Performance Analysis of the Thompson Constant Velocity Joint by using Finite Element Analysis

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Abstract - *The Thompson Constant Velocity Joints are used for power transmission at constant velocity between two driving and driven shaft it is also allow the shaft to bend and transmit the power. It consists of a two shaft in pair of hinges close together, generally at 90° oriented to each other, connected by a transverse axis. The Thompson Constant Velocity Joint to save the cost of gearing devices to cause the misalignment to align the torque transmission decreases to work to transmit. The problem lies in the Thompson Joint is due to failures that can produce errors of design, incorrect assembly, lack of raw materials, maintenance failures, material bankruptcy transformation, angular displacement of cyclic loading links, wear, noise etc. But the main problem in Thompson Joint is shear failure during working situation. Main objective is to decrease or reduce shear failure. Existing Thompson Joint design and modelling is prepared using the CATIA software. The analysis is carried out by the ANSYS software.*

Key Words: *Thompson Joint; yoke; Finite Element Analysis; ANSYS workbench; Assembly; Equivalent Stress*

1. INTRODUCTION

Thompson Joints is a mechanical device that transmits the power at constant rotational speed from one shaft to another with different angles. A set of similar or continuous speeds Thompson Couplings (Constant Velocity Coupling) transmits the speed with the speed of the angular velocity of integration between the two elements. Commonly known as Thompson Coupling, the device transmits movement speed and conductivity between angles greater than 0 degrees with different proportions of instantaneous angular velocity between operators.

The main work of the power transmission joint is to transfer torque to the drive shaft with a given output axis. In any system with direct mechanical drive, you need to add a lot of motivating elements that can be included. The Thompson mechanism, lead bolts and most drive elements, including other components, are controlled by a shaft supported by several bearings. This allows the shaft to be extremely simple and resistant to rotation, avoiding possible problems with balance and support. Because of this serious support, when they are connected, it is almost impossible to avoid minor misunderstandings between the steering and the axle. Transmission of force requires the possibility of torque from the drive shaft in order to move the shaft at a speed that is important to support the failure of the shaft. Shafts can stretch the axial and radial forces applied to the displacement of the coupling. Wrong on shaft applications, unwanted lateral loads are usually offered by the joint.

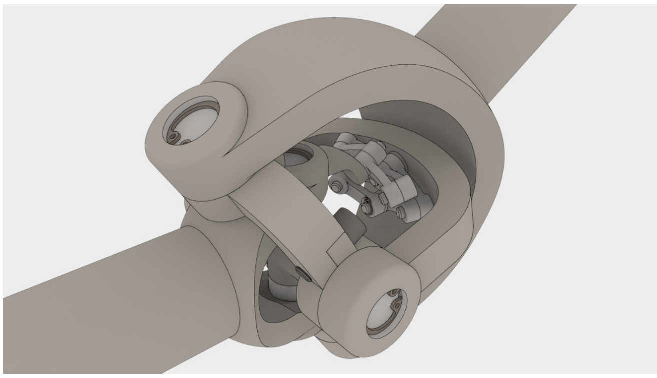

Figure 1 Schematic Diagram of Thompson Constant Velocity Coupling

Unwanted effects due to improper alignment include:

• Vibration, torsional or angular velocity, which reduces the accuracy of the system.

• Excessive force and heat in the system bearings, which shorten the life of the machine.

• Increased vibration and system noise.

Heat, vibration, traditional problems associated with the lack of rotation and the driving force around the built-in technologies of the axis of rotation, universal joints were solved by Thompson's constant speed and the defeated joint.

Working at ambient temperature, in its design there is no vibration, Thomson joins homo kinetics, and the associated shear shaft is, in fact, working to reduce the speed of the gearbox with vibration input units and engines that protect the system life and length.

There is no weight, because the bearing does not have an element, Thompson's joints are the homo-kinetic winding shaft and those born again realize that vector forces play in changing directions. Thompson constant speed seals do not require the required phase or parallel flange for traditional universal joints.

watsubo T., M. Saigo (1987) (1), draws the structure of the rotor driven by two universal joints under study and impacts asymmetry firmly supports the rotor shaft by limiting damping joints. Parametric vibrations and self-energized due to the torque transmitted when the crankshaft and shaft are inclined determined as demonstrated by the analysis may occur. The solidity rotor asymmetry generally has the impact balancing work on a rotor frame driven by cardanic isolation joint.

A.J. Mazzeia, R.A. Scottb (2002) (2), has an adaptive pin axis, with thick damping inside and outside, driven by a general. The scientific model of it consists of a series of mathematical instruction incomplete direct differential coefficients coupled with subordinate terms. Galerkin system that induces a straight-matched mathematical matrix arrangement coupled with time-subordinate coefficients used. Using these mathematical differential statement some impact internal sticky dampening in parametric uncertain areas and thrill from the network monodrome method are examined. Thrill areas are acquired by having the subordinate coefficients compared to the time difference by inducing an Eigen Examination value.

