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DESIGN & FABRICATION OF COIL LOADING CART

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Abstract - Proper material handling systems in the industries provide a very cost efficient and fast process of production. Designing proper material handling systems is the major need in every industry. Even though there are good material handling systems available with large industries, design and completion of a new model or a system provides a better usability to the workers. The new design is easily accessible and designed according to the requirements of the industry. The aim of the paper is to design and fabricate a system for loading the coils on the de-coiler machine. This will help to improve the material handling system of the industry. Also, it will reduce the final cost of production by a huge margin. The design will be done with the help of various software's.

Keywords – Fabrication coil, Cart, Design of fabrication, loading cart.

I. INTRODUCTION

In sheet metal processing industries which use the processes like punching, blanking, rolling, pressing, forming, piercing etc. of the sheet metal utilizes the sheet metal in huge amount. These sheets are available as a raw product for processing in the form of rectangular pieces of sheets, circular pieces and big rolls of sheet metal (metal coil).

In order for producing the metal sheet products on large scale the amount of sheet metal required is also large. Amongst the availability of the metal sheet in the form of rectangular pieces of sheets, circular pieces and big rolls of sheet metal (metal coil), the sheet metal rolled in the form the metal coil comprises large amount of material compare to other form of raw sheet metal.

Hence, most of the industries catering sheet metal as the raw material purchase sheet metal coils. These coils are in the form of cylindrical roll of sheet metal. The diameter and the length of the coil depend upon the amount of metal sheet included in a coil which depends upon the requirement of the buyer. The weight of such sheet metal coils is in tons and hence the handling processes of such coils are is crucial part.

Fig 1. Sheet metal raw material in form of rectangular sheets and hollow cylindrical coils

II. LITERATURE SURVEY

In many industries there are various types of setups and mechanisms are available in order to handle the sheet metal coils. Such mechanisms and setups are equipped with the heavy structures, platforms, cranes, chains, fabric polyester belts, rolling elements, bearings, motors, high strength welded structures, various kinematic links etc. Following are some reference papers about the elements that are needed to be designed and manufacture in the De-coiler feeding setup.

Wankhade Kaustubh V. et al carried out a research on Design and analysis of transfer trolley for material handling. Material handling task (of handling molten metal) in casting industries is very difficult and risky one. At present this task carried out manually for small-scale castings and with the help of ladle attached to the overhead crane hook for medium and large-scale castings. Now a day this operation required at least two workers in both cases, and aim of this research paper is to minimize labor requirement for handling and pouring molten metal and with less risk. This paper reviews the design, modeling, and computer simulation as a tool for aiding trolley used by various researchers earlier. The results of computer simulations and results obtained by real experimentation compared to get detailed idea about the design ideas. Rapid growth of industrialization is today's need to meet the goals of each and every industry. Faster the production, much faster is the profit. Any company looks after customers satisfaction, it take care for some parameters like lead time, production rate, optimal cost and most important quality. Earlier various researchers have done research to make material handling task in factory or warehouses, a safer and economical one. This research paper studied the earlier inventions for handling material in factory. As existing system like crucible and gear ladle which hooked to overhead crane is old methods and the risk associated with it, the need is to optimize these processes. Casting processes now a day's becoming the key process of metal manufacturing because of wide range of materials suitability and also economic conditions. Here includes several steps like design of part itself, specification of the material to be used, information to choose right casting process also environment. Then design the system necessary to get molten metal into the all regions of the mould cavity to produce sound casting. Now-a-days new technologies are available to give exposure to work in any field of engineering and technology. These techniques are computer aided design (CAD) and computer aided engineering (CAE). It really helps researchers to give wings to their thoughts and with practical knowledge and test or otherwise check the ideas of research in actual environment. Researchers have done tremendous work in the area of trolley design with greater reliability, protection and robust design also design was adequate and costs reduced. Speed of trolley can be increased by increasing gearbox speed and reducing failures in gearbox. Also did ergonomic study like adjustable handle for minimum pushing efforts for users. Trolleys used in many areas like in hot rolled product handling, grain feeding trolley, in casting industries, shopping malls etc. Much more work is still needed to make use of trolleys in different Areas.

