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Design, Analysis and Weight Optimization of Roller Conveyor System by using Glass Fiber Composite Material

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Abstract: ***In this paper I studied problem in existing conveyor system and optimized critical part of roller conveyor system like Roller. Industrial roller conveyor having MS rollers due to this sagging is induced in roller support. Hence Company required optimizing weight of roller to avoid sagging.***
Paper contains geometrical modelling and finite element analysis of existing design and optimizes design. Geometrical modelling is done Using CATIA V5R20 and FEA was done with the help of ANSYS 14.5. also manufacturing of new roller using glass fiber material and testing of both roller by using UTM to validation of ANSYS results.
Keywords: Composite material, Roller Conveyor, Weight optimization.

I. INTRODUCTION

Today's world is of automation and modernization in the manufacturing techniques. Material Handling is the part of this modern technique which are of importance in any of the industry. Almost every item of physical commerce is transported on a conveyor or lift truck or other type of material handling equipment in manufacturing plants, warehouses, and retail stores. Conveyor system is used for transportation of material from one place to other.
It is a material handling equipment that moves heavy and bulky material [1]. conveyors transport material with fast and efficiently, which make them very popular in packaging industries for material handling. Many types of conveyor systems are available like powered operated, nonpower operated, gravity conveyor, chain conveyor, roller conveyor, vibrating conveyor, pneumatic conveyor etc. and they are used according to the needs of different applications. Many factors are important to selection of accurate conveyor. Roller conveyor consists c-channel, bearings, rollers etc. for reducing cost and weight roller is a measure parameter [3]. Size and shape optimization technique used for reducing weight of roller. In conveyor now, a day's various advanced safety features added which help to prevent accidents [4]. Existing conveyor are used for moving water bottles which is 25 kg. so, load is divided on two rollers which is 12.5 kg.
Conveyor can be safer than using forklift or other machine to move materials [5]. They can be used in various industries like agriculture, automotive, computer, electronic, aerospace, food processing, bottling and canning, chemical, print finishing and packaging etc. [6].
There are many options available for running the conveyor such as hydraulic, pneumatic, mechanical, electric and fully automated system. Non-powered, gravity roller conveyors are used for moving unit load applications [8]. Testing and manufacturing is not possible for each roller so for optimizing weight of roller it's an iterative process for manufacturing physical design. It could be done by suitable software for analysis. For optimization glass fibre composite material used and appropriate new design of composite material get by iterative method and using optimization tool.

II. PROBLEM STATEMENT

The aim of this project is to redesign existing gravity roller conveyor system by designing the critical parts (Roller, Shaft, Bearing and Frame) to minimize the overall weight of the assembly and to save considerable amount of material. Industrial roller conveyor having MS rollers due to this sagging is induced in roller support.
Sagging problem occurs due to its own weight. Weight of existing conveyor is maximum. If we want to optimize weight of roller conveyor then 70% weight is only about roller.

III. GEOMETRICAL MODELLING OF ROLLER CONVEYOR

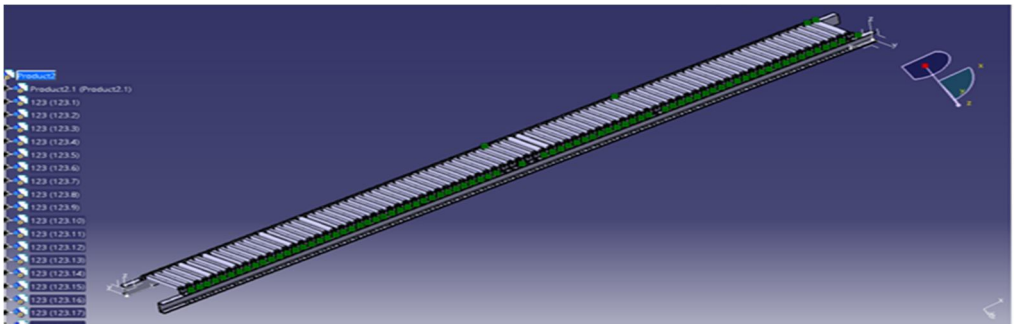


Fig 1- Conveyor Assembly

IV. FINITE ELEMENT ANALYSIS

For static analysis applied load is uniformly distributed (12.5 kg) because material is weight is divided on two rollers.

