EVLUATION OF OPTIMUM PARAMERETER OF ROLLER CONVEYER SYSTEM USING FEA

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Abstract— *A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. Many kinds of conveying systems are available, and are used according to the various needs of different industries. There are chain conveyors (floor and overhead) as well. Chain conveyors consist of enclosed tracks, I-Beam, towline, power & free, and hand pushed trolleys.*

Keywords—Conveyor; Handling; Transportaion; Material; Chain

1. INTRODUCTION

Conveyor systems are used widespread across a range of industries due to the numerous benefits they provide.

- Conveyors are able to safely transport materials from one level to another, which when done by human labor would be strenuous and expensive.
- They can be installed almost anywhere, and are much safer than using a forklift or other machine to move materials.
- They can move loads of all shapes, sizes and weights. Also, many have advanced safety features that help prevent accidents.
- There are a variety of options available for running conveying systems, including the hydraulic, mechanical and fully automated systems, which are equipped to fit individual needs.

Conveyor systems are commonly used in many industries, including the automotive, agricultural, computer, electronic, food processing, aerospace, pharmaceutical, chemical, bottling and canning, print finishing and packaging. Although a wide variety of materials can be conveyed, some of the most common include food items such as beans and nuts, bottles and cans, automotive components, scrap metal, pills and powders, wood and furniture and grain and animal feed. Many factors are important in the accurate selection of a conveyor system. It is important to know how the conveyor system will be used The components of maximum weight 450 kg has to be transported for storage station from job finish point. A mechanism for continuous and uninterrupted transport is desired. This is carried out with reference to roller conveyor system (Existing System). The existing system will be redesign and optimize for weight, resulting into material saving by modifying and analyzing the critical conveyor parts.

TABLE 1.1: PARAMETERS OF CONVEYOR SYSTEM COMPONENTS

Sr No	Components parameters	Feasibility to work on
1	Length of component	No, Can't compromise the length
2	Effect of Flange Thickness of chassis	Yes
3	Effect of Web Thickness of chassis	Yes
4	Effect of depth of section	Yes
5	Effect of width of section	Yes
6	Effect of Bearing dimensions	No, Very less weight + STD
7	Diameter of Shaft	No, it will change chassis holes, bearings and further roller dimensions change
8	Effect of Roller thickness	Yes
9	Effect of Support	No, These should be strong and also weight contribution is less

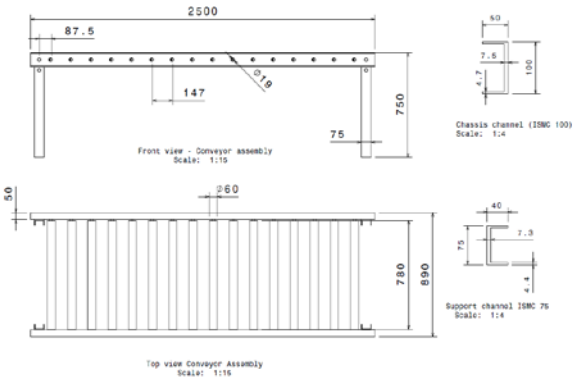


Fig 1.1: Existing Conveyor Assembly

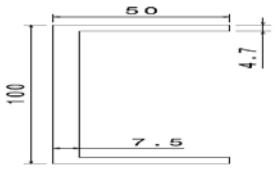


Fig. 1.2 Weight of C- Channels for Chassis

1) Material- Rolled Steel C-10,

E_c= 200GPa, ρ_c = 7700 Kg/m^3, S_{yt}= 450 MPa

2) Chassis Channel Dimension

Given C- Channel, ISMC 100

h= Depth of section, t_f = thickness of flange, t_w = thickness of web, A= Sectional area, L=Length of channel b= width of section

L= 2500 mm, h= 100 mm , b = 50 mm, t_f = 7.5 mm

t_w = 4.7 mm

A = [2(50 X 4.7) + (90.6 X 7.5)] = 1149.5 mm^2

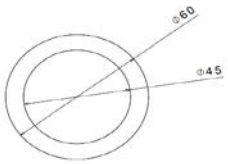
3) Weight of C-Frame for Chassis = Cross-Section Area X length of Frame X Mass Density = (1149.5 X 10^{-6} X 2.5 X 7700)

= 22.51125 kg/ per frame

= 2 X 22.1278

= 44.26 kg

Weight of Roller



1) Material – Mild Steel -AISI 1018 (AISI-American Iron and Steel Institute)

