



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 4, April 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com



Design, Development and Optimization of Bush Removal and Fitment from Suspension

Nitin Ashok Dhage, Dr. Kumar. D. Sapate, Priyanka B. Sawant

Department of Mechanical Engineering, Alard College of Engineering and Management, Pune, Maharashtra, India

Professor, Department of Mechanical Engineering, Alard College of Engineering and Management, Pune,
Maharashtra, India

Asst. Professor, Department of Mechanical Engineering, Alard College of Engineering and Management, Pune,
Maharashtra, India

ABSTRACT: Vehicles are running on different road conditions. Due to this, there are different problems occurs regarding various vehicle assemblies and systems. This is caused by end of life of rotating and moving parts which need replacement by new part and assemblies. Regarding the maintenance checks for steering and suspension. Like, excessive “play” in the wheel, feels wobbling, experience considerable sway or bounce when driving over a bump or turning corners. After rectification of issue in the bush of suspension, it is necessary to replace the bush. To repair the suspension, sometimes service technician or worker needs to remove the existing bush without damaging. For that activity, currently bush is getting removed using hammer and because of that bush is getting damaged. After damage of bush, that needs to place with the new one, and this will cost to customer and resulting into increasing the maintenance cost of vehicle. Such activities are usually very time consuming and it becomes very tedious job to remove existing parts. During such non-standard processes, there is always risk of failure of good, working part and also raises safety issue as some broken part may cause injury to workers or surrounding people. This project focuses on making of standard equipment / application to remove the bush easily and safely and without breaking any parts or assemblies.

KEYWORDS: 3D model, analysis, force, optimization, tools, bush, suspension

I - INTRODUCTION

Automotive tools have been designed to make automotive repairs, modifications and servicing easy, making them essential for use when working on vehicles. Without the right tools on hand, technicians will find it difficult to complete the tasks. Technician need to complete the task without errors or delays. Coupled with the right equipment and skills, automotive tools can help technician to solve almost every issue that a vehicle might experience. Every automotive mechanic or technician should have a reliable set of essential tools to service their cars or serve their customers. Nowadays, Automotive shops require a number of tools to get the job fast. Some of that are oil caddy, battery charger, engine hoist, air compressor, transmission jack and etc. Each tool has its own task and usage. Special applications are made and developed to reduce operational time, efforts, cost and provides safe working condition for repairing of a vehicle. These are specifically made for accessing particular aggregate and part where standard tools are unable to reach or function. These tools are special in nature and does the special purpose work. Use of these tools makes work easy and save time. Almost every part of a vehicle needs to be maintained to keep it running at its peak condition. For the separate vehicle systems like engine, transmission, etc, we can see a multitude of repairing tools. These tools are helpful in repairing as well as maintaining automotive. From a car mechanic to a non-professional car owner, everyone needs to have an understanding of the tools that can help him at the time of need. Each tool is made as per its function, which defines the types of loads to be considered. In case of special tools, path or method used to access the part defines the dimensional constraints. All these defined parameters, for every requirement of low-cost tool



and as we cannot consider all real-world situations, so taking appropriate factor of safety sets limitations on development of tools.

II - RELATED WORK

The objective of this project is to design, validate the special application to remove and fitment of bush of suspension. It is also to be seen if this design can be made flexible in structure so that it can accommodate different models.

- The objectives of this project are as below:
- Problem Analysis
- Concept finalization of special application to remove and fitment of bush from the suspension
- Designing of any special application
- Study and analysis of different forces and materials to be used in fabrication of application
- Digital validation
- Fabrication of application
- Validation / Testing of application

As both vehicles and utility vehicles are becoming more and more compact, this of necessity means that the increasingly confined areas pose greater challenges for assembly, maintenance and repairs – which required the corresponding tool solutions. Automotive maintenance tools are used to dismantle vehicle systems for their repair. This in turn helps the vehicles to function properly and run at their maximum possible efficiency. Furthermore, automotive maintenance tools are used for servicing or to replace parts and fluids of engine for the safety of the vehicles and to avoid any major damage. It is very difficult to remove and fitment of the bush of suspension. Currently, it is removed by using a hammer. Because of this, bush is getting damage, and affecting the increasing the cost of maintenance to the customer. A special application tool is used to remove and fitment of bush from the suspension. It is the combination of multiple tools, which are designed to remove the bush, without damaging the assembly. In service centers, it is very difficult to remove the bush from suspension, if any failure occurs in the same. Currently, hammer is used to remove the bush. It is very difficult to remove and fitment of the bush of suspension. Currently, it is removed by using a hammer. Because of this, bush is getting damage, and affecting the increasing the cost of maintenance to the customer. Using a hammer is not recommended by OEM, as it may damage the assembly or may cause an injury to technician. For this purpose, special application tool is designed and developed, which is a combination of multiple tools, is used to remove or fitment of bush.

