GUJARAT TECHNOLOGICAL UNIVERSITY

CHANDKHEDA, AHMEDABAD

L. D. COLLEGE OF ENGINEERING

AHMEDABAD

A REPORT ON

"Modification Of Gearbox design for Tube Bending Machine"

Under the Subject of

PROJECT – I (2170001)

B.E. IV, SEMESTER – VII (2018-19)

(MECHANICAL ENGINEERING)

Submitted by

1. **Mohak Shah (150280119106)**
2. **Meet Shukla (150280119109)**

Prof. S.P. Shah
(Faculty Guide)

Dr. S. M. Mehta
(Head of Department)

INDEX

Ch1 Introduction

1.1project summary

The gear box earlier and at present is mainly used for small torque transmission, and smaller gear ratio, order to achieve higher gear ratio and higher torque transmission various epicyclic gear trains are used but they possess higher mass which is not feasible also initially for moderate torques 78% of efficiency is obtained but when torque is increased at higher value, the efficiency drops at approximately 45%. we are basically going to experiment this on a tube bending machine. our main aim is to be able to achieve efficiency at a higher gear ratio and higher torque transmission capacity with a less mass as possible
For this we are basically experimenting three basic types:

- Epicyclic gear train
- Cycloidal gear(existing)
- Dynamically balanced cycloidal gear

Epicyclic gear train disadvantage:

Imbalances in the planetary gears can occur If one planetary gear is positioned closer to the sun gear than the others, leading to premature wear and failure. Also, due to the compact construction of planetary they tend to carry heat eadsily, so applications that run at very high speed or experience continuous operation may require cooling.

cyclodal disadvantage:

If the cycloidal disk is not balanced by a second disk or a counterweight ,Due to the eccentric nature of the drive, , it will generate vibration which will propagate through the driven shafts. it causes greater wear on the exterior teeth of the cycloidal disk, which in turn impacts life of gear as well as component bearings.

1.2 Theory of operation

The input shaft is mounted eccentrically to a Rolling-element bearing causing the cycloidal disc to move in a circular motion. The cycloidal disc will freely rotate around the bearing as it is

pushed against the ring gear. This is similar to planetary gears, and the direction of rotation is opposite to that of the input shaft.

According to working principle the number of pins on the ring gear is larger than the number of pins on the cycloidal disc. This causes the cycloidal disc to go around the bearing faster than the input shaft is moving it around, giving an overall rotation in the direction opposing the rotation of the input shaft.

The output pins will move around in the holes to achieve steady rotation of the output shaft from the quivering movement of the cycloidal disc in which important thing to note is cycloidal disc has holes that are slightly larger than the output roller pins that go inside them. The

Procedure to calculate reduction rate of the cycloidal drive is important aspect for a designer.where R means the number of the ring gear pins and N is the number of lobes on the cycloidal disc.

Reduction Ratio:

$$r = \frac{R - N}{N}$$

Single stage efficiency approaches 92% and double stage approaches 82%. Single stage reductions are available commercially up to 117:1 and double stage up to 7,539:1

Application

Welding

- Vibrationless positioning of tool
- Safe as per safety standard of industry
- Simple installation with short delivery

Robotics

- Hollow shaft version for cables, shafts, etc.
- Low vibration / High resonance frequency
- Compact, space saving design
- High Shock load capacity

Wind turbine

With the introduction of our new frothy and impact-resistant drive mechanisms

- 20 arc-min versions
- Integrated main bearings
- Rated torque = 414,800 in-lbs., Max torque = 714,200 in-lbs

Antenna system

- Compact design structure
- Integrated support bearings provide large robust capacity for burst of wind and huge antenna size
- Hollow Shaft unit for wave-guide, cables, etc. to pass through

1.3 project specification

Two-stage cycloidal design that gives large torque, significant shock-load preserving capabilities with extreme precision and superb industrial quality. This gear utilizes rolling contact elements to reduce wear, material for this can be subject of research , rolling contact extend life and lower backlash with the unique pin provides shock resistance and efficient gear box. The unique feature of reducer is it has large moment capacities and negate the need for external support devices since it integrates a set of large, internal angular support bearings

Main features include:

- Near Zero Backlash (less than 2 arc-min.)
- High accuracy
- Large E-Stop Capacity of 4X rated torque
- High Ratio availability - up to 100:1 for hollow shaft gearboxes
- High Torsional Rigidity for very significant performance