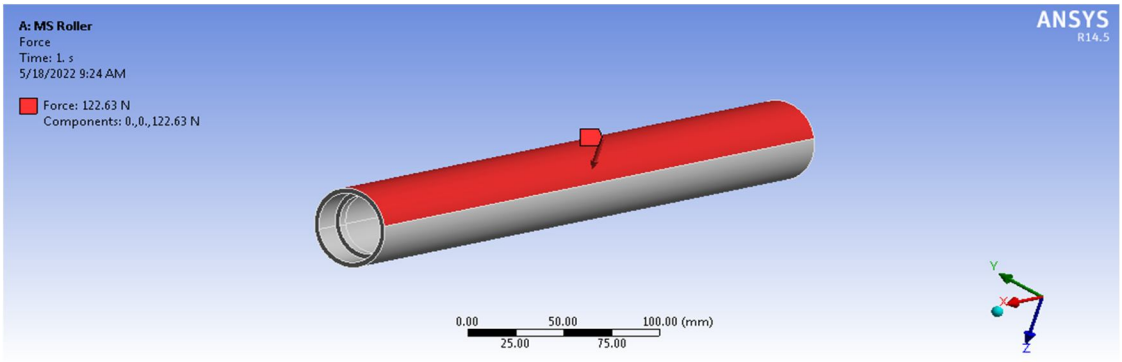


Fig 2 UDL Load on Roller

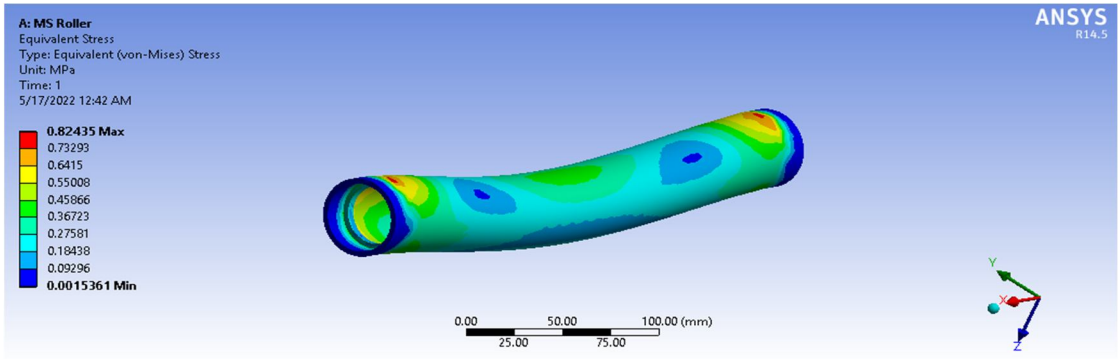


Fig 3 Equivalent Stress

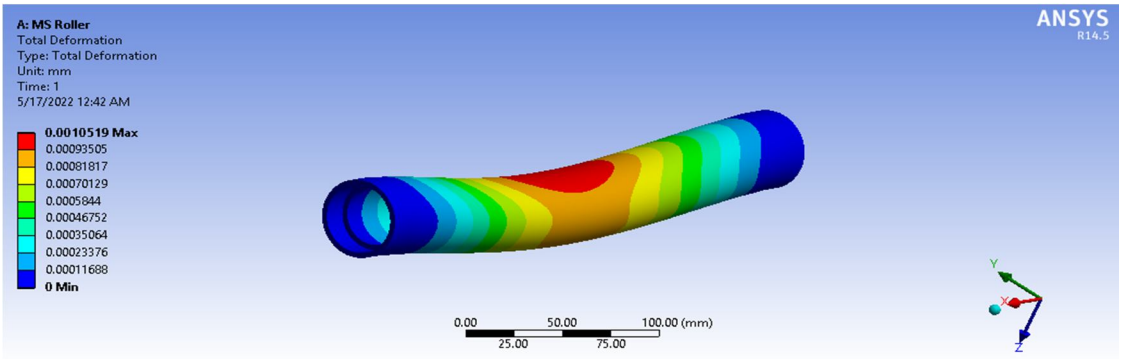


Fig 4 Total Deformation

Glass Fibre Roller

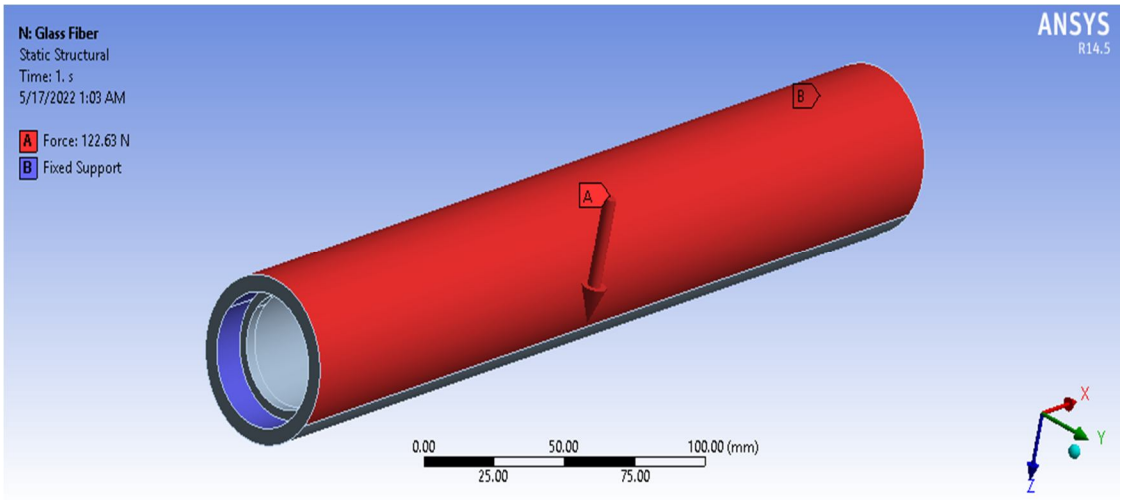


Fig 5 Load on Roller

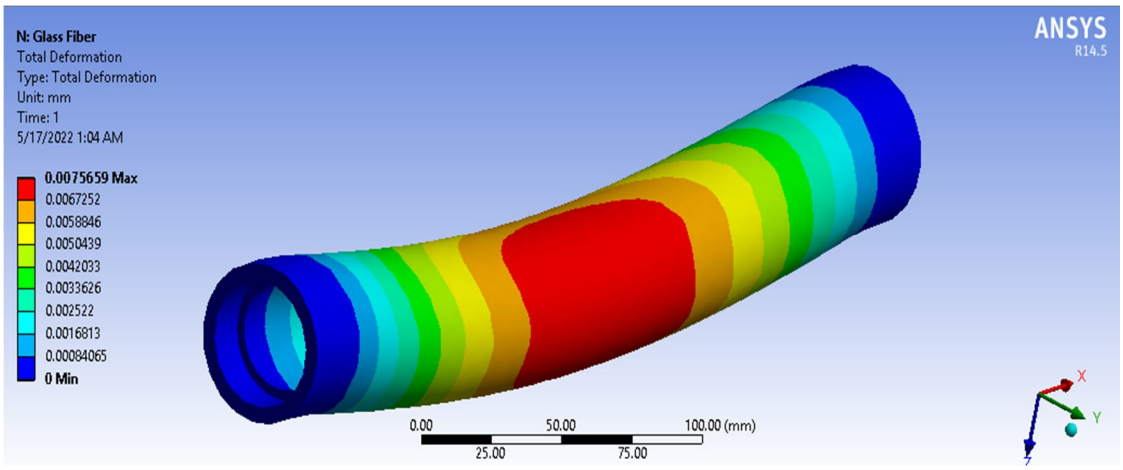


Fig 6 Total Deformation