G. Pantazopoulos, A. Sampani, E. Tsagaridis, (2006) (3), In this study examining the disappointment of a cracking phalanx, a general link frame is inserted. The coupling structures transmit the rotation movement downward of a sheet of aluminium sanding machine in an aluminium frame construction of the plant. Optical examination of faults surfaces and optical microscopy are used as key test methods to dissect previous disappointments. Survey of operating conditions and results of the examination found that strange oil capacity was a major model of deceit.

Guo Yanying, Sun and Sun Zhonghui Zhonghong, (2008) (4), this article another strategy for the space of scientific geometry is presented. Using the same kinematic characteristics of the single joint cross has broken. And contrasts with the conventional approach, for example, light geometry, three complex elements and multi-body components of the structure, the geometry of the braquiliac space diagnosis has the qualities and the ability to comprehend. It is more beneficial to examine the kinematic attributes of single cross to the board approach included. Matlab programming is used for recreation to dissect the cinematic qualities of the pin rhythm and increase the speed of the fork shaft.

Vishal Rathi, Prof. N. K. Mandavgade, (2009) (5), In this document, the traditional configuration was completed with the base count. In any case, with the increase in article implementation and constant quality it is difficult to take after the usual iterative schema systems. It is important to limit a computer with individual innovation capabilities to meet the needs of the market.

Armellin L., F. and G. Gatelli Tanghetti, (2009) (6), this paper describes the kinetic contact analysis and a constant speed of Rzeppa joint. Swivel joints are widely used in many applications, from a suitably simplified 3D model, with a hinge angle 45 a homocinetic joint made of all generic steel components. The rotation set on the internal track and resistive external track torque resistance was applied to reproduce working conditions in a typical application.

This article presents another system that is designed for power transmission between two meeting axes. The component comprises a body and a given body switched, six auxiliary arms and three interconnecting arms. The meeting point between body and body data performance that is coupled to trees and performance information can be moved up to 100 degrees. The speed ratio between the two poles remains constant. It also incorporates a kinematic and playback test using Visual NASTRAN, COSMOS, and Autodesk Inventor Dynamic Motion. From programming projects, this tool can transmit constant speed ratio across all edges between two poles. By noticing explanatory research diagrams and the examination of reproduction, the legitimacy of the comparisons shown. Manufacturing and component evaluation has shown that this system can essentially transmit a steady speed.

Stress steering stress straps cover the maximum effort and the structure you plan to keep without fatigue breaking. Steering columns in a steering system is one of the main devices in a car. To achieve the stability and constant movement of the vehicle is very important. It comprises two junks, one for each pole, a moderate associated transversal portion, that is, arachnid. There are some segments in the transmission mechanism of vehicle movement occasionally experiencing serious disappointments.

Some basic purposes behind the delusions may be assembly and configuration issues, maintenance deficiencies, raw material handling defects, and customer fault have begun to fail. Stress and displacement are made for the final product. To model a component, the CATIA V5 R17 software is used. Preprocessing work as a workout and analysis is performed using Hyperworks software. Using the FEA exam, the nature and quality of the following payload is also to assess the impact of poles, mass, geometry, and contour conditions on the yoke.

Sanjiv Kumar, Rakesh Sehgal, Rajiv Kumar, Sanjeev Bhandari (2011) (7), The main engine vibration of the machine is imbalance and alignment. A rotor produces more irregular vibrations and produces unnecessary operation in the bearing area and shortens machine life. Two rotors for unbalanced vibration research are used. If using a rotor, the structure is known as a flat insulation structure. To anticipate the vibration range, test studies were performed in a mechanical test set of two rotor elements for rotor imbalance. Adaptable elastic joints were used as part of the analysis. From the model and the uniform condition to the unequal resistance resistive recurrence range distinctive was further achieved. Rotor postures with irregular correction are analyzed in two distinct rotor areas.

System components and limited recreation strategy are complemented by using the CAD auxiliary exam for using CAD / CAM in the rationalization of rotational device culture (GIR). The characteristic parts of the Cultivator Spinner Culture Equipment are required geometrically to model the strong layout and recreation endpoints evaluation parameters to implement the actual field with the contour conditions. Vitality forced to a culture appliance appliance is 35hp and 45hp driving force and evaluated powers act on the tool-to-ground interface. The resulting impact is acquired by the transport of anxiety and deformity plots to cultivate the cutting edge and the complete collection of milling machines. Adequate resistance change resistance of milling area areas, side box apparatus evacuate the abundance weight of a strong segment, to increase the sharpness of the cutting edge for sound quality. This working model culture is examined for new schema challenges with changing geometry for the final efficacy of the evacuation weeds featuring functional field execution results.

