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Roller Chain Conveyor Linkfailure Analysis & Optimization

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ABSTRACT

Roller conveyor chains are mostly preferred in production or assembly lines to transport goods as a material handling system. Roller chains have to deal with different environment conditions, chemicals. This causes wear and tear of components of chains and hence unexpected failure and costly production. A conveyor consists of two or more endless strands of chain with attached non interlocking slats or metal flights to carry the material. Other examples are conveying pallets, tree-stumps or even whole cars. Wheeled cars, for example, can be carried by the chain but can also be pulled by the chain. In resent work I have studied the different failures of roller conveyor chain links under different loading conditions using Mild Steel. In chain conveyor system motor capacity of conveyor depends on the weight of chain. It was determined that maximum amount of weight of chain conveyor is covered by outer link and inner link. We concentrated on both link and weight reduction of link by using composite material (Glass Fiber & Carbon Fiber) to reduces the power requirement of conveyor.

Keywords— **Design of chain links, failure cases of chain system, Analysis using ANSYS,Chain Link Deformation**

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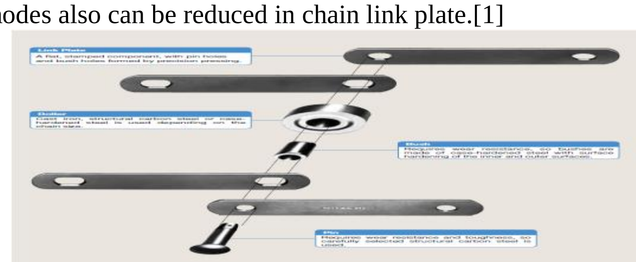
I. INTRODUCTION

A roller chain is known and used as a mechanical element for drive train or parts Conveyance systems In this paper the focus has been narrowed down to specific component of outer link because maximum stresses will be produced on outer link as compare to other components. In a case of long-distance transmission using a metal chain, a large driving force is required owing to the enlarged mass of the chain. To solve such a problem, weight saving for the chain is desired. Till now material steel and polymer has been used for the conveyor chain link but, with steel the design is so big, with steel its weight is more so, in this paper Analysis of the chain has been done with composite material to minimize weight of the link and failure modes. Its design is small as compared to steel and with this material failure modes also can be reduced in chain link plate.[1]



I. PROBLEM STATEMENT

Conveyor chain is the major mechanical material handling system which is used in today's industry so, it is very important to study about its failure and try to save it from failures. In case of long distance transmission with metal chain, large driving force is required to cover the huge mass of chain that means of course here power requirement is also high according to the weight of chain. So, weight is the main problem with metal chain. Moreover, most of the time chain is under tension while moving on track with heavy pallet sand this tension which causes failure of chain assembly which is the major problem for industrial sector such as, wear, fatigue Failure, noise, vibration, pin bushing galling etc. Causes of this failure are improper design mainly. For instant now material steel have been using for link .With steel it's design is quite big, moreover, it's factor of safety is approximately 10 and weight of the link is quite high. All these parameters can be considered simultaneously and chain link design optimally.

III.SELECTION OF CONVEYOR CHAIN

A suitable type of chain has to be selected for horizontal slat conveyor:

Given values:

Transported material	brown coal
Conveyor length	30mFlow
	30
Conveyor conduit width	350mm
Conveyor conduit height	250 mm
Number of chains	1 Number of
teeth of the sprocket	9 (pre-selected)

Corresponding type of chain according to DIN 8167 (ISO 1977) is MRC 80 x 125.

IV.MATERIAL PROPERTIES

Sr.No	Property	Steel	Glass Fiber	Carbon Fiber
	Ex (MPa)		43000	177000
1	Ey (MPa)	210000	6500	10600
	Ez (MPa)		6500	10600
	PR XY		0.27	0.27
2	PR YZ	0.3	0.06	0.02
	PR ZX		0.06	0.02
	GX		4500	7600
3	GY	410000	2500	2500
	GZ		2500	2500
4	ρ (kg/mm³)	7850	0.000002	0.0000019