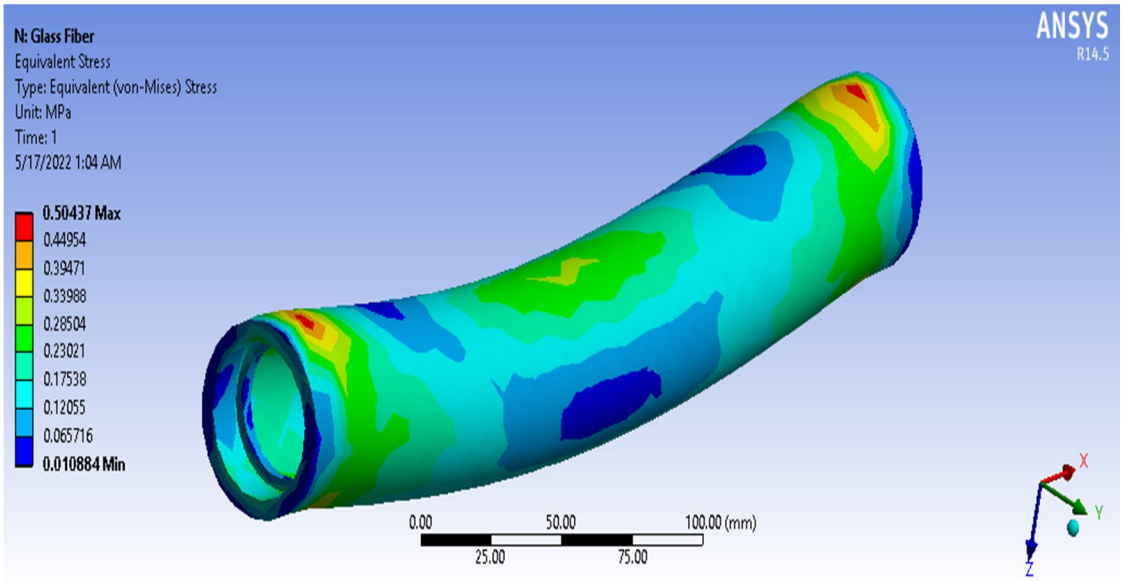


Fig 7 Total Stress

V. EXPERIMENTATION

A. Set-up for MS roller Deformation Testing on UTM

For experiments, existing roller conveyor designed and manufactured and this roller is tested under various loads for measuring maximum deformation. Fig 19 a) and fig 19 b) shows UTM is used for measuring MS and GF rollers maximum deformation. Actual physical model used for validation using optimized designed for finding that design is safe or not.

Fig. 8 Experimental setup of MS roller

Fig 9 Experimental setup of Glass fibre roller

VI. RESULT

Fig.20 shows the relation between load and displacement developed in the both rollers. It is observed that the steel roller having less deformation than glass fiber roller.