The chassis comprises two poles torsionally flexible hoses interconnected by a Hooke joint is analyzed by the method for the two levels of flexibility for the dynamic force of the torsional vibrations of the polar structure. ZED linear motion comparisons indicated to be part of a Mathieu-Hill layout of mathematical statements and stability of their responses is dissected according to the method of monodrome lattice strategy. The results are shown as charts on different plans developed reliability parameter. See the impact of several selected set of parameters safely.

Tatjana Lazovic. Aleksandar Marinković, Svetislav Markovic (2011) (8), In this work, joint or repair should be done. The universal joint is the type of mechanical coupling that consists of two junks connected to the transverse shaft (pin). Arms swarm weight over four needles tucked in yoke exhaust pipes. The cardan joint life is dictated by material tiredness after more than a million large oil investment and fixation. On the other hand, he does not reach his life expectant of fatigue. At the point where the oil is improper and / or fixing is not effective enough, the overall co-administration life is limited by erosion and wear. As it loses its intensive wear capacity it must be replaced by a new one or to be repaired. It involves additional workmanship of the worn parts of the roller bearing. The dimensions have changed and the entire geometry of the needle bearing has been modified. Internal geometry influences dynamics and roller bearing capacity and mathematical geometric relationships, mainly based on limited radial and circular play.

Douzi Imran Khan, Seppo Virtanen and AK Verma, (2012) (9), This paper describes the car frame diagram of unshakeable quality-based transmission taking into account sub-system level disappointment and the framework taking into account the ultimate goal of improving the reliability of the transmission frame And the prosperity below and also indicated with the results, while planning such a framework in light of constant quality parameters, reliability has steadily increased with improved estimate 1.5 variable security. Disappointment everywhere before is the appropriate time period is inadequate and therefore constantly in the wellness design and the constant quality of each framework is a perennially specialized primary objective. Configuration, level, control and transmission structure of the assembly vehicle has been discriminatory in terms of reliability and safety.

This article examines the impact of the relationship between driving dynamics and the articular damage involved in transition time. In the light of the hypothetical investigation of the pole structure with generalized set, the arrangement, the course of action and the load loaded with elements and the dynamic mathematical model have been solved by differential statements. The tests have been coordinated to ensure well-being and strength and in contrast to the basic requirements, precision and nature of generation and treatment, both mechanical and hot, for a type of sign of a total joint.

Prof. R. S. Powar, Prof. N. S Deshmukh (2012) (10), This paper presents the idea of a type of coupling suitable for transmitting force under light load conditions. In some cases of force transmission structure, the joint may drop following assembly and / or misalignment of airborne impediments. Adaptive connections are used as part of the type of belt strips being cut off. The straps are mounted on the restraint ribs so the load quality and ductile material is greater than the cutting pressure. In the schema above adaptive Link, more space and cube material configuration is needed. For this joint, it is necessary to use different types of tapes as part of the laminating connection between two poles. The individual straps are chosen and tested by coupling regimen. Due to changes in the configuration and determination of the material, a 20% reduction in weight is obtained and the radial separation also decreases by 25%.

S. B. Jaiswal, Prof. M. D. Pasarkar (2012) (11), This document is a search delusion that a flange is welded to a high transmission water pipe. Spines had disappeared in the middle of the operation. So it was the real indicator to help you. The examination was done using ANSYS Workbench 11.0 for the spine and also the welding joint. The disappointment occurred along the weld on the rib side. The rib is made of material such as steel core, we rely on a great show weldability. Research found that base steel had lower quality to allow weights. From now on, the new steel compound for the same compound is recommended and about 3 cycles indicated in the ANSYS flange addressed.

Rahul N. Yerrawar1, Vinod B. Tungikar, Shravan, H. Gawande, (2012) (12), Homocinetic joints (CVs) are prominent among the most critical segments of the front axle. It is subject to various concerns, such as anxiety inclination, shear loading and anxiety, etc. Among these fillers, it is further subjected to vibrations due to the tire or wheel balance and a pneumatic or rounded wheel, or a curved edge. The main objective is to reduce the shutter strength so that the shock absorber can withstand within the required limits, i.e., the recurrence rate is limited to 80 Hz to 150 Hz. To provide the sense of reversal of the damper, it investigates the free Vibration and vibration limited impacts. Analysis of the limited elements in the ANSYS-11 product has been made to anticipate dynamic driving chassis at 80 Hz to 150 Hz forced vibration frequencies under date stacking conditions.

