

# 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 Modeling 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 mises 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.

**Keywords**—Equivalent stress, Existing wheel Rim & Hub assembly, Lock mechanism, Von mises 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.

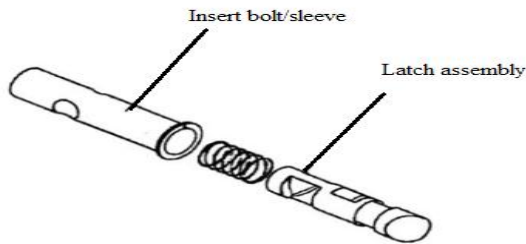
Number of bolts: 4,5,6,8

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.



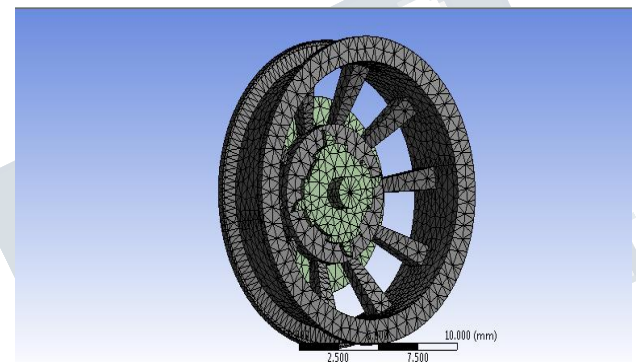
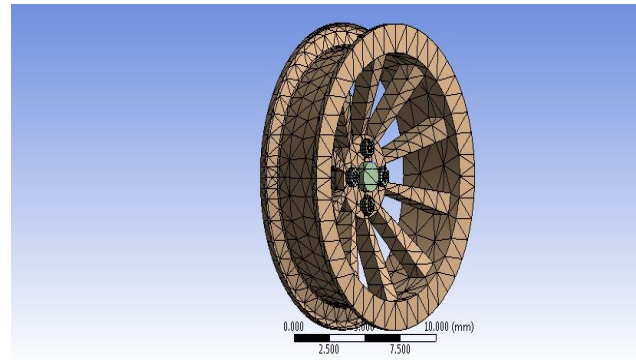
**Fig1.2: lock mechanism**

**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.

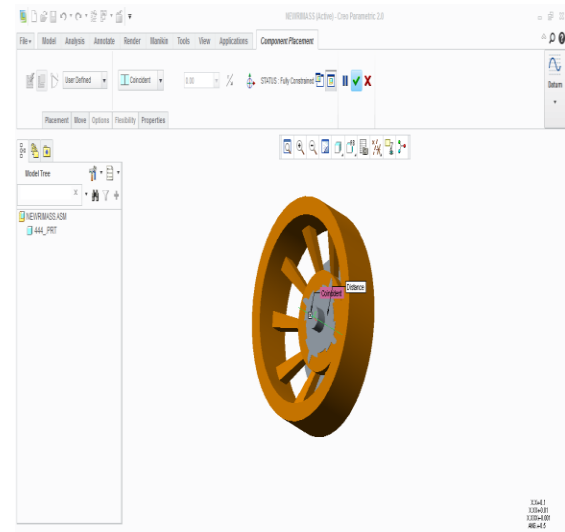
**Table 1.2: STATIC**

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

**Table 1.3: TRANSIENT**

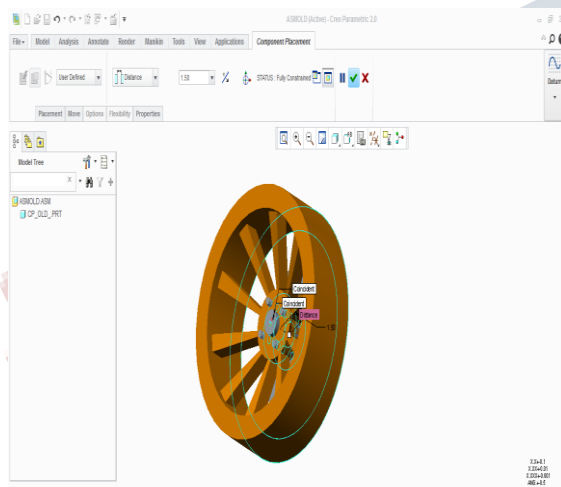
| Design | Time | Deformatio | Equivalen | Elastic |
|--------|------|------------|-----------|---------|
|--------|------|------------|-----------|---------|

|          |        | n        | t stress | 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  |



