Design modification and analysis of wheel fitting by using lock mechanism

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***Abstract*— Wheel fitting is an assembly section which has mainly two parts; they are wheel rim and Hub. In generally, these are fastened by using bolts and nuts, but now in this project new lock mechanism is introducing in wheel fitting assembly. This shows a clear cut comparison of the existing one with this new modification of lock mechanism which is used in behalf of nut and bolt fasteners in the existing wheel fitting design. It has completed in two stages of Modelling and Analysis like Designing of existing wheel Rim & Hub assembly, designing of modified wheel Rim & Hub with lock mechanism assembly are done by using PRO-E and Analysis of the entire modeling has been done by using ANSYS by monitoring some parameters like Equivalent stress, von misses strain, deformations and finally Compared with the existing wheel fitting design. The major advantage of using lock mechanism is, it can avoid thread failures and reduces fitting time.**

***Index Terms*— Equivalent stress , existing wheel Rim & Hub assembly , lock mechanism, von misses strain.**

I. INTRODUCTION

The wheel fitting section has mainly two parts; they are wheel rim and hub/bearing assembly. Wheel rim and hub/bearing assembly are fitting by using bolts and nuts. Archaeologies and historians of today see the introduction of the wheel as the real genesis of any old civilization. The wheel is perhaps the most significant discovery of old times. The wheel has developed from nothing more than an oversized bearing to a fully integral part of any modern transportation vehicle. The modern vehicle is also seen today a fashion item to complete people's individual requirements.

Fig: 1.1 wheel fitting section with bolts & nuts

Wheel Hub Nomenclature

Wheel hub is used to attach a wheel to an Axle. These are used in Agricultural and construction equipment, Transportation, and more, Wheel hub designs varies by industry. This publication addresses the agricultural and trailer industry hubs. The bolt circle and pilot diameter of agricultural low speed hubs are specifically designed not to accept high speed applications. Hub body material consists of either cast iron.

The main components of a Hub assembly are the hub body, tapered rollers bearings, seal, bolts studs and dust cap. Grease jerks are an optional component. Braking version hubs allow brake attachment and are also available.

Number of bolts: 4,5,6,8
Fastener: drill and tap
Bolt circle size: 4.40, 4.50, 5.50, 6.50.

1.1 Lock Mechanism

The locking mechanism is a single point, hook type latch with a torsion spring for return action for the handle. The hook engages to a keeper or strike type hardware on the inside of the bin. The handle actuates the locking mechanism and the torsion spring returns the handle back to the original position. The handle also has red colored flagging on each end that provides a visual indication that the latch is open. The function of the shroud is as a guard and for aesthetics purposes.

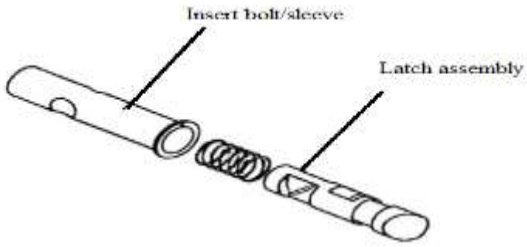

Fig1.2: lock mechanism

Table 1.1: MODELING AND MESHING SPECIFICATIONS

Specifications of Model Wheel Rim		Specifications of Model Wheel Hub
Wheel size = 16 inches		Hub size=10 inches
Length = 16inches		Hub length=10inches
Flange shape = J		Hub width=6inches
Rim width = 5.5 inches		Bolt length=1.5inches
Wheel type = disc wheel		Bolt diameter=0.5inches
Flange height = 0.68 inches		pitch =0.1inches
Tire type = radial		
Aspect ratio = 65		
Offset = 80.54		

Procedure for static and transmit Analysis

In ANSYS the wheel fitting is analyzed sequentially with static analysis preceding transmit analysis. Import the model in to Ansys then mention the element type *Main Menu→ Preprocessor → Element Type → Add* and at the left column mention structural solid and at the right column select the Solid 20 node 90 and Brick 8node 185. And mention the material properties of selected material. Next specify the mesh controls in order to get a particular mesh density. By select the Meshing → Mesh Tool and mention the element edge length is 0.5, and extrudes the meshed area into meshed volume with the diameter of the wheel fitting is 406. By apply the convection loads on surface elements, and then initialize the solution by select the *Solution→ Solve→ Current LS*. After the solution is done then select the General *post processor→ Plot results→ Counter plot→ Nodal solution* the results can be obtained.