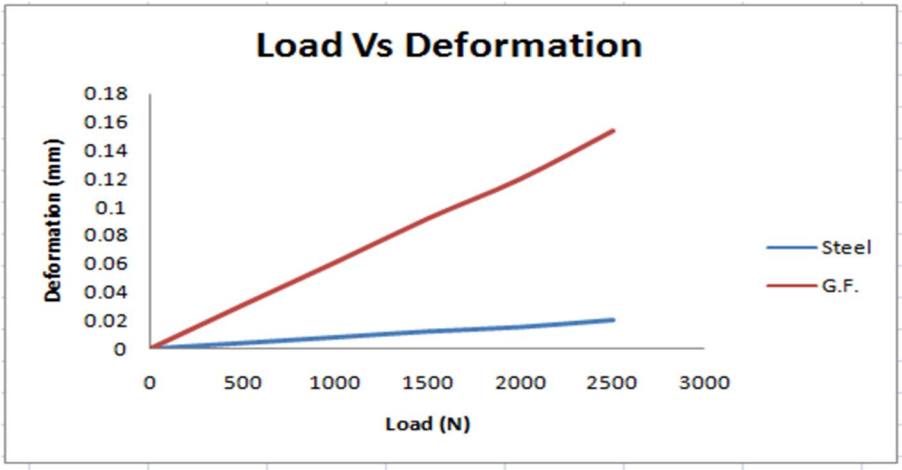


Fig.10 Load Vs Deformation of both Rollers UTM Result

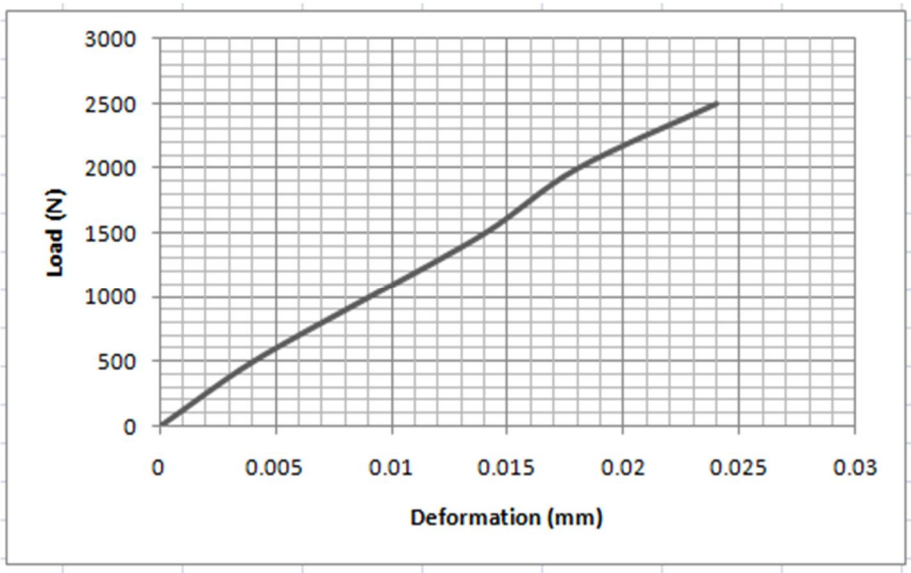


Fig.11 Load Vs Deformation of Steel Roller on UTM

Fig. 11 shows that when load gradually increases up to 2500 N it gives deformation level 0.024 mm for steel roller.

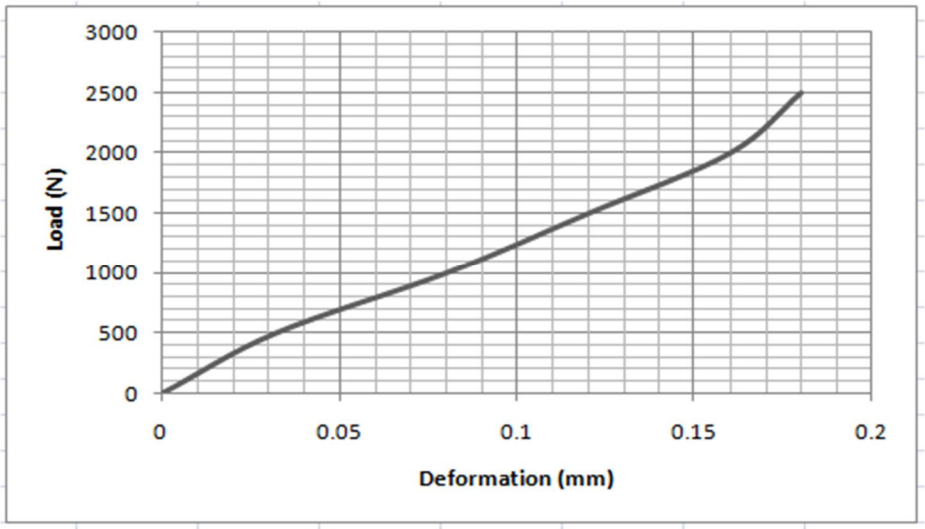


Fig12 Load Vs Deformation of Glass fibre Roller on UTM

Fig. 12 shows that when load gradually increases up to 2500 N it gives deformation level 0.18 mm for glass fibre roller.

