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DESIGN & MANUFACTURING OF LIGHT WEIGHT BOLT FOR ELECTRIC VEHICLES

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Abstract – *Electric vehicles is a future of automotive industry. Increasing rate of pollution by fossil fuels is very high. But the main demand of e-vehicle is power and battery capacity. To overcome this defect, from this study, we have to reduce weight of vehicle. In this, fasteners play important role. If we reduce the weight of fasteners then power output will increase. From this study we found, to reduce weight of fasteners we have to use composite material and alloys. As well as various types of heat treatment and manufacturing methods will help us to reduce weight without compromising strength.*

Key Words: Fasteners, Light weight, Heat treatment, etc.

INTRODUCTION

Electric vehicle is future of automobile industry. Hence the industry wants to improve quality of e-vehicles by replacing heavy materials. Extremely growing trend in automotive industry is to decrease CO2 emissions by reducing the weight of the passenger cars while enhancing safety and integrity of automobile structure. For this purpose, competition between automobile suppliers increases aggressively and research and development studies become very valuable. Light weighting efforts are mainly focused on chassis and engine components however fasteners were not deeply considered for weight reduction purposes. In this study, lightweight design concepts of hexbolts and ball studs were presented. In contrast to previous studies, weight reduction designs on this study do not cover the usage of non-ferrous alloys or unconventional forging techniques. Forging station designs were modified to get higher weight reduction ratios and cold forging process was investigated numerically by using finite element code Simufact. forming. Head of the fasteners has hemispherical hollow section for weight reduction while the rigidity was maintained. Simulations and forging trials showed that total weight of the fasteners can be reduced between 11% and 18% by using hollow head designs.

To achieve light-weight fastener design with steel, the first method is to use hollow geometries in load-free or low stressed sections instead of solid designs. M14 hex-bolts and Ø16 M10 ball studs were selected for the case study and above mentioned method was applied to these fasteners. Since the weight reduction was only applied to the head section, it is more accurate to compare the weight of the head of fasteners by neglecting shafts. With this consideration, weight reduction is about 11% for the bolt and 18% for the ball stud.

Literature review

MARCELO, A.L. 1) et. al ,The study of Author state , the fatigue of bolts with rolled threads before and after heat treatment is contradictory. In many cases, axial fatigue tests have been performed with a stress ratio (R) of 0.1, which is not a desirable preload condition as high strength bolts are used with higher preloads and, consequently, higher stress ratios. At a low stress ratio, there is generally a significant increase in the fatigue limit. These beneficial results have generally been extrapolated to a high stress ratio without testing. However, some researchers suggest that the benefits due to yarn winding after heat treatment are significantly reduced at high tension ratios. This reduction can be associated with a relief of the internal stress due to the high preload. Given this uncertainty, the industry prefers to roll the threads prior to heat treating to maximize lamination nozzle life and minimize costs. In addition, the rolling of the yarns after heat treatment (quenching and tempering) leads to more frequent replacement of the roll die, which lowers production rates and increases costs.

Jinn-Jong Sheu 2) et. al ,Author observed , An Integrated Design System was created to design a flanged nut product and create lightweight product geometry. The multi-stage molding process was evaluated using CAE simulations. A topology optimization technique was used to achieve a lightweight design that included maintaining the desired geometry and eliminating excess volume. The topological discrete model has been transformed into an important geometry that is able to meet the test load requirements specified in the fastener specification. The final design of the lightweight geometry was adopted to verify the ability to withstand the required test load using CAE simulation with boundary conditions of the appropriate ASTM standard. During the evaluation phase, the finite element method was used to optimize the topology, estimate the test load, the punching process, and analyze the die stress.

The simulation results showed that the lightweight design made it possible to reduce the weight of the product and maintain sufficient mechanical strength. The proposed process and die design made it possible to obtain a lightweight product without defects.

