Design of Rotary Fixture for Radiography of Propulsion System

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***Abstract*- A Rotary Fixture is designed, simulated and Automized in this paper. rotary fixture is a device which is used for the high energy material handling system . It is the important aspect to handle the propulsion system so the fixture designed is to be good factor safety and easier handling of high weight loads. This load is fixed on rotary fixture by hydraulic actuated swing type clamp. It reduces the manual operations during the N.D.T. Hence the safety perception of the workers is to be increased. Due to precise material handling accuracy of the requirement of operation is increased to high extent. This paper contains Design, simulation, clamping and automation of Rotary Fixture.**

***Index Terms*- Balls, Hydraulic clamp, Induction Brake Motor, Material Handling, Rotary Fixture, V F D.**

1. INTRODUCTION

The fixture is rotary and asymmetrical and it has to be statically balanced therefore it is called rotary fixture**.** The Rotary Fixture is important in precise Material Handling and as positioning equipment, In radiography process and machining, work holding is a key aspect and fixture are the elements to satisfy the general goal**.** Usually, a fixture solution is made of one or several physical elements, as a whole design fixture solution must satisfy the entire FR's and associated C's. i.e. Centering, locating orienting clamping and supporting can be considered for a functional requirement of fixture**.**

The rotary fixture contains rotary disc which is connected by the shaft with the help spline and another end Induction brake motor for torque generation and rotation load. Rotation, torque, start stop functions are controlled by V. F. D. The rotary disc is of mounted on the fixed ring which connected by the four legs having the caster wheels attached which is for the movement purpose. For the rotation purpose of disc the balls are inserted in between rotary disc and fixed ring for the purpose of reduction in friction. This fixture is used in radiography of propulsion system and various machining operations in industry for high weight parts or equipments.

II. PROBLEM IDENTIFICATION

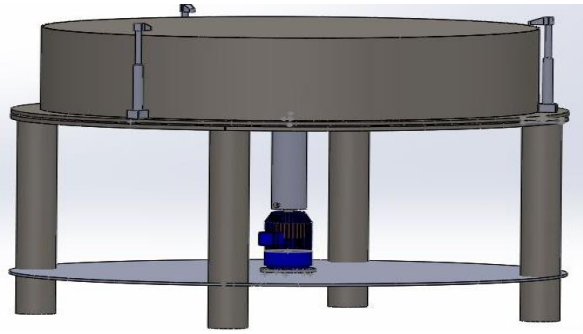
Material Handling is the important function in industry and day today life. As per the perception of the material handling it should be precise, easy, accurate and safe. Hence in N D T It is important to handle the propulsion system carefully and safely with desired requirement of various positioning in operation.

PROBLEM STATEMENT –

Design of Rotary Fixture for Radiography of Propulsion system. In this system the fixture being is rotary in nature which is to statically balance. The mass of 3 tones should be balanced on rotary fixture which is supported by clamps, joints and shaft which is working on movable table which plays an important role in designing the fixtures. In one revolution we have to take pictures of 36 different points at different angles with the help of Radiography (x-rays).

III .CAD MODELING

We prepared design on SOLIDWORKS software package. All the tolerances were taken into consideration during designing process.

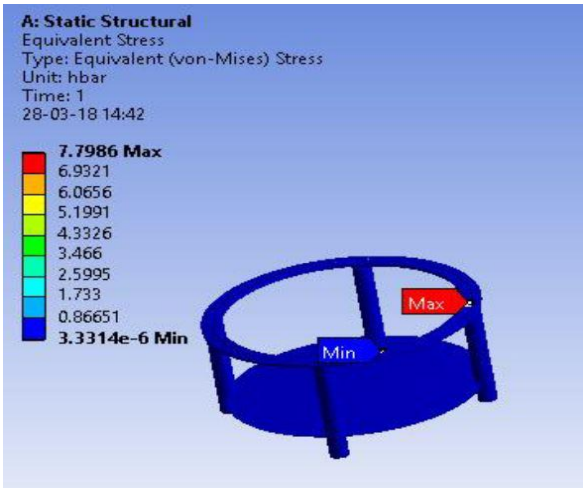


CAD MODEL

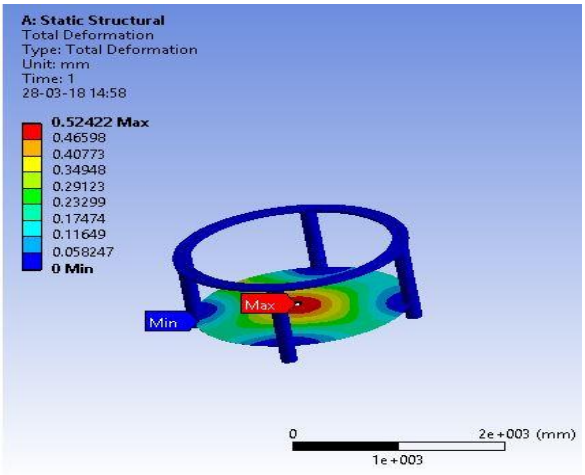
PARTS IN ROTARY FIXTURE – Rotary disc, fixed ring on legs, balls , hydraulic swing clamp , spline, keys Shaft , cotter pin ,Nut, bolt, Allen bolt .

