International Journal of Engineering Research and General Science Volume 3, Issue 3, May-June, 2015
ISSN 2091-2730

Modeling & Analysis Of Universal Coupling Used In Agro Industry

Dhwani V. Sanghani1, Nayan. D. Gosvami2

*1*PG Student, Atmiya Institute Of Technology And Science, Gujarat Technological University, India
*2*Asst. Professor, Atmiya Institute Of Technology and Science, India
*1*sanghani.dhwani@gmail.com
*2*smart_er.nayan@yahoo.co.in

Abstract — Universal joint in a rigid rod that allows the rod to bend in any direction, and is commonly used in shafts that transmit rotary motion. It consists of a pair of hinges located close together, oriented at 90° to each other, connected by a cross shaft. The Universal coupling saves the Gear arrangements cost for making misalign to align torque transmission, decreases the work space for transmitting arrangements. Main problem arises in universal coupling is due to failures which maybe manufacturing and design fault, shear failure, improper assembly, raw material faults, maintenance faults, material processing faults, drivable joint angle, cyclic load ,wear, noise etc. Main objectives are to reduce shear failures by Modification of pin (cross) in existing design of universal coupling.The modeling of proposed design is to be done by using CREO software & static and dynamic analysis is to be done in ANSYS software & results are compared with existing design.

Keywords — Universal Coupling,CREO, ANSYS , Assembly, Strain, Stress

INTRODUCTION

Universal coupling is used in rotating shaft that transmits rotary motion. It is a specialized rotary joint used to allow a rotating split shaft to deflect along its axis in any direction.It is a positive mechanical connection between rotating shafts which are not parallel but intersecting. The flexibility is achieved by constructing the joint with two U-shaped yokes which is joined by a cross shaped hub. One of the yoke is attached to the end of each portion of the split shaft and joined with the cross hub, with the U-sections oriented at 90 degree to each other. It is one of the oldest of all flexible couplings. It is commonly known for its use on automobiles and trucks.

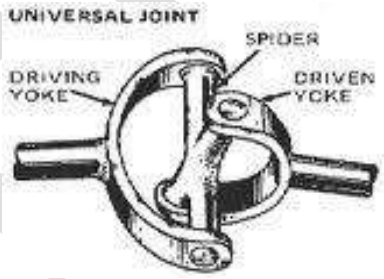

Figure 1 Universal coupling [1]

PROBLEM DEFINATION

Shearing occurs at the point of friction where both parts mate with each other. Shafts are jointed to the pin and transmit power from driver to driven shaft. Under the torque it will in shear and causes shear failure.

Figure 2 Shearing Failure In Existing Pin Of A Universal Coupling

MODELING OF PROPOSED DESIGN

CREO is a suite of design software supporting product design for discrete manufacturers and is developed by PTC. The suite consists of apps, each delivering a distinct set of capabilities for a user role within product development. CREO runs on Microsoft

Windows and it provides apps for 2D design, 3D CAD parametric feature solid modeling, 3D direct modeling, Finite Element Analysis and simulation, schematic design,technical illustrations, and viewing and visualization.

2D drawing of proposed universal coupling is shown in figure 3. Modeling of hub,pin & assembly is done in CREO software as shown in figure 4,5,6.

