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WHEEL MODELING AND ANALYSIS BY USING ALLOY STEELS

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Abstract:Automobile parts one of the major important part is a wheel spoke because of all of the automobile parts carried by spokes. Spoke is a few variety of rods divergent from the middle of wheel that connecting the hob with spherical traction surface. Originally spoke referred to portions of a log which had been split lengthwise into number of sections (4 or 6).Wheel is a radial member and spokes are in curving finished shape. Generally Heavy load carrying vehicles having high strength and good fatigue property spokes. The radial, lateral, and tangential stiffness of bike wheel spokes depends upon the rim's bending inertia, torsion inertia, spoke sizes, and spoke geometry. The wheel spokes are strained due to the radial loads and these are effected the fatigue resistance properties of the wheels of a motor cycle. Spooked bicycle wheels area unit economical, extremely evolved, structural systems. A useful analogy for a bicycle wheel supporting vertical loads is that of a circular beam on a pre-stressed elastic foundation, fixed at the center and loaded radially at the circumference. In this project we develop new wheel model With five spokes and four spokes and comparing these wheel spokes with composite and conventional alloy materials like Al-alloys and Mg-alloys. Here we using aluminum composites and conventional magnesium alloy Comparing properties of stress, displacement, and fatigue resistance of these materials and proposing the best material with number of spokes of wheel. The wheel spoke model is developed in PEO-E software and the analysis of different wheel spokes are done by using COSMOS software. Finally the results are obtained in analysis are comparing and choosing the best material for designing a wheel spoke

Keywords: Wheel spoke, Hub, stress concentration Displacement, Fatigue life, Pre-E, Cosmos, Al-alloys and Mg-alloy

INTRODUCTION

The wheel may be a device that permits economical movement of AN object across the surface, wherever there's a force pressing the article to the surface. Early wheels were straightforward picket disks with a hole for the shaft. thanks to the structure of wood a horizontal slice of a trunk isn't appropriate, because it doesn't have the structural strength to support weight while not collapsing; rounded items of longitudinal boards ar needed. The spoke wheel was fictitious a lot of recently, and allowed the development of lighter and swifter vehicles. Alloy wheels disagree from traditional steel wheels thanks to their lighter weight, that improves the steering and therefore the speed of the automotive, but some alloy wheels ar heavier than the equivalent size steel wheel. Alloy wheels are higher heat conductors than steel wheels, rising cooling from the brakes, that reduces the prospect of equipment failure in additional hard driving conditions. Over the years, achieving success in mechanical style has been created potential solely when years of expertise as well as rigorous field-testing. Recently the procedures have considerably improved with the emergence of innovative technique on experimental and analytical analysis. Alloy wheels meant for traditional use on rider cars ought to pass 3 take a look ats before going into production: the dynamic cornering fatigue test, the dynamic radial fatigue take a look at, and therefore the impact take a look at. several alloy wheels producing company had done various quantity of take a look ating of their product however their technique on simulation test on alloy wheel data typically unbroken restricted.
Historically, roaring styles was arrived when years of expertise well power-assisted value in depth field -testing. Since the 1970's many innovative ways of testing and experimental stress measurements are initiated. in additional recent2years, the procedures have considerably improved by the emergence of a range of experimental and analytical ways for structural analysis. sturdiness analysis, that is: fatigue life prediction and reliableness ways, for handling varied inherent in engineering structures has been used for the study of automotive rims. In its basic type a wheel may be a transfer part between the tire and therefore the vehicle. The perform of a wheel are often additional choppy into straightforward verb-noun mixtures to explain its purpose. A wheel;

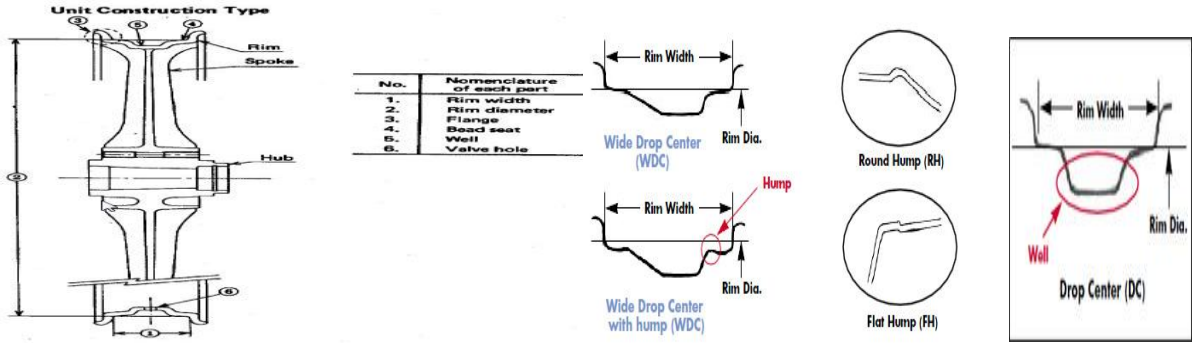
- *Transfers force, (braking and acceleration)*
- *Dissipates heat, (from braking)*
- *Absorbs impact, (road hazards)*
- *Support mass, (support the mass of the vehicle)*
- *Adds worth, (aesthetically pleasing)*
- *Adds mass, (damped mass for driving comfort)*
- *Conserves energy, (potential energy in momentum)*

HISTORY OF WHEEL-SPOKES

Several years past begin the history of wheel once the civilization began to use this to move serious objects. the initial wheel that spherical slices of a log and it had been step by step re-inforced and employed in this type for hundreds of years on each carts and wagons. This solid disc modified to a brand new style having many spokes, that radially organized to support the outer a part of the wheel keeping it equal from the wheel centre. A picket wheel that used laborious wood stakes as spokes was extremely popular as a wheel for several vehicles up to concerning 1920. afterward the disc wheel, within which the spokes were replaced with a disc product of plate, that introduced and continues to be

being employed to until the day. moreover, a light-weight alloy has return to be used presently as a wheel material for several sorts of vehicle. Lighter wheels will improve handling by reducing global organization sprung mass , permitting suspension to follow the parcel a lot of closely and therefore improve grip, but not all alloy wheels ar lighter than their steel equivalents. Reduction in overall vehicle mass can even facilitate to cut back fuel consumption.

1.2 WHEEL RIM NOMENCLATURE ***1.3 SHAPES OF RIM***



1.4 VARIETIES OF WHEELS

Wire spoke wheel

Wire spoke wheel could be a structural wherever the surface edge {part of|a half of} the wheel (rim) and therefore the shaft mounting part area unit connected by varied wires known as spokes.

Steel disc wheel

This is a rim that processes the steel-made rim and therefore the wheel into one by attachment, and it's used primarily for traveller vehicle particularly original instrumentality tires.