Table 1 Deformation and bending stress

Sr. No.			FEA	Theoretical	Testing
1	Deflection (mm)	Steel	0.002	0.00409	0.005
2		E-Glass	0.012	0.01038	0.02
1	Bending stress (Mpa)	Steel	1.27	1.24	NA
2		E-Glass	0.71	0.782	NA

Table 2 deformation FEA and Testing results for MS

Load (N)	Testing	FEA
500	0.0041	0.003
1000	0.0078	0.0079
1500	0.014	0.011
2000	0.017	0.015
2500	0.024	0.0199

Table 3 deformation and FEA results for GF

Load (N)	Testing (mm)	FEA
500	0.038	0.03
1000	0.08	0.061
1500	0.12	0.11
2000	0.16	0.12
2500	0.18	0.15

Table 4Analytical Weight of Roller Conveyor

Sr No	Part	Qty.	Weight(kg)	Total Weight(kg)
1	Bearing	168	0.3	50.4
2	C-channel	2	57.575	115.15
3	L-section	168	0.21	35.28
4	Roller	84	1.10	92.09
5	Shaft	84	3.542	297.52

Total weight of roller conveyor = 556 kg

VII. CONCLUSION

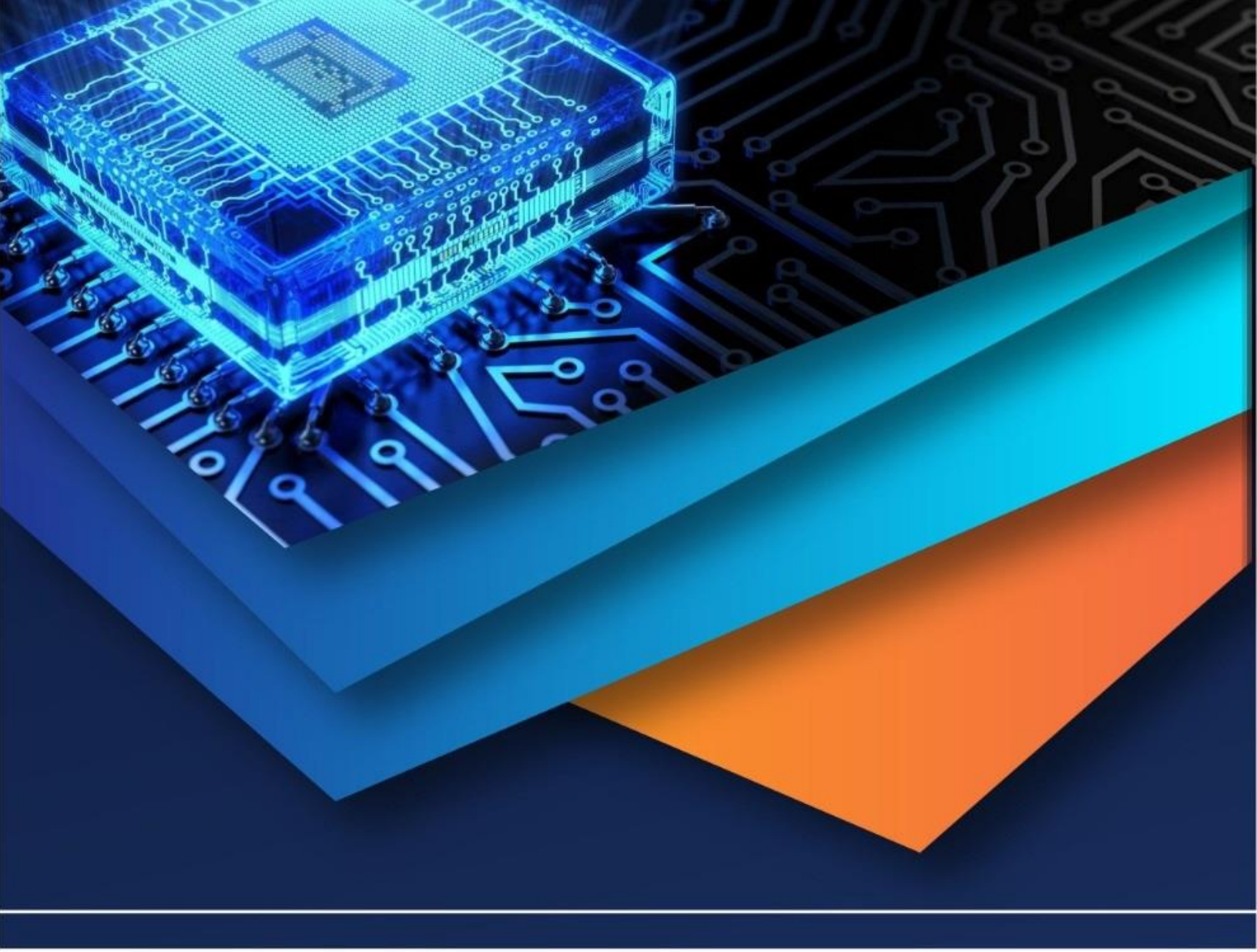
After studied the existing conveyor get the information about geometrical as well as structural analysis of roller conveyor and we will get the result of equivalent stress and deformation at required force.

