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An analytical study of mechanical power transmitting by utilizing CATIA and ANSYS techniques

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Abstract
This paper involves the fundamentals of chain drive modeling through reverse engineering approach. In this examination chain drive is broke down utilizing finite element analysis for wellbeing and dependability. A cad model of chain drive is designed in CATIA V5 part module. Pre-processing and post-processing operations are done in ANSYS workbench.
In this project, we applied material properties of AISI 1050 steel, EN 8 steel, EN 32 steel, EN 19 steel and C45 steel at different vehicle speeds (40,60 and 80 km/hr) values for Von-Missies, total deformation, equivalent strains and stresses has been compared.
Keywords: steel alloys, speed, CATIA and ANSYS

1. INTRODUCTION

Chain drive is a method of sending mechanical force starting with one spot then onto the next. It is frequently used to pass on capacity to the wheels of a vehicle, especially bikes and cruisers. It is likewise utilized in a wide assortment of machines other than vehicles [1-3].
Regularly, the force is passed on by a roller chain, known as the drive chain or transmission chain, ignoring a sprocket gear, with the teeth of the apparatus fitting with the gaps in the connections of the chain [4][5]. The rigging is turned, and this pulls the chain placing mechanical power into the framework. Another sort of drive chain is the Morse chain, developed by the Morse Chain Company of Ithaca, New York, United States. This has altered teeth [6].

Fig:1 chain sprocket

Materials Used

A chain sprocket can be made of different materials based on required strength and service conditions. In this an examination is established on materials of iron family element, an alloy and a carbon element [7].

This gives a better choice of chain sprocket based on application. As materials reduce in weight, noise and cost will improve efficiency of chain sprocket [8].

AISI 1050 STEEL

Carbon steels hold numerous carbons Similarly as those fundamental alloying components. They are designated Toward AISI four-digit numbers, and hold 0.4% for silicon and 1.2% about manganate. Molybdenum, chromium, nickel, copper, and aluminum would be introduced in little amounts [9-11].

EN 8 STEEL

EN8 steel material is suitableness for those the greater part all building provisions requiring a higher quality over gentle steel similar to:

- General-purpose axles
- Shafts,
- Gears,
- Bolts and studs.

C45 steel	210000	700	0.3	0.0000078

2. LITERATUREREVIEW

EN 32 STEEL

EN32 is a case solidifies steel by little tensile power to be utilized in all-purpose engineering production of lightly stressed components.
The material displays good weld ability and mach inability characteristics in the supplied condition and has a solid exhausting exterior. EN32 is group as an unalloyed low carbon grade [12-14].

EN 19 STEEL
EN19 is a high quality, high tensile steel usually supplied readily machine able in 'T' condition, giving good ductility and shock resisting properties combined with resistance towear [15].

C45 GRADE STEEL
C45 grade steel is defined as a medium carbon steel offering tensile strength in the modest range. The material can be maneuvered with hardening by means of quenching and tempering on focused and restricted areas. C45 can also be instigated with induction hardening up to the hardness level of HRC 55 [16].

Table: 1 mechanical properties of materials:

Mate rials	Young's modulus(Mpa)	Tensile strength(Mpa)	Poisson's ratio	Density (kg/mm3)
AISI	200000	690	0.29	0.000007

1050 carbon steel				85
EN 8 steel	190000	465	0.3	0.000000 78
EN32 steel	206000	430	0.29	0.000000 70
EN19 steel	205000	1230	0.3	0.000008

Based on Literature Review, different design optimization processes and techniques were worn by different researchers. Some of them re-designed the Chain sprocket, dissection utilizing FEA and utilizing the effects starting with FEA they optimized the weight of sprocket [17]. A percentage need provided for heat medication By Different sorts for compound medicine of the sprocket will improve its mechanical properties. To this review, large portions universal and national papers were supportive. Overall specialists bring connected the deliberations should plan By attempted with streamline those weight for chain sprocketas,. [18] Tushar d. Bhoite et al mulled over under Different requisition viewpoints By manufacturing viewpoints on plan A thought of the framework. At long last limited component Investigation (FEA) need been used to behavior state streamlining. Since great deal of worth of effort need at that point been carried over different components, in this fill in the concentrate need been limited down with particular part from external connection. Inside the external link, most oak measurements in the industry would parametrically define, nonetheless morals person dimension, the span that is amidst the bury vivos trust interfacing gaps will be left with producer comfort. In this paper we evaluate the sway for this span on the anxiety in the framework Also check whether material sparing By Subsequently effectiveness increase is possible. 1. [19] m. Koray KESİKÇİ generally investigated On expositive expression the hypothetical contrasts and the superiorities of the systems over one another (. In the study, roller chains which are utilized By pulling Also crashing parts for materials taking care of components are inspected. Stress Investigation of a standard roller chain connection is performed utilizing both limit By limited component techniques. The mechanical practices of a standard roller chain which will be stacked by the greatest permitted load are recognized. Analyzings those effects of the both systems with one another (and the effects about literature, those proper strategy for those roller chain issue is proposed. [3] shoji noguchi et al recommends a few methodologies for lessening anxieties and weight sparing in the connection plate about roller chain. Anxieties would 3% higher done suggested design, yet the weight decreased done 10%. Ductile tests are performed on connection plates settled on by tar and the viability about recommended model will be affirmed.