E_r= 205 GPa, ρ_r = 7870 Kg/m^3, S_{yt}= 370 MPa

2) Roller Dimensions

D_1= Outer diameter of roller = 60 mm

D_2= Inner diameter of roller = 45 mm

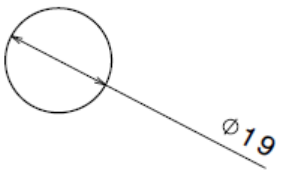
w = Width of roller = 780 mm

3) Weight of Rollers = Cross-Section Area X Width X Mass Density X Number of Rollers

= Π/4(0.060^2 - 0.045^2) X 0.78 X 7870 X 16

= 121.495 Kg

Weight of Shaft



1) Material – Mild Steel -AISI 1018 (AISI-American Iron and Steel Institute)

E_s = 205 GPa, ρ_s = 7870 Kg/m^3, S_{yt}= 370 MPa

2) Shaft Dimension

D = Outer diameter of shaft = 19 mm

w = Width of shaft = 840 mm

3) Weight of Shafts = Cross-Section Area X Width X Mass Density X Number of Shafts

= Π/4(0.019^2) X 0.84 X 7870 X 16

= 29.9896 Kg

Weight of Bearing

1) Standard MRC Bearing,

MRC Bearing Number CONV-4 SFZZ2, Weight =0.099792032 Kg

d= Bore diameter = 19 mm

D=Outer diameter = 45 mm

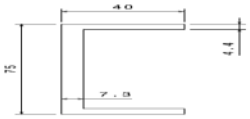
B= width = 15.50 mm

Bearing is suitable for High radial loads, economical. Total bearing used = 32

2) Total Weight of Bearing = 32 X 0.099792032

= 3.1933 kg

Weight of C- Channels for Supports



1) Material- Rolled Steel C-10,

E_c= 200 GPa, ρ_c = 7700 Kg/m^3, S_{yt}= 450 MPa

2) Support Channel Dimensions

Given C- Channel, ISMC 75

h= Depth of section, t_f = thickness of flange, t_w = thickness of web,

A= Sectional area L=Length of channel b= width of section

L= 750 mm, h= 75 mm, b= 40 mm , t_f = 7.3 mm

t_w = 4.4mm

A = [2(40 X 4.4) + (66.2 X 7.3)] = 835.26 mm^2

3) Weight of Channels = cross section area X length X mass density X Number of Channels

= 835.26 X 10^{-6} X 0.75 X 7700 X 4

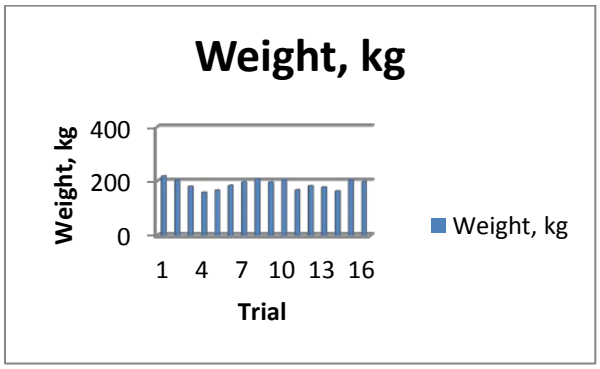
= 19.2945 Kg

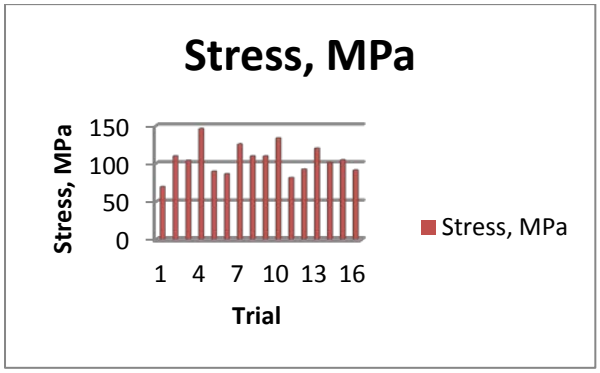
TABLE NO 2.1 TOTAL WEIGHT OF CONVEYOR ASSEMBLY