Alloy wheels

These wheels supported the employment of sunshine metals like atomic number 13 and metal became standard within the market. These wheels chop-chop become standard for the initial instrumentality vehicle in Europe in 1960's and for the replacement tire in us in 1970's. The options of every light-weight alloy wheel area unit explained as below
Metallic element alloy wheel Metal alloy wheel Metal alloy wheel Stuff wheel

1.5 WHEEL MATERIAL: Magnesium alloy AM60B** and **Aluminium Alloys LM25

	Magnesium alloy AM60B	***Aluminium Alloys LM25***			
Mechanical Properties		***LM25-M***	***LM25-TE***	***LM25-TB7***	***LM25-TF***
Tensile Strength	***225 – 240***	***130-150***	***150-180***	***160***	***230-280***
Yield strength	***130***	***2***	***1***	***2.5***	***2.5***
Elastic modulus	***45000***	***71***	***71***	***71***	***71***
Poisson's ratio	***0.35***	***0.33***	***0.33***	***0.33***	***0.33***
Mass density	***1.8***	***2.685***	***2.685***	***2.685***	***2.685***

HEAT TREATMENT

- *LM25-TE (Precipitation treated) - Heat for 8-12 hours at 155- 175oC and permit to cool down in air*
- *LM25-TB7 (Solution treated and stabilized)-heat for 4-12 hours at 525-545oC and quench in predicament, followed by a helpful treatment at 250oC for 2-4 hours.*
- *LM25-TF (Fully heat treated)- heat for 4-12 hours at 525- 545oC and quench in predicament, followed by a precipitation treatment of 8-12 hours at 155-175OC.*

1.6 EFFECTS OF ALLOYING COMPONENTS

The Al Association's Designations and Chemical Composition Limits for Al Alloys within the variety of Castings and block of metal lists for every alloy ten specific alloying components and additionally incorporates a column for "others". Not all of the listed components area unit major alloying ingredients in terms of Associate in Nursing alloys supposed uses; and a few major components in one alloy aren't major components in another. Also, some components, like Sr as an example, may be vital to microstructure management and mechanical properties however aren't specifically known within the Al Association document and area unit instead area unit simply enclosed within the class "others". For functions of understanding their effects and importance, alloying components for the bulk of alloys area unit most likely best classified as major, minor, microstructure modifiers or impurities; understanding, however, that impurity components in some alloys may be major components in others:

***Major components** - usually embody semiconducting material (Si), copper (Cu) and atomic number 12 (Mg)*

***Minor components** - embody nickel (Ni) and tin (Sn) -- found for the most part in alloys that possible wouldn't be employed in high integrity die castings.*

1.7 TESTS CONDUCTED ON WHEEL

Wheels area unit a part of a vehicle and in and of itself subjected to a high load. The sturdiness of the wheel is vital for the safe operation of the vehicle. Therefore, it's necessary to look at a wheel for each strength and fatigue resistance. Endurance check in direction of radius of rim Check of disc Impact check Others

1.8 LIMITING AMOUNT OF WHEEL

Tho' we predict it's attainable to for good use a wheel till it rusts away there's a limit to a wheels helpful life. If a rim is employed in severe operations like sport or rallying hidden harm is caused. this might end in Associate in Nursing accident or sharp rim failure while harm is caused. this might end in Associate in Nursing accident or sharp rim failure while the vehicle is in commission. The lifetime of a rim is varied in keeping with mistreatment conditions. A rim commonly lasts longer than a tire thus at time of a tire amendment a rim ought to be checked for harm or sign of failure. If any area unit found the rim ought to be scrapped. within the case of steel wheel, cracks and corrosions by rust at the joint elements of rim and disc, nut seats, between decoration holes of the rim or the rim is bent, you must scrap the rim.

1.9 MAINTAINING RIMS

Terribly necessary however typically unmarked, it's vitally necessary to examine your bike rims and clean them on an everyday basis to assist stop spoke failure or corrosion weak points. you'll be able to positively suffer flat tires if some spokes fail on your bike rims. this may happen underneath standard everyday conditions. The broken spoke pushes into the wheel and punctures the tube. thus continually keep your wheels clean and check them for signs of corrosion or different harm. it's going to solely take one dangerous spoke to ruin your ride. The Al bike rims area unit typically coated. Some chemicals used for bike maintenance of different systems (like brake fluid) will harm that coating. Once the vacant Al on the bike rim is exposed to air it will begin to corrode. Wheels will come back underneath loads of stress and even tiny areas of corrosion will become a degree of failure.

1.10 FAILURE OF A WHEEL RIM

Motorbike rim issues

If we've been in Associate in Nursing accident or purchased {a bike|a motorbike|a motorbike} with unknown history it's attainable that your motorcycle wheel might be out of true. The wheel may {appear} to oscillate laterally (side to side) or appear to maneuver up and down (out of round). motorbike rims may be nonchalantly inspected by supporting the bike on the centre stand or alternative stand and spinning them whereas viewing facet on or edgewise.

New tire, new wobbles

If you have got simply had new tires put in and you're feeling or see a wobble it's a lot of doubtless that the tire is that the cause not bent rims. What will happen once mounting a brand new tire is that the installer fails to urge the new tire absolutely seated on the motorbike rims. it should be shut and since the tire incorporates a tube in it there'll be no leak to grant it away. What you would like to try to to is that this.

1.11 NECESSITY OF EXPLOITATION ALLOY WHEELS

Alloy wheels square measure automobile (car, motorbike Associate in Nursingd trucks) wheels that square measure made of an alloy of Al or metal metals (or generally a mix of both).

Alloy wheels take issue from steel wheels in a very range of ways:

Typically lighter weight for identical strength Better conductors of warmth Improved cosmetic look Lighter wheels will improve handling by reducing unsprung mass, permitting suspension to follow the parcel of land a lot of closely and therefore give a lot of grip, but it is not continuously true that alloy wheels square measure lighter than the equivalent size steel wheel. Reduction in overall vehicle mass {can also|also will|can even|may also|may} facilitate to cut back fuel consumption higher heat conductivity can facilitate dissipate heat from the brakes, that improves braking performance in additional demanding driving conditions and reduces the prospect of equipment failure thanks to heating. The earliest light-weight alloy wheels created were fabricated from metal alloys. though they lost favor for common vehicles they remained widespread through the Sixties albeit in terribly restricted numbers. within the middle to late Sixties Al casting refinement finally began to permit manufacture of wheels that were safe. till now most Al wheels suffered from low malleability, sometimes starting from 2-3% elongation. Once these Al casting enhancements were a lot of wide adopted, the Al wheel took its rightful place as low value high performance wheels for motorsports.

Most alloy wheels square measure solid into a mildew, and also the final result may be a sander ride and fewer tire stress than the standard steel wheel and hubcaps. Most steel wheels square measure "cold rolled and welded," and frequently have some movement - either high or low - within the welded seam space. They conjointly tend to be heavier within the welded seamed areas and lots of have leaks, like a number of the Hyundai steel wheels. however Al wheels square measure solid into a mildew in a very hot liquid state and cooled, that makes them a lot of correct in each the heavier and lighter areas. the top result's a balance that has less weight on the wheel and fewer stress on the tire. Steel wheels square measure an excellent thanks to give basic transportation for a basic automotive, except for those that need to increase the lifetime of their tires and have a sander ride, alloy wheels square measure the thanks to go. Al wheels conjointly give a lighter weight for the athletics enthusiast, and might be machined for an excellent look.