III. SYSTEM ARCHITECTURE

The concept which is being executed in order to handle the heavy sheet metal coils is based upon an automated cart system. There are three carts in whole setup viz. platform cart, intermediate cart and coil carrying cart equipped with gear motor which would make the cart travel in specified direction on guide rails laid on the floor of the shop floor area. A de-coiler is a very simple machine which consists of a rigid foundation at the base in order to sustain the weight of the coil. A de-coiler shaft protrudes through the de-coiler on which a sheet metal coil is mounted; this shaft keeps rotating when the coil is mounted on to it thus, de-coiling it and extracting the flat sheet metal through the coil and to use it for the further processes like rolling, stamping, blanking etc. Thus a cart system is to be developed in order to transfer the coil from the inventory to the de-coiler and thus to extract the sheet metal from it. Three carts are to be made in which two of the bottom carts are to be given separate motion perpendicular to each other i.e. motion X and motion Y.

A De-coiler feeding setup

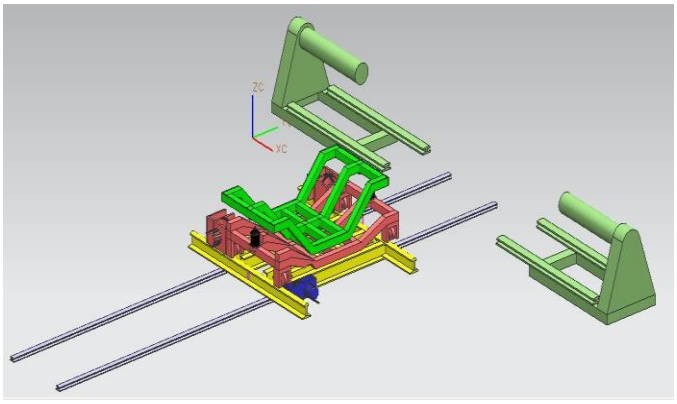

Fig 2 De-coiler feeding

IV. RESULT ANALYSIS

A. Platform Cart

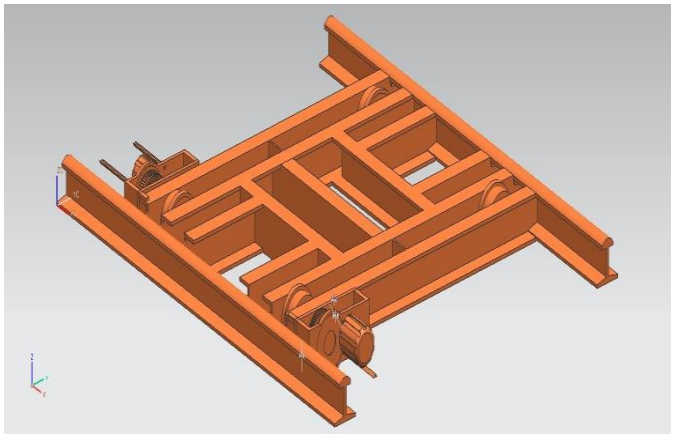

Fig.3 Platform Cart

Platform Cart is the base cart over which the whole mechanism is mounted. This cart is equipped with two gear motors which would make this cart travel along the guide rail up to the de-coiler machine. Wheels assist the easy movement of the cart on the rigid guide rails. A guide rail is also mounted on the structure of the cart so that it would assist the movement of the intermediate cart in the direction perpendicular to the movement of platform cart.