Vaibhav G. Patange 3) et. al, Author state, Bolted connections are used as one of the most common fasteners in mechanical engineering and design. A bolted joint used as a machine connector, which has often been used to improve productivity and maintenance during a machine, can be clamped between machine components and an assembly. However, many problems often arose, such as loosening of bolted connections, shear, fatigue failure, bolt deformation. Shearing and loosening of bolted connections in static and dynamic environments has been an ongoing problem associated with many engineering applications. In this author studied, analyzes are performed on dyno components using computer simulations and finite element analysis of each component using Unigraphics / CATIA and ANSYS. In addition, bolt displacement and tension characteristics were analyzed with greater accuracy in various cell sizes under static loading conditions and their simulation results were compared to analytical results. The compiled preload diagrams of the fastener allow you to evaluate the self-tightening resistance of the fastener. The test can be performed on the locking mechanism, which is part of the nut, and on the bolt or washer.

M. s. Sonawane 4) et.al, Author presented, The automotive industry (automobiles and components) is a strategic and important business sector. With possible trade liberalization, car manufacturers and dealers will need world-class vehicles and components. A truck chassis is the backbone of a vehicle and integrates the main components of a truck system such as axles, suspension, power train, cab and trailer. A truck chassis is usually loaded with static, dynamic as well as cyclic loads. Static loading arises from the weight of the cabin, its contents and passengers. The movement of the truck affects the dynamic load on the chassis. Engine vibration and uneven road surfaces create cyclic stress. The inclusion of bolted connections in the aircraft structure leads to the formation of stress concentration zones. Composite materials are relatively brittle and generally provide limited localized stress relief compared to metals. ... This, coupled with inadequate failure prediction capabilities, can result in conservatively designed composite bolted joints that result in severe structural weight loss. Bonded spacers provide greater design efficiency but limit availability and can increase manufacturing and service costs. Optimizing composite bolting using improved modeling tools remains a priority for airframe manufacturers. Countersunk head clasps are of particular interest for use in leather joins where aerodynamic efficiency is important. Many of these hinges are single-turn. Lap joints result in a significant stress concentration and lower bearing capacity compared to lap joints, while countersunk head joints clearly imply a very complex stress distribution in laminates. Therefore, countersunk single-turn connections are critical to the aviation industry, but they are also the most difficult type to analyze. To date, few detailed studies have been conducted on this type of joints.

Santanu Das 5) et. al, Author explained , Threaded connections are popular for the temporary connection of various components because they retain high clamping forces and torque for a long time. However, they can loosen under vibration and cause system failure. This experimental work uses bolts to test the ability to resist loosening of various 5/8-inch BSW fasteners, such as a common nut and locknut with flat washer, spring washer, and internal and external toothed washers made of stainless steel (SS). The hybrid double nut is inserted using a single nut and nylock nut on the outside and a typical glued nut with 5/8 ”BSW bolt to prevent loosening. Some hybrid double nuts and nuts glued for 5/8 inch stainless steel BSW bolts when vibrated are recommended. Fasteners such as a nut and washer have been found to play a key role in preventing the fastener from loosening. The starting torque is also important. It was found that the flat washer does not impede significant loosening. Even the use of spring washers, internal or external, serrated washers provides only marginal anti-loosening performance for the tested 5/8 '' BSW stainless steel bolts. The Nylock nut has good anti-loosening properties and is less likely to loosen in bright conditions. The nylock nut provides additional frictional grip on the bolt threads to prevent loosening. You will find a hybrid double nut that uses one inner nut and a Nylock nut on the outside to prevent it from loosening quite effectively compared to a single Nylock nut. The use of an adhesive nut also provides sufficient resistance to loosening compared to a nylock nut and exhibits the same locking performance as a hybrid double nut for stainless steel bolts, so it can be recommended.

B. Lonyuk 6) et.al, Author state , High-strength automotive fastener steels are often protected against corrosion by electrochemical plating. This can lead to hydrogen ingress and, as a result, to operational failures due to hydrogen embrittlement. In the presence of hydrogen, catastrophic fastener failure can occur unpredictably at applied stress levels well below the fracture stress. Hydrogen tends to accumulate in areas of high stress concentration and reduces the stress required to initiate fracture and the energy barrier to crack propagation.