2. PROBLEM DEFINITION

- The failure of the part happens because of several reasons which can be producing and design fault, raw material faults, maintenance faults, material process faults, drivable joint angle, cyclic load etc.
- Thompson Constant Velocity Joint wears from high mileage and an absence of standard lubrication. It rusts and seize, causing noises and vibration. It worn-out simply and; will break, inflicting expensive damage.
- Due to pin (fork), wear happens at the mating surface of Thompson Constant Velocity Joint.
- In existing design cross section area is less, therefore the strength of Thompson Constant Velocity Joint is less.

3. MODELLING

CATIA is a suite of configuration programming supporting item outline for discrete producers. The suite comprises of applications, each conveying a particular arrangement of capacities for a client part inside of item advancement.

CATIA keeps running on Microsoft Windows and gives applications to 2D configuration, 3D CAD parametric component strong demonstrating, 3D immediate displaying, Finite Component Analysis and reproduction, schematic design, technical outlines, furthermore, survey and representation

4. RESULTS

- ANSYS is a broadly useful programming, used to mimic collaborations of all controls of physical science, basic, vibration, liquid flow, warmth exchange and electromagnetic for architects.
- So ANSYS, which recreates the working conditions and test the component in virtual environment. Moreover, it can decide and enhance the focus of engineer, to find out the life and predicting performance by 3D reproductions.
- Material use for manufacturing of Thompson Constant Velocity Joint is EN-24 material.

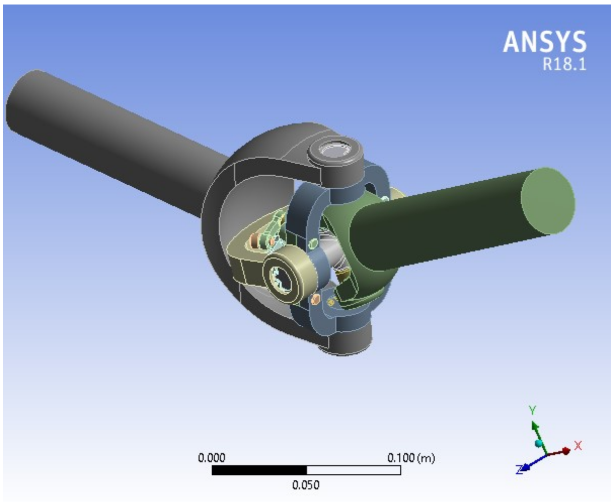

Figure 2 Assembly of Thompson Constant Velocity Joint

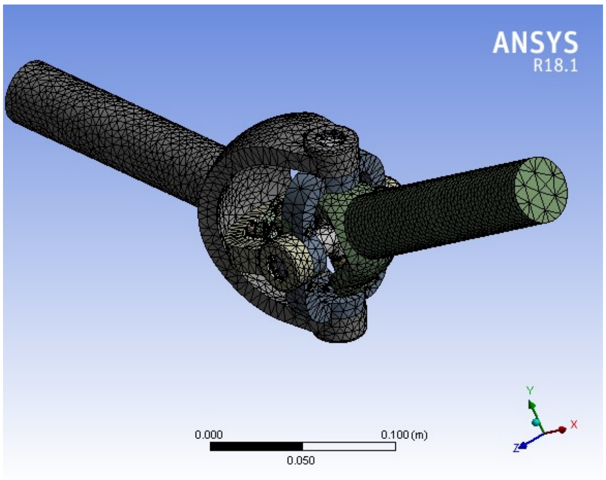

Figure 3 Triangular type of meshing of Thompson Constant Velocity Joint

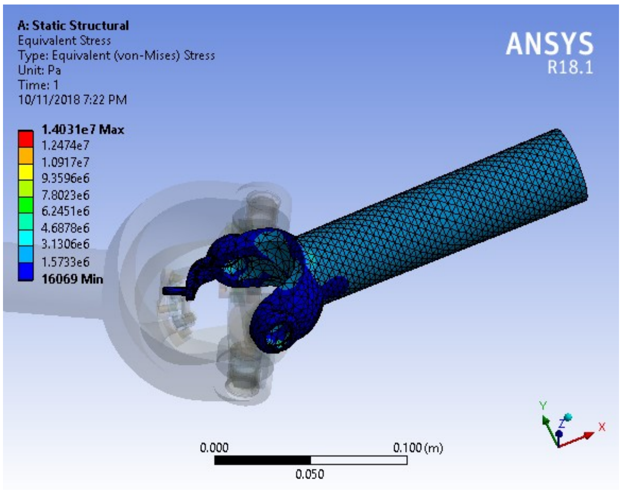

Figure 4 Equivalent stress maximum generated in driving shaft is of 14.03 MPa & minimum is of 0.016 MPa