When MS material is used, stress is more as compared to GF composite material. Value of deformation and stress is more in case of GF but it is allowable. GF composite material used for weight reduction at the same capacity of roller conveyor system. 42.42% of weight reduction done. Another benefit is that by using glass fibre roller noise get reduced than MS.

REFERENCES

[1] Goldberg, D. E. “Genetic algorithms in search, optimization, and machine learning”. New York: Addison-Wesley,1989.
[2] Back T., Fogel, D., and Michalewicz, Z. (Eds.) “Handbook of evolutionary computation. New York: Institute of physics publishing and oxford university press.” 1997.
[3] Chun-Hsiung Lan, “The design of a multi-conveyor system for profit maximization” International journal advanced manufacturing technology 22: 510–521, 2003.
[4] Alsbaugh M.A. "Latest developments in belt conveyor technology", Overland conveyor Co., Inc Presented at MINExpo, Las Vegas, USA. 2004.
[5] Masood S.H. Abbas B., Shayan E. and Kara A. "An investigation into design and manufacturing of mechanical conveyors systems for food processing", springer-Verlag London limited ,2004.
[6] Long R., Rom T., Ansel W.H., Ansch T.W.H. and Reichel J. "Long distance magnetic conveyor for precise positioning of ultra-cold atoms" Eur. Phys J.D.35, 125-133, 2005.
[7] Nazzal and Nashar Ahmed, "Survey of research in modelling conveyor-based automated material handling systems in wafer fabs” proceedings of the winter simulation conference, 2007.
[8] John R. English, John Usher, “Availability modelling of powered roller conveyers” university of Arkansas, 2010.
[9] S. M. Shinde, R.B. Patil, “Optimization technique used for the roller conveyor system for weight reduction” International journal of engineering research & technology, Vol. 1 Issue 5, 2012.

[10] Yogesh T. Padwal, S.M. Rajmane, "Weight reduction technique used for a roller conveyor "International journal of latest trends in engineering and technology, E-ISSN2249–8974, 2013.
[11] S.S. Gaikwad, N. Aitavade, "Static analysis of a roller of gravity roller conveyor for structural strength & weight optimization" International journal of advanced engineering technology,0976-3945, 2013.
[12] Wang Ying and Zhou Chen, "A model and an analytical method for conveyor system in distribution centers", 2010.
[13] Amol B. Kharage, Balaji Nelge, Dhumal Ketan, "Analysis and optimization of gravity roller conveyor using Ansys" International journal of engineering sciences & research technology: 2277-9655, 2015.
[14] Pradnyaratna A. Meshram, A R Sahu, "Design, modelling and analysis of conveyor system used for transportation of cartons" International journal of research in advent technology, Vol.4, No.1: 2321-9637, 2016.
[15] Mr. S.M. Math, S.B. Naik, "Review of finite element analysis of roller conveyor for material handling system" International journal of advance research in science and engineering, Vol.5, Issue No. 6, 2016.
[16] P.S. Solankar, "Design and analysis of roller conveyor for weight reduction by using composite material" International journal of engineering sciences & research technology: 2277-9655,2016.
[17] Prashant Boke, Abhijit Kabule, "FEA of conveyor roller and optimization by using composite material" International conference on ideas, impact and innovation in mechanical engineering ISSN 934-942, 2017.
[18] Chun-hsiunglan, "The design of a multi-conveyor system for profit maximization" international journal adv, 2003.
[19] Alsbaugh M.A. "Latest developments in belt conveyor technology", Las Vegas, USA. 2004.
[20] Masood S.H. Abbas B., Shayan E. and Kara A. "An investigation into design and manufacturing of mechanical conveyors systems for food processing", springer-Verlag London limited ,2004.



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