II.LITERATURE REVIEW`

A wheel rim may be a extremely stressed part in Associate in Nursing automobile that's subjected to hundreds. owing to the long life and high stresses, likewise because the would like for weight reduction, material and producing method choice is vital in rim style. There square measure competitions among materials and producing processes, thanks to value performance, and weight. this is often a right away results of business demand for elements that square measure lighter, to extend potency, and cheaper to provide, whereas at identical time maintaining fatigue strength and alternative practical necessities.

Cuixia, Z. (2006). "Design and structural analysis of Al alloy wheel", Ph.D treatise, Zhejiang University, Zhejiang. This Simulation work tries to model the wheel of a 2 wheeler athletics by exploitation the CATIA software system, and conducting the tests: Static and Fatigue analysis exploitation the ANSYS software system by reducing the quantity of spokes from five to four for the present model. supported simulation work, a far better material for alloy wheels could also be analyzed from the results obtained and valid. A paper revealed within the year 2009,which is regarding the fatigue analysis of Al wheel rim by Liangmo Wang - Yufa subgenus Chen - Chenzhi Wang - Qingzheng Wang faculty of engineering science, city University of Science & Technology, China. to boost the standard of Al wheels, a brand new technique for evaluating the fatigue lifetime of Al wheels is projected therein paper. The ABAQUS software system was accustomed build the static load finite component model of Al wheels for rotary fatigue check. exploitation the strategy projected during this paper, the wheel life cycle was improved to over one.0×105 and happy the look demand. The results indicated that the projected technique of group action finite component analysis and nominal stress technique was an honest and economical technique to predict the fatigue lifetime of Al wheels. during this paper, for predicting the wheel fatigue life, the nominal stress technique was integrated into the CAD / CAE technology to simulate the rotary fatigue check. N. Satyanarayana & Ch.Sambaiah: throughout the a part of project a static analysis of Al alloy wheel A356was applied exploitation FEA package. the three dimensional model of the wheel was designed exploitation CATIA. Then the 3D model was foreign into ANSYS exploitation the IGES format. we discover out the entire deformation, different stress and shear stress by exploitation FEA software system. And conjointly we discover out the life, factor of safety and injury of alloy wheel by exploitation S-N curve. S-N curve is input for Associate in Nursing A.356.2 material. For a wheel maker, reduction within the development time means that a discount within the value. Hence, to search out impactive|an efficient|a good} method of static analysis which may be love identical impact effect of dynamic loading is a very important issue.

Jufu Jiang and Yuansheng Cheng have performed the analysis on impact of Pressure on Microstructure and Mechanical Properties of AM60BAlloy Used for motorbike Wheels shaped by Double management Forming. a group of novel forming die combining the benefits of dies casting and shaping was designed, by that double management forming plan was first off projected. The motorbike wheel fabricated from AM60B alloy was used because the typical part to demonstrate benefits of the double management forming. The impact of pressure on the mechanical properties and microstructure of the elements shaped by double management forming was investigated. The results showed that prime mechanical properties and complicated form were achieved within the elements shaped by double management forming. Compared to die casting, the mechanical properties of the shaped half considerably enhanced and also the microstructure modified from the coarse dendrites to fine equi-axed grains. The shrinkage voids and small cracks within the shaped elements were clearly reduced or perhaps utterly eliminated with the rise of pressure. once a pressure of 4000 kN was applied, the best mechanical properties like final strength of 265.6 MPa and elongation of twenty first were achieved and also the microstructure was characterised by fine and uniform equi-axed grains thanks to the massive below cooling degree caused by the high.WU Li-hong1, LONG Si-yuan2, and gallinacean Shao-kang: Replacement of A365 with AM60A, service stress distribution within the wheel becomes a lot of uniform, the height worth of the targeted stress reduced thanks to low modulus of Mg alloys. The service stress level of redesigned Mg wheel is relaxed additional owing to its optimized structure by sterilization the spoke configuration and increasing the fillet between spoke and ring, satisfying the specified dependableness with weight saving. MohdZulHazml Bin MhdFauzy, Ruzanna Nadia and BintiNisah: throughout the a part of project a static and fatigue analysis of metallic element alloy wheel was meted out victimization FEA package. the three dimensional model of the wheel was designed victimization CATIA. Then the 3D model was foreign into NASTRAN victimization the IGES format. we discover out the entire deformation, various stress and shear stress by victimization FEA software package. There square measure too several tests that has to be thought of before associate degree alloy wheels square measure able to enter the market. For this project, static take a look at were value more highly to analyze on the look of the alloy wheels.

EXPERIMENTAL WORK

"A solid model may be outlined as geometric illustration of a finite volume. This volume is diagrammatical diagrammatically, via curves and surfaces, further as none diagrammatically through a topological tree structure that provides a logical relationship that's inherent solely with solid models". The topological information defines and maintains connective relationship between the varied faces and surfaces of pure mathematics.the conventional is outline specified it points off from Boolean operations, the system nature is desecrated for instance, because of improper binary operation, the system informs the users with various error messages, solid models by definitions. Satisfy the necessities for speedy prototyping and producing (RP&M) input file. Figure shows a 1 of the geometry created by victimization PRO-E(Wildfire 5).

3.2 Description of pro-e(wildfire 5)

Pro-E (computer power-assisted 3 dimensional interactive application) as a replacement user of this software package package, developed by PTC France is totally reengineered, next generation family of CAD/CAM/CAE software package solutions for product life cycle management. Through exceptionally simple to use state of the art interface

Pro/ENGINEER conflagration is that the normal in 3D product style, that includes trade-leading productivity tools that promote best practices in style whereas making certain compliance along with your industry and company standards. Integrated Pro/ENGINEER CAD/CAM/CAE solutions enable you to style quicker than ever, whereas maximising innovation and quality to ultimately produce exceptional merchandise.Customer needs might modification and time pressures might still mount, however your product style desires stay identical - despite your project's scope, you wish the powerful, easy-to-use, cheap resolution that Pro/ENGINEER provides