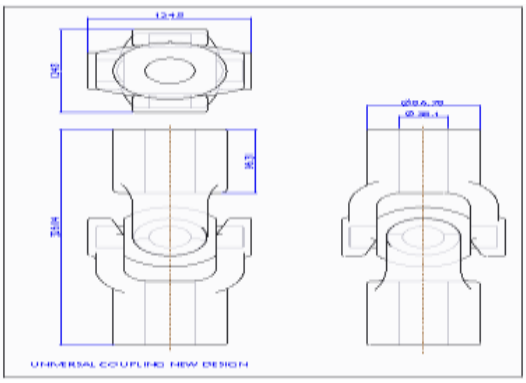

Figure 3 2D Drawing Of Proposed Design

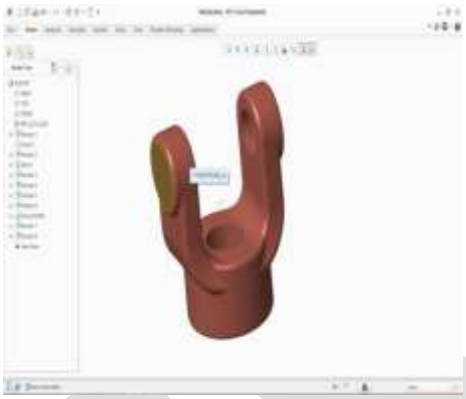

Figure 4 Modelling Of Hub

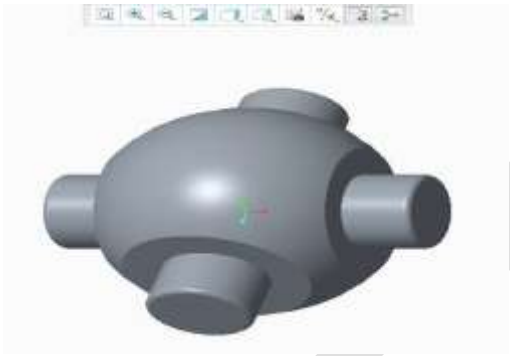

Figure 5 Propossed Design Of Pin

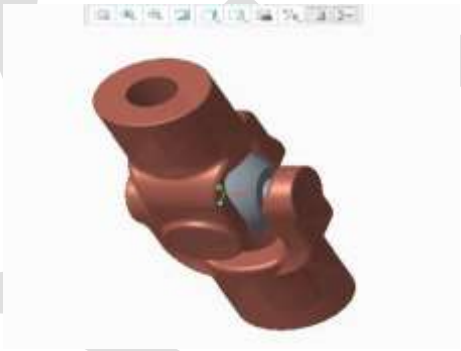

Figure 6 Modelling Of Propsed Assembly

ANALYSIS IN ANSYS SOFTWARE

After modeling in CREO software, triangular type of meshing of hub,pin & assembly is done in ANSYS software.In hub number of elements are 6033 & number of nodes are 10904.

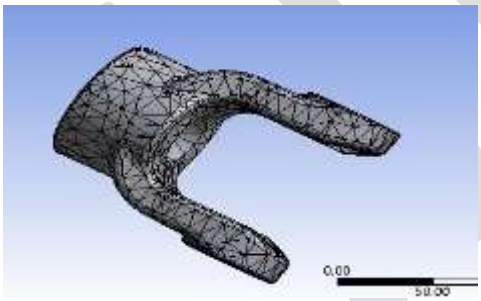

Figure 7 Meshing Of Hub

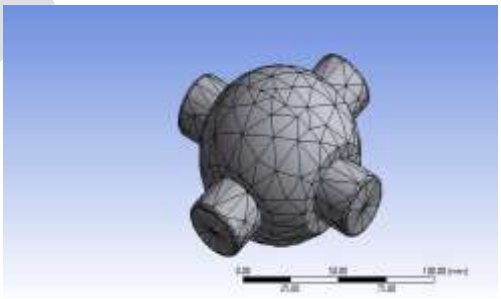

Figure 8 Meshing Of Proposed Pin

In case of pin number of elements are 10649 & number of nodes are 19647.Meshing of hub,pin & assembly is shown in figure 7,8,9. After that individual components & assembly is analyzed.

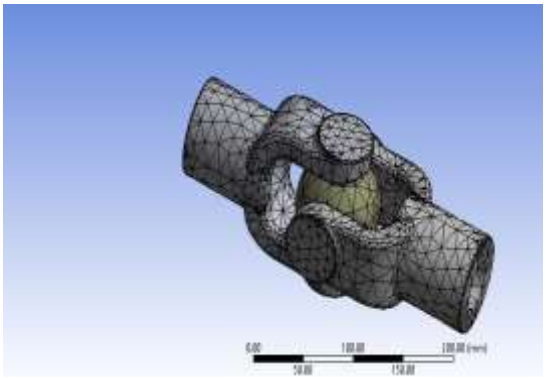

Figure 9 Meshing Of Proposed Assembly

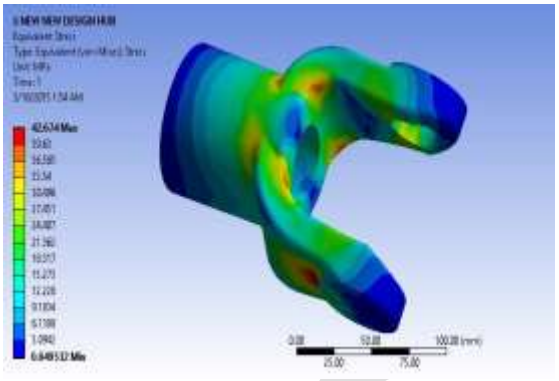

Figure 10 Stress Analysis Of Hub

As shown in figure 10 hub is analyzed in ANSYS software.The maximum value of stress in hub is 42.674 MPa & minimum value is of 0.049532 MPa.