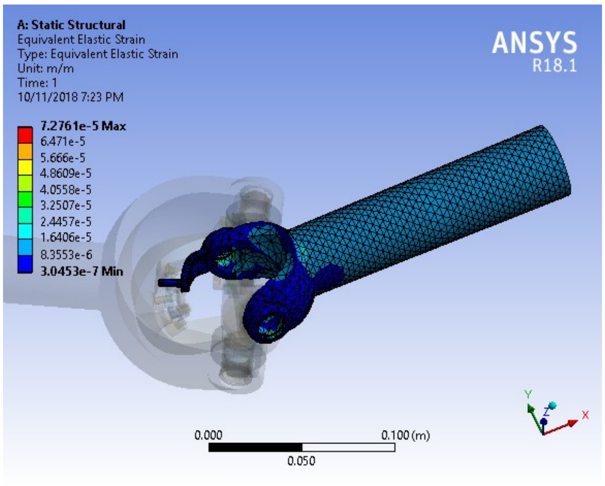

Figure 5 Equivalent elastic strain maximum generated in existing driving shaft is of 7.27 X 10^{-5} & minimum is of 3.04 X 10^{-7} m/m

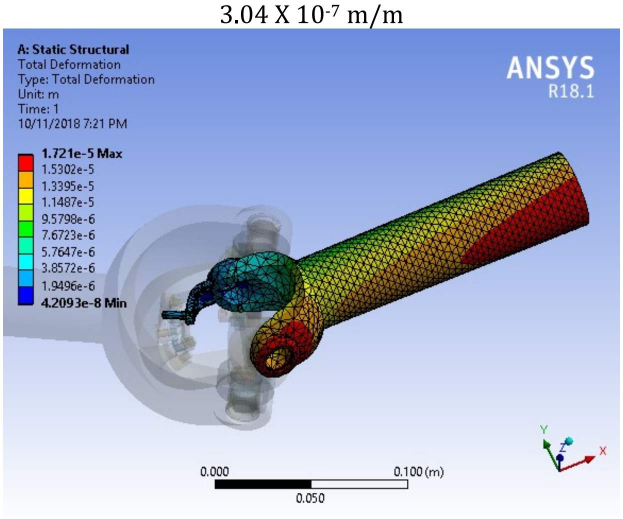

Figure 6 Total Deformation maximum generated in existing driving shaft is of 1.72 X 10^{-5} & minimum is of 4.2 X 10^{-8} m.

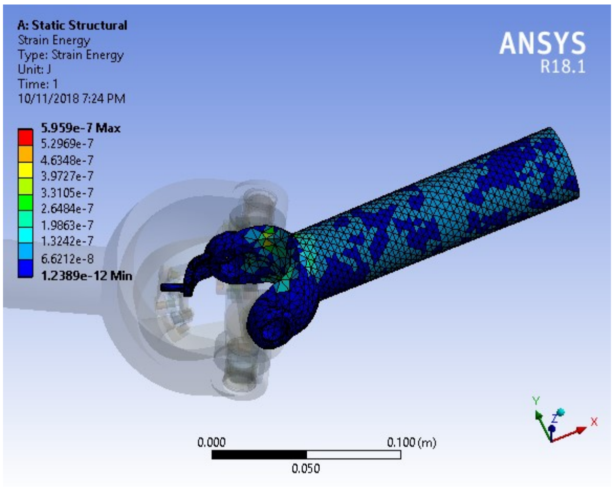

Figure 7 Strain Energy maximum generated in existing driving shaft is of 5.95 X 10^{-7} & minimum is of 1.23 X 10^{-12} J.

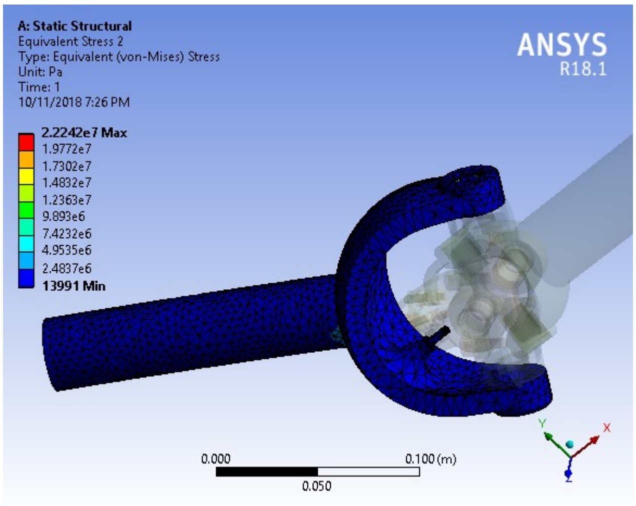

Figure 8 Equivalent stress maximum generated in driven shaft is of 22.24 MPa & minimum is of 0.013 MPa

