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"A REVIEW ON FAILURE ANALYSIS OF DIFFERENT WIRE ROPES USED IN EOT CRANE"

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ABSTRACT

As consumables in mine, wire ropes have great significance for safe operation of coal mines. The complex structure makes the nondestructive testing particularly difficult. This paper summarizes the existing methods of analysis at home and abroad from the perspective of strong magnetic and weakly magnetic; introduces the main methods of wire rope at the present, including principle and current status. At last, several critical problems in nondestructive testing of wire rope are discussed.

Key Words: *Wire Rope; Nondestructive Testing Technology; Electromagnetic Detection Method*

I. INTRODUCTION

Crane is a hoisting device use for lifting and lowering load with means of drum or lift wheel around which there will be rope or chain wraps. EOT crane is a mechanical devices used for lowering or lifting material, also used for making the material move vertically or horizontally. It will be useful when the task is beyond the human capacity to moving or lifting the loads. Crane is a special design structure equipped with mechanical elements for load by lowering or raising by manual or electrical operation. Applications of cranes are generally in the transport industries for unloading and loading of load, in construction industries for the materials movement; and in manufacturing industries for assembling of heavy equipments. This device decreases the cost of the production by increase the output, speed up the deliveries & improve quality. Due to increase in labour costs and issues related to labour . management the utility of this device has further been increased. Crane is very much useful in increasing human comfort by picking up load from one point and transport the object from one place to another. In designing of cranes there are three major considerations. First, the weight of load must be lifted up by the crane. Second, no topple of the crane. Third, rupture should not be there in crane. Cranes are available in lot of categories. They are called as Jib crane, Telescopic crane, Tower crane, Gantry crane, Truck mounted, Aerial crane, EOT crane, etc. The constructions of EOT cranes are typically of two types, either single girder or in double girder.

1.1 Types of EOT crane

On the basis of structure cranes are :
I. Overhead bridge
II. Gantry crane
III. Jib crane

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Fig 1.1 Overhead bridge crane

II. LITERATURE REVIEW

High strength wire ropes are very crucial structural members which used to transmit tensile forces. Because of their high strength and flexibility, wire ropes are in widespread use throughout the electrical, mechanical, mining and naval engineering industries. Some of the applications are electrical power transmission ,suspension bridges, mining equipments, aircraft arresting cables, safety and anchoring cables, lifts. They are necessary part of the various equipments that are designed specifically to aid the materials movement, machinery movement, etc. It includes tower and harbor cranes, powered industrial trucks, derricks, conveyors and hoists,. These transport devices depend upon WR, to be more specific, WR slings, to carry and hold their suspended loads. As computer sciences and technology were developing and became readily available, numerical analyses have started to be used frequently in predicting the behaviour of wire rope. Theoretical and analytical analyses were needed, because it was required to conduct many tests very often during exploitation to determine the structural condition of wire rope, bearing capacity and for detecting the damage resulting due to the repeated working loads. Specific, expensive & large testing devices are required for doing experimental work on WR, so numerical analysis such as FEA and non-destructive method, were the next logical step in the behavioural studies of wire rope.To predict the WR behavior, analytical studies and theoretical models presented in the literature in.

Gordana Kastratović(2014) Here the stainless steel core's FEM of two IWS as 1*19 and 7*19 were investigated, with special focus on different types of tensile forces & different types of contacts. As a member of complex WR, the sling WR core which carries the huge amount of axial load, subjected to two different types of tensile forces. Also, linear bonded and nonlinear frictional contacts were the two different types of contacts between wires were applied. Finally, analysis carried on model of 7*19 sling wire rope, for linear and nonlinear contact. Force applied as axial strain. Analysis for load distribution analysis was carried out here. All emphasis was on the creating the suitable fem of the WR, in order to have a better understanding and prediction of the mechanical behavior of the sling WR.

Shaiful Rizam Shamsudin(2015) Here failure analysis of a broken wire rope of an offshore platform crane was performed. Wire rope was in operation for less than 5 years. Here Wire is of seven strands, one central core strand and six strands around it. 0.78 -0.94 mm is the dia. of small wires and 1.52 - 1.78 mm is the larger wires. Large size wires was found fractured due to cyclic torsional stresses, characterized by presence of the cracking originating due to fatigue in the outer surface of the wire. Meanwhile fractured of the smaller wires were in a ductile manner after the larger wire broken out under excessive load due to the fatigue mechanism.

