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DESIGN VALIDATION AND BUCKLING ANALYSIS OF STRAIGHT AND SLANT SPOKES

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Abstract

The existing car model wheel rim is drawn in the design software **Creo 2.0** andvarious loads and forces are theoretically calculated and applied on the model andanalysed through ansys (17.0) software. Initially the static analysis and dynamicanalysis is done by giving the corresponding engineering data that consisting ofmechanicalpropertiesandtheirrelatedchemicalcompositions,thevon-Misesstresses, deformations, and shear stresses are determined for the complex loadingthat has been applied on rim models. And the fatigue analysis which includes theproductlife, the damagefactorand safetyfactorsaredeterminedand allthisanalysisisdonebytakingthreedifferentdesignsofthesamemodelofcar(Volkswagen polo 1.0 TSI) and rim materials (**AL 201.0 T43, AL201.0 T7, MgAlloy ZK60**) are changed in each case to know the best design and best materialfor a particular type of loading and later fatigue analysis is also carried forthesame cases to know which design and material will be more durable. This materialhad the advantages of both the materials and also economically best. From theresults obtained by analysing these two new alloys we have more life and fewerdeformationsforthesameloadingconditions forthe rimmodel.

Keywords: Alloywheel, Designvalidation,BuckingAnalysis,Ansys

1. INTRODUCTION

Aluminum wheels should not fail during service. Their strength and fatigue lifeare critical. In order to reduce costs, design for light-weight and limited-life isincreasinglybeingusedforallvehiclecomponents.Intheactualproductdevelopment, the rotary fatigue test is used to detect the strength and fatigue lifeofthewheel.Therefore,areliabledesignandtestprocedureisrequiredtoguaranteetheservice

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strengthunderoperationalconditionsandfull functioningof the wheel. Design is an important industrial activity which influences thequality of the product. The wheel rim is designed by using modeling softwareSolidWorksv2014. In modeling the time spent in producing the complex 3-Dmodels and the risk involved in design and manufacturing process can be easilyminimized.Sothemodelingofthewheelismadebyusing SolidWorks.COSMOS . Works is a design analysis system fully integrated with SolidWorks.COSMOSisthesoftwareusedforsimulatingthedifferentloads(forces,pressure, etc.) acting on the component and also for calculating and viewing theresults. A solver mode in COSMOS software calculates the stresses, deflections,bendingmomentsandtheirrelationswithoutmanual.The wheel is perhaps the most significant discovery of old times. The wheel hasdeveloped from nothing more than an oversized bearing to a fully integral part ofany modem transportationvehicle.Wheel is an important structuralmember ofthe vehicularsuspension systemthat supports thestatic anddynamicloadsencounteredduringvehicleoperation.Awheel is a circular devicethatiscapableofrotatingon itsaxis,facilitatingmovementortransportationwhilesupportingaload(mass),orperforminglabourinmachines.Commonexamplesarefoundintransportapplications. A wheel, together with an axle overcomes friction by facilitatingmotion by rolling. In order for wheels to rotate, a moment needs to be applied tothe wheel about its axis, either by way of gravity, or by application of anotherexternal force. More generally the term is also used for other circular objects thatrotate or turn, such as a ship's wheel, steering wheel and flywheel. Safety andeconomyareparticularlyofmajorconcernswhendesigningamechanicalstructure so that the people could use them safely and economically. Style, weight,manufacturability and performance are the four major technical issues related tothe designofanewwheeland/oritsoptimization.

2. MATERIALUSED

The wheels are made of steel, Magnesium alloy and cast/forge Aluminium alloys.Titanium is also being used in the recent alloy wheel models. Generally we havemany wheel designs for the same model, how can we decide one is the better onethantheother!Sofordecidingthatwehavetakenageneralcase(loadingconditions) appliedon theparticularthreerandomdesigns.