V Finite Element Analysis

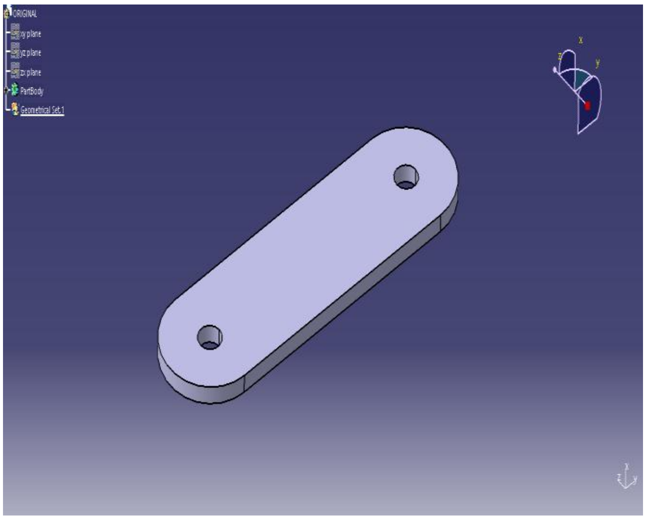


FIG 1 Outer link CATIA model

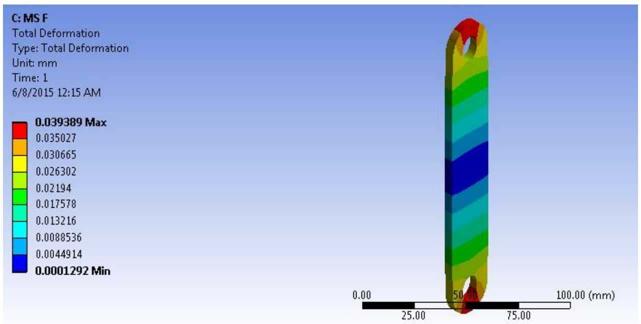


FIG 2 Deformation of the Mild Steel Link

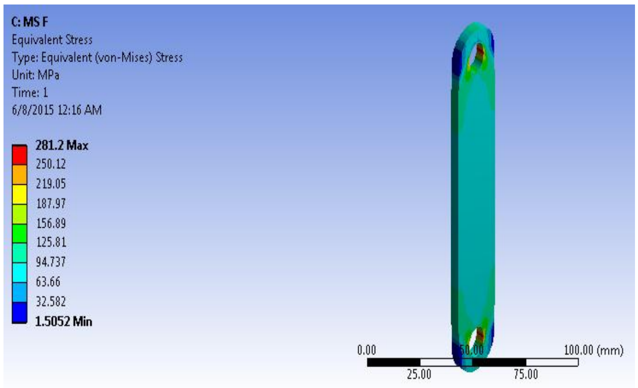


FIG 3 Stresses in Mild steel Link

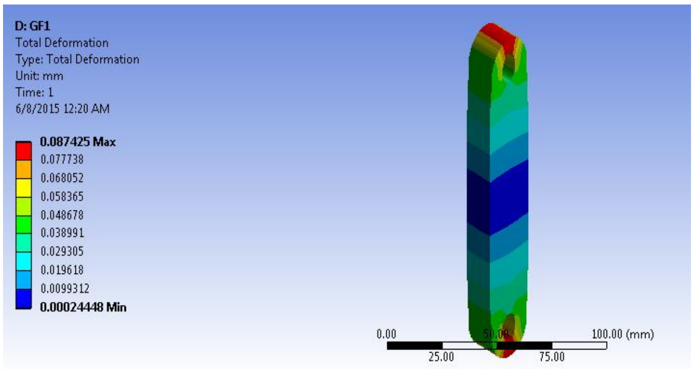


Fig 4 Deformation of glass fiber link

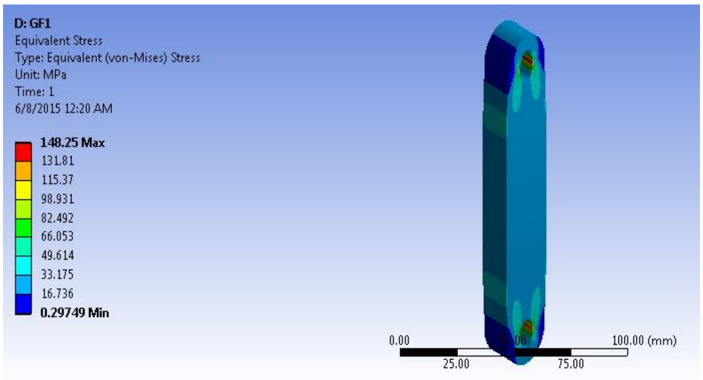


Fig 5Stresses in glass fiber link