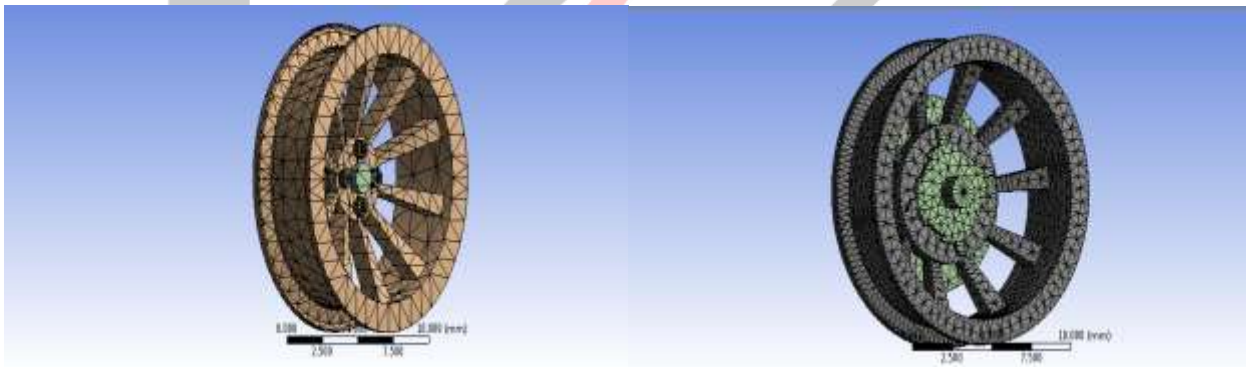

Fig1.3: Meshing of wheel fitting for existing and new design

The structural analysis is carried out after thermal analysis. For structural analysis define the element type as Solid 20 node 90 and Brick 8node 185, and proceed the meshing as same as thermal analysis. Then mention the material properties according to the selected material. By apply the pressure and displacement loads on areas and initialize the solution by select the Solution→ Solve→ Current LS and then plotted the results.

Table 1.2: STATIC

Design	Deformation	Equivalent stress	Elastic strain
Modified	0.004735	174.77	0.0017489
Existing	0.0026851	1065.1	0.011536

Table 1.3: TRANSIENT

Design	Time	Deformation	Equivalent stress	Elastic strain
Modified	10 Sec	0.00557	201.18	0.00207
	15 Sec	0.006025	217.21	0.002245
	20Sec	0.00648	233.56	0.0024146
Existing	10 Sec	0.019155	648.46	0.00356
	15 Sec	0.019376	648.46	0.003601
	20Sec	0.01969	659.03	0.003659