In the automotive industry, the most commonly used method to reduce the risk of hydrogen embrittlement is post-coating heat treatment, often referred to as heat treatment. The degree of embrittlement depends largely on parameters such as strength and microstructure, as well as the amount of hydrogen introduced into the steel. The roasting treatment should reduce the hydrogen concentration and, as a consequence, increase the fracture stress. In accordance with established practice, the required post-firing conditions (time and temperature) depend on the strength level of the steel. According to the specification, galvanized fasteners do not require heat treatment if they are made of steel with a hardness of less than 31 HRC. However, Raymond et al. Report that standard bake heat treatment did not have a positive effect on the fracture toughness of galvanized specimens up to 52 HRC. This article presents the results of a study of the effect of hydrogen treatment on two typical commercial joint steels. The author noted: Firing, applied in accordance with the standard recommendations for high-strength clamping steels, is ineffective in reducing hydrogen embrittlement. An increase in the firing time to 24 hours had no effect on the embrittlement of the steels under study.

John P. Mersc 7) et. al, Author's experiment resulted , additional testing and finite element analysis to simulate threaded fasteners subjected to multiple loads and load velocities, while identifying simulation sensitivity factors that influence the process. Fasteners NAS1352-06-6P have been tested for tensile under quasi-static loading and tensile and shear under dynamic loading. Quasi-static stress tests provided calibration and model fit data, but this process was complicated by the difference in traditional (global) and new (local) bias measurements. The implications of these differences are explored in detail by deriving calibrated models from displacement measurements and evaluating their performance when applied to dynamic stress and shear applications. Common quantities of interest are investigated, including fault-tolerant load, time to failure, and offset-to-failure. Finally, the mesh sensitivity of both dynamic analysis models is examined to assess the reliability and report the simulation accuracy. This study is conducted in the context of the application of these fastener models in large-scale full-scale finite element analysis of complex structures, and therefore the models selected are relatively basic to meet this desire and reflect typical modeling approaches. Quasi-static voltage results show the sensitivity and importance of bias measurement techniques in a test procedure, especially when conducting experiments with multiple components that interfere with local sample measurements. Additional conformance to test fixtures and load frames has an increasingly significant impact on displacement data as measurements become more global, and models must capture these effects in order to accurately reproduce displacement data. evidence. Analysis difficulties were also found in lateral load simulations, as the results were very sensitive to mesh discretization, further complicating the ability to analyze joints subjected to varying loads. These variables can contribute significantly to the error and uncertainty associated with the model, and this study begins to quantify this behavior and provide recommendations for mitigating these effects. When attempting to capture multiple loads and loading rates in fasteners using simulation, you must carefully study and practice testing and analysis procedures to ensure that the final model is suitable for the intended application.

Kale Amol 8) et. al, Author described, Threaded components are critical structural elements that significantly affect the strength and strength of the entire assembly. Threaded connections are used because of their ability to create clamping force and because of the possibility of disassembly, which is important for service. The weakening of fastening under the influence of dynamic loads in the form of vibration is also widely observed. This reduces the preload force of the bolt and leads to joint failure. Such a failure can be disastrous for security-critical applications. Threaded fasteners facilitate the operation of some parts of the machine so that they can be easily assembled or disassembled without damaging any components. This is necessary for fastening, installation, repair, inspection, repair, etc. However, under conditions of unfavorable vibration, threaded connections often do not withstand the torque, which leads to loosening. The evolution of set screws goes back several thousand years. This article looked at the stresses that occur in screw fasteners due to the initial clamping load and external load, along with examples. Thereafter, the combined effect of initial tightening and external stress on the bolts.