3.5. WHEEL MODELING IN PRO-ENGINEER

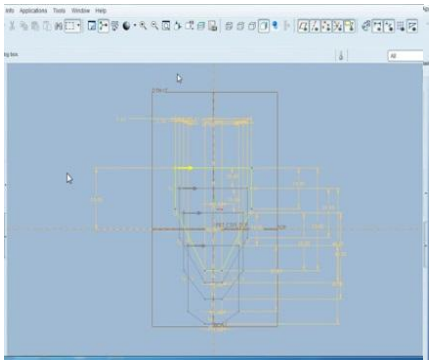


Fig 3.14: Sketcher mode of the Spoke

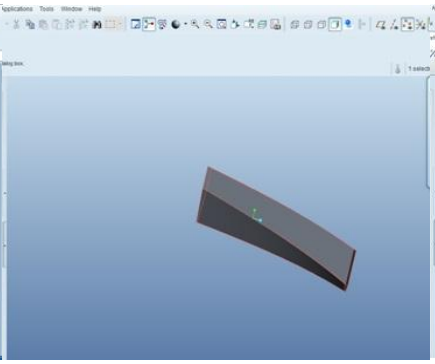


Fig 3.15: Spoke of the wheel

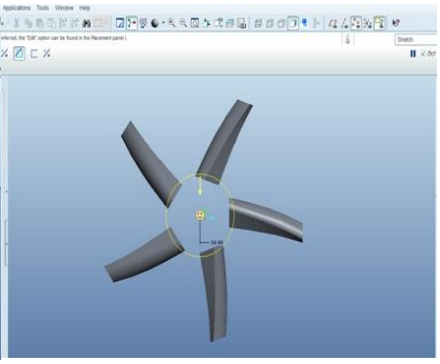


Fig 3.16: Circular Pattern for Spoke

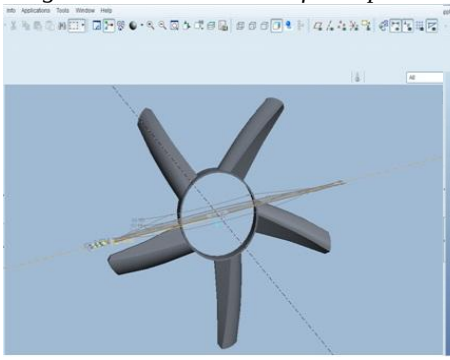


Fig 3.17: HUB half for wheel

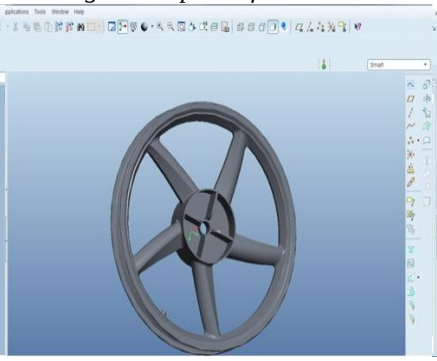


Fig 3.18:Rim a part of wheel

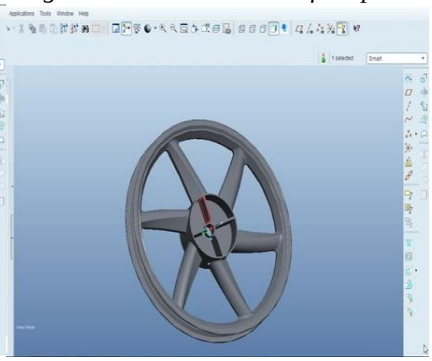


Fig 3.19: Ribs for Hub half

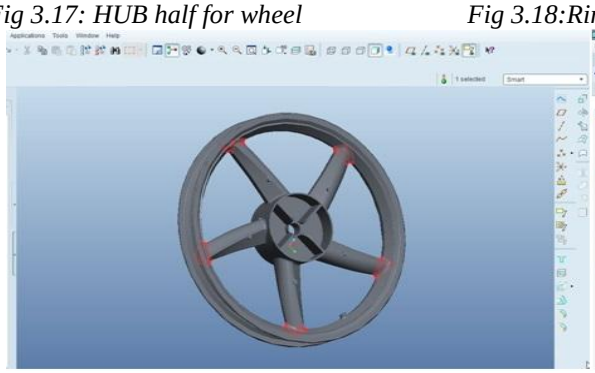


Fig 3.20: spherical edges at corners

Fig 3.21: making the air nipple

INTRODUCTION TO COSMOS

4.1. Victimization the COSMOS Program

Cosmos may be a feature-rich management and configuration software package for the Avitech line of merchandise. It uses a GUI (graphical user interface) for configuring and piece of writing complicated Multiviewer systems. planned configurations may be created, edited, are called. Cosmos is intended to interface with third-party hardware such a routing switchers, production switchers, and Tally management systems giving dynamic label changes and Tally indicators on the show. The program contains a inherent alarm and fault reportage. Solid Works Simulation Xpress is style analysis software package that's absolutely integrated in Solid Works.

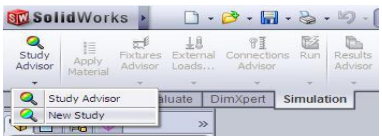
Solid Works Simulation Xpress simulates the testing of your part's image in its operating surroundings. It will assist you answer queries like: however safe, efficient, and economical is your style. Solid Works Simulation Xpress is employed by students, designers, analysts, engineers, and alternative professionals to supply safe, efficient, and economical styles.

4.4. Description of Commands employed in COSMOS

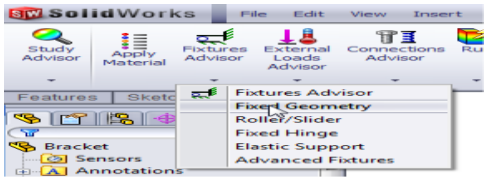
4.4.2. Stress Analysis:

Study on Static Stress Analysis

Solid Works Simulation Xpress offers associate degree easy-to-use initial pass stress analysis tool for Solid Works users. Solid Works Simulation Xpress will assist you scale back price and time-to market by testing your styles on the pc rather than costly and long field tests. Solid Works Simulation Xpress uses identical style analysis technology that Solid Works Simulation users to perform stress analysis. The wizard interface of Solid Works Simulation Xpress guides you thru a 5 step method to specify material, restraints, loads, run the analysis, and look at the results.

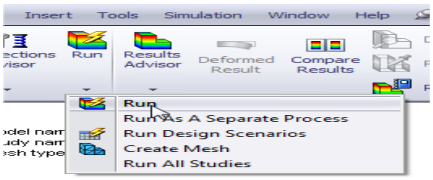


To create a static study, click the Simulation tab within the upper-left. There ought to be a button labeled "Study authority." Click the arrow simply to a lower place it and opt for "New Study," as in Figure. Here you'll be able to see all the kinds of studies offered in Simulation. Click "Static," name the study one thing unforgettable, and click on the inexperienced check.



Apply the fabric, as from the fabric library given. to line up the fixtures on the model, either right-click "Fixtures" within the static study pane or click the arrow to a lower place "Fixtures Advisor" within the Simulation tab. opt for "Fixed Geometry" because the fixture kind for this study.

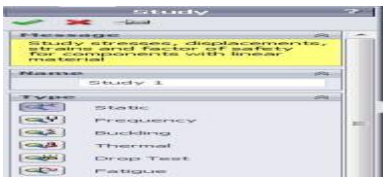
With the pressures and fixtures specified , we are able to run a finite component analysis now! Solid Works must break the model into little triangular units, that along square measure known as a mesh. Smaller meshes (as in meshes with smaller individual units) turn out additional precise results however need further computing time. giant meshes run quickly however might turn out wildly inaccurate results, particularly around sharp edges. it's common to use a mesh with variable component sizes: smaller units round the areas of interest in an exceedingly model, like potential failure points, and bigger units wherever precise results square measure less valuable.