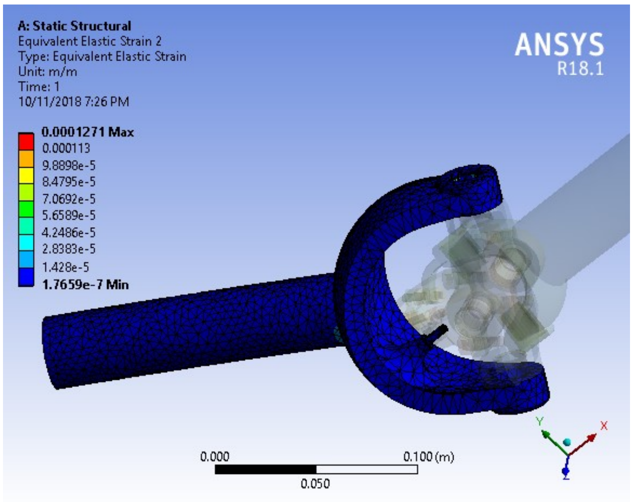

Figure 9 Equivalent elastic strain maximum generated in existing driven shaft is of 1.27 X 10^{-4} & minimum is of 1.76 X 10^{-7} m/m

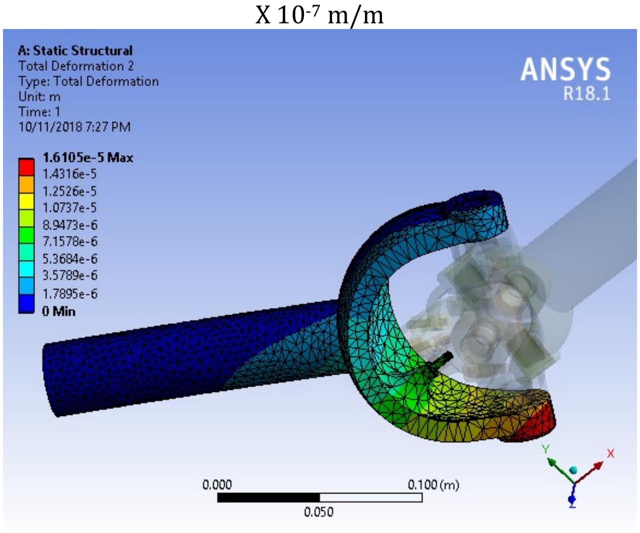

Figure 10 Total Deformation maximum generated in existing driven shaft is of 1.61 X 10^{-5} & minimum is of 0 m.

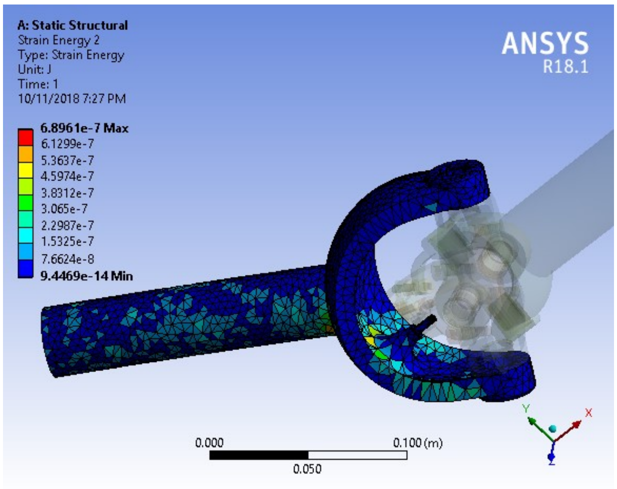

Figure 11 Strain Energy maximum generated in existing driven shaft is of 6.89 X 10^{-7} & minimum is of 9.44 X 10^{-14} Joules.

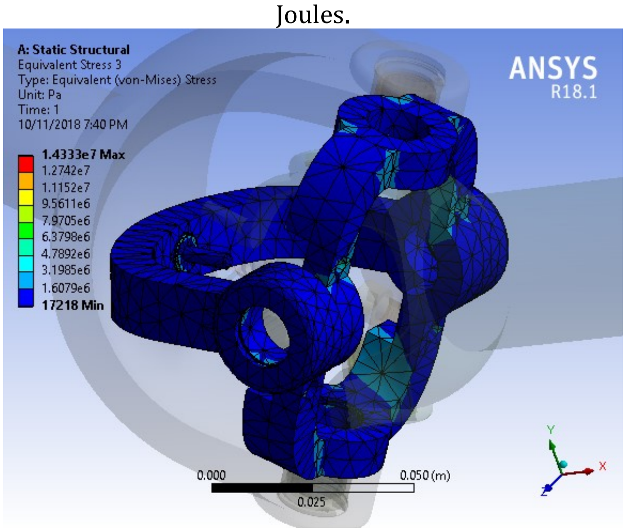

Figure 12 Equivalent stress maximum generated in existing Centre Hub is of 14.33 MPa & minimum is of 0.017 MPa