1.4 Main work:

Emphasis is given on dynamic balance of cycloidal gear ,When the torque required by the driven machine is more than the torque setup by the prime mover, the gearbox is used to increase the torque. Gears or speed reducers are used widely in multiple application for speed and torque conversion. This speed reducer having in volute profile and point contact between roller and disc.so wear and tear is more and noise is also more. so we designed cycloidal speed reducer to overcome that problem. Cycloidal speed reducer is having cycloidal profile due to the rotation of this speed reducer noise is also reduced. This reducer is having parallel shaft and all the power, speed or torque is changes collinearly from input shaft to the output shaft. Cycloidal speed reducer is having line contact between the rollers and the rotating disc and due to that the wear and tear is also less with the noise. All problems are overcome due to use of this cycloidal speed reducer. In this speed reduction is happen in collinear way. All other are not having collinear shaft and due to that multi-staging of gears are required for all other speed reducer but we used collinear shaft and due to that multi-staging is not required in this cycloidal speed reducer.

Ratio=(R-N)/N

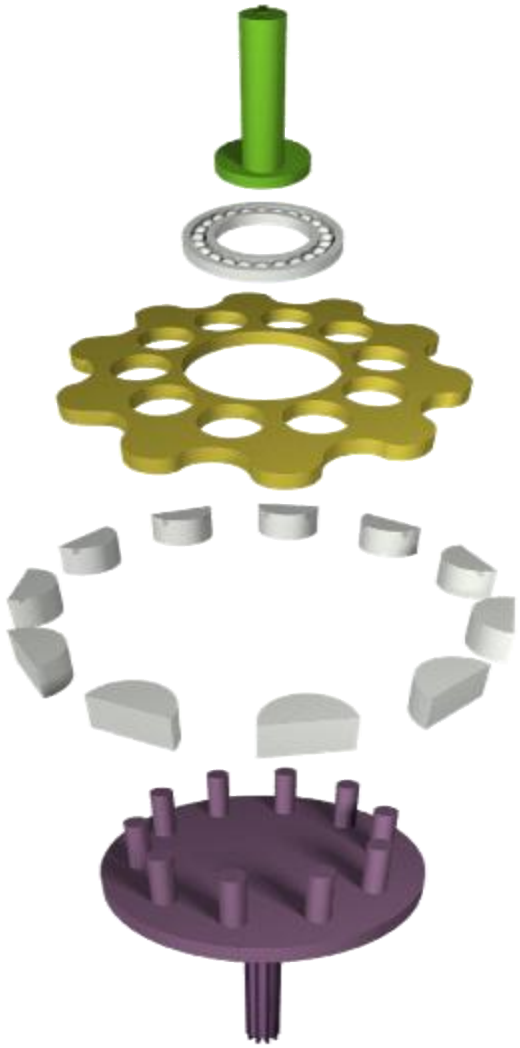
N = Number of lobes on a cycloidal disc

1) Input Eccentric shaft

2) Roller bearing (NU316)

3) Cycloidal disc/lobe

4) Output pin shaft



Input shaft

Eccentrically mounted bearing

Cycloidal disc

Ring pins (part of chassis)

Output rollers and shaft

1.5 LITERATURE REVIEW

A. Design of double stage cycloidal drive using roulette curve generation technique

Published year:-2017
Author:-Dr. K.B. Waghulde et al
Description:-Balancing of the drive is important as meshing of the gear drive. Double stage cycloidal speed reducer design andmodeling is done and they are not bound to specific boundaries and optimization is possible in ratio holes of cycloidal disk.

B. Design and manufacturing of cycloidal speed reducer

Published Year:-2016
Author:-Aditya k. Vasaikar et al
Description:-In this paper they just research on design and manufacturing of cyclodal speed reducer. Purpose of this paper is study

of simple, exact and theoretical and experimental investigation on innovative cyclodal speed reducer.

C. A new design of two stages cycloidal speed reducer

Published Year:-2011
Author:-Blaza Stojanovic et al
Description:-In that represent a new concept of the two stage cycloidal speed reducer where only one cycloidal disc is used for each stage. Analysis and definition of two stage cycloidal speed reducer is theoretically obtained. Two stages are used but they have common input shaft. And for each stage only one cycloidal disc is used

D. Stress and strain state of single-stage cycloidal speed reducer

Published Year:-2011
Author:-MirkoBlagojevic et al
Description:-Analysis of stress and strain is done for single cycloidal speed reducer by using software CATIA, 3D finite elements for study of favorable condition.