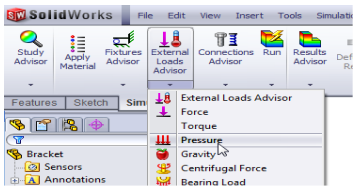
In the static study pane, right-click "Mesh" and opt for "Create Mesh." settle for the default mesh size and check OK. this may produce a uniformly sized mesh over your entire model, that ought to look one thing like Figure shown. If you ever would like a non-uniform mesh, you'll be able to do therefore by right-clicking "Mesh" and selecting "Apply Mesh Control" instead.

Begin the static study by clicking "Run" within the Simulation tab. you'll see that even this straightforward downside consumes important memory and time. If all goes well, a folder named "Results" can seem within the static study pane. Right-click the folder and opt for "Define Stress Plot," then settle for the default settings that seem.

Create a replacement result plot to indicate displacement. Right-click "Results" once more and opt for "Define Displacement Plot." within the settings pane that seems, set "Deformed Shape" to True Scale and check OK. By default the displacement is measured in URES ("resultant displacement"—U is usually accustomed abbreviate displacement), that may be a straightforward live of displacement magnitude. mensuration displacement on the X, Y, or Z axes is additionally associate degree possibility here, tho' we'll persist with URES, like in Figure.



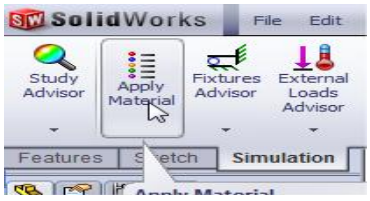
4.4.3. Fatigue Analysis



throughout style validation, a structure is exposed to each static strength tests and fatigue tests. However, once a structure is deployed, it spends the overwhelming majority of its life being subjected to smaller perennial forces that may cause accumulative injury over time. For this reason, testing the sturdiness of a structure makes up a bigger proportion of the tests that square measure run. sturdiness is one amongst the foremost vital attributes that structures will posses.

Fatigue testing measures sturdiness and is outlined because the perennial mechanical loading of a structure to work out failure points. It needs complicated analysis victimization the sector of fracture mechanics, that is that the analysis of fabric flaws to find people who square measure safe and people that square measure at risk of propagate as cracks and cause failure.

To create a fatigue study, click the Simulation tab within the bottom-left. There ought to be a Pop-up menu labeled as "New simulation study." Click thereon and opt for "Fatigue" as in Figure. Here you'll be able to see all the kinds of studies offered in Simulation. Name the study one thing unforgettable, and click on the inexperienced check.



Add an occurrence as constant amplitude for a needed variety of cycles, with zero primarily based condition. Then outline S-N curve for the applied material, as log-log graph. The Stress-Life (S-N) or Total Fatigue Life technique is wide used for HCF applications. throughout HCF testing, a fabric spends the bulk of life {in a|during a|in an exceedingly|in a terribly} state wherever the cracks square measure very little, the expansion is controlled, and therefore the structure integrity is preserved.

4.5 Design Calculations for Wheel

Applied Loads

Load1	*Load2*	*Load*	*Load4*
weight of Bike (175 kg)	*(175+50) kg*	*(175+100) kg*	*(175+150) kg*

4.5.3 Analysis for strength needed

Mass of Bike, Dead Weight of Bike =155 Kg — *Other Loads= 20 Kg*
Total Gross Weight= 155 + 20 = 175 Kg = *175 * 9.81 = 1716.75 N*
Tires and Suspension system reduced by 30% of Loads — W_{net} *= 1716.75 * 0.7 = 1201.725 N*
Reaction Forces On Bike F_T *= 1201.725 N* — *Number of Wheels = 2*
Reaction Force on Each Wheel F_T *= 600.8625 N* — *Number of spokes = 5*

Stress on the each Rim $= \frac{F_T}{Area}$ *= 0.012443 N/mm²* — *Stress on the each rim for load = 0.012443 N/mm²*
Area of rim at stressed parts = 48287.08 mm²

With Load2 on Bike (175+50)Kgs

*Total Gross Weight = 225 * 9.81 = 2207.25 N*
Tires and Suspension system reduced by 30% of Loads — W_{net} *= 2207.25 * 0.7 = 1545.075 N*
Reaction Forces On Bike: F_T *= 1545.075 N* — *Number of Wheels = 2*
Reaction Force on Each Wheel F_T*=722.5375 N* — *Number of spokes = 5*

Stress on the each Rim $= \frac{F_T}{Area}$ *= 0.015998 N/mm²* — *Stress on the each rim for load2 = 0.015998 N/mm²*

Area of rim at stressed parts = 48287.08 mm²

With Load3 on Bike (175+100)Kg

*Total Gross Weight = 275 * 9.81 = 2697.75 N*
Tires and Suspension system reduced by 30% of Loads — W_{net} *= 2697.75 * 0.7 = 1840.356 N*
Reaction Forces On Bike: F_T *= 1888.425 N* — *Number of Wheels = 2*
Reaction Force on Each Wheel F_T *= 944.2125 N* — *Number of spokes = 5*

Stress on the each Rim $= \frac{F_T}{Area}$ *= 0.019050 N/mm²* — *Stress on the each rim for load3 = 0.019554 N/mm²*

Area of rim at stressed parts = 48287.08 mm²

With Load4 on Bike (175+150)Kg

*Total Gross Weight = 325 * 9.81 = 3188.25 N*
Tires and Suspension system reduced by 30% of Loads — W_{net} *= 3188.25 * 0.7 = 2231.775 N*
Reaction Forces On Bike: F_T *= 2231.775 N* — *Number of Wheels = 2*
Reaction Force on Each Wheel F_T *= 1115.8875 N* — *Number of spokes = 5*

Stress on the each Rim $= \frac{F_T}{Area}$ *= 0.02309 N/mm²* — *Stress on the each rim for load4 = 0.02309 N/mm²*
Area of rim at stressed parts = 48287.08 mm²