Laurence Claus 9) et. al, Author conclude , New Regulations To Increase Fuel Consumption And Improve Vehicle Efficiency, Automotive Engineers, Suppliers And Original Equipment Manufacturers Are Working Hard To Introduce New Technologies And Processes That Will

Reduce The Weight Of Traditional Structures, Both Components And Vehicle Structures. cars. However, one of the challenges of introducing a new technology is often the need to simultaneously invent or implement a new assistive technology. Often, a truly revolutionary idea had to wait for assistive technologies to catch up or integrate with it, triggering the development of completely new and innovative ideas and products. Take, for example, the emergence of SMART phones. While the technology for making a phone has probably been around for a while, without the technological explosion associated with processing speed, memory, and a generation of dedicated operating systems. These phones are likely to remain concepts on the drawing board. In a similar vein, take the new Boeing 787 Dreamliner, a revolutionary airliner made mostly of carbon fiber. To turn the concept into reality, it was necessary to completely re-invent the classic means of forming aircraft structures and holding them together. Likewise, as automotive engineers began to develop more body components and structures using lightweight materials such as plastic, aluminum, magnesium and carbon fiber, it became necessary to develop innovative means of holding these elements together or attaching them to structures. This article will focus on two different fastening technologies designed to meet the challenges of these 21st century weight loss innovations. In the first case, self-tapping tapping screws for thermoplastics will be studied. This document will show how these fasteners can facilitate design possibilities with less weight when made from similar lightweight materials or when greater strength is required in the clamping connection using conventional threads and modern technology for maximum flexibility. perhaps in lightweight material suggested by the designer. While these bras work on the same principles as their heavier counterparts, recent innovations in materials and manufacturing techniques make them viable candidates to complement a weight loss program. In the second case, as thin steel sheets are replaced for body panels and aluminum structural elements, it becomes more difficult to realize connection points (which in some common cases are already complicated). The second part of this article will explore the technology of the heat flow formation process, which combines the formation of extrusion and threads in one technological cycle to provide a mechanically strong and safe threaded connection. It is a “breakthrough” technology for joining thin sheets, for which there have historically been few good and reliable threaded joints. This will provide opportunities for thinning the plate, converting steel to aluminum, and providing secure bonded joints in areas where welding or nut and bolting is difficult or impossible to use because access is limited to one side only.

Atsushi Noma 10) et. al , The author presented that threaded connections using bolts are inexpensive and easy to install and remove. Therefore, they are used not only in industry but also in various fields such as precision instruments and medicine. There are several types of fastening methods that use bolts, such as the method of connecting bolts and nuts or the method of using self-tapping screws, and the designer can choose based on the conditions in which the various products are used. However, problems with loosening threaded connections are inevitable when using the bolt tightening method, and in fact there are many reported accidents. For example, the 2002 UK railroad crash is one of the most famous accidents. This accident occurred because the screw used for the turnout was out of order and a vibration fatigue failure occurred. To prevent this type of accident, bolts or screws with a locking function have been designed and developed. In this study, the characteristic spring effect is of interest. The goal is to make preventable threaded fasteners that are automatically released by applying spring characteristics to the bolts. The intrinsic spring effects can be applied to bolt structures by introducing a helical cutting process into prefabricated bolts to produce self-dissolving avoidable head fastenings. The characteristic spring effects are the swelling effect when turned clockwise (falling direction) and the compression effect when turned clockwise (tightening direction).

J. P. FARIA 11) et. al , Author explained , Wheel hubs are often used in nut assembly. In wheel mounts, safety is always a priority. The nuts used in this system must provide the tensile strength that the system maintains, ensuring that they are secured in the assembled joints. Some features for connecting components are also desirable, such as simplicity, low cost and reusability. Considering the three most common self-locking wheel hub solutions, each has its own advantages and disadvantages. This study presents the prevailing torque nut as a replacement solution for PA nuts and stop nuts in drive and fixed wheel hubs. The advantage of the Stover nut is that it is very simple in design and has a very good competitive price, on the other hand, it requires more control during production and is more suitable for damaging the threads of the mating part. The innovative solution is an all-metal torque dominant nut with an integral washer that meets all the requirements for a higher and more uniform dominant torque and an elastic field of the locking element that prevents damage to the threads. Its advanced design allows it to be optimized for each specific application. The solution can replace your current hob and washer in wheel hub sealing, with obvious benefits.