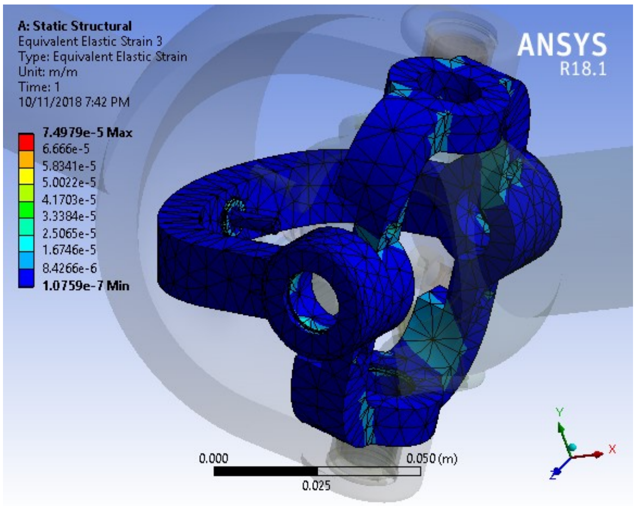

Figure 13 Equivalent elastic strain maximum generated in existing Centre Hub is of 7.49 X 10^{-5} & minimum is of 1.07 X 10^{-7} m/m

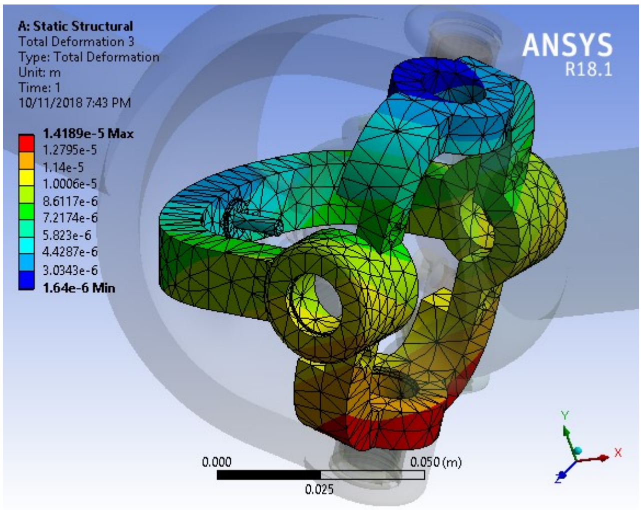

Figure 14 Total Deformation maximum generated in existing Centre Hub is of 1.41 X 10^{-5} & minimum is of 1.64 X 10^{-6} m.

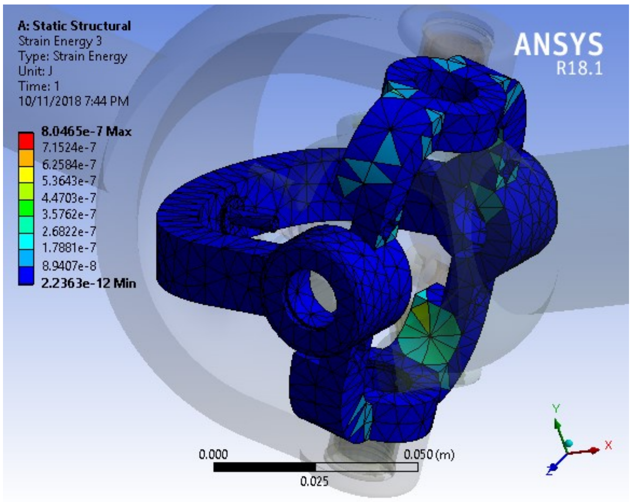

Figure 15 Strain Energy maximum generated in existing Centre Hub is of 8.04 X 10^{-7} & minimum is of 2.23 X 10^{-12} Joules.

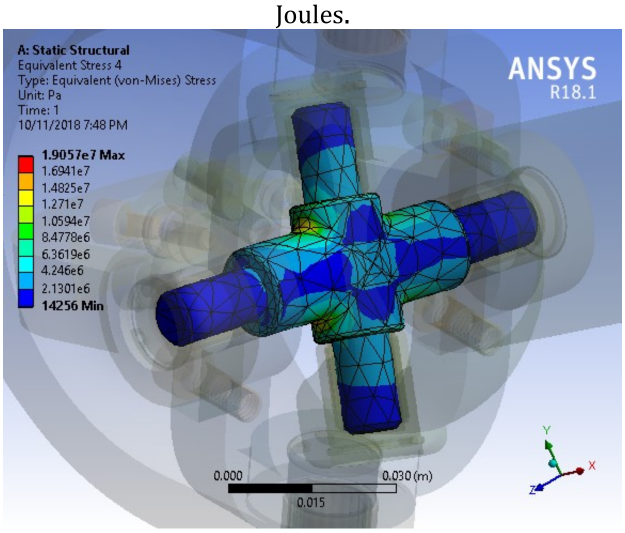

Figure 16 Equivalent stress maximum generated in existing Cross Pin is of 19.05 MPa & minimum is of 0.014 MPa