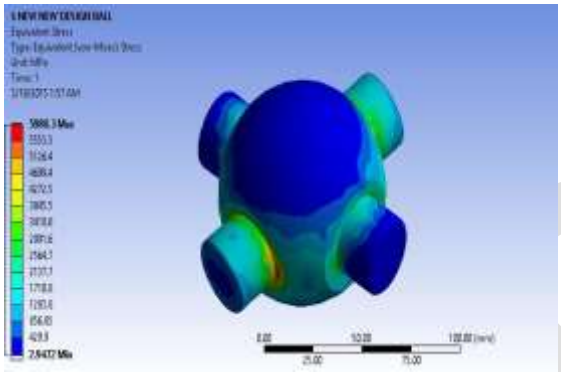

Figure 11 Stress Analysis Of Pin

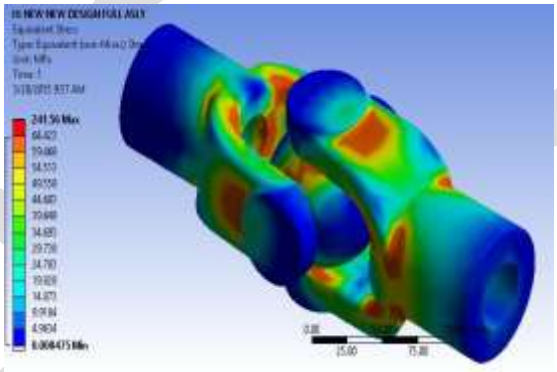

Figure 12 Stress Analysis Of Assembly

As shown in figure 11 pin is analyzed in ANSYS software.The maximum stress generated in proposed pin is of 5980.3MPa & minimum stress is of 2.9472 MPa. In figure 12,proposed assembly is analyzed for stress analysis. The maximum stress generated in proposed assembly is of 241.56 MPa & minimum stress is of 0.008475 MPa.

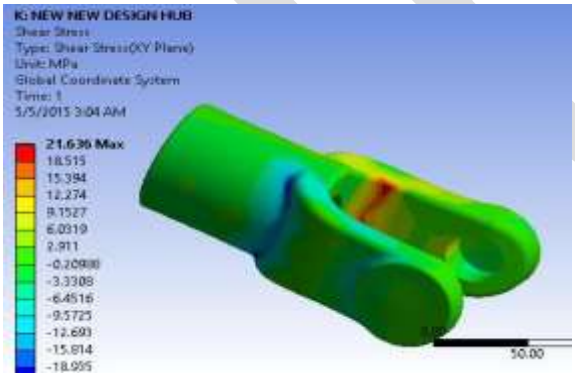

Figure 13 Shear Stress Analysis Of hub

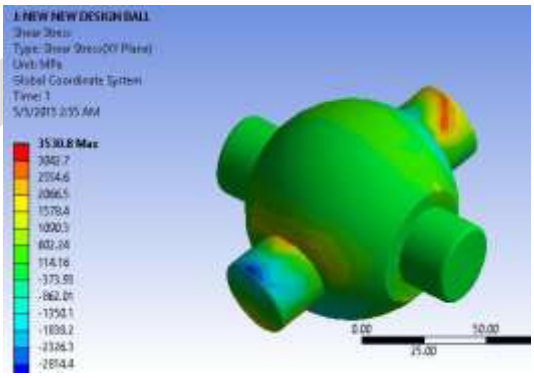

Figure 14 Shear Stress Analysis Of Proposed Pin

As shown in figure 13 hub is analyzed for shear stress analysis. The maximum shear stress generated in hub is of 21.636 MPa.And in case of pin maximum shear stress generated in proposed pin is of 3530.8 MPa as shown in figure 14.

COMPARISON BETWEEN EXSITING DESIGN & PROPOSED DESIGN

Stress analysis of existing design is ANSYS is done which is shown in figure 15.Whole assembly of propsed design is analyzed for stress analysis which is shown in figure 16.

In existing design von mises stress is 704.21 MPa. By comparing existing design with proposed design stress value is decresed from 704.21 MPa to 241.56 MPa.