4.6 commerce of Alloy Wheel

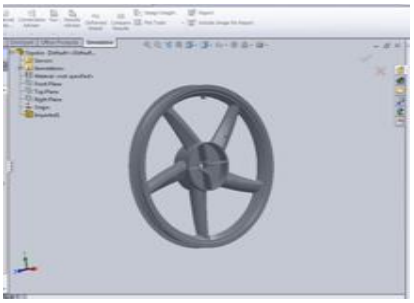


Fig4.3: the making of Static Study

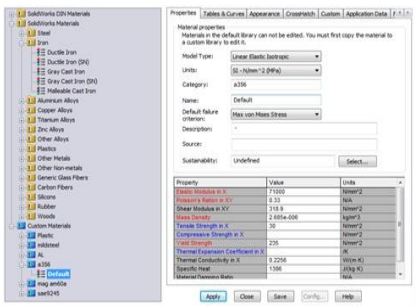


Fig 4.4: way to Assign the fabric

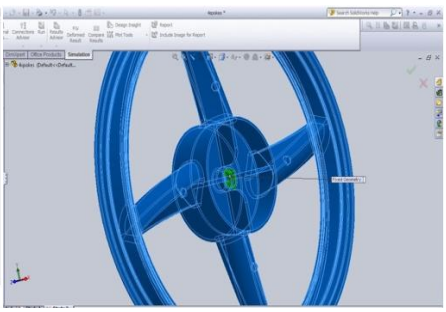


Fig 4.5: way to Assign the Fixtures

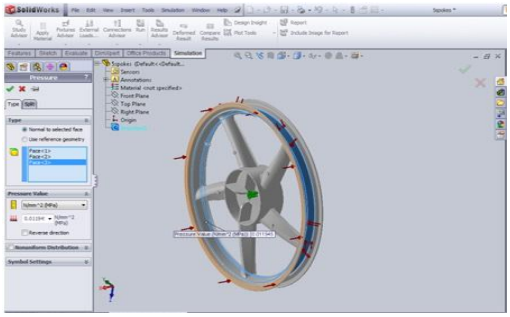


Fig 4.6: way to Assign the Pressure

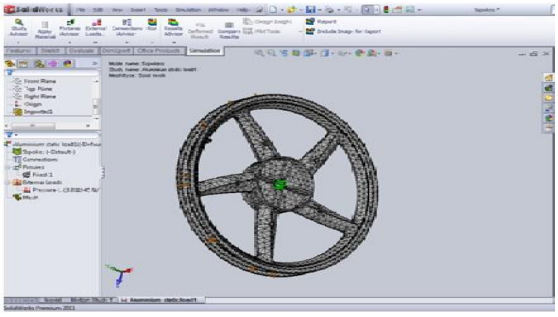


Fig 4.7:way to Meshing the half model

SIMULATION OF ALLOY WHEEL

5.1 Static and Fatigue analysis for 5-spokes (Al alloy) alloy wheel

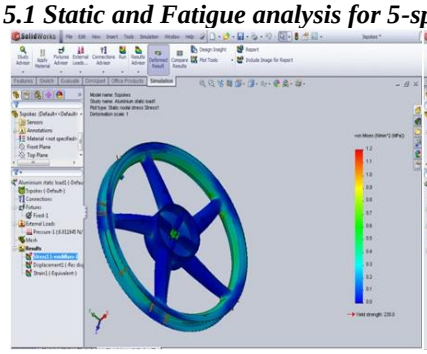


Fig 5.1: Stress 5-spokes Al alloy

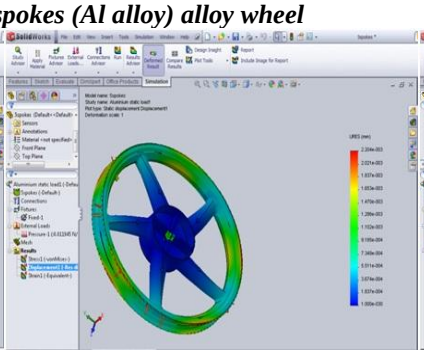


Fig 5.2: Displacement 5-spokes Al alloy

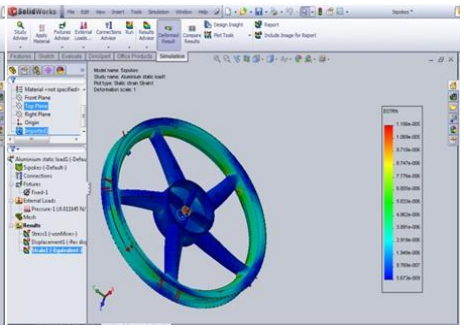


Fig 5.3: Strain 5-spokes Al alloy

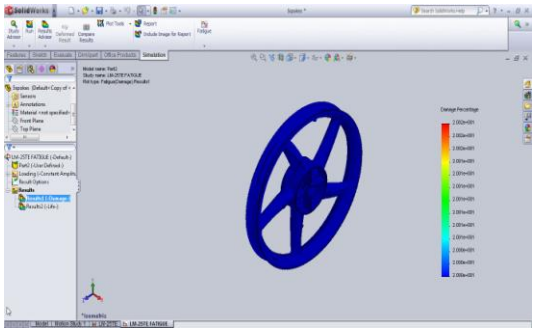


Fig 5.4: injury share 5-spokes Al alloy

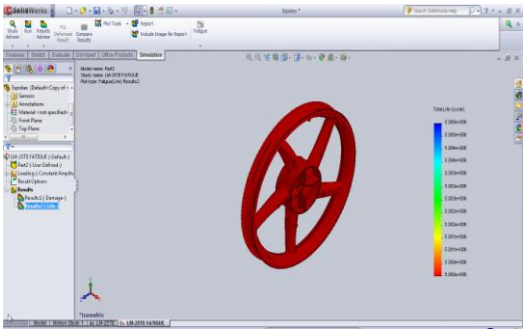


Fig 5.5: Total Life (cycle)5-spokes Al alloy

Fig 5.1 Shows the grievous bodily harm stress 2.40489 N/mm2 and mini stress 0.000963685 N/mm2 that square measure iatrogenic in 5-Spokes Al alloy wheel (LM 25TF)

Fig.5.2 Shows the grievous bodily harm displacement 0.00487283 mm and mini displacement 0 mm that square measure iatrogenic in 5-Spokes metallic element Alloy (LM 25 TF).

Fig 5.3Shows the mini strain 1.07986e-008 and grievous bodily harm strain 2.20937e-005 that square measure iatrogenic in 5-Spokes Al alloy (LM 25 TF).

Fig 5.4, Shows the grievous bodily harm fatigue life and mini fatigue 1e+007 cycle that square measure iatrogenic in 5-Spokes Al alloy (LM25TF).

Fig 5.5, Shows the grievous bodily harm injury and mini control is ten that square measure iatrogenic in 5-Spokes metallic element Alloy (LM 25 TF).