E. On the lobe profile design in a cycloid reducer using instant velocity center

Description:-lobe profile is main part of cycloidal reducer. In previous paper study of single cycloidal drives lobe profile is study. In this paper four types of the cycloid drives by the lobe profile of the cycloid plate gear and the roller gears motion, the stationary ring gear type epicycloid reducer, the rotating ring gear type epicycloid reducer, the stationary ring gear type hypocycloid reducer and the rotating ring gear type hypocycloid reducer.

1.6 FUTURE SCOPE

In cycloidal speed reducer collinear shaft is used for power transmission, where the collinear power is required used of cycloidal drive is done. Replace the bevel and worm and worm type gear box by cycloidal speed reducer, because the speed reduction is more for same size.

1.7Performance criterion

-Rolling movement makes insignificant rubbing. Insignificant grating adds to negligible wear and insignificant warmth age. Worm reducers execution is greatly limited by thermal rating. The heat capacity of each casing size and proportion of cycloidal reducers exceeds its thermal safety limit. Worm equip reducers are characterized by bring down effectiveness; you can choose a littler size cycloidal reducer and still obtain appreciably bigger yield control,yet final product is longer administration life and enormous vitality sparing.

1.8 Conclusion

To increase the torque gearbox reduced the speed between the driving and driven shaft. Cycloidal speed reducer is also known as cycloidal drive. Cycloidal speed reducer gearbox is better than
other ,cycloidal speed reducer gives high gear ratio in compact size.
Gear box has purpose to reduce the speed or to increase the torque, therefore this condition is satisfy. Cycloidal drive used the parallel shaft. Due to cycloidal lobe the speed reducer should be less noise. The normal gear box is worm shaft and worm wheel type used for high speed reduction and torque increment. But it is not having collinear shaft and is big in size also cannot be fitted
on motor mounting. Further high speed reduction is not possible in it. In involute gearbox interference will be generated due to that non conjugate action occurred so tooth of gearbox

gets damage so to overcome all these problems we can select the cycloidal gearbox for the speed reduction.

Bearing selection procedure

load exerted due to cycloidal disc on bearing (F) =mrω2

= 0.5 * 42 * 1473.04

= 30.933 KN

Calculation for equivalent load (Peq)

= (VX Fr + Y Fa) * S* Kt

Where, X = Radial load factor

Y= Axial load Factor

S= Service Factor

Fr = Radial load

Fa= Axial load

Kt = Temperature coefficient.

V= Rotation Factor

= (1 * 1.2 * 3100 + 0) * 1.2 * 1

= 4464 kgf

Calculation of required dynamic load capacity (C)

= (L/L10)