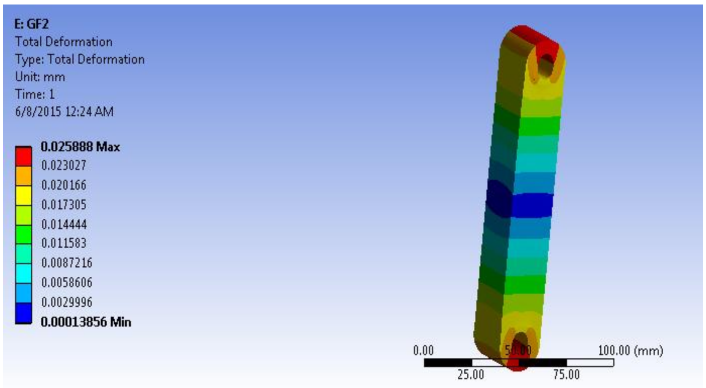


Fig 6 Deformation in Glass Fiber with Mild Steel bush

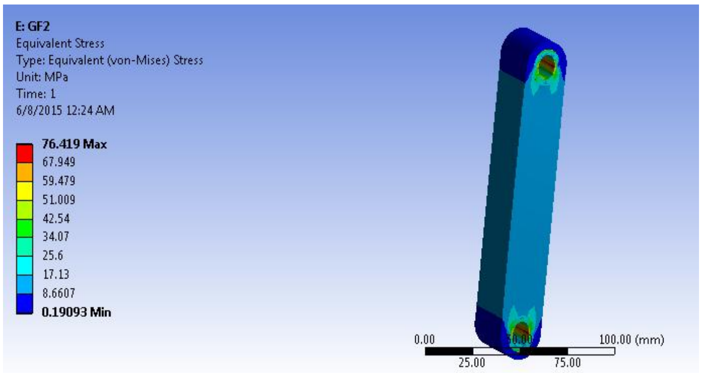


Fig 7 Stresses in Glass Fiber with Mild Steel bush

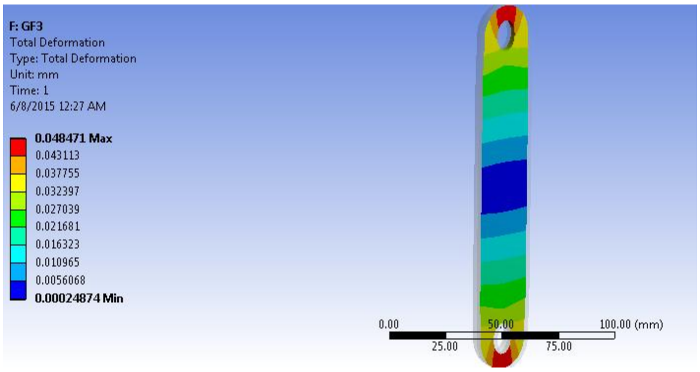


Fig 8 Deformation in Combination of Glass fiber and Mild Steel (Sandwich)

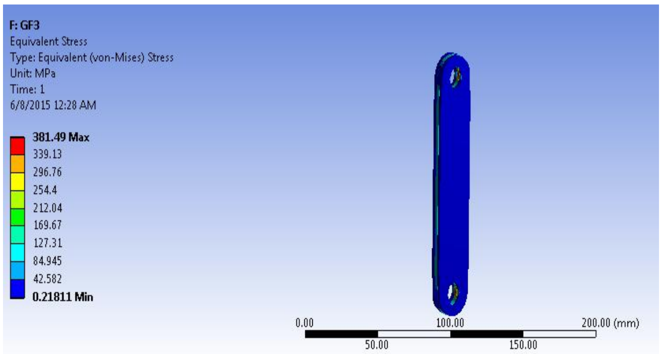


Fig 9 Stresses in Combination of Glass fiber and Mild Steel (Sandwich)