1.2 MODELING OF EXISITING WHEEL HUB

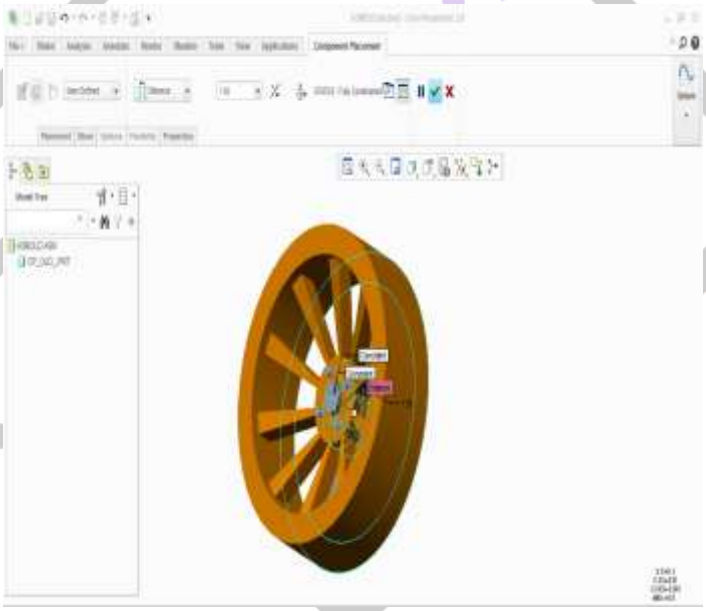

Fig1.4: Modeling of existing wheel hub assembly

1.3 modeling of modified wheel hub with lock mechanism

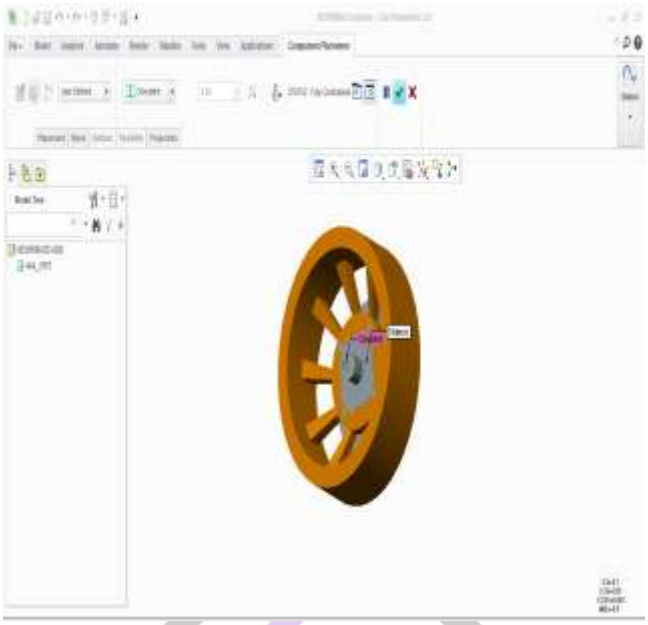

Fig1.5: Modeling of modified wheel hub assembly

1.4 Static analysis of existing wheel hub

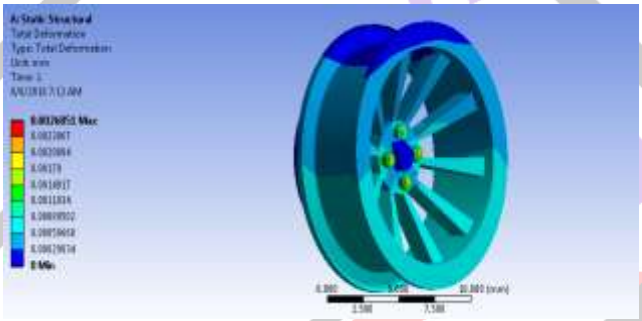

Fig1.6: Total deformation for Static analysis of existing wheel hub

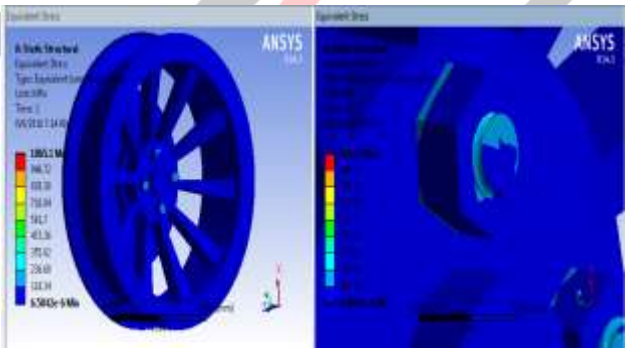

Fig1.7: Equivalent stress for Static analysis of existing wheel hub

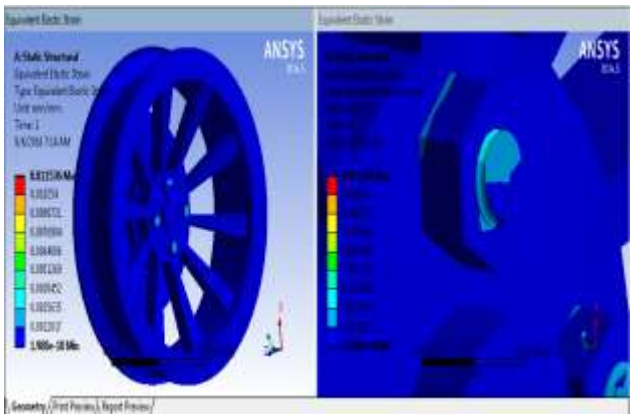

Fig1.8: Equivalent elastic strain for Static analysis of Existing wheel hub

1.5 Static analysis of modified wheel hub with lock mechanism

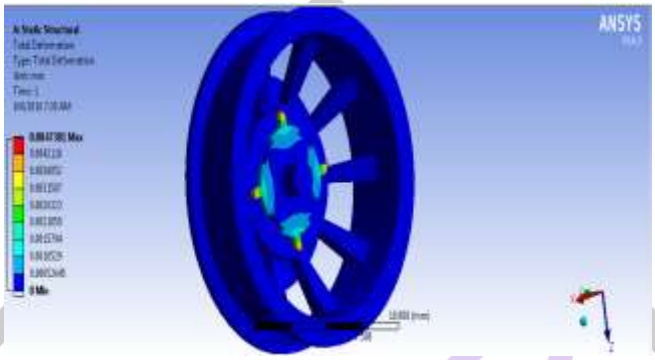

Fig1.9: Static analysis of Total deformation for Modified wheel hub with lock mechanism