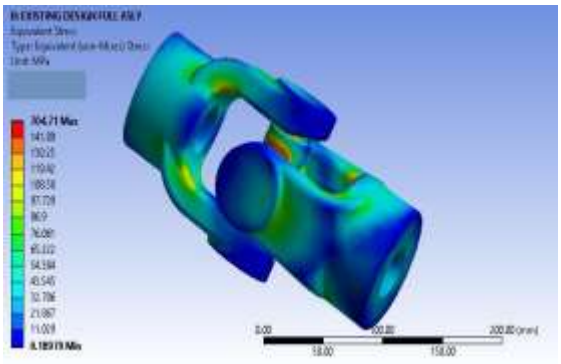

Figure 15 Stress Analysis Of Existing Design

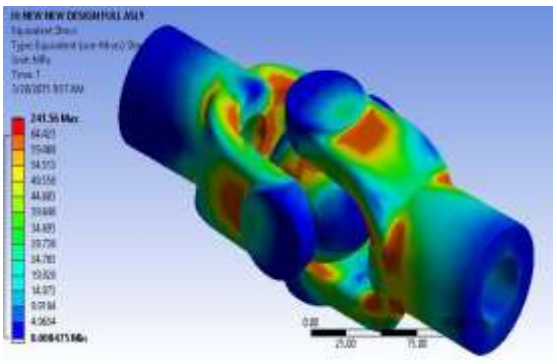

Figure 16 Stress Analysis Of Proposed Design

Comparison				
Existing Design And Proposed Design Analysis Data For Von Mises Stress				
Sr	**Part / Assembly Name**	**Existing Design**	**Proposed Design**	**Difference**
1	Full Assembly Stress	704.71	241.56	463.15
2	Hub Stress	46.19	42.67	3.52
3	Pin / Ball Stress	23101	5980.3	17120.7

The shear stress analysis for existing design is of 351.3 MPa which is shown in figure 17 & shear stress for proposed design is 120.04 MPa is shown in figure 18. Hence shear stress is reduced in proposed design of universal coupling.

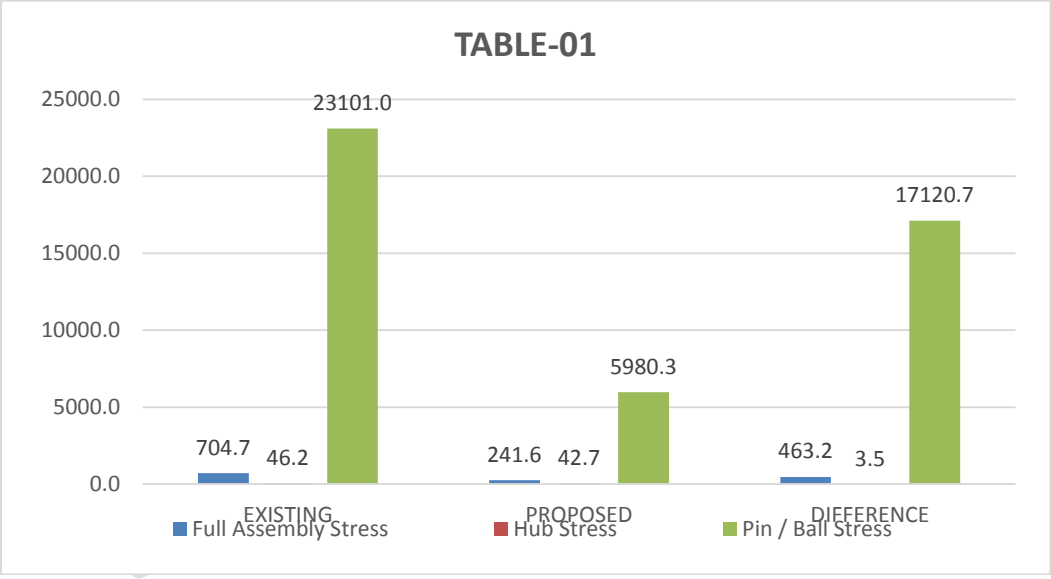

Chart 1 Comparison of Existing Design & Proposed Design - Analysis Data For Von Mises Stress