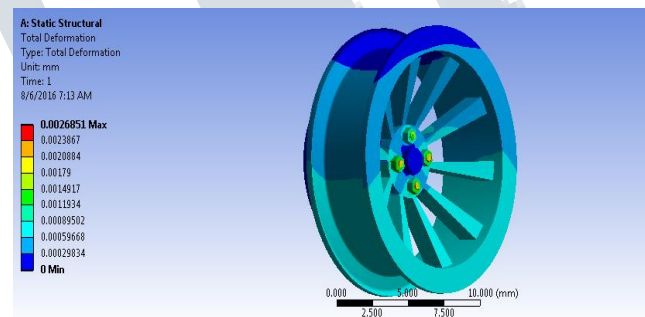
**Fig1.5: Modeling of modified wheel hub assembly**

## 1.2 Modeling of Existing Wheel Hub

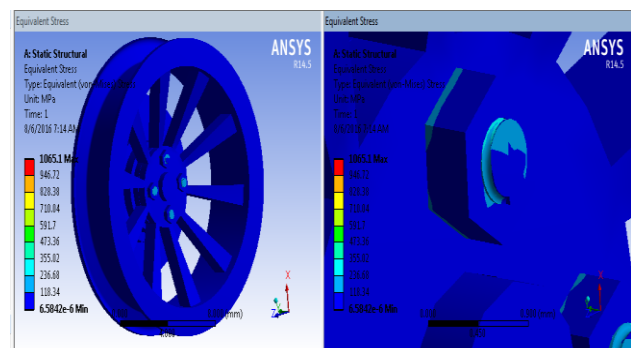


**Fig1.4: Modeling of existing wheel hub assembly**

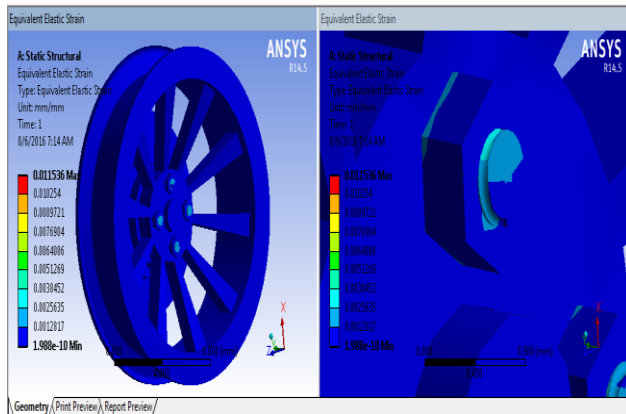
## 1.3 modeling of modified wheel hub with lock mechanism



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

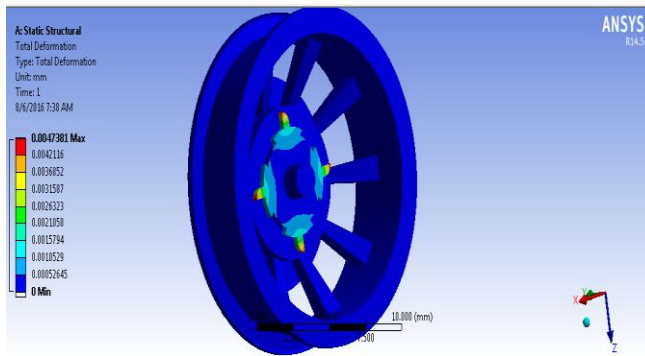


**Fig1.7: Equivalent stress for Static analysis of existing wheel hub**

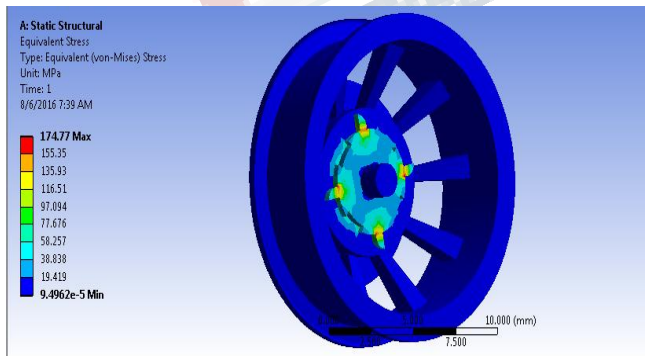


**Fig1.8: Equivalent elastic strain for Static analysis of Existing wheel hub**

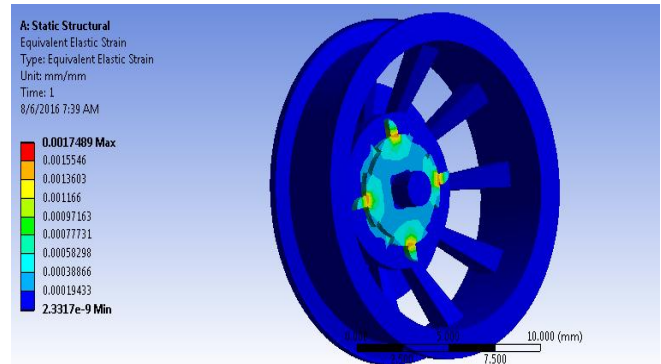
### 1.5 Static analysis of modified wheel hub with lock mechanism