T Matsunar 12) et. al, Author's experiment shows , The influence of the radius of curvature of the bottom of the thread and the difference in the pitch between the M16 bolt and the nut on the fatigue strength of the bolted joint is experimentally considered. Prepare samples of M16 bolt-nut having two types of lower thread radius and pitch difference. The S-N curves for threaded specimens with different thread shapes are obtained using a controlled stress fatigue test (stress ratio R> 0). The results obtained from the study are that the effect of pitch difference and large radius of the lower thread of a bolt on the fatigue strength of a bolted joint was investigated using an experimental technique. Fatigue testing was performed using bolt-nut specimens with different pitches and smaller thread radii to investigate service life and endurance limit. The results showed that fatigue life was significantly increased by increasing the radius of the bolt threads and introducing a small difference in pitch. Compared to the standard bolt-nut connection, the endurance limit of the new bolt connection has also been improved by about 1.5 times. From observations of the crack, it was found that the crack propagation path is changed by changing the pitch.Therefore, the present method is effective for improving the fatigue strength of bolt-nut joints.

Harish V Umarji 13) et. al, Author observed , A "clasp" is a hardware device that mechanically connects or locks two or more objects together. Typically, fasteners are used to create non-permanent connections; that is, gaskets that can be removed or disassembled without damaging the joint components. "Nuts and bolts are the most widely used items in the family of industrial fasteners, and their demand is growing rapidly with the expansion of production in the country. A bolt is a piece of metal rod with the end inverted and the other end threaded. Hydrogen embrittlement remained the only likely cause of the observed destruction. Unlike stress corrosion cracking and cooling cracks, hydrogen embrittlement cracks usually do not branch out and show rusty surfaces. Typical hydrogen embrittlement characteristics were observed on the fracture surfaces of both bolts. The bolts were galvanized with zinc, which is used to inject hydrogen into metals and anneal. If any of these factors are missing, it is unlikely that a failure will be confirmed as hydrogen embrittlement. Uncured fasteners and fasteners of Grade 5 or Grade 8.8 or less will not fail due to hydrogen embrittlement. Parts cleaned mechanically rather than acid are unlikely to fail due to hydrogen brittleness. Installation failures are not related to hydrogen embrittlement.

Cenk Kılıçaslan 14) et. al, Author shows , A hugely growing trend in the automotive industry is to reduce CO2 emissions by reducing the weight of passenger cars while improving the safety and structural integrity of the vehicle. As a result, the competition between car suppliers is increasing dramatically and research and development is becoming very valuable. Lightening efforts primarily focused on chassis and engine components, however fasteners were not seen as a means of reducing weight. The authors' experiments show that, in contrast to the work done by many researchers and engineers, the lightweight designs of these fasteners do not encompass the use of non-ferrous alloys or unconventional forging methods in this work. The weight of the bra has decreased from 11% to 18%. Finite element modeling has shown that socket head fasteners can be successfully cold forged by modifying the forging stations. The study also found that conventional engineering techniques must first be applied to current structures to produce lightweight cold formed products before non-ferrous alloys or unconventional forming techniques are used.