1/3.33 * P

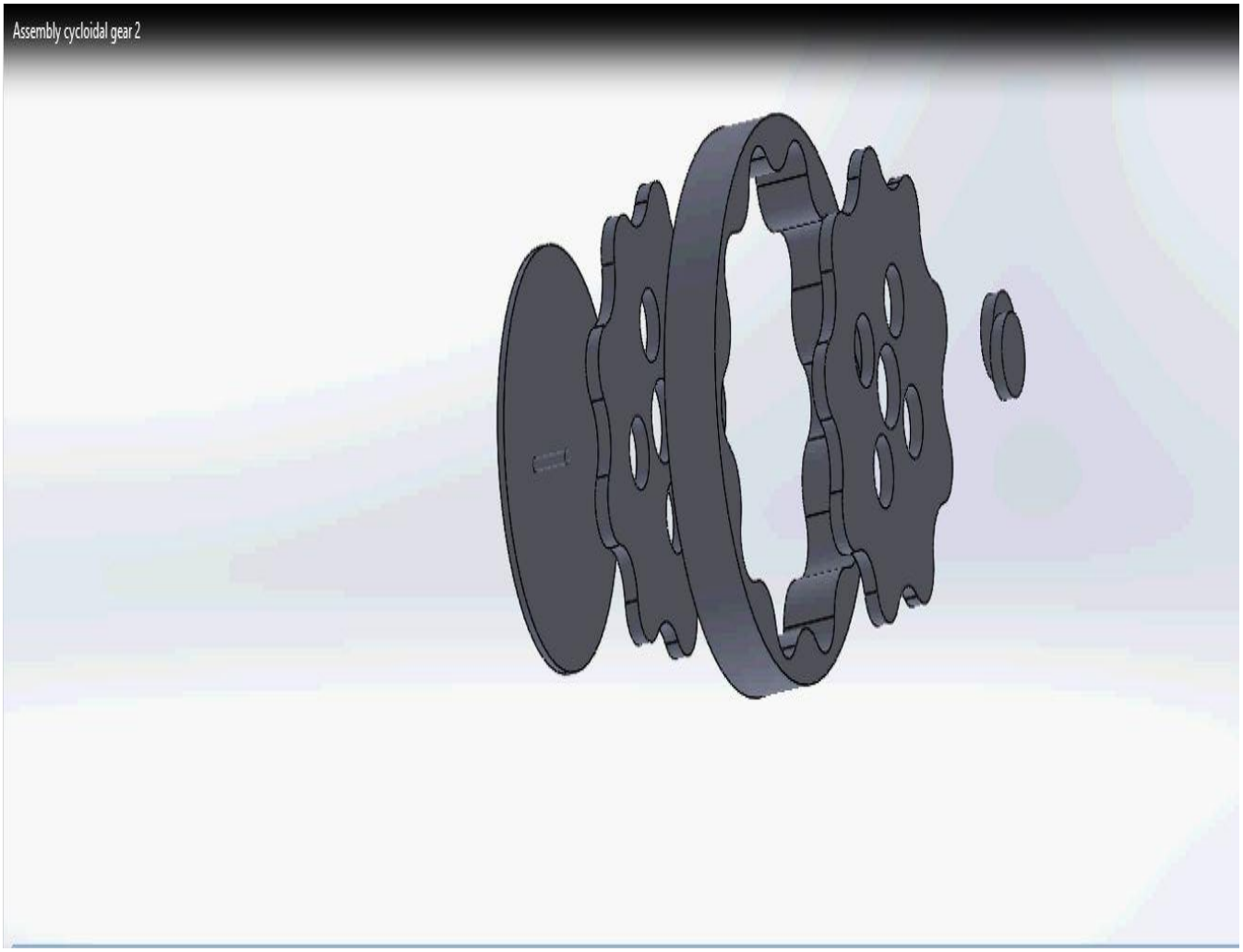
= (100/1)1/3.33 * 4464

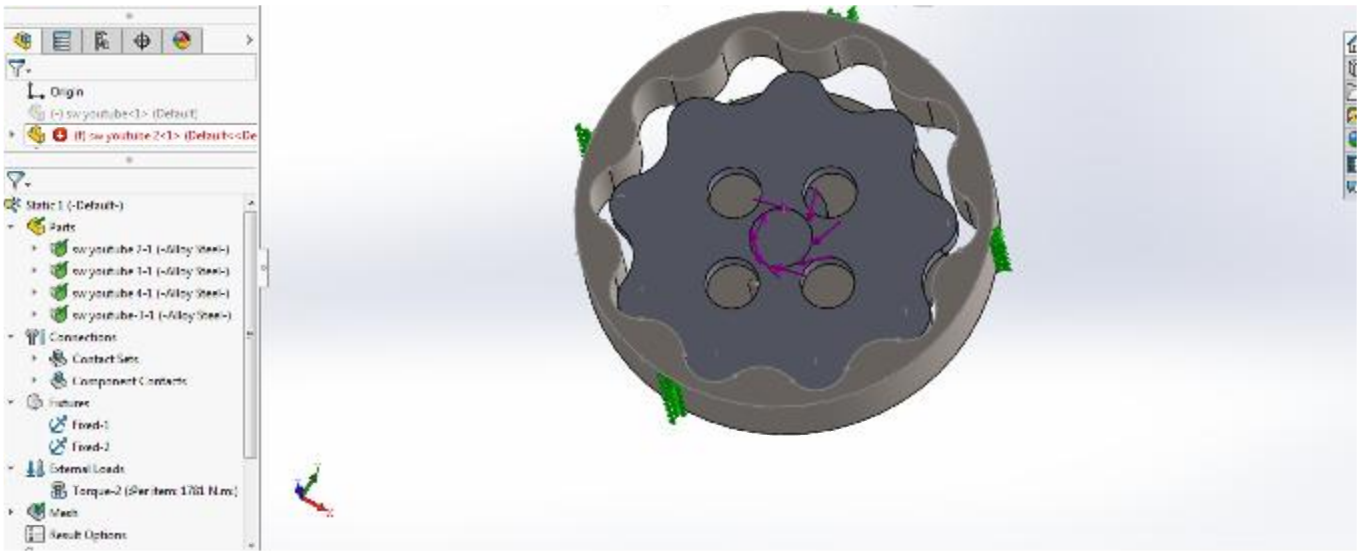
