Case Study in Wire Coiling Zone to Reduce Time Losses in Manual De-coiler

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Abstract— This project is about feeding wire accurately and in a controlled way for different applications like spring making coil making, multi-forming parts and many other applications. We focus on the accurate feeding method for different sections of wires as per the requirement. Here we will establish a basic line for the feeding mechanism of wire; we will also define a flow path for the wire. The gear train required for pinching and feeding of wires is also discussed. This paper consists of scope of problem, problem statement, identification of problem. In this paper we have also accumulated data and based on data accumulation we have made calculations. The paper also contains CAD models of De-coiler Machine, its detailing, FEM & FE results of De-coiler machine.
Key words: Coiling, Feeding Mechanism

I. Introduction

Many products which were made from metal sheet coils by stamping on High Speed Presses are now being converted to wire coils process so as to save material and cost. As directly stamping from steel strip method leads in wastage of costly raw material due to blanking operation. In process where wire can be used, it is first bend in required form by different methods as per manufacturers requirement then this formed wire is blanked in the required shape. This project aims to standardize the setting done for getting the desired output and involve very less parameters changes for component changeover and feed length setting.

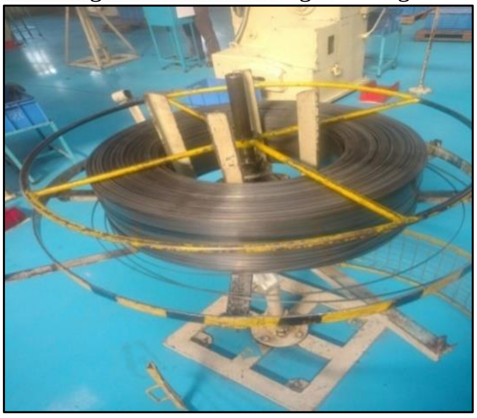


Fig. 1: De-coiler machine

II. Scope of the Problem

A wire form is a term that incorporates many shapes, textures and dimensions. The forms are engineered in two or three dimensions and commonly generated from wire and sometimes from tube. Typically, the raw stock for wire forms is fed off a coil that can weigh as much 5,000 pounds (2,300 kg) or as little as five pounds (2.3 kg). In some cases, the raw material commences production in blank forms that are fed from a hopper.

The company uses the Coils upto the weight of 600- 800 kgs. During the de-coiling of the wire coil, the problems of wire hangings occur continuously as the wire stuck into each other. It blocked the coil rotation. But on the other hand machine is continuously pulling the wire. Thus it result falling of de-coiler and the coil.

The extra worker is continuously engaged in taking care that the wire will not hang into each other.

III. Problem Identification:

The Manual De-coiler which company is using currently require extra worker to check the proper working of machine and smooth flow of wire. They have to adjust the coil and wire again and again as it gets hanged. One or Two workers are continuously engaged in adjusting the wire.

Due to above reasons lead time of the machine increases which results in decrease in productivity.

So to reduce the production cost and to improve the safety of the workers above point is selected.

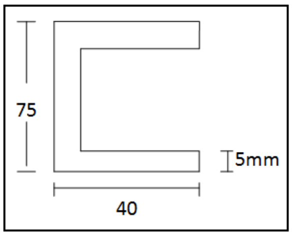
IV. Data Accumulation

Outer diameter of wire bundle
(OD) = 1000mm
Inner Diameter of wire bundle
(ID) = 800mm
Weight of wire bundle = 800 kg

V. Calculation

1) Vertical Member:

Length = 700mm
Number = 4
Total weight = 800 + 200
= 1000 kg
(cross section)



$$\frac{1000}{4} = 250 \frac{kg}{member}$$

P = 250 x 9.81
= 2452.5 N
Buckling ,

$$Pcr = \frac{\pi^2 EI}{Le^2}$$

F = 250 x 9.81
= 2452.5 N
E = 210000Mpa
I_1 = Consider C as solid rect

$$= \frac{bd^3}{12} = \frac{75 X 40^3}{12} = 400000$$

$$I_2 = \frac{bd^3}{12} = \frac{65 X 35^3}{12} = 232239.5$$

I = 167760.41 mm^4

Le = 350mm

$$Pcr = 2833.39 = = \frac{\pi^2 X 210000 X 167760.41 EI}{350^2}$$

Pcr = 2838.4 KN

Pcr> P

Thus it is safe .