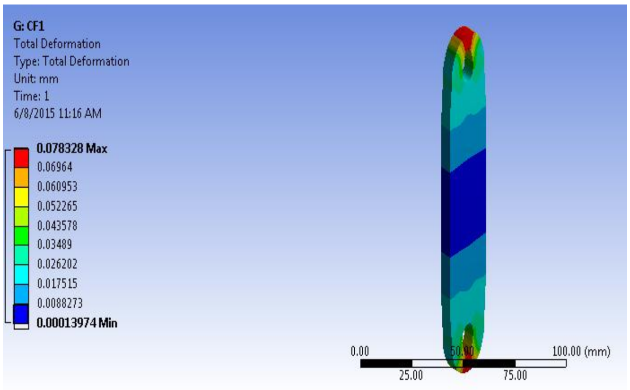


Fig 10 Deformation in Carbon Fiber Link

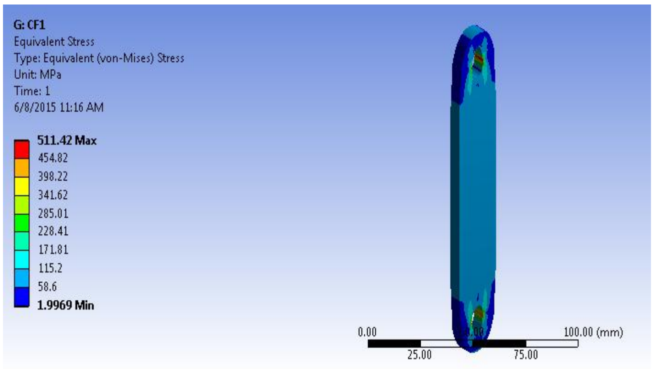


Fig 11 Stresses in Carbon Fiber Link

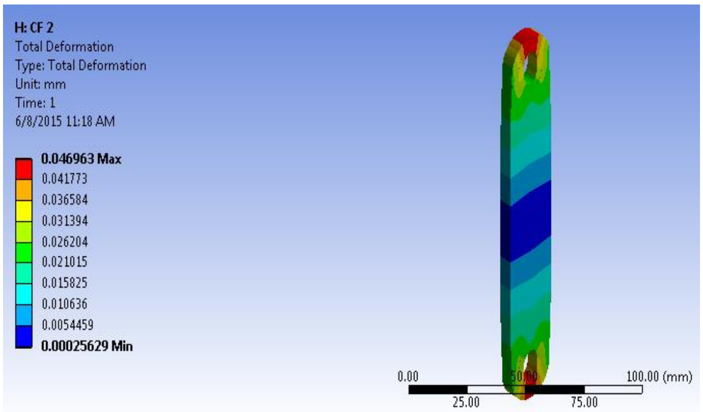


Fig 12 Deformation in Carbon Fiber Link with Mild Steel bush

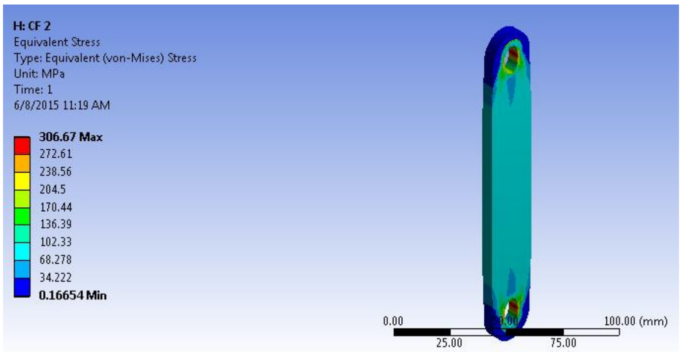


Fig 13 Stresses in Carbon Fiber Link with Mild Steel bush

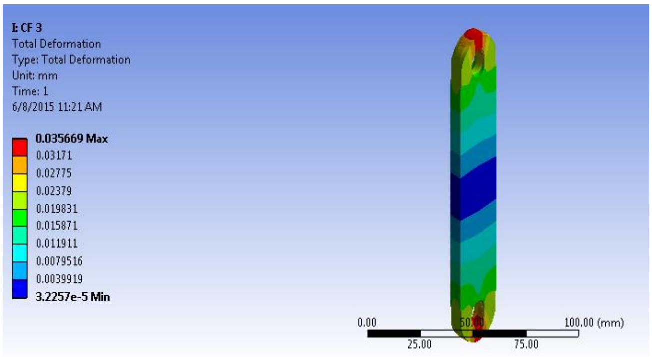


Fig 14 Deformation in Carbon Fiber and Mild Steel(Sandwich)

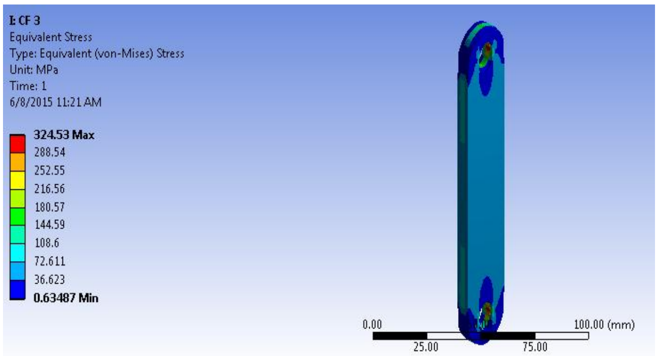


Fig 15 Stresses in Carbon Fiber and Mild Steel(Sandwich)