= 17771 kgf

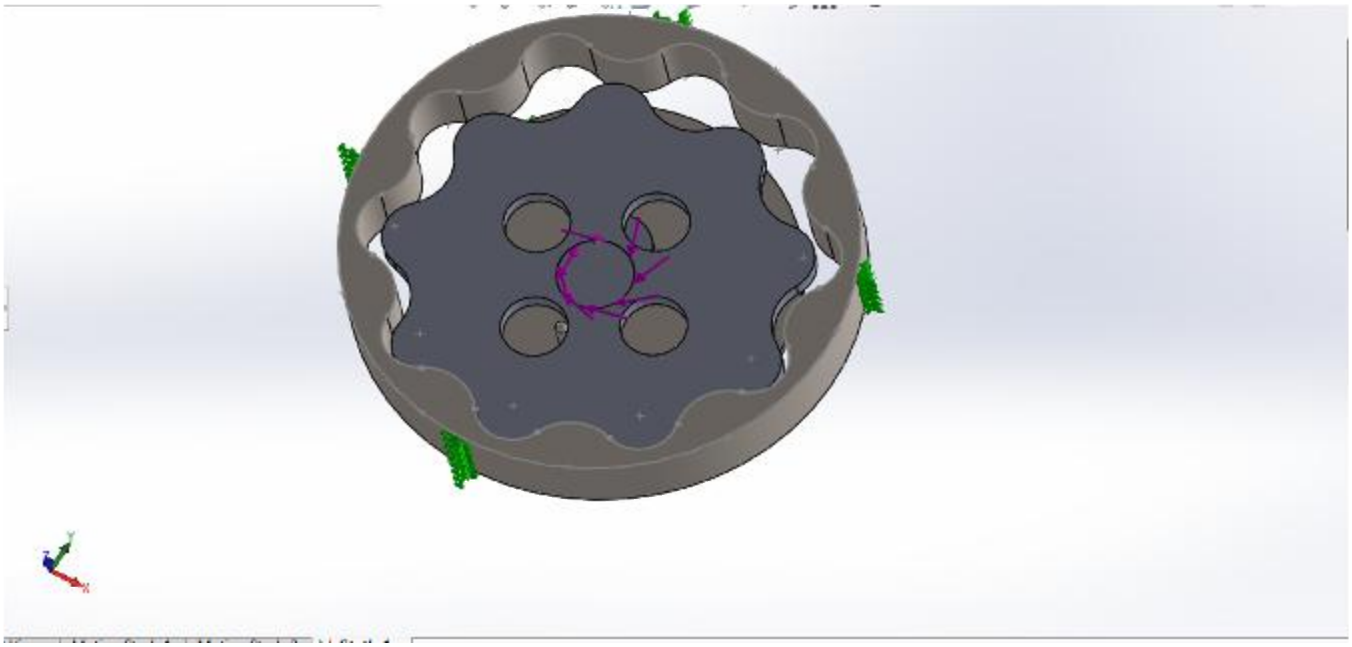
Selecting NU316 ECJ of dynamic capacity 22000 kg