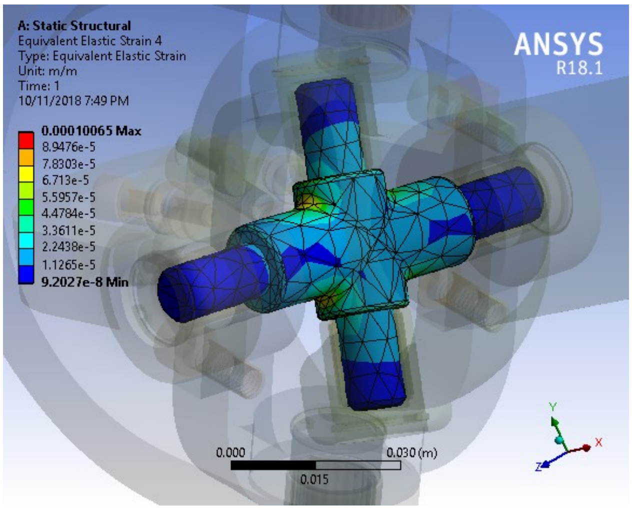

Figure 17 Equivalent elastic strain maximum generated in existing Cross Pin is of 10.06 X 10^{-5} & minimum is of 9.2 X 10^{-8} m/m

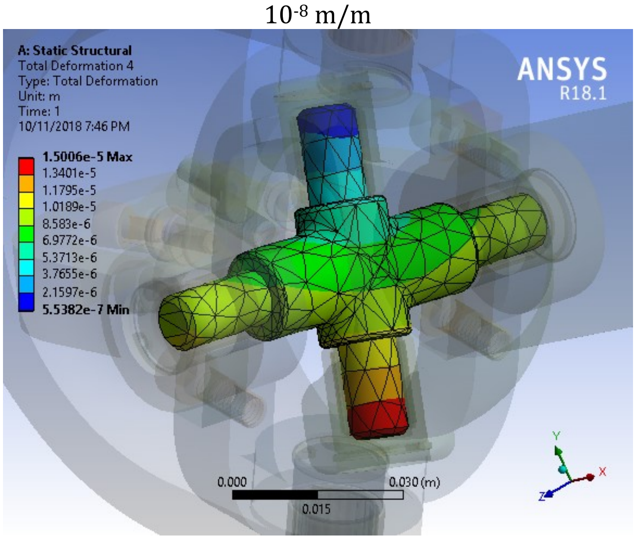

Figure 18 Total Deformation maximum generated in existing Cross Pin is of 1.5 X 10^{-5} & minimum is of 5.53 X 10^{-7} m.

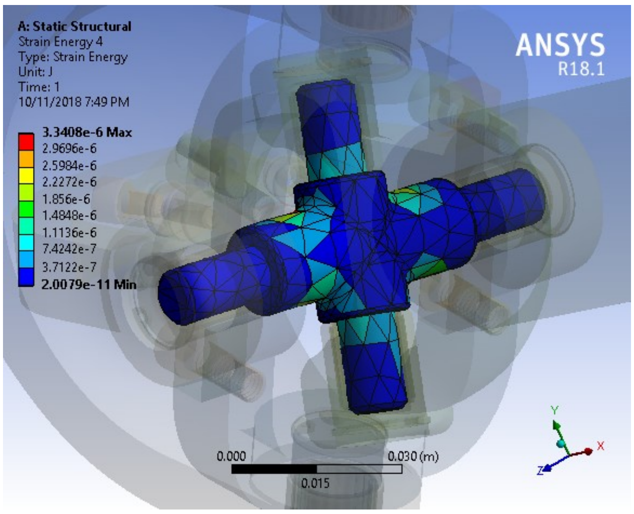

Figure 19 Strain Energy maximum generated in existing Cross Pin is of 3.34 X 10^{-6} & minimum is of 2.0 X 10^{-11} Joules.

5. CONCLUSION

The modelling of proposed design is done by using CATIA software & static and dynamic analysis is done in ANSYS.

On the basis of the current work, it is concluded that, the design parameter of the Thompson Constant velocity Joint gives sufficient results to predict the performance of the joint. The total deformation is found maximum near the ring support. This can be reduced by increasing the material at the fork end. The equivalent elastic stress is found maximum near the Yoke support.

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