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

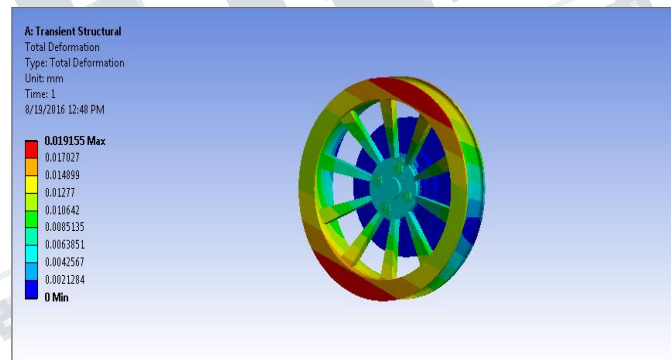


**Fig1.10: Static analysis of Equivalent stress for Modified wheel hub with lock mechanism**

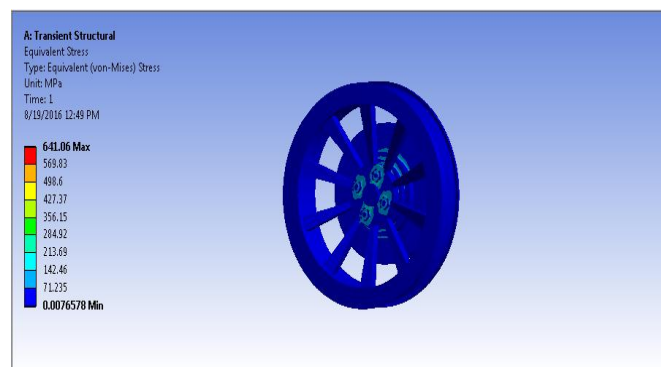


**Fig1.11: Static analysis of Equivalent elastic strain for modified wheel hub with lock**

### 1.6 Transient Analysis Of Existing Wheel Hub Of 10 Sec

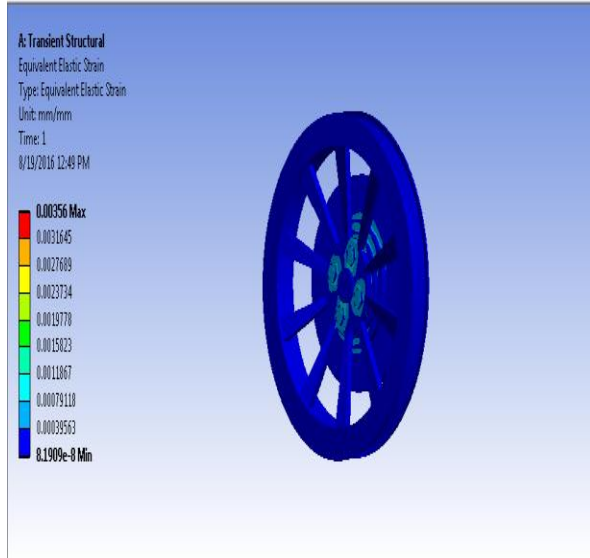