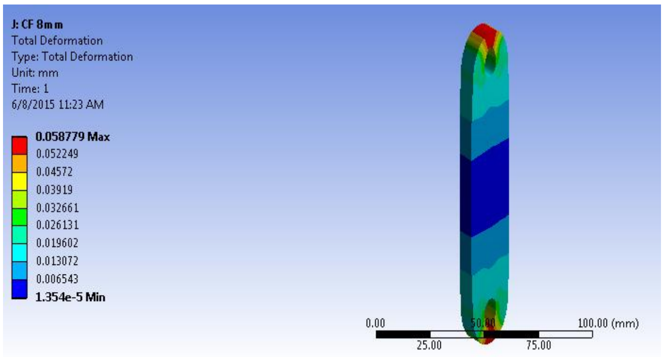


Fig 16 Deformation in Carbon Fiber with 8 mm thickness

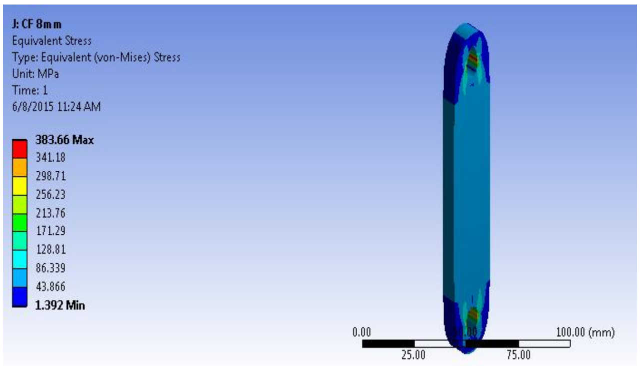


Fig 17 Stresses in Carbon Fiber with 8 mm thickness

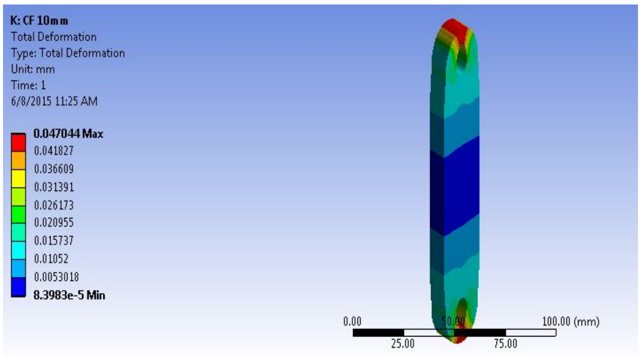


Fig 18 Deformation in Carbon Fiber with 10 mm thickness

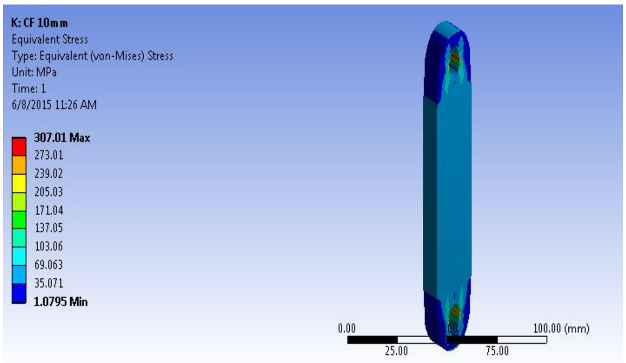


Fig 19Stresses in Carbon Fiber with 10 mm thickness

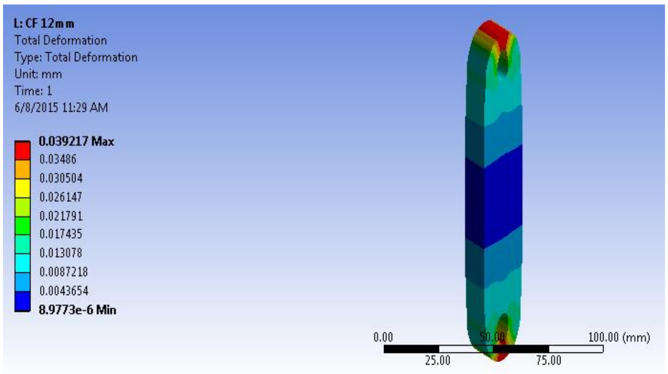


Fig 20 Deformation in Carbon Fiber with 12 mm thickness

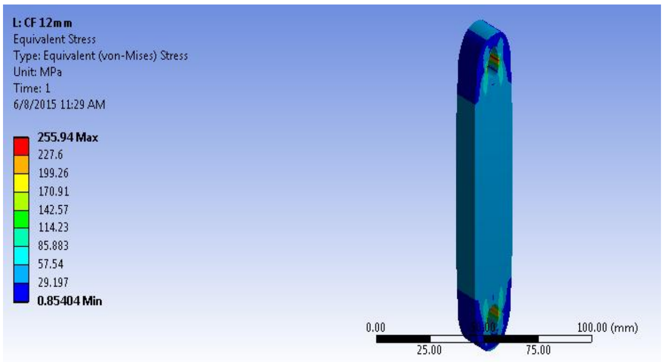


Fig 21 Deformation in Carbon Fiber with 12 mm thickness

VI. COMPARATIVE RESULT TABLE

SR. NO.	Material	Thickness (mm)	Total Deformation (mm)	Equivalent Von Mises Stress (MPa)	Weight (kg)
1	MS	5	0.03938	281.2	0.13446
2	GF	15	0.08742	148.25	0.10227
3	GF+MS Bush	15	0.25888	76.149	0.22077
4	GF+MS+ GF	15	0.04847	381.49	0.10111
5	CF	6	0.07832	511.42	0.03288
6	CF+MS Bush	6	0.04696	306.67	0.03656
7	CF+MS+ CF	6	0.03586	324.53	0.09156
8	CF	8	0.058779	383.66	0.04385
9	CF	10	0.047044	307.01	0.05481
10	CF	12	0.039217	255.94	0.06577

VII. CONCLUSION

Static analysis was performed and in results it is found that there is a maximum deformation of 0.039389 mm in the mild steel link and the Corresponding deformation in carbon fiber is 0.039217mm. We can also see that the von-misses stress in the mild steel is 281.2 MPa. And the von-misses stress in carbon fiber is 255.94 MPa. A comparative study has been made between steel and composite link with respect to strength and weight. It must be noted that in typical industrial application thousands of such links will be needed. Thus, the weight and material saving will have significant impact on cost of the chain. So, to achieve second objective, 51.08% Weight reduction was achieved with composite material

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