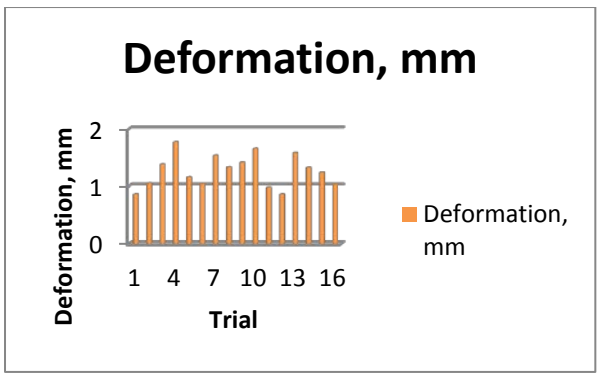
Sr. No.	Name of Component	Weight (Kg)
1	C- Channel for Chassis	44.26
2	Rollers	121.495
3	Shafts	29.9896
4	Bearing	3.1933
5	C- Channel for Supports	19.2945
	Total	**218.20**

From existing analysis we get that stresses generated are 75.879 MPa and Deformation is 0.792 mm; while from optimized analysis we can see that Stresses are 101.53MPa and Deformation is 1.3219 mm .

- Weight for existing conveyor system using FEA is 218.89 kg and for optimized assembly is 163.37 kg
- From DOE results we can see that Roller thickness is having highest impact on weight, Stresses and deformation; i.e. it plays important role in weight reduction in this case.
- FEA deformation is 1.32 mm and experimental deformation is 1.36 mm and is close to each other.







REFERENCES

[1] Ying WANG,Chen ZHOU "A Model and an Analytical method for conveyor system in distribution centers" J SysSciSysEng (Dsc2010) 19(4) 408-429

[2] Rajkumar Roy, SrichandHinduja , Roberto Teti, "Recent advances in engineering design optimization: Challenges and future trends", CIRP Annals - Manufacturing Technology 57 (2008) 697–715.

[3] T. Gaoa,W.H. Zhanga, J.H. Zhua, Y.J. Xua, D.H. Bassirb, "Topology optimization of heat conduction problem involving design-dependent heat load effect", Finite Elements in Analysis and Design 44 (2008) 805 – 813.

[4] M. A. Alspaugh, "Latest Developments in Belt Conveyor Technology" MIN-Expo 2004, Las Vegas, NV, USA. September 27, 2004.

[5] S.H. Masood· B. Abbas · E. Shayan · A. Kara "An investigation into design and manufacturing of mechanical conveyors Systems for food processing", Springer-Verlag London Limited 2004.

[6] DimaNazzal, Ahmed El-Nashar" Survey of Research in Modeling Conveyor-Based Automated Material Handling Systems In wafer fabs" Proceedings of the 2007 Winter Simulation Conference.

[7] John Usher, John R, G. Don Taylor "Availability modeling of powered roller conveyors".

[8] C.Sekimoto "Development of Concept Design CAD System", Energy and Mechanical Research Laboratories, Research and Development Center, Toshiba Corporation.

[9] Sergio Butkewitsch, Valder Steffen Jr. "Shape optimization, model updating and empirical modeling applied to the design synthesis of a heavy truck side guard", International Journal of Solids and Structures 39 (2002) 4747–4771.

[10] Che Jing, Tang Shuo, "Research on integrated optimization design of hypersonic cruise vehicle", Aerospace Science and Technology 12 (2008) 567–572.

[11] Pradnyaratna A Meshram1, Dr. A R Sahu2 "Design , Modeling and Analysis of conveyor system used for transportation of Cartons"

[12] Kyoungho An, Adam Trewyn, Aniruddha Gokhale "Model-driven Performance Analysis of Reconfigurable Conveyor System used in Material Handling Application"

[13] A Singh, S.P.Joshi "A Review on Design of Live Roller Conveyor System" IJSTE(Volume1 Issue 1 May 2015)

[14] Suhas M. Shinde and R.B. Patil , Design and analysis of a roller conveyor System for Weight Optimization and Material saving (IJET, 25 Apr 2012).

[15] "Structure & Mode Shape Analysis of Roller conveyor Using FEA" (RajratnaA.Bhalerao, Dr. R.J. Patil, IJRAME-II, 6 June 2014)

[16] M.S. Deepak, R. Kandasamy, Dr. R. Thenmozhi Investigation of lateral – torsional buckling of Cold-formed steel c-channel sections , (IETED-II, Vol 4, May 2012).