**Fig1.12: Total deformation for transient analysis of existing wheel hub**



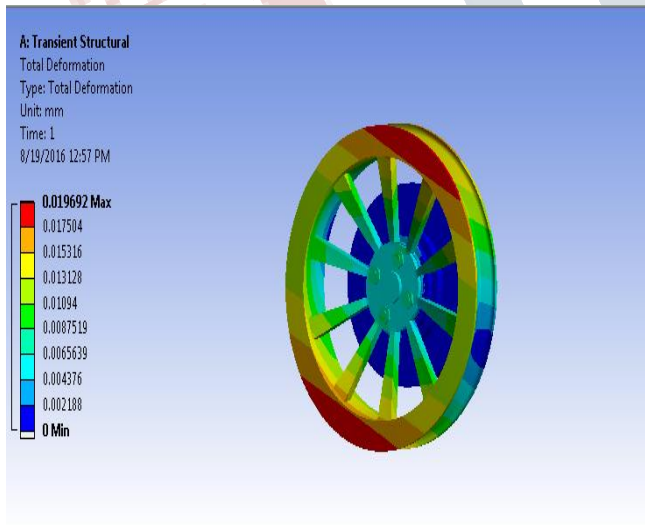


**Fig1.13: Equivalent stress for transient analysis of existing wheel hub**

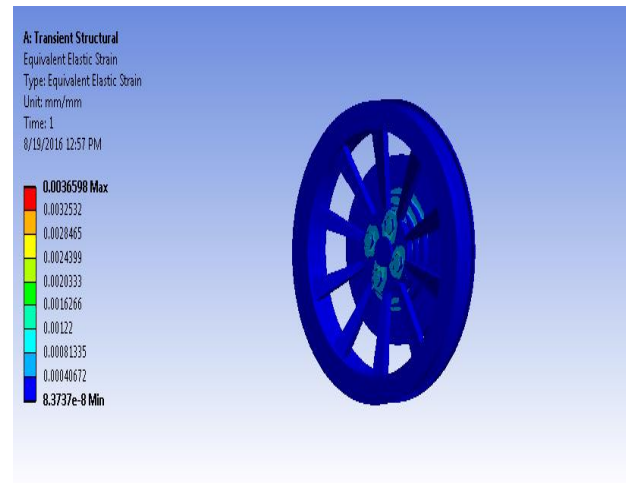


**Fig1.14: Equivalent elastic strain for transient analysis of existing wheel hub**

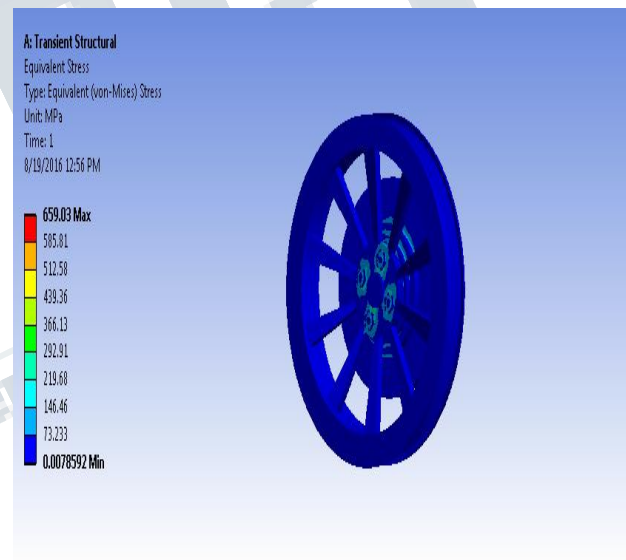
### 1.7 Transient analysis of existing wheel hub of 20 sec