Erik l. g. 15) et. al, Author derived , it is prudent to investigate the causes of the flow failure. One parameter that appears to determine the failure mode of bolt and nut assemblies, despite the limited attention in the literature, is length violation. Thread failure of bolt and nut assemblies subjected to tension is generally undesirable. because it is a less tough type of fracture than a threaded bolt shank fracture (indicated by a bolt fracture). Another problem is that initial thread failure due to over-tightening is difficult to detect when installing the threaded bolt shank located inside the handle. Validated finite element simulations were performed to obtain information on failure mechanisms. When was short, the bolt had a taper near the nut so that the overlap between the bolt and nut threads was reduced, further damaging the threads. This article suggests several practical approaches to reduce the likelihood of flow failure. The author noted that the likelihood of thread failure can be reduced by increasing the length or height of the nut, that is, the length of thread engagement. Therefore, for bolts under tension, either due to external loading or due to preload, it may be beneficial to use bolts with full threads rather than partial threads. Alternatively, you can use washers, shims, tall nuts, or two nuts together to reduce the chance of thread failure.

Shao-Yi Hsia 16) et. al, The author presented Improvements in manufacturing equipment and widespread use of simulation software have allowed Taiwanese fastener technology and industry to develop. Consequently, consistent quality and performance have placed Taiwan-based bra manufacturers in a critical position in the global bra supply chain. A kinked bolt can be dangerous and fatal, so it is especially important that bolt fractures do not occur in equipment where accidents

can occur. The author concluded that, with respect to the process, it is better to remove the phosphorus on the pins prior to heat treatment and use a phosphate reagent or metallographic observation for confirmation. After the bolt heat treatment is completed, the phosphate coatings and phosphating layers are not easy to remove. With regard to mechanical properties (tensile strength, elastic limit and breaking moment), bolts with and without dephosphorization do not differ significantly; In other words, dephosphorization does not affect the mechanical properties of the bolts. Metallographic observations before and after heat treatment help to accurately judge the bolt dephosphorization process.

Gerhard H. Junker 17), Author state , The theory of self-tightening of pre-loaded bolted joints under vibration is discussed. Explains the importance of auto-tuning as a cause of failure and provides design guidelines to avoid auto-tuning. Test methods are described and discussed in relation to a newly developed test machine that provides quantitative data to evaluate the blocking properties. These methods are applicable to all types of closures. Finally, a simplified method for large-scale testing and inspection is proposed. Dynamic shear forces are more dangerous than dynamic axial forces. Axial forces cause relative movements by expanding the thread of the nut; Lateral forces cause relative movements due to the rocking action of the screw on the female thread (or the rocking motion of the nut on the external thread). The relative displacements caused by shear forces are greater. None of the existing dynamic test methods measure the blocking efficiency of shutoff elements. A new vibratory machine is described that generates shear forces and displacements in pre-loaded joints, as well as combinations of shear and axial forces. Displacement, shear forces, preload and swing angle can be measured. In addition, the fatigue strength of sheet metal bolted joints can be evaluated, which is a means of assessing the damage that the blocking element causes on the surface of the fastened parts.

Toshio HATTORI 18) et. al, Author described , Threaded connection is often used for productivity and maintenance as part of a machine. However, many problems were often encountered, such as loosening of the bolted connection or bolt fatigue. Much attention must be paid to increasing the strength and reliability of threaded connections. It is generally believed that the axial clamping force is rapidly reduced by weakening the rotation of the nuts if the relative slip at the joints between the nuts and the body to be clamped exceeds a certain critical limit. The author presents the results of a study of the deformation behavior of a bolt-nut connection under transverse load conditions, taking into account the reactive moment per nut (Mn). Finally, we can confirm that these estimated critical slip results are in good agreement with the experimental results. The author presented a model for evaluating the critical slip Scr for bolt loosening under transverse loads. In this estimation method, we present a new predictive equation for the reaction moment Mn based on the bolt / nut connection model. With these estimation methods, we can predict the critical slip in each fastening state, such as bolt size, bolt length, clamping force, etc. And these methods can be used for the CAE design tool for each machine frame.

