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A Review on Failure Analysis of Hex Bolt M30 in Rotating Machine

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Abstract- This paper deals with identifying the main cause of failure of Hex Bolt 30.Time saving is time earning in order to make efficient use of time. Bolts may be the smallest part in the design but this does not minimize their importance. Failure of bolts results in accidents, fire incidences, damage to products, breakdowns which results in huge loss to company. The most common mode of failure of bolts used for mounting is fatigue failure, overloading, over tourquing, under tourquing, vibratory conditions. Other modes of failure include corrosion, varying temperature conditions, and exceeding the shear stress limit. Loosening of bolts in Vibratory conditions is a common problem in engineering applications. Rotating or reciprocating machines are subjected to vibration of relatively high frequency.

Index Terms- Fatigue failure, Tourquing, Vibratory conditions

1. INTRODUCTION

Hex bolt M30 are a very common choice for machine repairs, decks, and several outdoor applications. Hex bolts, also called hexagon screw head bolts, hex cap bolts, hex-cap screws, or machine bolts. Hexagon screw head bolts come in a large variety of sizes and diameters. The best way to choose the right hex bolt is to find the bolt material that best suits your needs.
Each different hex bolt material has particular properties to fit specific applications. Hexagon screw head bolts are made from a variety of materials to accommodate the wide range of applications in which hex cap bolts are used. Below are just a few of the more common types of hexagon screw head bolts.

- **Stainless steel bolts:** Common choice of hex screws since they don't need any coating and are corrosion resistant.
- **Carbon steel bolts:** The most common

Hexagon screw head bolts are zinc plated for added corrosion resistance.

- **Alloy steel bolts:** These types of hex bolts are made to withstand an enormous amount of pounds per square inch. They are coated with either cadmium or zinc plating to protect them against corrosion.

Hex bolts M30 are available with standard threading or full threading, depending on the length of the bolt. Applications for hexagon screw head bolts can vary from exterior and automotive to marine, coastal, and high temperature environments.
The bolt & nut connections can be regarded as one of the most important material joining techniques. They are widely used in various engineering fields, Including aerospace, automotive and mechanical/civil engineering constructions. In many cases bolted joints are the weakest elements in structures or mechanisms, so that understanding their mechanical behavior turns out to be the key when they are subjected to an increasing monotonic load until fracture (for instance due to a bad design) or in presence of cyclic loads (fatigue). Although bolts may be subjected to multiple types of loads (torsion, bending), they always present a strong component of tension, loading condition. Distribution of load, fatigue life & strength, shape of bolt are crucial factors which helps in preventing failures due to Hex bolt M30.
Hex bolt M30 is a threaded fastener utilized throughout industry to secure two or more mechanical parts together. Bolts may be subjected to thousands of pounds of tensile force as well as alternating forces at a range of frequencies. When a threaded fastener cannot sustain the expected loading and becomes detached, a significant loss may occur. Although rare, bolt failure has caused wheel detachment on vehicles, structural failure in buildings, and crashes of aircraft. Failure of bolt occurs due to overloading, lack of locking mechanism, metal fatigue, and failure from

improper torque, failure from improper design, failure from improper manufacturing, corrosion failure, evidence handling, and hydrogen embrittlement.

2. LITERATURE REVIEW

Yakushev investigated the effect of manufacturing technology on the fatigue strength of thread connections. His work showed that the rolled thread improves the fatigue strength significantly compared with the cut thread and grinded thread . The effect of type of thread on the fatigue life of screws, including triangular thread, trapezoidal thread, positive buttress thread and negative buttress thread. In addition to the shape of bolt thread, some studies also paid attention to the effects of the tightening or loading conditions on the fatigue life of bolted joints

Kenny and Patterson studied the load and stress distribution in a bolt-nut connector by using 3-D frozen-stress photo elastic analysis and compared their results with theoretical and numerical solutions. They also fully reviewed the distribution of the load between the engaging threads.

According to **Xin Chen & Nako-Aki Noda** to improve the fatigue life of the bolt, the key is how to deal with the non-uniform loading along the bolt threads, as well as, reducing the high stress concentration at the root of the thread. In this study, a Slight pitch difference is introduced between bolt and nut.

According to **Neville Sachs** A ductile failure is one where there is a great deal of distortion of the failed part. Commonly, a ductile part fails when it distorts and can no longer carry the needed load, like an overloaded steel coat hanger. Brittle fracture is when a part is overloaded and breaks with no visible distortion. This can happen because the material is very brittle or when a load is applied extremely rapidly to a normally ductile part. A severe shock load on the most ductile piece can cause it to fracture.
According to ***Brown, Morrow, Durbin, Baca*** the most common mode of failure is overloading. Operating forces of the application produce loads that exceed the clamp load, causing the joint to loosen over time or fail catastrophically. Over torquing might cause failure by damaging the threads and deforming the bolt, though this can happen over a very long time. Under torquing can cause failures by allowing a joint to come loose, and it may also allow the joint to flex and thus fail under fatigue.

According to Dr. Paul Roffey a common failure mechanism in Hex bolt M30 is Hydrogen Embrittlement. The problem arises due to the migration of hydrogen into the structure being possible at the manufacturing stage or through corrosion in service, or a combination of both. Identification of the presence of hydrogen within the structure is difficult, and made more so due to the fact that following failure, the hydrogen can exit the structure as easily as it entered. HE is barely detectable from a visual perspective and occurs suddenly. The only positive aspect is that it is often detected at installation when the torque is applied to the bolt, or, can even occur before fitment whilst in storage where embrittlement was a result of the manufacturing process.

According to **Dr.Saman Fernando** vibration causes bolt loosening. By far the most frequent cause of loosening is side sliding of the nut or bolt head relative to the joint, resulting in relative motion occurring in the threads. If this does not occur, then the bolts will not loosen, even if the joint is subjected to severe vibration. By a detailed analysis of the joint it is possible to determine the clamp force required to be provided by the bolts to prevent joint slip.

According to **Charles C. Roberts** corrosion of metals is disastrous to bolts. Surface and pitting corrosion attacks bolts as a result of contact with moisture or other corroding media. Since bolts often carry high loads, stress corrosion cracking is another corrosion related failure mode. Corrosion, coupled with forces in a bolt, tends to accelerate cracking. Fracture surfaces of bolts showed progressive
Environmentally assisted cracking as a cause of the bolt failure.

Alex Hudgins & Brad James identified that many times cause of bolt failure is fracture by fatigue, which is often created by inadequate tension and clamping force upon installation. It is the most common form of fracture of metal structures, accounting for up to 80% of all costs associated with fracture. Bolts are no exception, as fatigue remains the most common cause of fastener breaks. Fatigue crack initiation and growth

Occurs when cyclic stresses exceed the fatigue strength of local material for a sufficient number of loading cycles. Bolt material, geometry, stress amplitude, mean stress, and assembly parameters all affect fatigue performance.

3. CONCLUSION

Bolts play an important role in many engineering structures, and their failure can result in significant consequences. The most common cause of bolt failure is fracture by fatigue, which is often created by inadequate tension and clamping force upon installation. Overloading promotes fatigue, and leads to fatigue crack growth. Fatigue strength can be increased using rolled thread. To avoid fatigue due to load uniform loading should be done. Vibrations

should be reduced so as prevent the self loosening of bolts. Machines should be regularly maintained & lubricated to avoid corrosion. Material of bolt should be selected properly & should be structured properly keeping in the loading conditions, the environment in which it will be used, vibratory conditions etc so as to avoid the failure of bolts. And regular inspection of bolts & other equipments should be carried out so as to detect the problems that would occur in near future using preventive maintenance.

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