B. Intermediate Cart

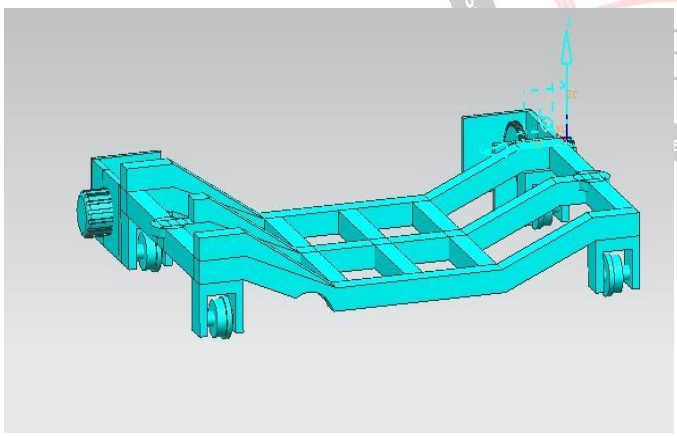

Fig. 4 Intermediate Cart

This cart is placed directly above the Platform Cart whose wheels are perfectly in the touch with the guide rails that are mounted on the Platform Cart. Intermediate cart is also equipped with the same type of gear motor that is used to move Platform Cart only the difference is that this motors are fitted such that the movement of the Intermediate Cart is perpendicular to the direction of the Platform Cart. The inclination given to the Intermediate Cart is given in order to attain the specific height of the shaft of the de-coiler. The hydraulic jacks are also mounted on the Intermediate Cart in order to lift or lower down the Coil Carrying cart.

C. Coil Carrying Cart

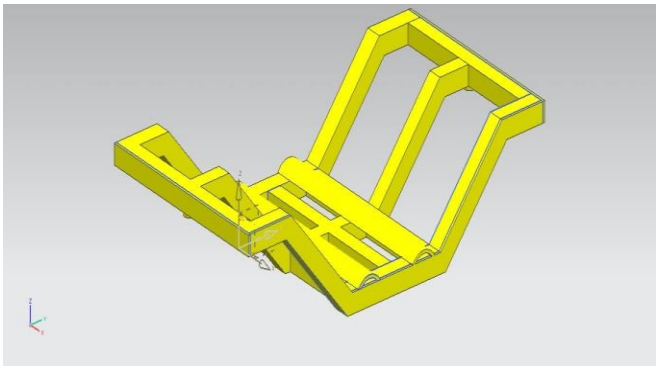

Fig.5 Coil Carrying Cart

The Coil Carrying Cart is the actual on which the coil is placed. A specific inclination is given to the Coil Carrying Cart in order to accommodate the coil of variable diameter as the weight of coil also varies according to the supplier. This cart is directly placed on Intermediate Cart. Now as the Intermediate Cart will go towards the de-coiler & coil which is on the Coil Carrying Cart will be loaded on the de-coiler apparently.

V. CALCULATION

A Upper Frame

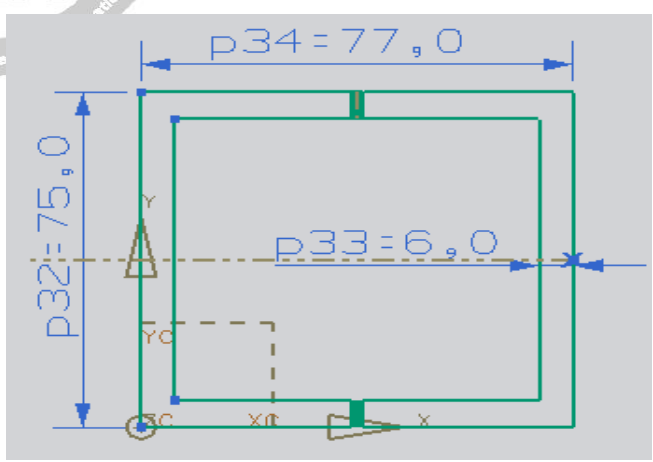

Fig. 6 Cross section of coil carrying cart structure

Now,

$A = 0.864 \times 10^{-3} m^2$

Total weight of coil carrying cart = 74.54 kg

B Calculation of Reactions on Coil Carrying Cart

$\sum M_A = 0$

$R_C \times 820 + R_D \times 1020 - R_F \times 1840 = 0$

$\therefore R_F = 39.24$ KN

$\sum F_y = 0$

$R_A + R_F = 78.48$ KN

$\therefore R_A = 39.24$ KN

C Shear Force Calculations:

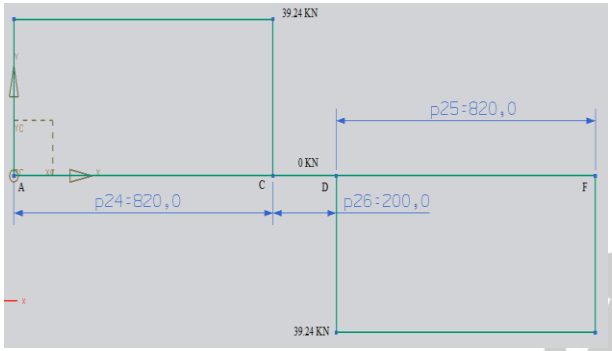

Fig.7 SFD diagram

$A_L = 0$ KN

$A_R = 39.24$ KN

$C_L = 39.24$ KN

$C_R = 0$ KN

$D_L = 0$ KN

$D_R = -39.24$ KN

$F_L = -39.24$ KN

$F_R = 0$ KN

D Bending moment calculations

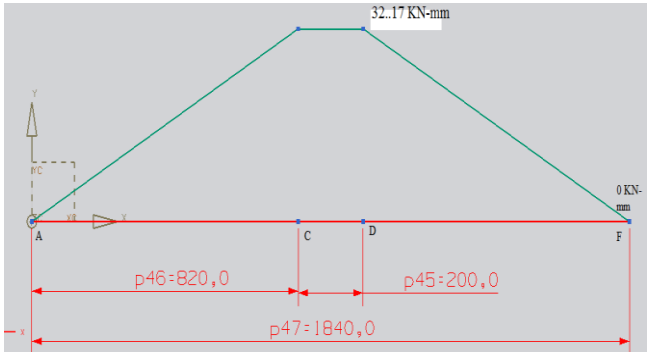

Fig. 8. BMD diagram

$M_A = M_F = 0$

$M_c = 39.24 \times 820 = 32.17$KN-m

$M_D = 39.24 \times 820 = 32.17$ KN-m

E. Bending stresses

Maximum bending moment,

$$M_{max} = \frac{wl^2}{8} = \frac{39.61 \times 10^3 \times 1.015^2}{8}$$

$$= 5.1 \times 10^3 \, Nm$$

$$y = \frac{d}{2} = \frac{140}{2} = 70mm$$

F. Flextural formula to find Permissible bending stress:

$$\frac{M}{I} = \frac{\sigma}{y}$$

$$\sigma_{perm} = \frac{5.1 \times 10^3 \times 70 \times 10^{-3}}{1.037 \times 10^{-12} \times 10^6}$$

$= 344.26$ N/mm^2

VI. CONCLUSION

The implementation of De-coiler Feeding Setup in Mungi Engineers has improved the material handling of the sheet metal coil. The process of feeding the sheet metal coil to the de-coiler has now become safer, economical and consumes less time for coil loading unlike before implementation. The overall functioning has drastically improved the amount of coils getting consumed per month leading to improved production rates. Also the amount of money needed for outsourcing the crane for lifting, loading and unloading the coil has been eliminated which saves around minimum of Rs. 3750 per coil that was earlier spent only for one time unloading or one time loading of minimum 3 coils a day.

Thus it could be concluded from this report that implementing the De-coiler Feeding Setup or Coil Loading Cart has drastically impacted the whole process of loading sheet metal coil on the de-coiler and hence it has proved to be very beneficial for the company.

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