Chapter 2: Design: Analysis, Design Methodology and Implementation Strategy

2.1 Modeling:

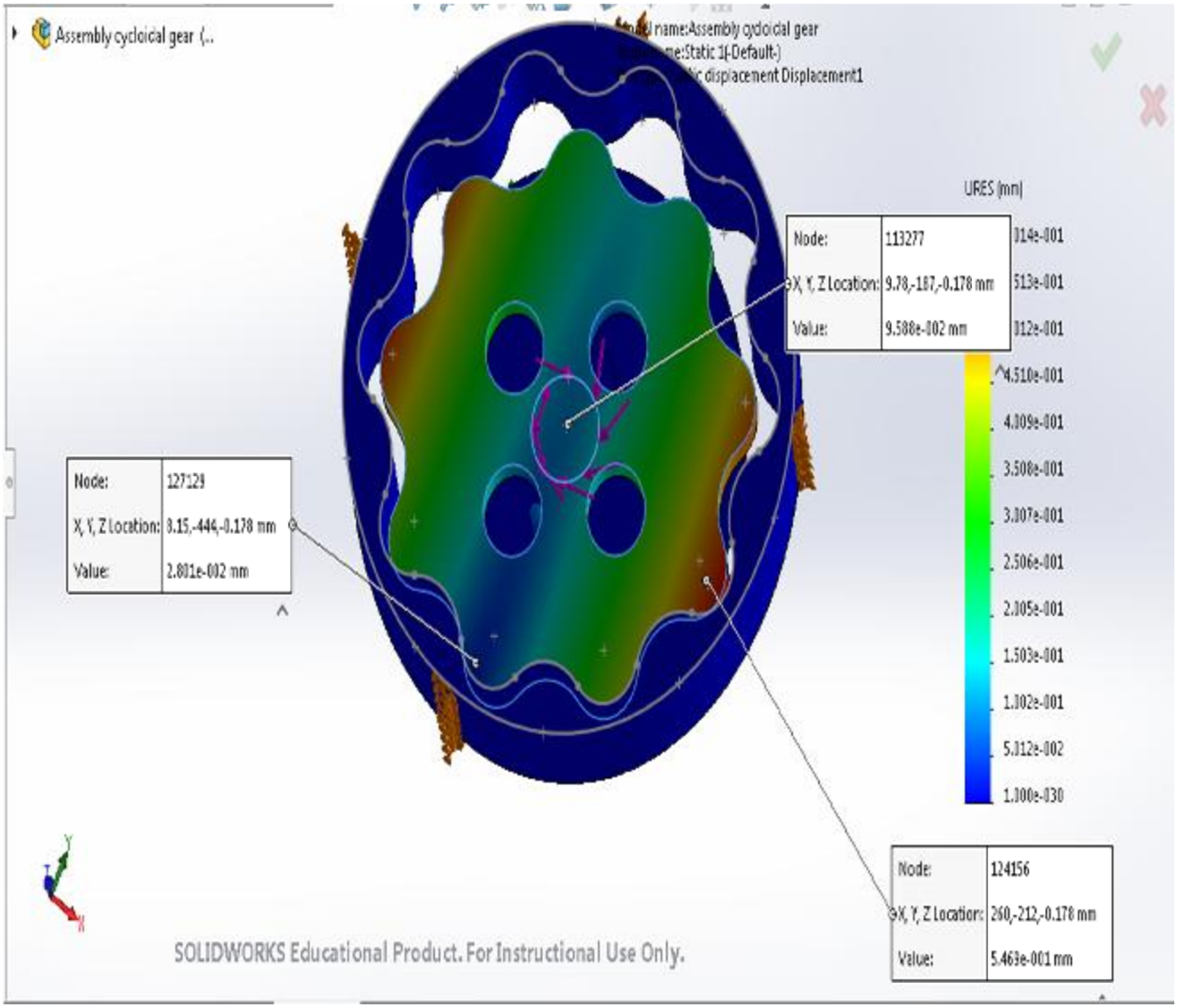



Origin
Static 1 (-Default-)
Parts
Connections
Contact Sets
Component Contacts
Fixtures
Fixed-1
Fixed-2
External Loads
Mesh

