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FAILURE ANALYSIS OF COUPLER SCREW IN NARROW GAUGE RAILWAYS

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ABSTRACT

In every system, equipments or component failure happens for some reason. Proper root cause analysis identifies the basic source of origin of failure problem. Root cause analysis is step by step approach that lead to identification of fault's or root cause. In this project, failure of Coupler Screw is one of the problems in South East Central Railway Narrow Gauge, Nagpur. Due to some reasons there is failure in Coupler Screw. The task given is to find out the cause of failure of Coupler Screw. In this project step by step approach is carried out to find out the root cause of failure. For conducting this, mechanical testing, metallographic and non destructive test has been performed. Analysis software is used to get optimum solution and support overall failure analysis of coupler screw

Keywords: Failure Analysis, Coupler Screw, Narrow Gauge Railway.

I. INTRODUCTION

The analysis of failure and proper assignment of primary and secondary causes of failure are often a very complex problem. In narrow gauge railways, screw coupling is used to connect two wagons or Bogies. This is the main assembly for attachment of two wagons.

Coupler screw is one of the important part in coupling, It is used to tight the coupling so that hook from the other end of wagon does not come outside. It has right and left handed thread it called as knuckle thread which is fixed in front shackle and back shackle. The main purpose of Coupler Screw is to tight the coupling with the help of cover.

Main function of coupling to transfer tensile and compressive forces between wagons during coupling, rough shunting, minor collision, braking, accelerating and curving. In this condition the coupling works, but due to some reason coupler screw fails during working condition. According to Indian Railway Standard it should be steel class 4 (plain carbon steel). It is manufactured on lathe and material properties should be conforming as per standard. In addition coupling equipment should meet the mechanical strength requirement, material properties, metallurgical condition, and surface treatment. It should be selected to meet operating condition with respect to dynamic condition, tensile, compressive and impact load during working condition.

If the coupler screw deviates from the operation or due to some reason it will brake, so there may be a chances of accident, wagons may be separated from each other.

Knowledge of each type of failure is important to avoid or to minimize future problems. Application of this accumulated knowledge to the prevention of failure is the goal of the failure analysis

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Fig: - 1.1 photograph of screw coupler assembly

Fig:- 1.2 photograph of broken coupler screw

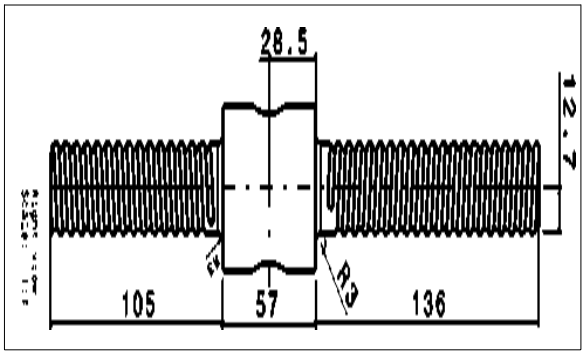

Fig:- 1.3 drawing of coupler screw (front view)

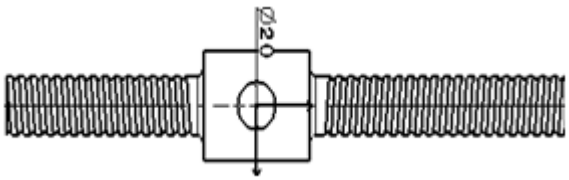

Fig: -1.4 Drawing of coupler screw (top view)

II. SPECIFICATION OF COUPLER SCREW

As per Indian Railway standard Board material, chemical composition and physical property as under follow.

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* Material Name	Plain carbon steel
* Class	steel class IV

- Chemical composition :-

Carbon	0.4 to 0.5%
Mg	0.6 to 0.9%
Silicon	0.15 to 0.35%
Sulpher	0.4 max
Phosphorus	0.04 max

- Mechanical Properties:-

Tensile strength	630 - 710N/mm^2
Yield strength	360 N/mm^2
Elastic modulus	2e+o11N-m^2
Poisson Ratio	0.28
Density	7850 kg/m^3
Elongation	15%
Normalize Temp	(830-860)^0 C

III. LITERATURE REVIEW

"Mechanical coupling system" this document published by Rail Safety and Standard Board, London in 20 October 2004, this document gives guidance on the details of the main type of rail vehicle mechanical coupling system currently in use on rail vehicles that operates on rail controlled infrastructure. It also provide basic information on the requirements for ensuring safe and reliable mechanical coupling system design for new or modified rail vehicle.

It provide coupling system type, railway industries standard, operating condition and maintenance requirement. "Engineering failure analysis" edited by Dr. R. H. Jones, department of engineering, university of Cambridge UK. He highlighted 36 case studies describing the analysis of real engineering failure which have been selected from the first three volumes of engineering failure analysis, he worked on specific failure mechanisms, that covered, brittle fracture fatigue(initiation based), fatigue fracture, environmental attack, manufacturing failure and design failure.