Compressive stress

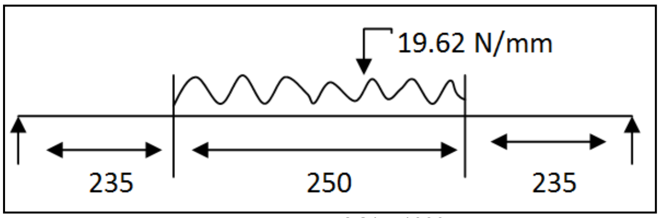
$$ʒ_c = \frac{2452.5}{735.73}$$

$ʒ_c$ = 3.33 N/mm^2

Horizontal member (same cross section)

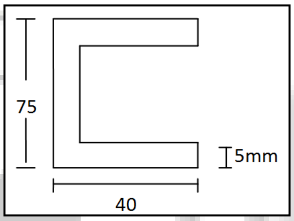
L = 800 mm,

Number = 2



$$Total load = \frac{9.81 X 1000}{2}$$

= 4905 N



(Cross section)

$$Load intensity = \frac{4905}{250}$$

= 19.62 N/mm

Ra + Rb = 4905 N

Ra = Rb = 2452.5 N

Bmx = (2452.5 X 125) – (19.62 X 125 X 62.5)

Bmx = 153281.25 N/mm

$$I_1 = \frac{bd^3}{12} = \frac{40 X 75^3}{12} = 1406250$$

$$I_2 = \frac{bd^3}{12} = \frac{35 X 65^3}{12} = 800989.58$$

I = 605260.5

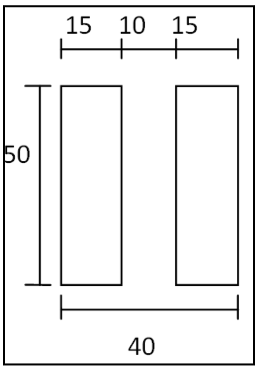
Y = 37.5 mm

$$ʒ = \frac{M X Y}{I}$$

ʒ = 9.5 MPa

Rectangular bar of ring structure cross section

L = 492



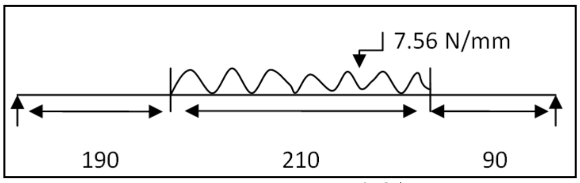
Number = 6

Total load = 1000 X 9.81

= 9810 N

$$Load on two bar = \frac{9810}{6}$$

= 1635 N



$$Load intensity = \frac{1635}{216}$$

= 7.56N/mm

Ra = 1635N

Bmx = (105 X 1635) - (7.56 X 105 X 52.5)