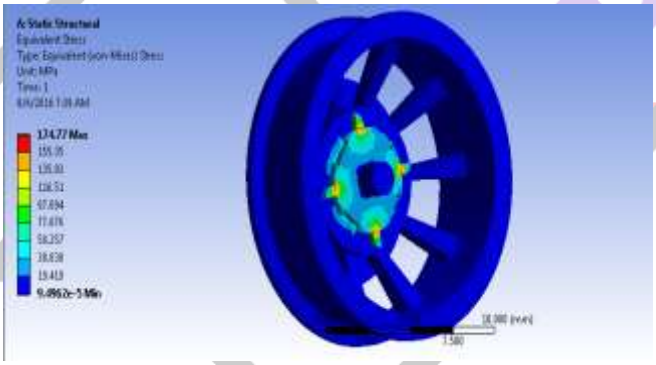

Fig1.10: Static analysis of Equivalent stress for Modified wheel hub with lock mechanism

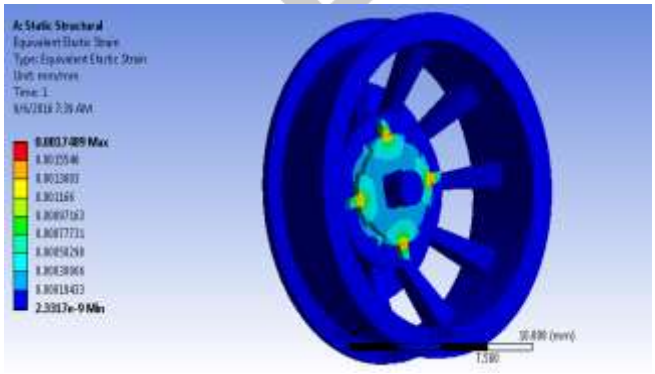

Fig1.11: Static analysis of Equivalent elastic strain for modified wheel hub with lock