"Root cause failure analysis" – understanding mechanical failures written by Neville sachs president of saches saivatera & associates which was founded in 1986. This firm specializes in improved plant and equipment reliability and technical support services. Among the firms capabilities are mechanical failure analysis, corrosion and material engineering, design reliability analysis and wide variety of nondestructive examination method. Failure analysis is an engineering approach to determining how and why equipment or a component has failed. Some general causes for failure are structural loading

"An introduction to failure analysis for metallurgical engineering" by Thomas Davidson paper contest winner 1999, the objective of this paper is to introduce the reader to the procedures generally followed when conducting the failure analysis. He highlighted six case studies on failure analysis like crank bolt failure, rider roller shaft failure etc. He worked on over the summer 98 for Noranda technology centre in the material

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technology for failure prevention group. He stated that, the first step in conducting any failure analysis is to gain a good understanding of the conditions under which the part was operating. The investigator must ask questions from those who work with, as well as those who maintain the equipment and visit the site whenever possible. Contacting the manufacturer may also be necessary. A simple questionnaire, is a good place to start and will lead the investigator to more detailed questions. Unfortunately, in many instances the investigator will receive a failed part with little information about its history and operating conditions.

IV. CAD MODEL

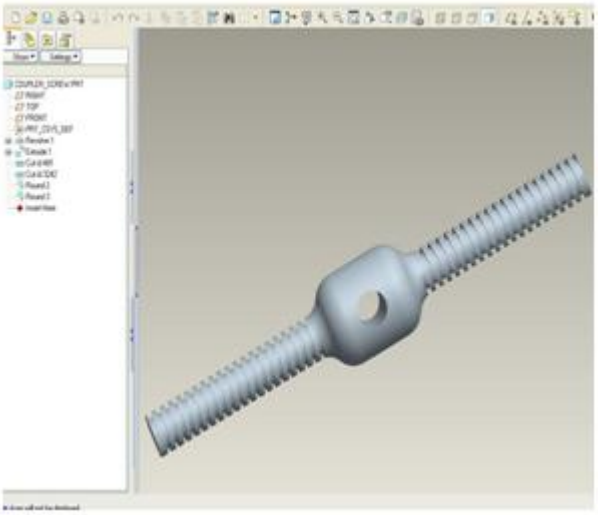

Fig: -1.5 CAD Model of Coupler Screw (Using PRO-E Software)

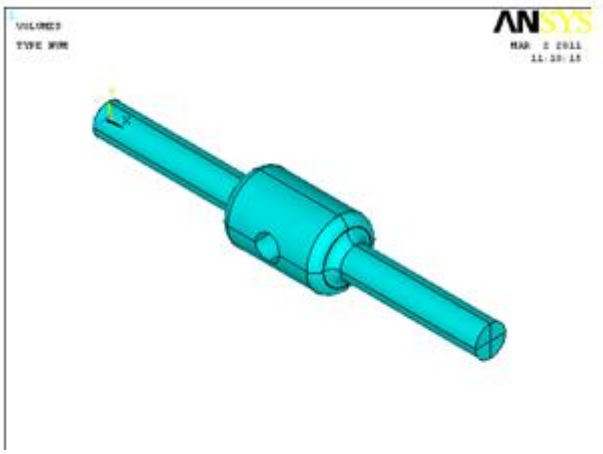

Fig: -1.6 CAD Model of Coupler Screw (Using ANSYS Software)