3. M

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ODELLINGSCREENS

Modelingoforiginalwheel

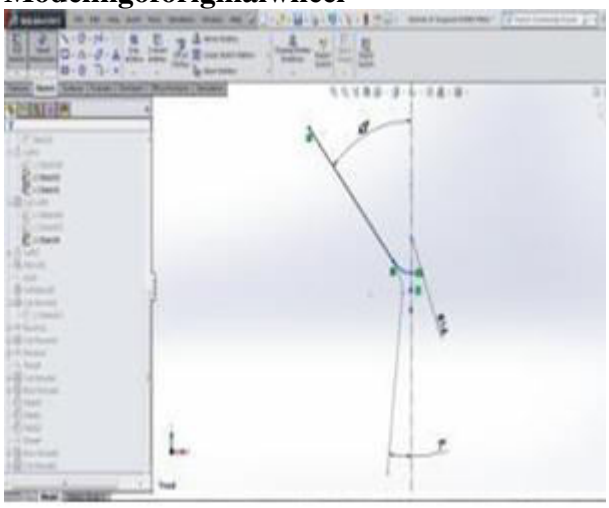

Fig1ProfileofSpokeinSketcher

SpokeModel inPart

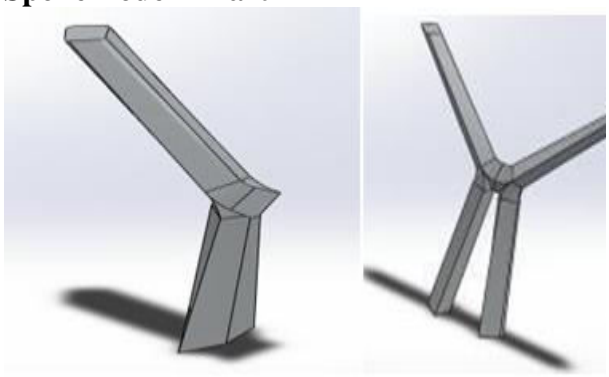

Fig2RimwithSpokes

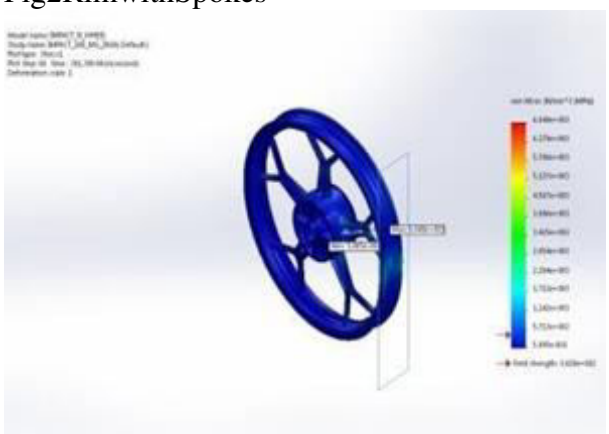

Fig3 Von-Misesstress.

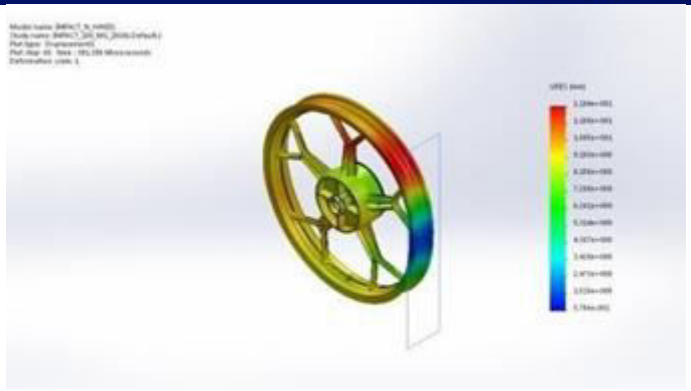

Fig 4 Displacement.

4. RESULT &SUMMARY

Static Analysis Results

Stress values for Original and Modified Al and Mg-alloywheels Table .1 Stress analysis values for Original Al and Mg-alloy wheel

S. No	Load(N)	Type of Study Results	AL201 T43	AL201T7	Mg Z
1	1030	Von miss stress (N/mm^2)	0.7434	0.7434	0.7
2	1991	Von miss stress (N/mm^2)	1.44	1.44	1.
3	2472	Von miss stress (N/mm^2)	1.792	1.792	1.
4	Permissible stress	225	344	382	

Table1showsStaticAnalysisvalues

5. CONCLUSION

The objective to reduce the weight and improve the functionality of the alloywheel has been achieved. The current design is 1.5% lighter than the originaldesign.In this work the overall dimensions are controlled by changing the angleof Y-spoke and gradually increasing the thickness of spoke from rim to hub ofalloywheelwithbetterfunctioningstability andlessweightwiththesamematerial when compared with original model. AL201 T7 provides high factor ofsafety when compared toAL201 T43 (original material) and MG ZK60. The stressand displacements in current alloy wheel are lesser than original alloy wheels andalso having higher FOS in the current model. From the results of impact analysis,that Mg ZK60 exceeds the permissible stress. By comparing three materials fororiginal and modified models, the factor of safety is better for AL201 T7. FinallyweconcludethatcurrentmodelwithAL201T7isbetter thantheexistingmodel.

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