[4] Sagar n. Vasoya, p. L. Koradiya by b. J. Patel, “Development for sprocket should change the torque to off way Bike”, in this paper, theprocess.

For improvemen on sprocket might have been contemplated by rigging proportion the middle of them might have been investigated. They examined four sorts for materials which will a chance to be best suiting to sprocket to be specific gentle Steel, Chromoly Steel, carbon fiber Also aeronautics review aluminum compound. They created the sprocket utilizing 15/41 teethe under those 13/39 teethe and found that torque need expanded by 9. 91% By utilizing those created sprocketratio.

[5] Parag Nikam By Rahul Tanpure,” Design streamlining about chain sprocket utilizing limited component Analysis”, in this research, the chain sprocket might have been intended by broke down

utilizing limited component Investigation to safety and dependability. ANSYS programming might have been utilized to static and weariness split Investigation for sprocket plan. Utilizing these effects streamlining for sprocket for weight diminishment need been completed. By sprocket experience vibration, modal examination might have been Additionally performed. The configuration about sprocket need been effectively optimized for weight decrease for 15. 67%. Likewise von-mises anxiety for changed configuration might have been lesseps over preliminary outline with little build to deformation, which Eventually brings about those security And unwavering quality of design..

3. MODELING ANDANALYSIS

CATIA is an acronym for machine helped Three- dimensional intelligent provision. It will be a among the heading 3d product utilized toward associations to numerous commercial enterprises going from aerospace, car will consumer products.
CATIA may be An multi stage 3d programming suited produced by Dassault Systems, including CAD, cam and in addition CAE. Dassault may be a french building titan dynamic in the field for aviation, 3d design, 3d advanced mock-ups, and item lifecycle oversaw economy (PLM) programming.

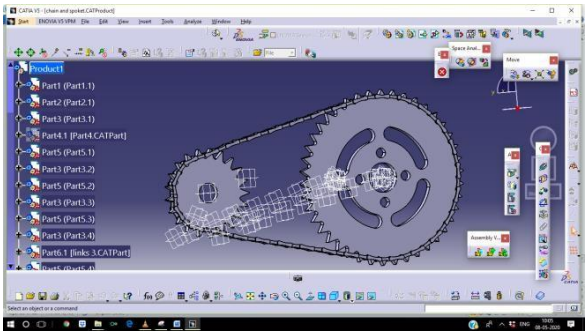


Fig: 3D model of chain sprocket

ANSYS

ANSYS is universally useful limited component examination (FEA) programming bundle. Limited component Investigation is A numerical system for deconstructing an intricate framework under very little bits (of user-designated size) known as components. The programming executes equations that legislate the conduct about these components and solves them all; making a thorough illustration of how the framework acts overall.

Force Calculations

The following calculations are made considering that 2g force acts,

Approximated bike weight = 110 kg+160 (the weight of the bike + 2 persons)

Force = 9.81*270

= 2648.7 N

Rotational velocity Calculations

To alter km/hr to rad/s, multiply by 0.278 to get m/s, and after that divide by the radius of the wheel to get

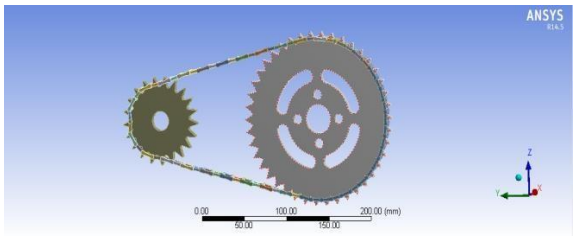
rad/s. (v = rω so ω = v/r

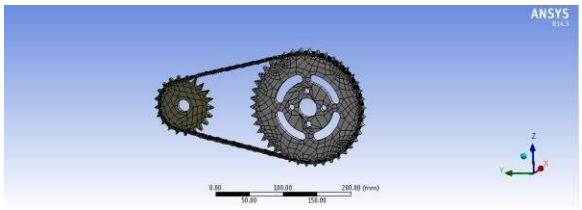
v Rotational speed $(\boldsymbol{\omega})$ r