Ing. Nabil Motosh 19), Author explained , Approximately 65 percent of bolt failures in bolted connections occur with the first thread in the contact between bolt and nut. Many researchers have tried to explain this phenomenon by calculating the load distribution between threads and showing that the first contact thread carries a much higher load than subsequent threads. It is believed that the first turn accounts for about 35 percent of the total bolt load, and the subsequent turns carry a steadily decreasing load so that the fifth turn is practically unloaded. If the cornering load decreases upward from the bearing surface of the nut, it must, after reaching the minimum value, begin to increase again in order to obtain an overall response that coincides with the axis of the bolt. Fatigue failure usually starts at the first point of contact, as fatigue is a surface effect. To increase the fatigue strength of bolted connections, many nut designs are designed in an attempt to achieve an even load distribution between threads and to reduce overloading on the first turn. It was also expected that when the nuts are made of duralumin, silumin, and other materials that have a lower modulus of elasticity than steel, the distribution of forces in the wire turns will become more even. In this work, the pressure distribution between the threads is calculated for the titanium tension nut, as it is widely used in the aviation industry.

Sayed A. Nassar 20) et. al, As the author explained, the emphasis is on describing the elastic and plastic deformations of the bolted joint. The bolt material is assumed to be plastic hardened. For a typical bolted joint, a nonlinear combined stress model was created to study its creep behavior. The joint action of axial and torsional stresses on a hermetically sealed threaded connection is considered. The authors noted that a new approach to tightening to predict the clamping load was proposed based on the elastic-ideal plastic model of the bolt material, and also analyzed the influence of the thread and bearing friction coefficients. Research shows that a new approach to creep tightening can predict clamping load with very high accuracy when the thread friction coefficient μt is almost the same as the bearing friction coefficient μ b for an ideal plastic material for bolts. Experimental tests show that analytical formulas for

elastic / plastic deformation behavior provide a very reasonable prediction for the T −θ and F −θ curves. This means that the proposed model of plastic deformation can characterize the behavior of elastoplastic deformation of bolted joints under elastic tightening when there is no significant damage to the bolted joint.

Santanu das 21) et. al, Author's study shows , the phenomenon of preventing loosening of threaded fasteners, a test bench was designed and manufactured in which the clamping force can be continuously recorded by applying accelerated vibration of a known frequency between two plates of nuts and bolts. The results obtained with regard to the anti-loosening property of various threaded fasteners are presented, discussed, and an effective one is identified. The results show that nylon insert nuts, which provide more frictional grip, when installed with a standard metric bolt, show good resistance to loosening compared to other fasteners tested with an initial clamping force of 1.50. tons and 0.94 tons, respectively. M10 bolt with 3/8 "BSW nut, with small difference in nominal diameter and pitch, has significant anti-missile properties. However, some permanent deformation can damage the mating surfaces of the nut and bolt. Conventional BSW fasteners show less tendency to loosen than metric nut and bolt, which may be due to the lower side slope angle. Other types of fasteners, such as for internal and external toothed washers, have been observed to exhibit slight attenuation under vibration conditions.

Len Reid 22) et. al, Author state , The physical act of connecting many of these subsets requires the use of blind retention systems. The most common of these methods is a riveted nut. Satellite rivet holes, in addition to increasing complexity, assembly and fabrication costs, have proven to be a major source of structural fatigue cracks. Attempts to create an efficient "rivetless" nut have been unsuccessful. Only one fixing hole is required to install the retainer, which does not rely on mechanical grooves to resist torque and therefore reduces the stress concentration (Kt) of the installation. The nut plate system has excellent fatigue life because the nut plate retainer expands radially in the fastener hole when cold, and simultaneously expands the retainer and base material when cold, creating beneficial residual stresses around the machine. The stress factor of the installation under cyclic loading is reduced by cold expansion and interference fit of the holder, which allows it to withstand higher working loads or reduce the thickness of the main structure (ie, weight reduction). This new nut concept is currently being developed for military and commercial aircraft production.