Bmx = 130000.5

I_1 = consider as solid bar

$$= \frac{bd^3}{12} = \frac{40 X 50^3}{12} = 416666.6$$

$$I_2 = \frac{bd^3}{12} = \frac{10 X 50^3}{12} = 104166.6$$

I = 416666.6 – 104166.66

= 312500 mm^4

$$ʒ_b = \frac{M X Y}{I} = \frac{130000.5 X 25}{312500}$$

$ʒ_b$= 10.4 MPa

ʒ = Torsional shear stress of shaft

$$\frac{T}{J} = \frac{ʒ}{R}$$

T = 3.75 N/mm

R = 40

$$J = \frac{\pi}{64}(D^4 - d^4)$$

$$J = \frac{\pi}{64}(40^4 - 20^4)$$

J = 117809.72

$$ʒ = \frac{3.75 X 10^3 X 20}{117809.72} = 0.63$$

VI. CAD MODELING:

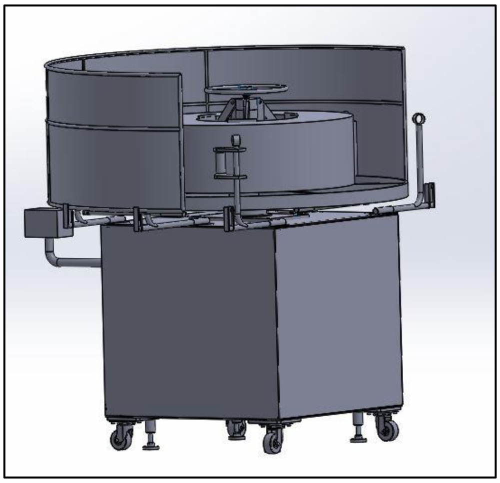


Fig. 2: cad model of de-coiler machine

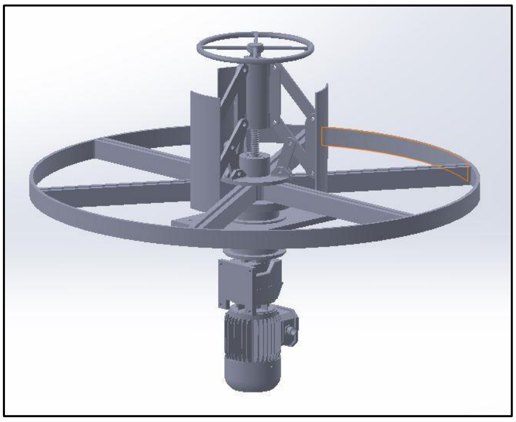


Fig. 3: cad model of de-coiler motor assembly