$=$

STATIC ANALYSIS OF CHAIN DRIVE

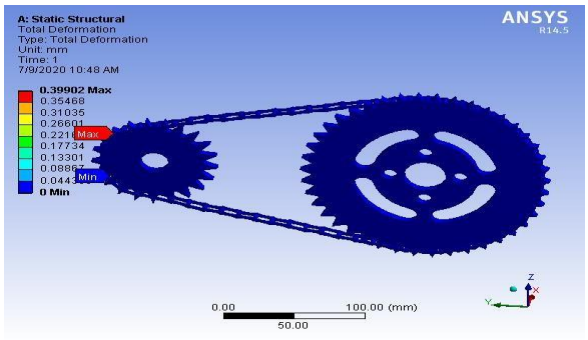
Imported model



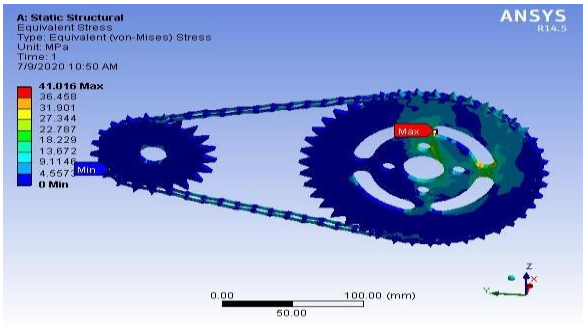


Existing material –stainless steel

At -40 km/hr Total deformation

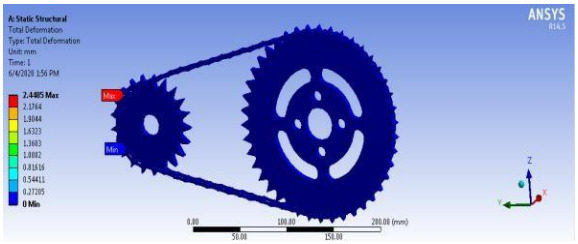


Stress

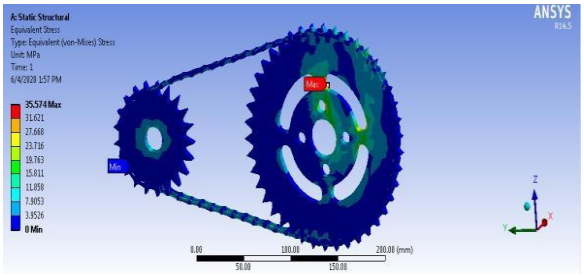


Material: EN 32 Steel At speed -40 km/hr

Total deformation



Stress



RESULTS AND DISCUSSION

Table: results of material stainless steel

Speed (km/hr)	Deformation (mm)	Stress (N/mm^2)	Strain
40	0.39902	41.016	0.0021315
60	1.0417	45.711	0.00023751
80	4.244	63.802	0.00033879

Table: 2 results of material AISI 1050 steel

Speed (km/hr)	Deformation (mm)	Stress (N/mm^2)	Strain
40	2.3598	36.076	0.0001809
60	3.7463	41.26	0.0002068
80	4.0859	48.467	0.0002417

Table: 3 results of material EN8 steel

Speed (km/hr)	Deformation (mm)	Stress (N/mm^2)	Strain
40	0.42236	35.919	0.00018959
60	0.95329	41.095	0.00021689
80	1.4668	48.213	0.00025609

Table: 4 results of material EN32 steel

Speed (km/hr)	Deformation (mm)	Stress (N/mm^2)	Strain
40	1.824	35.574	0.00017318
60	2.4458	40.16	0.00019549
80	8.2948	46.607	0.0022686

Table: 5results of material EN19steel

Speed (km/hr)	Deformation (mm)	Stress (N/mm^2)	Strain
40	4.0518	36.087	0.00017654
60	9.8737	41.36	0.00020219
80	11.252	48.77	0.00024375

Table:6 results of material C 45 steel

Speed (km/hr)	Deformation (mm)	Stress (N/mm^2)	Strain
40	0.5662	35.951	0.00017169
60	0.88231	41.101	0.00019626
80	1.6205	48.163	0.0002309