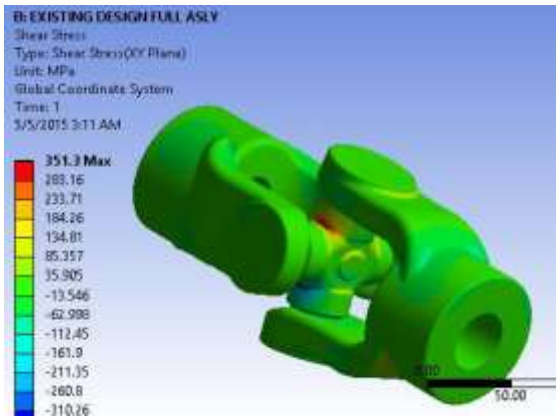

Figure 17 Shear Stress Analysis- Existing Design

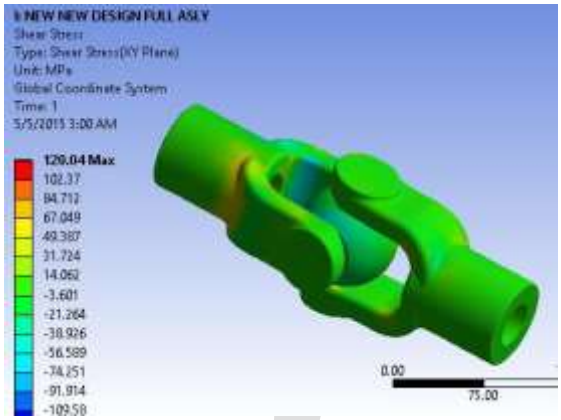

Figure 18 Shear Stress Analysis- Proposed Design

Comparison				
Existing Design And Proposed Design Analysis Data For Shear Stress				
Sr	**Part / Assembly Name**	**Existing Design**	**Proposed Design**	**Difference**
1	Full Assembly Stress	351.3	120.04	231.26
2	Hub Stress	23.41	21.63	1.78
3	Pin / Ball Stress	11507	3530.8	7976.2

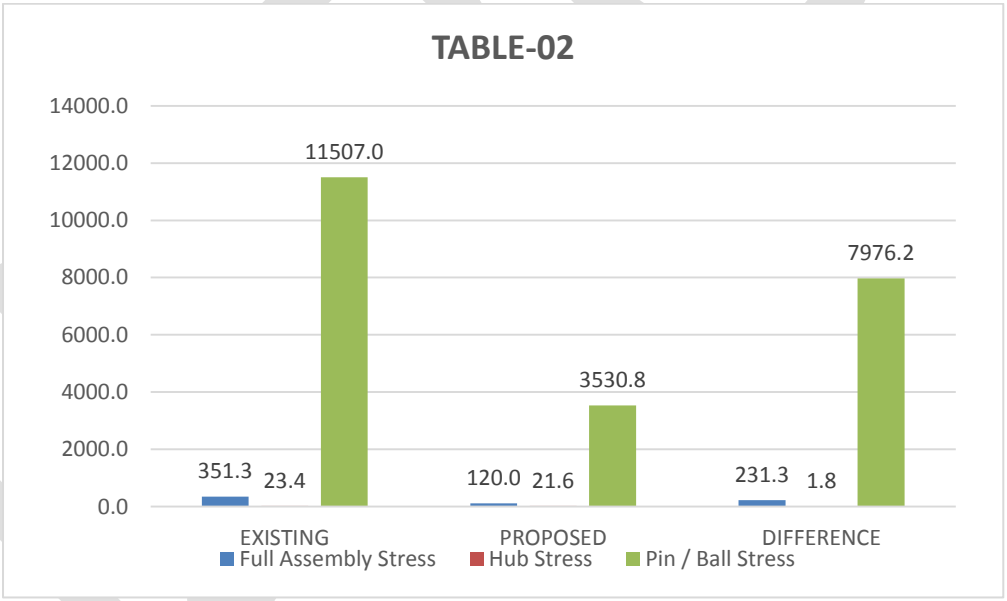

Chart 2 Comparison of Existing Design & Proposed Design - Analysis Data For Shear Stress

DYNAMIC ANANLYSIS

Power is of 90KW & universal coupling rotate at 250 RPM. So torque is find out by the use of equation as mentioned below for dynamic analysis purpose.The factor of safety 1.5 is considered.

$$T = \frac{P \times 60}{2\pi N}$$

$$= \frac{90 \times 10^3 \times 60}{(2\pi \times 250)}$$

$$= 3440 \times 10^3 \text{ N-mm}$$

By considering factor of safety of 1.5 , moment 3440*1.5=5200 is applied to the assembly for dynamic analysis.