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V. FAILURE ANALYSIS

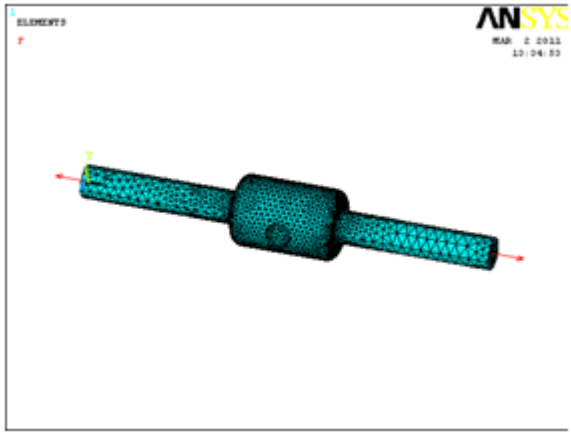

Fig: -2.1 Meshed Model of Coupler Screw

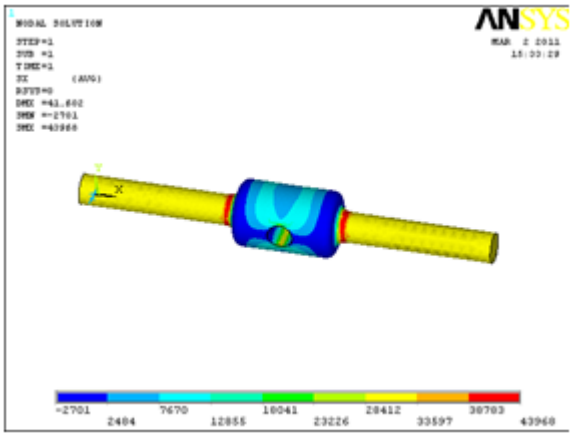

Fig: -2.2 Analysis Model of Coupler Screw Nodal displacement in x-direction

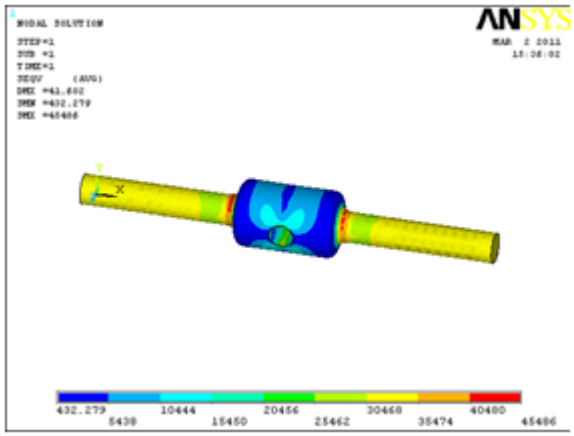

Fig: -2.3 Analysis Model of Coupler Screw Nodal displacement in y-direction

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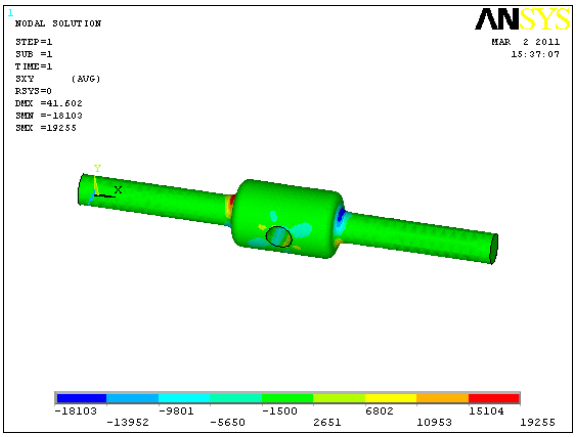

Fig: -2.4 Analysis Model of Coupler Screw Nodal displacement in x y- plane

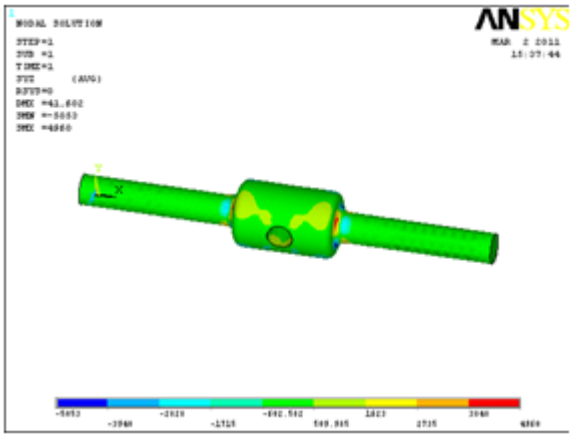

Fig: -2.4 Analysis Model of Coupler Screw Nodal displacement in y z- plane

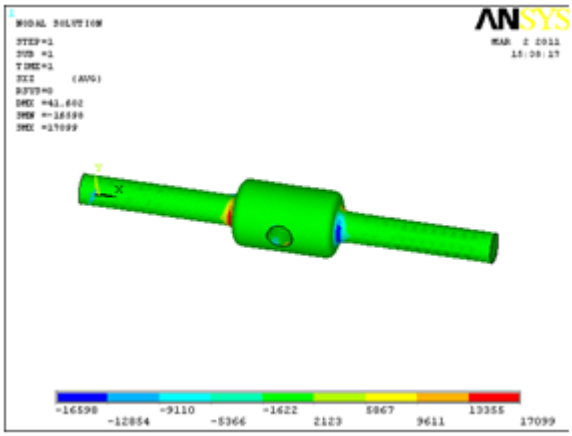

Fig: -2.5 Analysis Model of Coupler Screw Nodal displacement in x z- plane

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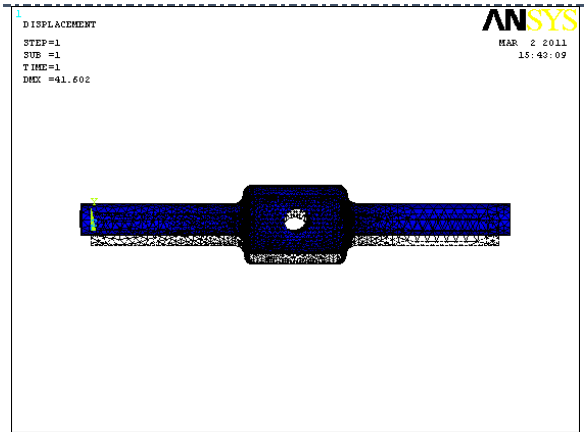

Fig: -2.6 Analysis Model of Coupler Screw Displacement OR Deformation of screw in loading condition

VI. RESULT

From the above analysis of existing coupler screw, It is observed that the maximum stresses are developed in the neck region.

Hence coupler screw failure occurs in neck region.

In order to minimize this there is need to change either diameter or to apply composite material in that region.

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