two-stage de scaling operation is performed to clean off the scale that has grown on the bar during roughing



The Roughing Mill

The Finish Mill

AIR COOLING BED

After finishing roll, structures are allowed to cool in open air on the flat bed. During the air cooling process the temperature of sections are reduced to 100^{o}C. This cooling allows sections to gain strength and required properties. After sections get cooled to 100^{o}C and then sent for cutting of required lengths.

END SHEARING:

End shear is adopted to cutoff the fishtail of rolled structure and is also used to cut as per customer requirement. The shearer is a flywheel operated machine, undergoes heavy working load.

Air cooling bed

The Shearing Machine

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STRAIGHTENING:

After shearing done as per required lengths of structures and these structures are passed through straighteners' to ensure the lengths are straightened for export. In this process the length is passed through the straightening machine having number of precision rollers. In this process scaling is removed from the surfaces.

It offers a full line of hot and cold shears necessary in a bar mill or rod mill for a wide variety of requirements, such as head/tailcropping, dividing, sampling or scrapping, cutting-to-length. Sawing units are available for rails, medium-large sections, large bars, and special steel grades, where sawing is preferred over shearing

BUNDLING:

Bundling is done after straightening operation. In this process a bundle of structures are tied by metal strips. And numbers of bundles are stacked for transportation.

The Straighteners

The Bundle of Structures

FINAL TESTING

After shearing done as per required lengths of structures and sample is chosen for final inspections. This inspection includes testing of chemical and mechanical properties of given sample that intern reflects the similar properties of bulk materials produced.

Mechanical Test:

Universal Testing Machine:

A **universal testing machine** (**UTM**), also known as a **universal testermaterials testing machine** or **materials test frame**, is used to test the tensile stress and compressive strength of materials. It is named after the fact that it can perform many standard tensile and compression tests on materials, components, and structures.

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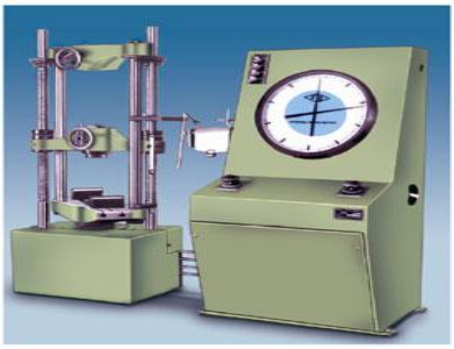
SPECTROMETER ANALYSIS:

Mass spectrometry (MS) is an analytical technique that measures the mass-to-charge ratio of charged particles, for determining masses of particles, for determining the elemental composition of a sample, and for elucidating the chemical structures of molecules, such as peptides and other chemical and other chemical compounds. MS works by ionizing chemical compounds to generate charged molecules or molecule fragments and measuring their mass-to-charge ratios. The ions are detected, usually by a quantitative method.



Universal Testing Machine

The Spectrometer

CONCLUSION:

During the internship program in SUJANA TOWERS LIMITED (UNIT-IV), we have learnt about the complete mechanical processes that are under operation in the plant. This program fetched me with use of electrical drive mechanism in real time use. We have also learnt about the concept of mechanical elements by using of UTM and finding chemical compositions of structures by using spectrometer analysis.

FUTURE SCOPE:

The study of structural shape rolling will enhances development in hot rolling of mild steel elements. As rolling process is a major metal forming process, in which large quantity of production can be achieved. As compared with extrusion, cold rolling and drawing production rate of hot rolling is higher.