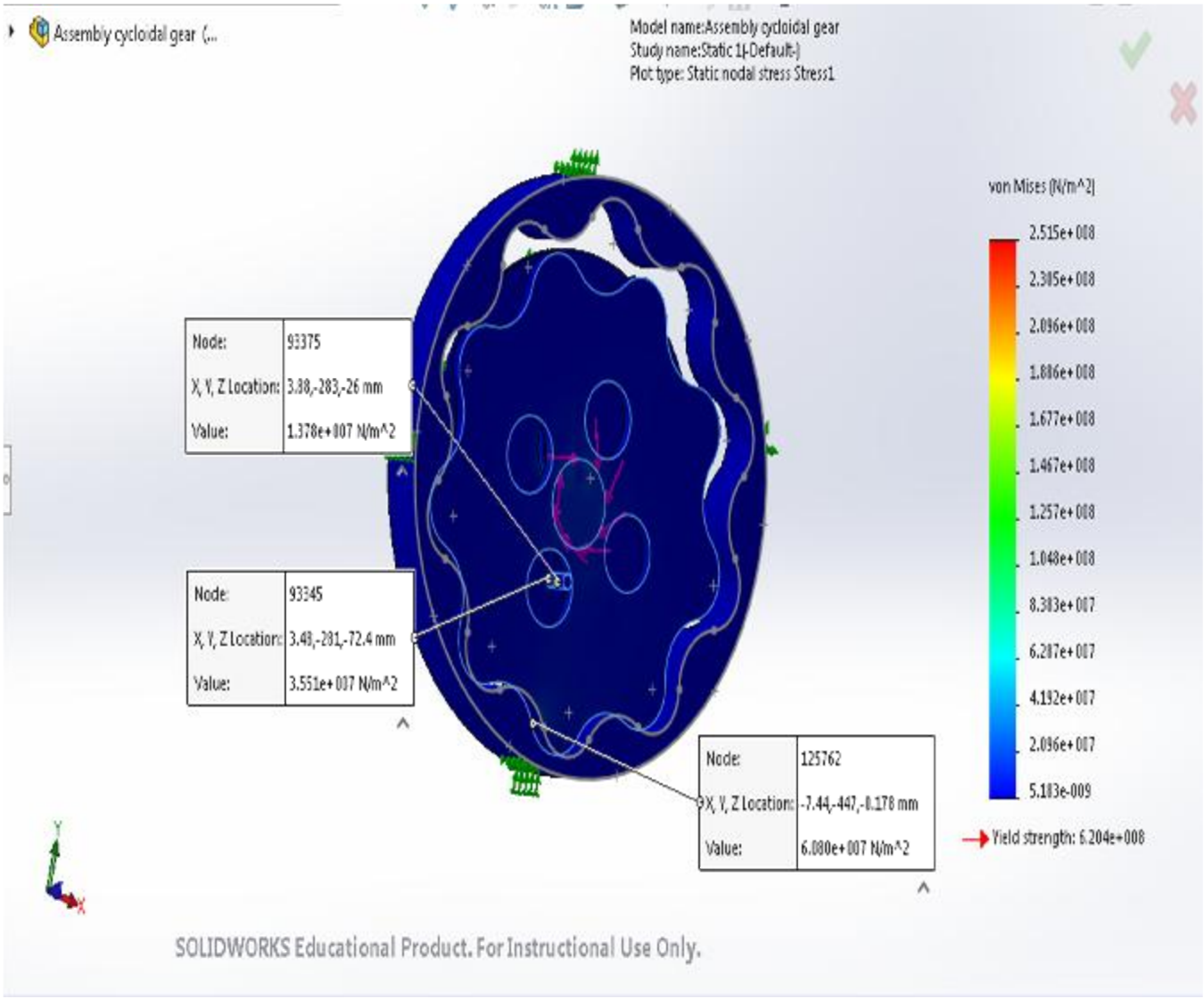


2.2 SIMULATION RESULTS:

1)Strain analysis



2)Stress analysis



2.3 REFRENCES

- [1] Aditya K. Vasaikar , MayurSasane,GaneshValekar,DipakChoudhari.(2016). ” Design and Manufacturing of Cycloidal Speed Reducer”IJSRD - Vol. 4, Issue01, 2016 | ISSN (online): 2321-0613.
- [2] MirkoBlagojevic, NenadMarjanovic, ZoricaDjordevic, A New Design of a Cycloidal Speed Reducer, Journal of Mechanical Design, AUGUST 2011,Vol.133/085001-1.
- [3] Joong-He Shin, Soon-Man Kwon” On the lobe profile design in a cycloid reducer using constant velocity center” Mechanisms and Machine Theory 42 (2006)596–616.
- [4] Ivan pantić1 - mirko blagojević1,(2015)” kinematic analysis of single-stage cycloidal speed reducer”machine design, vol.7(2015) no.4, issn 1821-1259 pp. 113-118.
- [5] Todak R Bobak “dynamic analysis of cycloidal gearbox using finite element method”By American Gear manufactures associations, October 2012.
- [6] Anghel Drugarin Cornelia Victoria1, M. Ahyaz Ahmad2, Vyacheslav V. Lyashenko3 (2013).” A Study of New Cycloid Swing Link Speed Reducer by using Algorithmic Design” (IJSR) ISSN(Online): 2319-Volume 4 Issue 5, May 2015.
- [7] Dr. K B Waghulde1, Mr. Agale V B2, Mr. Kamble A B3, Mr. Kale S S4, (2017).” Design of Double stage cycloidal drive using roulette curve generation technique.” June 2017 | IJIRT | Volume 4 Issue 1 | ISSN: 2349-6002.