V. Marimuthu 23) et.al, Author described , Attempts have been made to use these fasteners to connect primary structural members made from cold formed steel (CFS) sections where the screw heads must contact thick plates for which there are no instructions. Existing instructions refer to installations where the head of the screw is in contact with thin blades. Because these fasteners are used to connect the main structural members, the SDS (SDSJ) connection characteristics play an important role in the analysis and design of such structures. The author explained the details of the experiments, the SDSJ strength and stiffness assessment methodology, and the comparative studies. The author noted: Samples with one and two bolts failed due to the shear of the bolt, since the strength of the thin sheet under the bearing, throughput and net section is greater than the shear strength of the bolts. The sample with four screws failed due to the destruction of a section of the mesh. However, the specimens showed high ductility, since creep follows plasticization of the web of the thin sheet. The applied load is evenly distributed between the number of bolts, which is determined by the recorded deformation values located in the support area next to the bolts.

M. Wayne Simon 24) et. al, Author derived, Structural connections using a T-trunnion often result in tension fasteners. The load generated by the fastener depends on the stiffness and deformation of the T-neck itself. Tests have shown that this "tearing off" phenomenon can affect the performance of the fastener. Several analytical and experimental models have been developed to predict the relationship between applied force and subsequent bolt force. The results of the authors' experiments are that it is believed that the finite element analysis can be effectively used for the analysis of bolted joints. Effective bolt and flange designs can be obtained prior to any fabrication. In addition to the force and displacement information, a detailed stress report is provided at all nodal points. The designer could minimize costs by including a "rough" model when analyzing the overall behavior of the joints. In any case, finite element methods can be used in the design of bolted connections.

H. A. Hamid 25) et. al , Author explained , A self-drilling screw is a type of fastener with the ability to drill your own hole and make your own thread when driving into sheet steel with a screwdriver. A study was conducted to find out the behavior of simple-cut self-tapping joints in cold formed steel. The study focused on the design parameters of the joint, such as the type of fastener, the distance between screws and the number of screws used in the joint. This will provide information on whether the parameters will affect the strength characteristics of the joint itself. Therefore, studies of the self-drilling screw behavior under simple shear loading in cold-formed steel

are needed, which will also provide a platform for future research. In this study, two tests were carried out: a direct shear test for various configurations of self-drilling screws and a tensile test on cold-formed steel plates that were used in the shear test. The main comparisons were the effect of the configuration pattern and the effect of the number of screws. These two factors were associated with the bond strength of the test samples.

Bo Zhang 26) et. al, The author's goal is to present a method developed to determine the optimal placement of multiple fasteners in a bolted joint to achieve an even distribution of loads between the fasteners during multiple loading events. This method combines finite element analysis (FEA) with optimization software using multi-objective optimization algorithms. The optimization analysis also took into account multiple constraints. During operation, each bolted connection is subjected to several operating conditions (loading). The author concludes that the process gave the desired result. The tool used a multi-purpose optimization process to accommodate different vehicle workloads and variable fastener positions. In the future, this tool will be implemented and used at a very early stage in the development of an automotive program. The benefits of this process must be accounted for early on in order to influence the components of large bore tools.

D. Ortiz 27) et. al, The author's study shows Effect of Cold Work on the Tensile Properties of 6061, 2024, and 7075 Al Alloys. Aluminum alloys 6061, 2024, and 7075 were heat treated to various tempers and then subjected to a range of plastic strain (stretching) in order to determine their strain limits. Tensile properties, conductivity, hardness, and grain size measurements were evaluated. The effects of the plastic strain on these properties are discussed and strain limits are suggested.

CONCLUSION

From the study we conclude that, joints are very weak portions in structure or mechanism. To protect joints bolting is the most efficient method. But for electric vehicles traditional bolts and fasteners are not suitable. Hence , fasteners which made up of light weight materials can protect joints as well as it will reduce the entire weight of vehicle. Compact size bolt test rig developed for better adaptability in industrial application, where fasteners are use under extreme vibration conditions. The baking treatment applied according to the standard recommendations for high strength fastener steels is ineffective in reducing the hydrogen embrittlement. tension nuts of materials having a lower modulus of elasticity than bolt steel results in a uniform distribution of load on thread turns.

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