Er. G.S. Ramteke(2015) In this paper a study was carried out on simple 7 wires single strand rope using the FE as well as analytical approach. The obtained results further compared. It is concluded that the behavior is significantly changed in the conditions 1. rotation of the WR is allowed and 2. rotation is prevented. Each case analyzed. The obtained results

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suggest the allowing rotation decrease the direct stresses. However, these needs to be further investigated as the direct stresses are. significant cases in comparison with the operational conditions in which rotation is not allowed. This detailed study is justified for the variation in the rotational elongation. In the real application in which hauling through a long distance rotation and local unwinding of the WR involves, is not uncommon and often is a chief cause of reduction in life of the WR. Therefore the analytical results & FE results are in agreement a detailed investigation involving variation in helix angle, coefficient of friction, % elongation, rotational elongation allowed, etc

Bart C. de Jong(2017) investigate the two question arised because of the Det Norske Veritas (DNV) a Norwegian certification instance which prescribes for bending wire rope, a capacity reduction factor. Here the questions answered are: Around a shackle, how does the forced bending of a steel wire rope affect the break load of the WR? And: How does the forced bending of a steel WR relate to the reduction factor for bending enforced by DNV? By constructing an analytical model, these questions are answered. In addition to this, to verify this model experiments are performed at laboratory of the civil engineering faculty. The assumption made or the analytical model is based on that the behaviour of every single wire is as an Euler-Bernoulli beam. Due to the effect of individual wires being bent, dominantly the reduction in capacity takes place, similarly as bundle of loose beams being bent. To accurately describe D-d ratios plastic deformation has to be considered. Axial tension causes friction forces due to the helix structure between the strands and the wires. When WR is bent the higher stresses and strains value generates this increases the stiffness of wire rope. Due to the slippage of wires it lowers the stiffness drastically and any further deformation causes a much lower increase in the stress and strain.

Rakesh Sidharthan(2017) Tensile test is carried out for single wire and the test is extended for an IWSC of 7x19stainless steel WR of the IWSC by using of UTM. The geometrical construction of the IWSC has stranded construction of 1-6-12. A material used is of grade 316 AISI stainless steel. A geometric model is developed by using of CAD for the single wire and WR of the IWSC. A numerical analysis carried out for both the WR and single wire. Depending on the wires contact region numerically a frictional coefficient is calculated. And also to check the wear rate experimentally wear test is carried for wire rope.

Steven Joseph R1-ieinberger(2018) The objective from the paper was to review factors which affect wire rope life and propose a method for choosing a design factor which incorporates yard costs. Several factors involved in determining design factors introduced here. The first, line type or use, suggested that it may not be appropriate to use the same design factor for all lines used in a cable yard operation. Wire rope Lines which constantly moves over sheaves, under high tensions, or subjected to abrasion should have higher chances to fail so higher design factors induce than lines which is static or not move since lives of moving lines will have shorter lives. The second approach dealt with the length of the WR in use. At longer lengths, wire ropes operated in elastic region are capable of storing significant amount of energy. In terms of impact loads or hang-ups, this ability to store energy (stretch) may be important to provide reaction time for an operator to prevent a tension above the elastic limit. On a shorter span this may not be possible due to the small amount of energy required to stretch the line to its elastic limit. Therefore, it is possible, lower design factors are appropriate for long life of wire rope.

Ailin Zhang(2018) Here the evaluation of design method of the initial tension and sectional area of pre stressed braced steel moment frame structure system's wire rope brace was done, A theoretical analysis of the structure system is conducted. Formula for Lateral stiffness is derived. The lateral stiffness and lateral stiffness of bare steel are interrelated to distance between column, story height, moment frame, story drift, and the lower end of brace, sectional properties & material properties of WR is reveals from the study. Relationship curve is looked like concave shape & Lateral stiffness increase with the growth of story drift. It is presented that the initial pre stress degree design formula and method in light of the criterion for determining the initial pre stress degree. Story drift decreases with growth of the WR sectional area and relationship curve is looks like concave shape now, here, the design formula for sectional area of wire rope & method are proposed. The proposed design formula and method of wipe rope brace is by an example analyzed using ABAQUC a finite element ftware package.LEX MUGANE KARUGI (2019).

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III. METHODOLOGY

3.1 Failure modes

Here we consider only the following modes for the failure of WR. The stresses generated in rope exceed the yield point stress with safety factor applying. This will lead to take rope into plastic deformation zone Nominal rope dia. reduced by more than the amount shown in Table3.1 for the applicable size rope, or unexpected increase in lay length, as compared to previous lay length measurements.

IV. CONCLUSION

Using both numerical and experimental approaches a study on wire rope was performed. The simple approach used enables one to comprehend the basic concept of wire rope and utilizes it both in research and in field failure analysis. Further, it was found that the wire ropes failure

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