VII. DETAILING OF DE-COILER MACHINE:

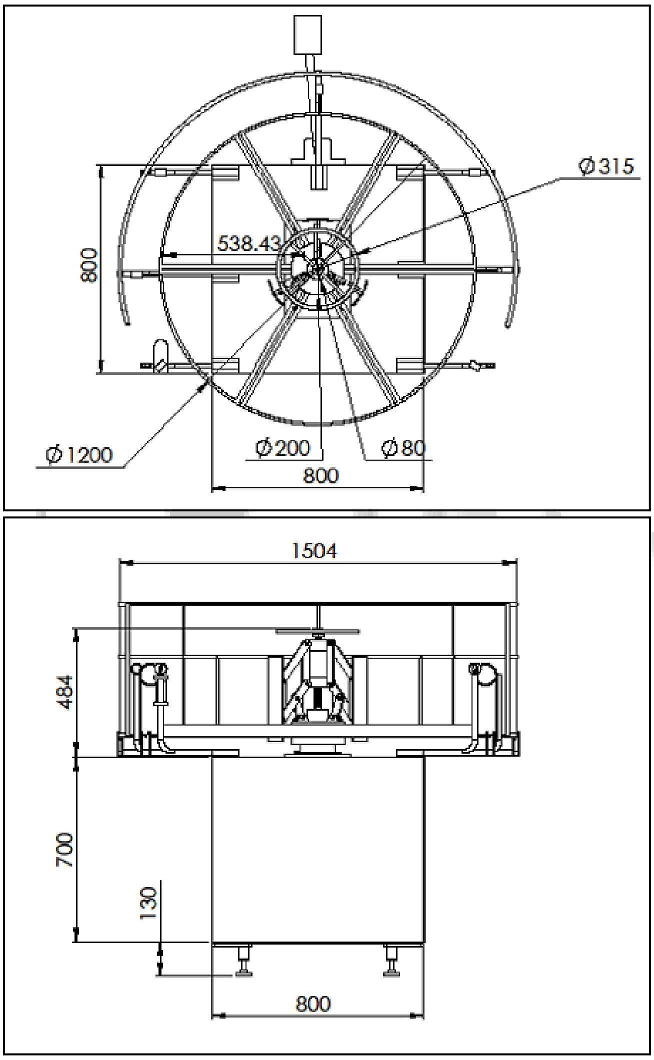


Fig. 4: detailing of decoiler machine assembly

VIII. FINITE ELEMENT MODELING:

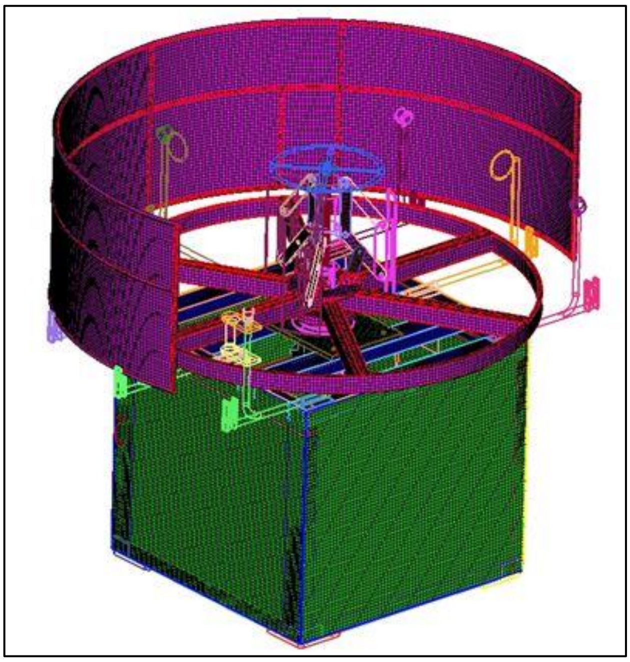
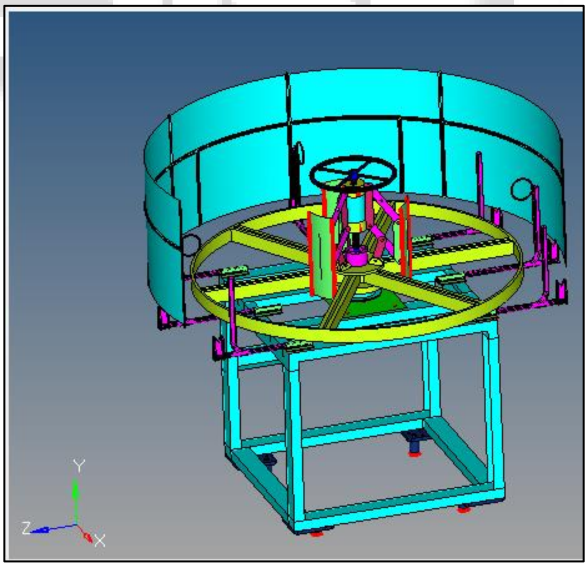


Fig. 5: meshing of decoiler machine

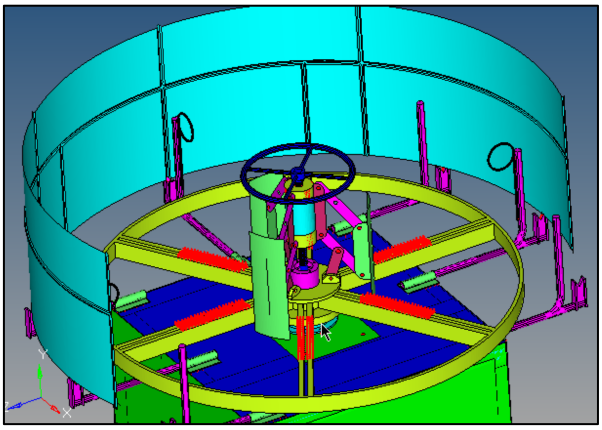
A. Boundary Condition:

The boundary condition is the application of a force and/or constraint. In HyperMesh, boundary conditions are stored within what are called load collectors. Load collectors may be created using the right click context menu in the Model Browser (Create > Load Collector).

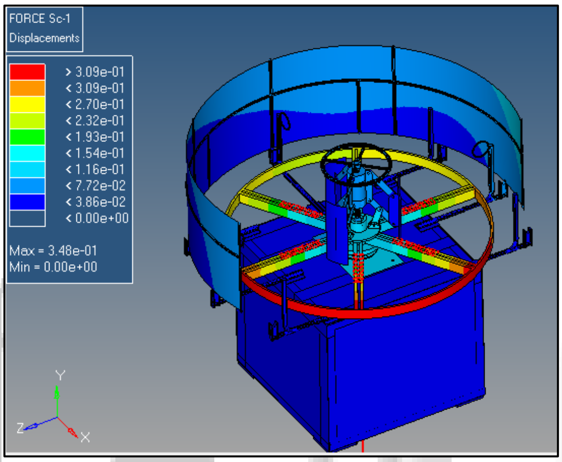
B. Constraint:



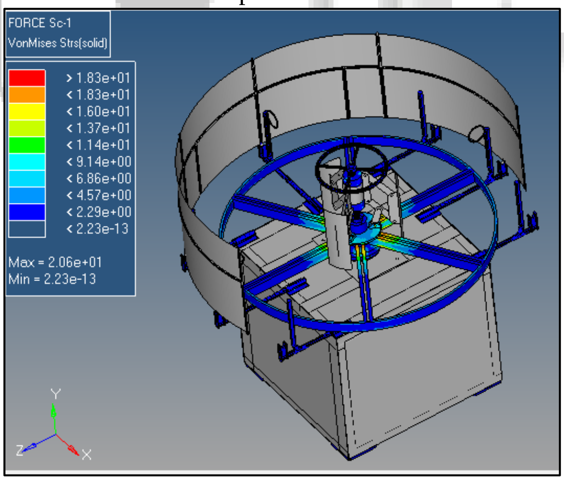
C. Forces:



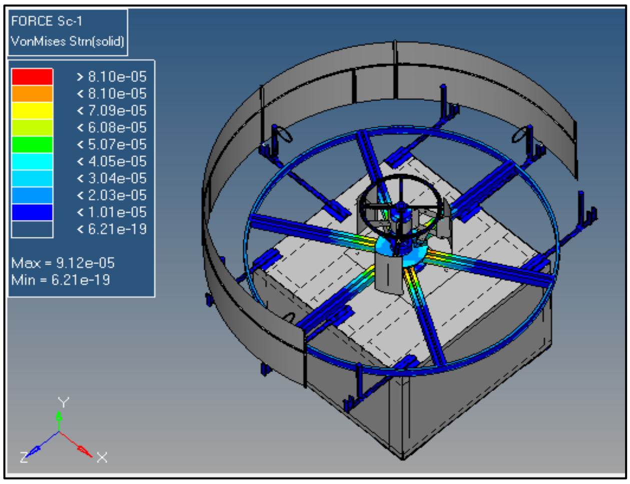
IX. FINITE ELEMENT ANALYSIS RESULTS:



Maximum Displacement = 0.348mm



Maximum VonMises Stress = 20.6Mpax



Maximum VonMises Strain = $9.12X10^{-5}$

X. CONCLUSION

By studying literatures and types of De-coiler machines. The machine we design supplied the metal strip at the control way without any interference and it will save time and the operating cost. From the results of design, we concluded that stresses obtained in static analysis are within the limits. Hence the design of Decoiler machine is safe.

REFERENCES

[1] Development of simulation model of electric drive of decoiler Galina A. SIVYAKOVA1, Sergey Y. ORLOV2, Waldemar WÓJCIK3, Paweł KOMADA
[2] Development of Automatic Transformer Winding Machine By Prathmesh Mulik Department of Electronics & Telecommunication Engineering, Brahmdevdada Mane Institute of Technology, Solapur, India
[3] EQUIPMENT FOR DECOILING AND STRAIGHTENING COIL STOCK by David Alkire Smith, 530 Hollywood Drive, Monroe, Michigan 48162 rev September 15, 2000
[4] COIL WINDING MACHINE by Dr. SARINA BINTI SHAFIE
[5] Study of Tension and Bending in Coilers of Mobarakeh Steel Company Hot Strip Mill and Preparing a Computer Model to Calculate the Required Current in Coilers" Mohammad Eghtesad*, Ebrahim Farjah**, Samad Javid*** and Mojtaba Rasouli****School of Mechanical Engineering, Shiraz University, Shiraz, Fars, Iran*School of Electrical and Computer Engineering, Shiraz University, Shiraz, Fars, Iran.
[6] DEVELOPMENT OF AN AUTOMATIC REWINDING MACHINE FOR CABLE TAPE CONSIDERING AFFECTIVE ANALYSIS by NORAIDAH BINTI .
[7] Design, Testing and Manufacturing of Decoiler Unit of a Semi-Automated Spooling Machine " by K. A. Mahajan, J.M. Solomon, S. J. Sukhu, K. V. Deshpande, L. S. Singh .
[8] Contol system for uncoiler with induction motor drive" by BROGUMILA MROZEK