1.6 Transient analysis of existing wheel hub of 10 sec

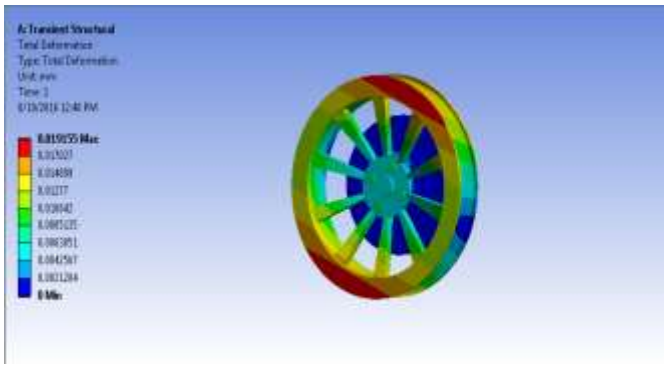

Fig1.12: Total deformation for transient analysis of existing wheel hub

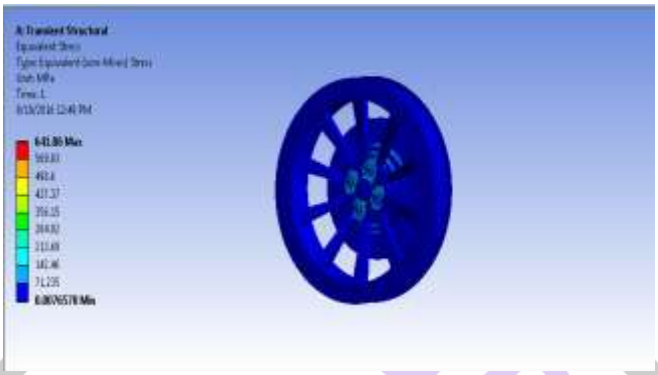

Fig1.13: Equivalent stress for transient analysis of existing wheel hub

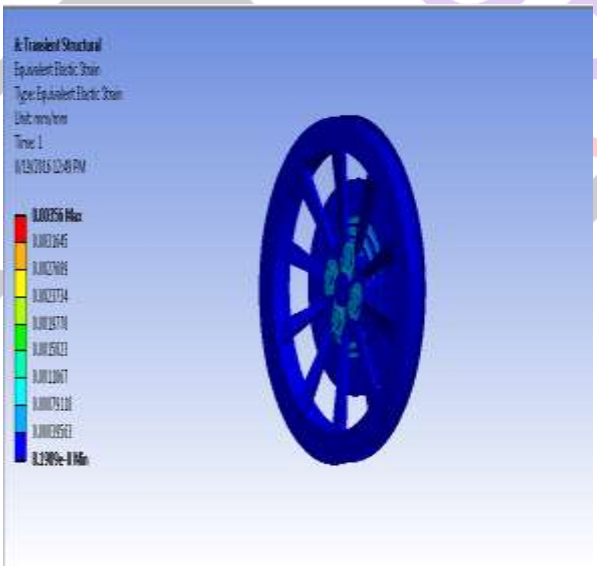

Fig1.14: Equivalent elastic strain for transient analysis of existing wheel hub

1.7 Transient analysis of existing wheel hub of 20 sec

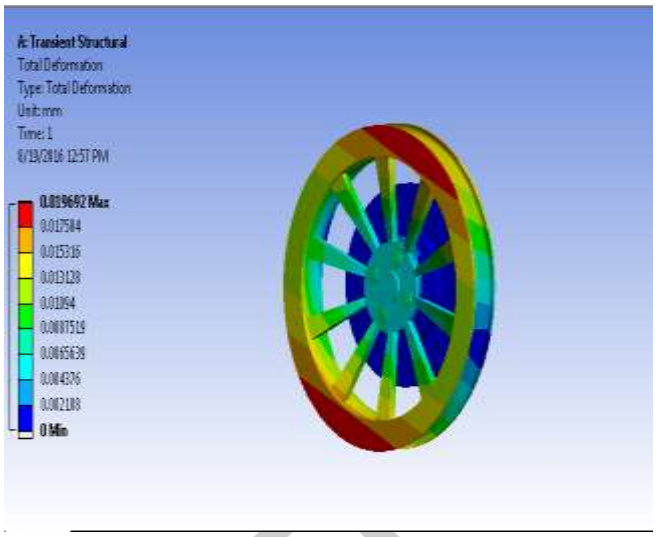

Fig1.15: Total deformation for transient analysis of existing wheel hub

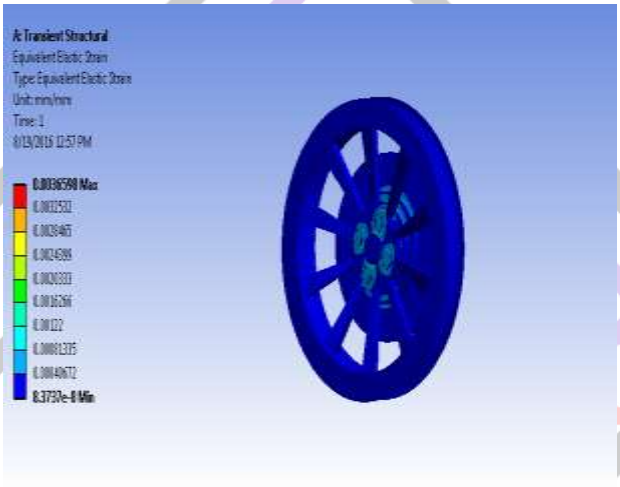

Fig1.16: Equivalent Elastic strain for transient analysis of existing wheel hub

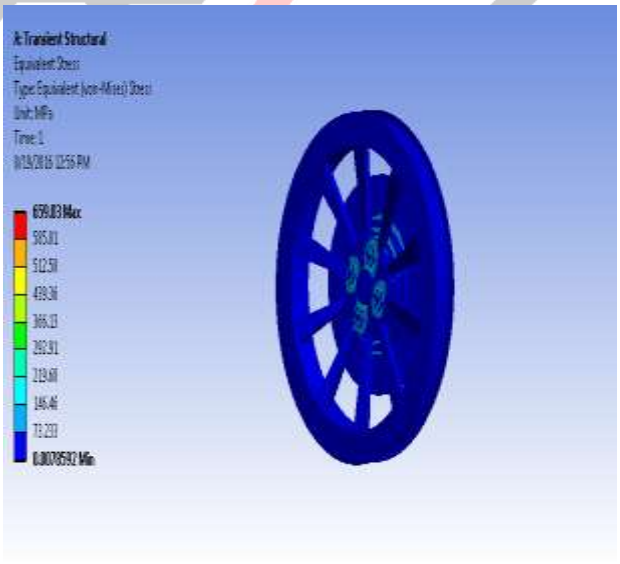

Fig1.17: Equivalent stress for transient analysis of existing wheel hub

1.8 Transient analysis of Modified wheel hub assembly of 10 sec