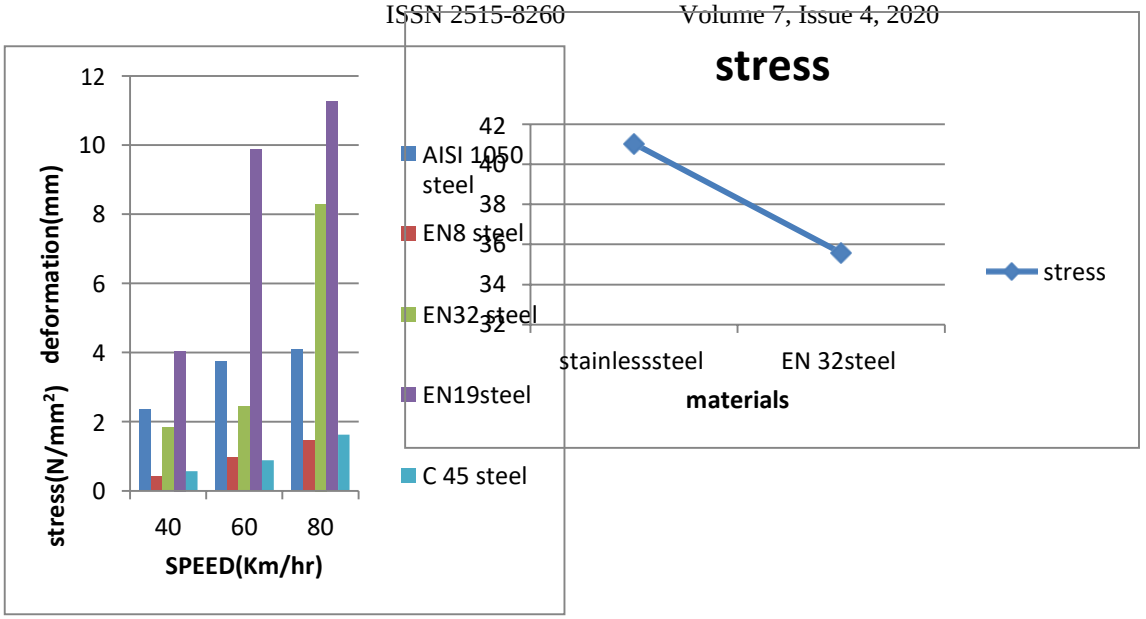
By observing the above results and comparing the five materials and three speeds results are discussed below.

• Total deformation value in EN 8 steel is 0.4226 mm is less at speed of 40 km/hr when we comparing to othermaterials

• Equivalent elastic strain in EN 32 steel is 0.00017167 mm/mm is less compared to othermaterials.

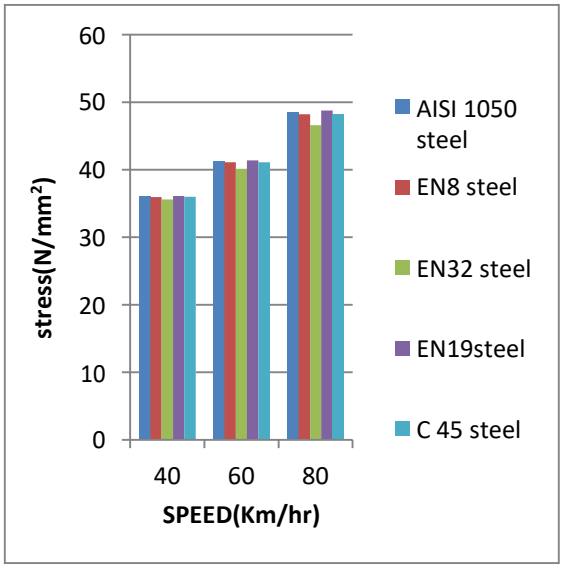
• Equivalent stress or von misses stress of EN 32 steel is 35.574 MPa. Which indicates safer design as the material is ductile in nature.

4. GRAPHS



CONCLUSION

Plot 1: shows comparison of materials and speed versus deformation



Plot 2: shows comparison of materials and speed versus stress
Plot 3: shows stress comparison of existing and proposed material

In this paper, we applied material properties of AISI 1050 steel, EN 8 steel, EN 32 steel, EN 19 steel and C45 steel at different vehicle speeds (40,60 and 80 km/hr) values for Von-Missies, total deformation, equivalent strains and stresses has been compared.

From finite element analysis of above materials, stress values of EN 32 Steel and C 45 Steel are in permissible limits for safer design. As compared to material properties, EN 32 steel is best suited for chain drive due to its low density, availability and less investment. Also, C45 steel alloy shown better results adjacent to EN 32steel.

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