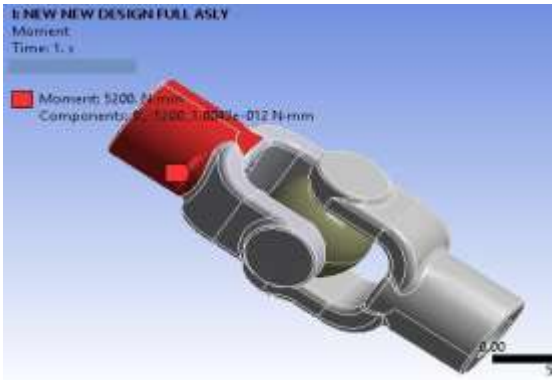

Figure 19 Moment Applied To Proposed Assembly

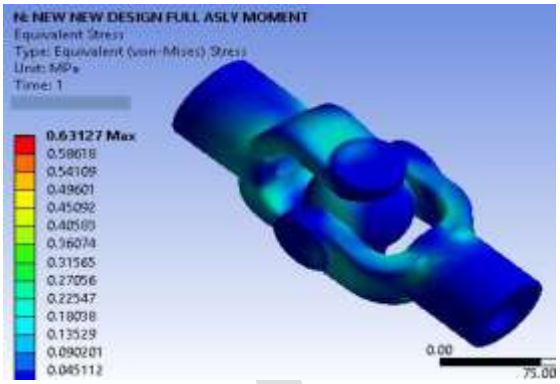

Figure 20 Dynamic Analysis Of Assembly For Stress

The moment of 5200 is applied to whole assembly f proposed design as shown in figure 19. By analysis in ANSYS software, maximum stress generated in assembly is of 0.63127 MPa as shown in figure 20.

7. CONCLUSION

In this work design & finite element analysis of universal coupling is carried out. The failure of component is occure due to manufacturing and design fault, shear failure, improper assembly, raw material faults, maintenance faults, material processing faults, drivable joint angle, cyclic load ,wear, noise etc. The main objective of this work is to reduce shear failure. The modeling of proposed design is done by using CREO software & static and dynamic analysis is done in ANSYS software.In exisiting design von mises stress and shear stress are 704.71 MPa & 351.3 MPa respectively. After the modification in pin`s design von mises stress and shear stress are reduced to 241.46 MPa & 120.04 MPa respectively.By the comparison of both the result it is found that the von mises stress is reduced from 704.71MPa to 241.46MPa & shear stress is reduced from 351.3MPa to 120.04MPa.So shear failure is automatically reduced.

REFERENCES:

[1] Motor Vehicle Mechanic's Textbook By F. K. Sully 2014 Pg 241
[2] S G Solanke1 And A S Bharule “An Investigation On Stress Distribution For Optimization Of Yoke In Universal Joint Under Variable Torque Condition: A Review” Vol. 3, April 2014
[3] Sunil Chaudhry, Anit Bansal “Finite Element Analysis And Weight Reduction Of Universal Joint Using Cae Tools” (IJERT) Issn: 2278-0181 Vol. 3 Issue 10, October- 2014
[4] Mr.P.G.Tathe, Prof.D.S.Bajaj “Review On Failure Analysis Of Yoke Assembly Of A Transmission Drive Shaft Subjected To Torsion And Shear” (IJERT) Vol. 2 Issue 10, October – 2013
[5] M. Saigo, T. Iwatsubo “Transverse Vibration Of A Rotor System Driven By Two Cardan Joints” Journal Of Sound And Vibration (1987) 114(3), 405-416
[6] A.J. Mazzeia,, R.A. Scott “Effects Of Internal Viscous Damping On The Stability Of A Rotating Shaft Driven Through A Universal Joint ” Journal Of Sound And Vibration 265 (2003) 863–885
[7] Jian-Wei Lu, Gong-Cheng Wang, Hao Chen1, Alexander F. Vakakis And Lawrence A. Bergman “Dynamic Analysis Of Cross Shaft Type Universal Joint With Clearance” Journal Of Mechanical Science And Technology 27 (11) (2013)
[8] G. Pantazopoulos , A. Sampani, E. Tsagaridis “Torsional Failure Of A Knuckle Joint Of A Universal Steel Coupling System During Operation – A Case Study” Engineering Failure Analysis 14 (2007) 73–84
[9] Lozica Ivanovic, Danica Josifovic, Boris Rakic, Blaza Stojanovic, Andreja Ilic “Shape Variations Influence On Load Capacity Of Cardan Joint Cross Shaft” 2012