IV. SIMULATION

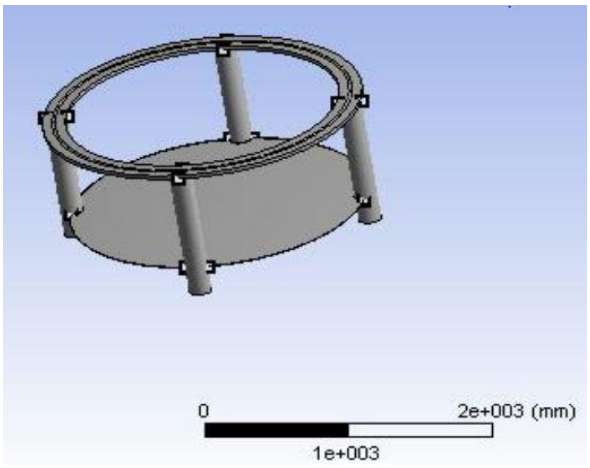
We simulated the design in ANSYS software package. All the standard consideration taken in analysis of the Rotary Fixture.



Von Mises Stress



Total deformation



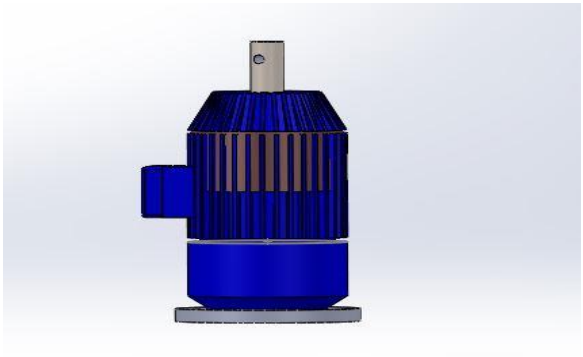
Nodal Displacement

V. COMPONENTS USED

The following components are used in design of Rotary Fixture:

Induction Motor with Brake

An Induction Motor with brake is rotary machines that give the mechanical power by converting from the electrical supply. This motor gives high torque and variable speed with variable supply of power. The function of brake is to stop motor shaft rotation at instant with precise accuracy.



INDUCTION MOTOR WITH BRAKE

Variable Frequency Drive (V F D)

Variable Frequency Drive is a component used in Industry is growing rapidly and it is now more important than ever for maintenance personnel to keep VFD installations running smoothly. VFD change the speed of motor by changing voltage and frequency of the power supplied to the motor. In order to maintain proper power factor and reduce excessive heating of the motor, the volts/hertz ratio must be maintained. It gives the torque reduction and

increment and start, stop with high accuracy during operation. This operations is the main task of

Variable Frequency Drive

Variable Frequency Drive (AC drives) are used to stepless speed control of squirrel cage induction motors mostly used in process plants due to its ruggedness and maintenance free long life. .VFD control speed of motor by varying output voltage and frequency through sophisticated microprocessor controlled electronics device. VFD consists of Rectifier and inverter units. V F D is the future of Mechatronics systems

Variable Frequency Drive

Caster Wheels

Caster and wheel carries a maximum recommended load capacity, based on manual operation with intermittent service at speeds. Absorbs shock while moving this is important for movement purpose.

VI .METHODOLOGY

Design of Rotary fixture is on trial and error basis after some iteration we come with best resolution .The rotating disc is mounted on ball which is placed on fixed ring grove. The rotating plate is connected with shaft by using of splines, at another end of shaft we connected it to motor for rotation purpose. As we included some suitable features for our designing purpose. As we included Variable frequency drive (VFD) with encoders, splines, hydraulic clamping, cotter pin, induction motor with brake, caster wheels, balls for rotating disc. As per designing, analysis, and calculation as per requirement Induction motor generates high torque which is important for the desired given load as we connected it to the V F D it increases the torque and control the speed. V F D gives signal for starts and stop operation of motor as per our requirement to stop in 36 points to take N D T by using radiography (X-Ray). Due to using of balls in between the fixed ring and rotating disc it reduces the friction between them and operates precisely. For the designing purpose high factor of safety is taken in consideration because it is most delicate and hazardous system is to be handling by this Rotary Fixture.

VII. CALCULATIONS

TORQUE CALCULATION

Force Calculations: -

F = m* g
= 3000 * 9.81
= 29430 N
= 29.43 KN

Torque calculations: -

T = F * r
= 29.43 *1120/2
= 16480.8 Nm

Shaft Torque Calculations:-

Moment of Inertia

I = 1 / 2 *3500 *(1.120) ^2
= 2195.2

ώ = □ D N /60
= 3.14 * 2.24* 27 / 60
= 3.16512

T = I ώ
= 2195.2 * 3.1651

T = 6948.0714 Nm
= 6.9480*10^6 N-mm

VIII. CONCLUSION

The Rotary fixture is designed, simulated and modeled with the help of various literature survey and other journal papers. The fabrication done based on the design. Thus we performed testing on model which is precise material handling in successfully in working condition.

ACKNOLEDGEMENT

We would like to take this opportunity to express our sincere gratitude to all those who helped in our project work .Particularly we are grateful to our project guide Prof. V. C. Mali ,Mr. R. S. Kapse for guiding us throughout this project with all respect.

We would like to thank the college authorities for providing us with full support regarding lab facilities and related software's. We would like to thank all the people, who have helped us directly or indirectly.

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