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

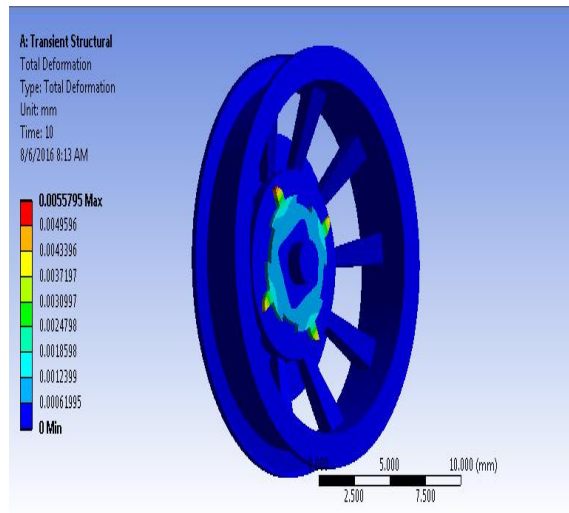


**Fig1.16: Equivalent Elastic strain for transient analysis of existing wheel hub**

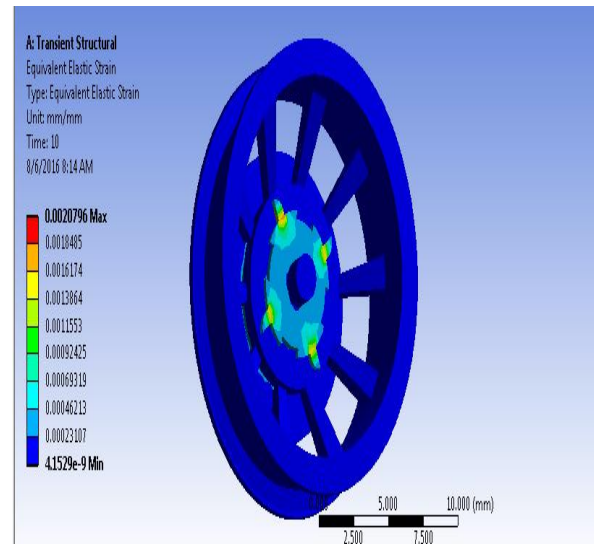


**Fig1.17: Equivalent stress for transient analysis of existing wheel hub**

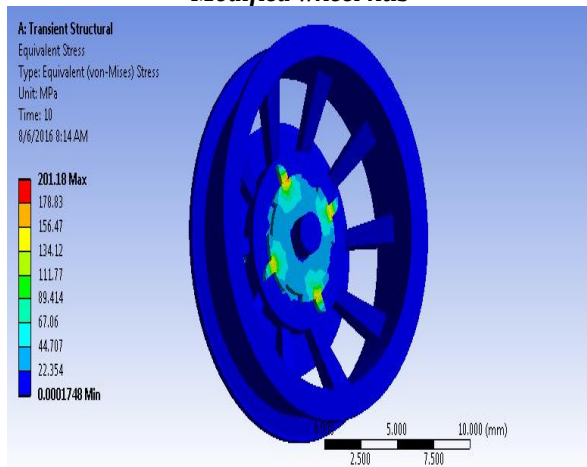
### 1.8 Transient analysis of Modified wheel hub assembly of 10 sec



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

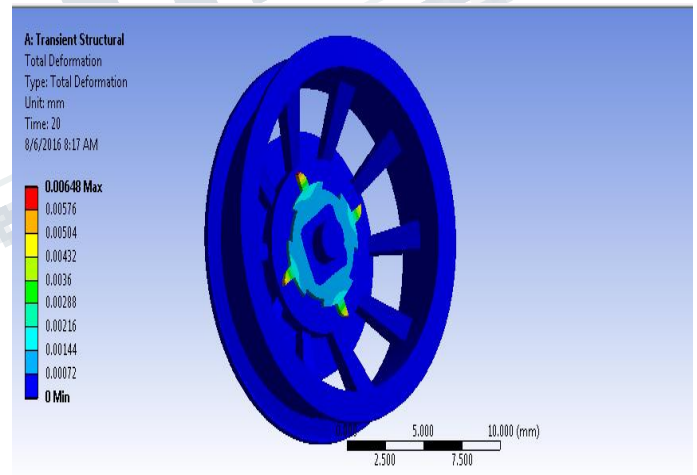


**Fig1.20: Equivalent elastic strain for transient analysis of modified wheel hub**

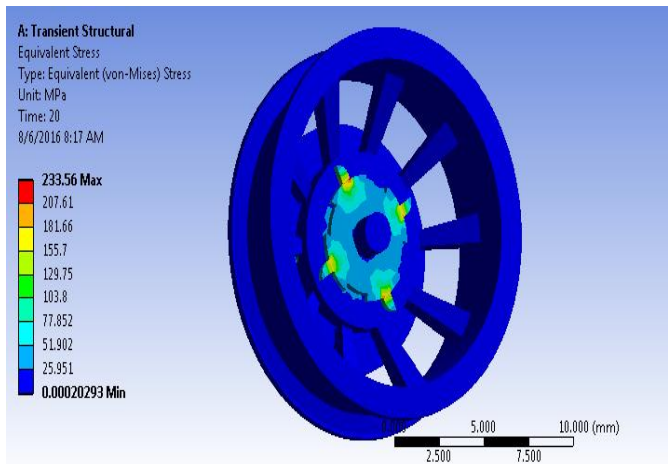


**Fig1.19: Equivalent stress for transient analysis of modified wheel hub**

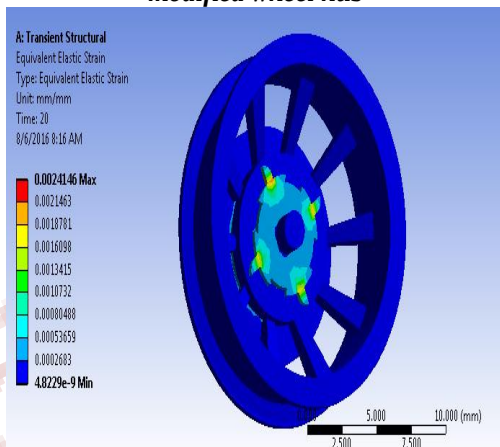
### 1.9 Transient analysis of modified wheel hub assembly of 20 sec



**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.

## REFERENCE

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