5.2 Static and Fatigue analysis for 4-spokes Magnesium alloy wheel

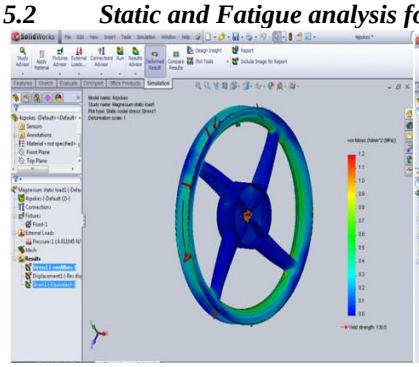


Fig 5.6: Stress 4-spokes Mg alloy

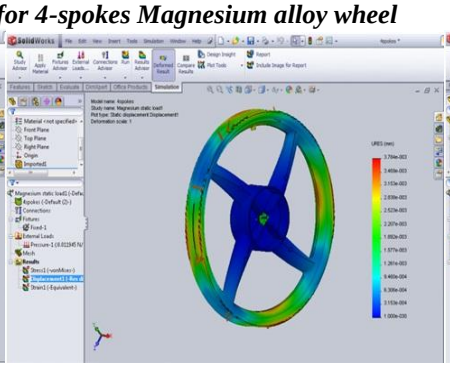


Fig 5.7: Displacement 4-spokes Mg alloy

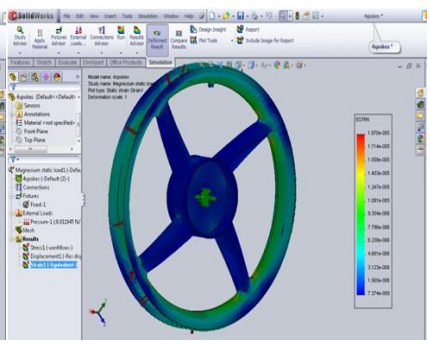


Fig 5.8: Strain 4-spokes Mg alloy

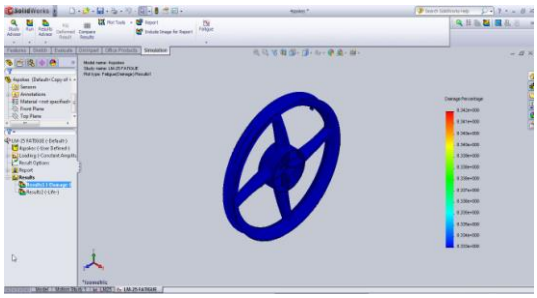


Fig 5.9: injury share 4-spokes Magnesium alloy

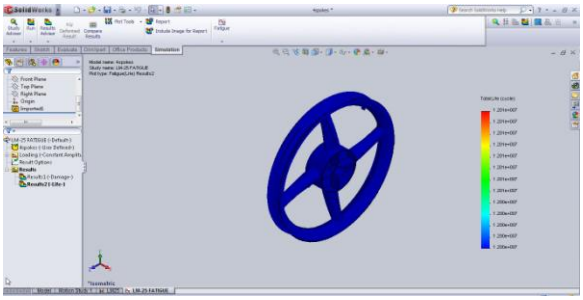


Fig 5.10: Total Life(cycles) 4-spokes Magnesium alloy

Fig 5.7, Shows the grievous bodily harm displacement 0.00714043 mm and mini displacement 0 mm that are iatrogenic in 4-Spokes Magnesium Alloy (AM 60B).
Fig 5.6, Shows the grievous bodily harm stress 2.24657N/mm2 and mini stress 0.000775803 N/mm2 that square measure iatrogenic in 4-Spokes Magnesium alloy (AM60B)
Fig 5.8, Shows the grievous bodily harm strain 3.5419e-005 and mini strain 1.40248e-008 that square measure iatrogenic in 4-Spokes Magnesium alloy (AM60B)
Fig 5.9, Shows the grievous bodily harm fatigue life and mini fatigue 1e+008 cycle that square measure iatrogenic in 4-Spokes Magnesium alloy (AM60B)
Fig 5.10, Shows the grievous bodily harm injury and mini control is one that square measure iatrogenic in 4-Spokes Magnesium alloy (AM60B)`

RESULTS TABULATED AND DISCUSIONS

5-Spokes	***Aluminum Alloys***				***Magnesium alloy (AM60B)***
	LM 25	***LM 25TB7***	***LM 25TE***	***LM 25TF***	
LOAD1	*1.24274*	*1.24236*	*1.24196*	*1.24150*	*1.25328*
LOAD2	*1.61375*	*1.61330*	*1.61285*	*1.61208*	*1.62449*
LOAD3	*2.02649*	*2.02615*	*2.02576*	*2.02532*	*2.10273*
LOAD4	*2.40636*	*2.40563*	*2.40527*	*2.40489*	*2.41683*

Table 6.1: Stress analysis values for 5-Spokes Mg-alloy and Al-alloys

The Stresses induced in the 5-Spokes Aluminum Alloy wheel (LM 25TF) 2.40489 MPa is less as compared with the Stresses induced in the 5-Spokes Magnesium alloy (AM60B), Al-alloys (LM 25, LM 25TB7, LM25TE) wheels.

4-Spokes	***Aluminum Alloys***				***Magnesium alloy (AM60B)***
	LM 25	***LM 25TB7***	***LM 25TE***	***LM 25TF***	
LOAD1	*1.17985*	*1.17963*	*1.17945*	*1.17923*	*1.19112*
LOAD2	*1.53030*	*1.52978*	*1.52926*	*1.52876*	*1.54417*
LOAD3	*1.89690*	*1.89643*	*1.89589*	*1.89531*	*1.99896*
LOAD4	*2.23214*	*2.23168*	*2.23113*	*2.23074*	*2.24657*

Table 6.2: Stress analysis values for 4-Spokes Al-alloys and Mg-alloy

The Stresses induced in the 4-Spokes Aluminum Alloy wheel (LM 25TF) 2.23074MPa is less as compared with the Stresses induced in the 4-Spokes Magnesium alloy (AM60B), Al-alloys (LM 25, LM 25TB7, LM25TE) wheels.

5-Spokes and 4-Spokes	***Magnesium alloy (AM60B)***	***Aluminum Alloys***			
		LM 25	***LM 25TB7***	***LM 25TE***	***LM 25TF***
LOAD1	*1.0E8*	*1.2E7*	*5.0E6*	*5.0E6*	*1.0E7*
LOAD2	*1.0E8*	*1.2E7*	*5.0E6*	*5.0E6*	*1.0E7*
LOAD3	*1.0E8*	*1.2E7*	*5.0E6*	*5.0E6*	*1.0E7*
LOAD4	*1.0E8*	*1.2E7*	*5.0E6*	*5.0E6*	*1.0E7*

Table 6.3: Fatigue Life values for 5-Spokes and 4-Spokes Al-alloys and Mg-alloy

Fatigue life of Mg-Alloys are more compared with all Al-Alloys, because of High Strength and Hardness

4-Spokes	***Aluminum alloy (LM 25TF)with Fillet 9 mm***	***Aluminum Alloy (LM 25TF) with Fillet 10mm***
LOAD1	*1.17750*	*1.17175*
LOAD2	*1.52923*	*1.52288*
LOAD3	*1.87765*	*1.87056*
LOAD4	*2.23074*	*2.21884*

Table 6.4: Stress analysis values for 4-Spokes Al-alloys (LM 25) and Mg-alloy (AM 60B) with different Fillet radii.

The Stresses induced in the 4-Spokes Aluminum Alloy wheel (LM 25TF) 2.21884 MPa is less as compared with the Stresses induced in the 4-Spokes Aluminum Alloy (LM25TF) wheels.