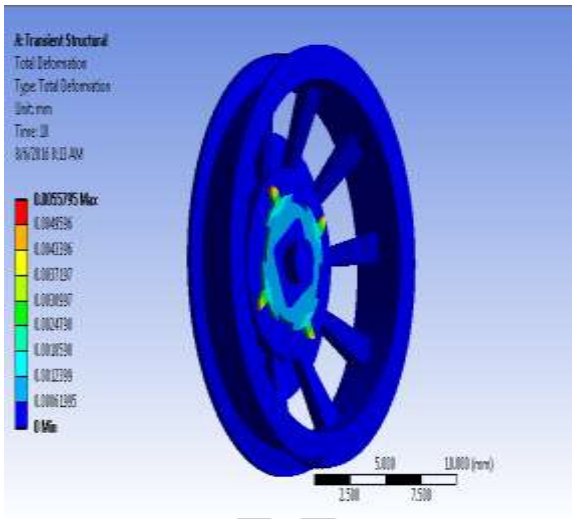

Fig1.18: Total deformation for transient analysis of Modified wheel hub

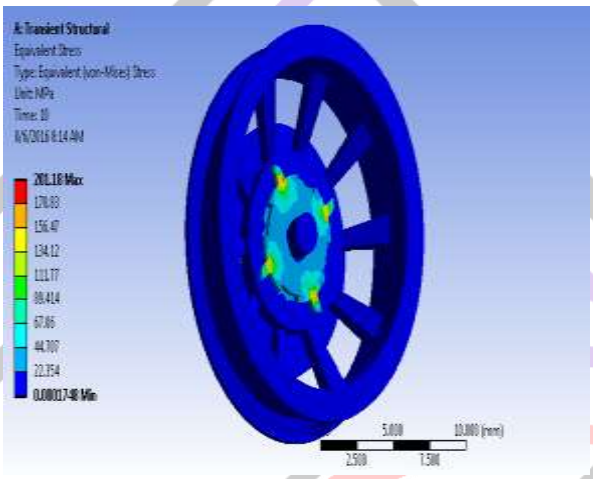

Fig1.19: Equivalent stress for transient analysis of modified wheel hub

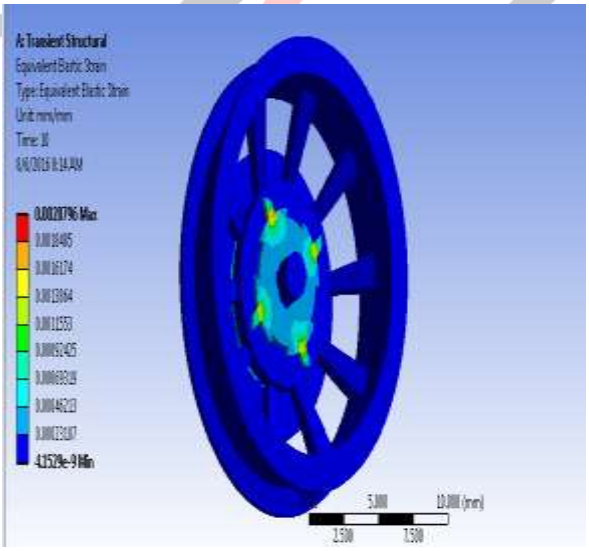

Fig1.20: Equivalent elastic strain for transient analysis of modified wheel hub

1.9 Transient analysis of modified wheel hub assembly of 20 sec

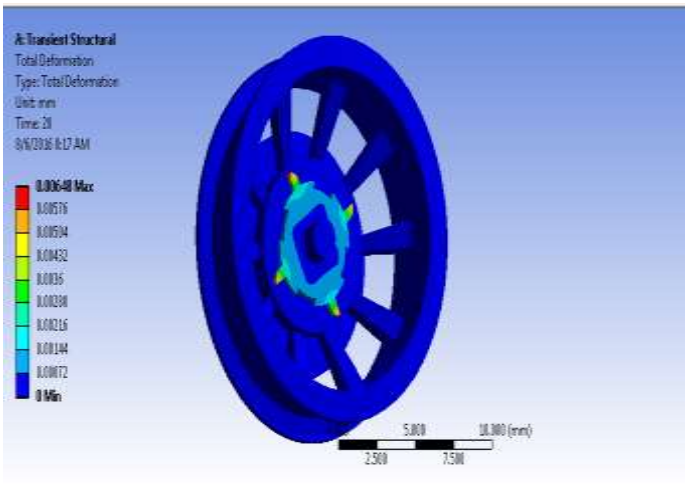

Fig1.21: Total deformation for transient analysis of modified wheel hub

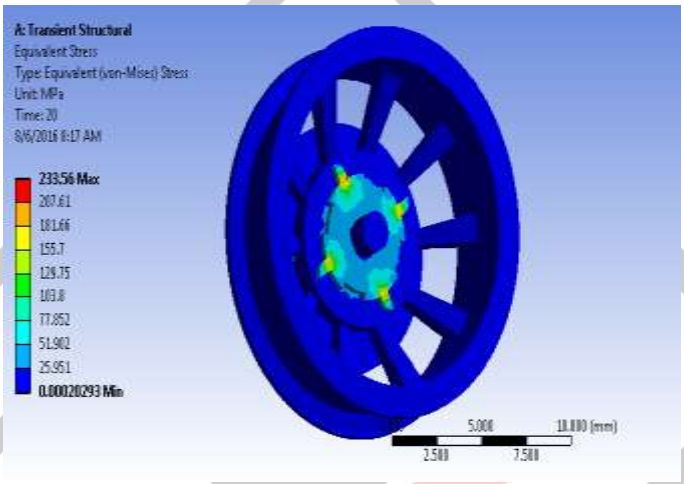

Fig1.22: Equivalent stress for transient analysis of modified wheel hub

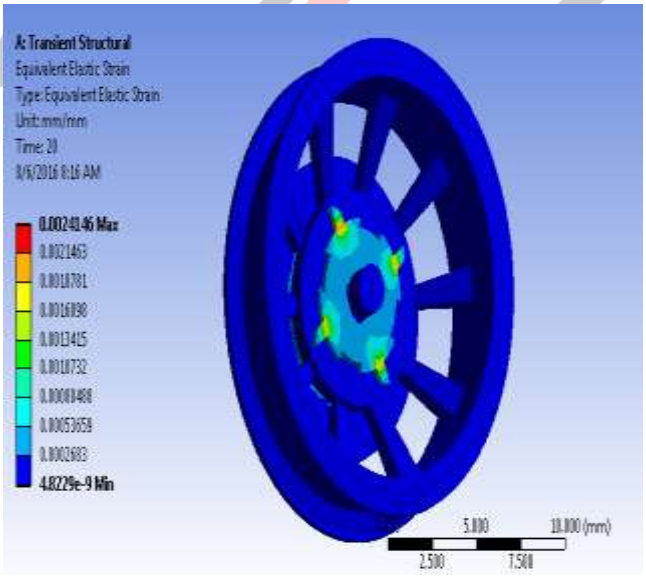

Fig1.23: Equivalent elastic strain for transient analysis of modified wheel hub

CONCLUSION

Design and analysis of wheel fitting by using lock mechanism is carried out with different models consisting of static analysis and transient analysis. It is found that total time for fitting and disassemble of wheel fitting using in lock mechanism is done in very short time.

The static and transient analysis is carried in Ansys and it is observed that the stresses and deformations is reduced in wheel fitting of lock mechanism compared to present existing bolt and nut fitting model and also by providing lock mechanism the total fitting time is reduced and the life time of the wheel hub is increases.

Future Scope

In the present analysis wheel fitting with lock mechanism is done. But in future it may be possible to provide the power locks to improve the performance of wheel fitting and to reduce the wheel fitting time.

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