The Stresses iatrogenic within the 4-Spokes metallic element Alloy wheel (LM 25TF) 2.21884 MPa is a smaller amount as compared with the Stresses iatrogenic within the 4-Spokes metallic element Alloy (LM25TF) wheels.

Due to totally different Heat Treatment conditions, metallic element Alloys obtained square measure luminous flux unit 25TB7, luminous flux unit 25TE and luminous flux unit 25TF. Analysis is completed on the 3 totally different Al-alloys associate degreed conjointly on an existing material of the Magnesium alloy (AM 60B).

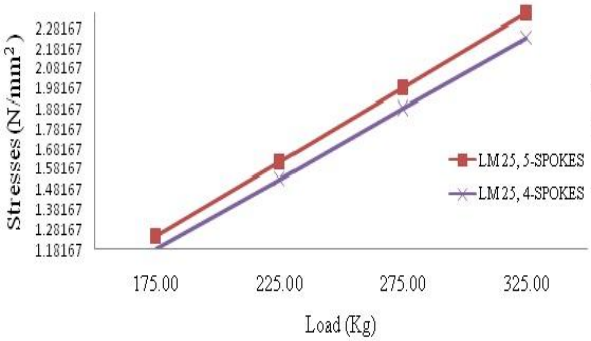
The stresses obtained within the 3 totally different alloys square measure less as compared with the LM25, as a result of if a fabric is heated to warmth followed by ending in predicament or speedy cooling,

Larger grains can entered little grains.

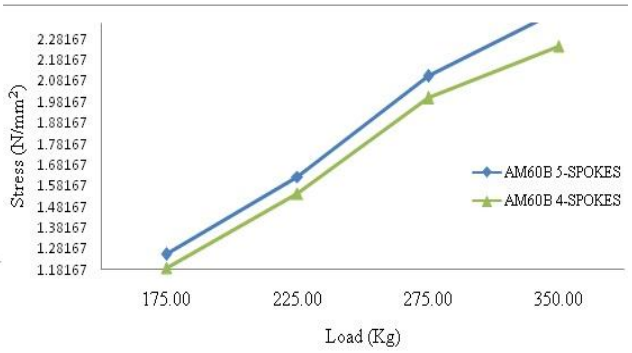
Hardness and Strength will increase, because of electrostatic bond between the molecules.

But the Stresses obtained within the Magnesium alloy (AM 60B) is additional as compare with all the 3 metallic element Alloys, as a result of associate degree HCP structure exists in atomic number 12 that makes atomic number 12 additional brittle owing to their few active slip systems. conjointly atomic number 12 is very active in presence of chemical element forming magnesia associate degreed an improvement is required in chilling and micronization of Crystal grains of Magnesium alloy. because of of these, the stresses obtained in Mg-alloy square measure additional as compared with all Al-Alloys.

Graphical Representation



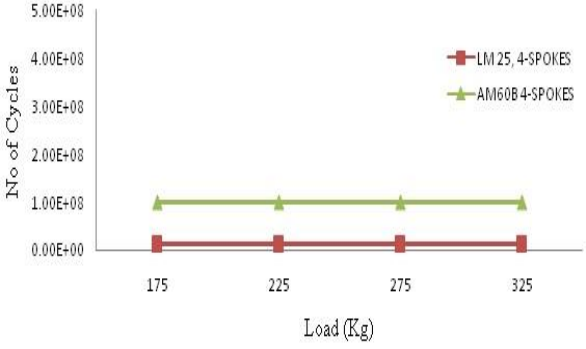
Graph 1: Stress Comparison between 5-Spokes and 4-Spokes Al- Alloy wheel (LM 25)



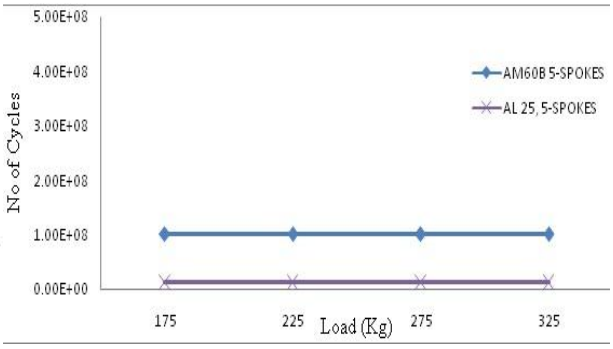
Graph 2: Stress Comparison between. 5-Spokes and 4-Spokes Mg-alloy wheel (AM 60B)

Graph 1 indicates Stresses iatrogenic within the 4-Spokes alloy wheel as less as compared with the strain iatrogenic within the 5-Spokes alloy wheel, for identical metallic element Alloy material (LM 25TF) by zero.065%.

Graph 2 indicates that, Stresses iatrogenic within the 4-Spokes alloy wheel as less as compared with the strain iatrogenic within the 5-Spokes alloy wheel, for atomic number 12 Alloy (AM 60B – ASTM Standards) by zero.069%.



Graph 3:Fatigue Life Cycle of 4-Spokes wheel of Mg and Al alloy



Graph 4:Fatigue Life Cycle of 5-Spokes wheel of Mg and Al alloys.

The higher than 2 graphs (Graph 3 and Graph 4) indicates that, Fatigue life cycle of atomic number 12 alloy wheel is additional as compared with the Fatigue life cycle of metallic element alloy wheel. because of High Strength of Mg-Alloy, Fatigue life is additional compared with all Al-Alloys.

CONCLUSION

An Al-Alloy Wheel was sculpturesque by victimization Pro-E of 2 Spokes that square measure four and five with fillet radii (9mm and 10mm).These models were analyzed victimization COSMOS for 5 totally different materials, LM 25, LM25TB7, LM 25TE, LM25TF and AM60B.

From the obtained results we have a tendency to complete that The analysis results showed that the most stress space was placed at Spoke-Rim contact. Stresses iatrogenic in four-Spokes metallic element Alloy (LM 25TF) square measure less as compared with atomic number 12 Alloy (AM 60B) and every one the 3 metallic element Alloys of five and 4 Spokes.

Fatigue life cycle is calculable supported the Equivalent Stresses iatrogenic on Al-alloys and Mg-alloy materials. Fatigue life cycle for the Mg-alloy is additional as compared with all Al-alloys materials.

Re-model of alloy wheel, from 5-Spokes to 4-Spokes, with chickenfeed in Fillet radius from 9 mm to 10 mm at Rim-Spoke contact. The Stresses iatrogenic in metallic element alloy (LM 25TF) square measure more reduced as compared to all or any the 3 Al-alloys.

Thus, it's clear that by adding the fabric at fillet edges the strain concentration are reduced that successively will increase the fatigue lifetime of the fabric and material reduction may be done by reducing variety of Spokes.

Even tho', the Fatigue lifetime of atomic number 12 alloy is additional, by considering all the properties of metallic element alloy like simple availableness, recyclable, sensible chilling rate. metallic element Alloy (LM 25TF) is that the higher material for alloy wheels.

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