III - METHODOLOGY

The optimization of a special tool is done as per steps below: -

Step 1: Defined direction of forces applied

Step 2: Designing of tool and data generation

Step 3: Material Selection

Step 4: CAE Analysis

Step 5: Validation

Step 6: Testing of tool in field

IV - EXPERIMENTAL RESULTS

Below image shows design consideration. CAD model is prepared based on original concept. Input and output parameters are considered as below

- Geometry of front upper wishbone suspension
- Geometry of suspension Bush in assembly
- Material properties
- Applied forces
- Stresses induced
- Feasibility of tool
- Cost

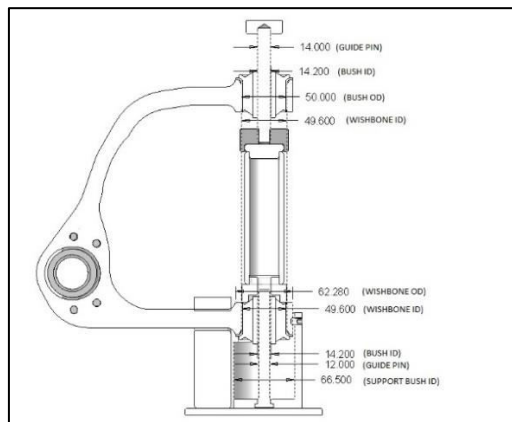


Fig. 1 Design Consideration

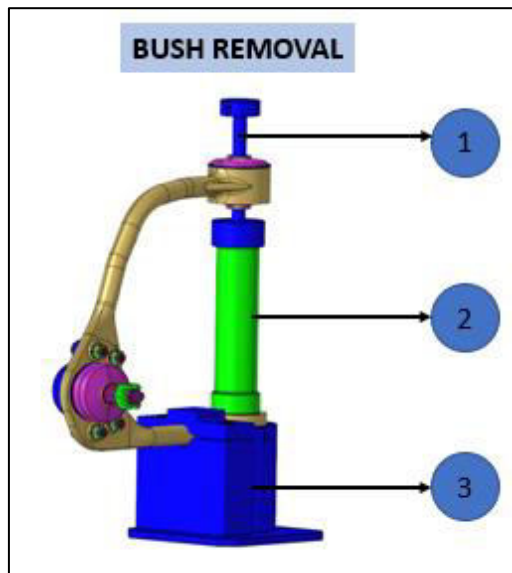


Fig 2 CAD Model Preparation - Bush Removal

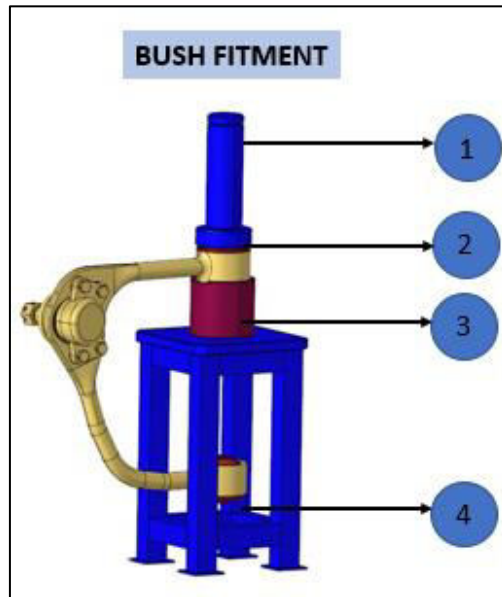


Fig 3 CAD Model Preparation - Bush Fitment

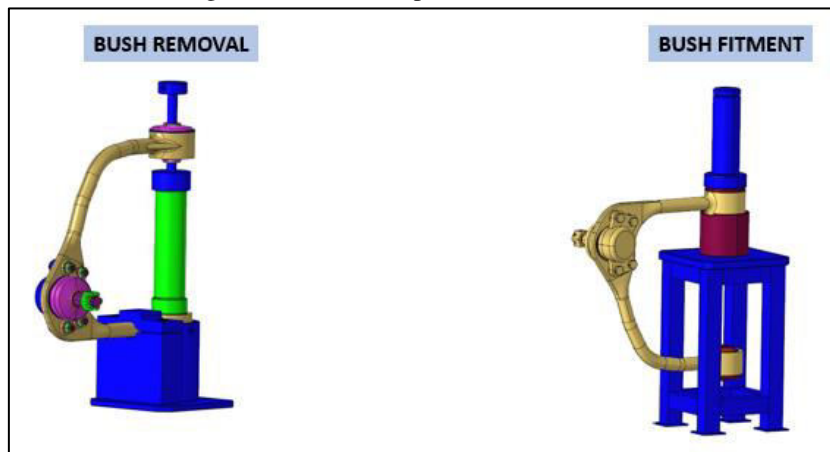


Fig 4 Application View

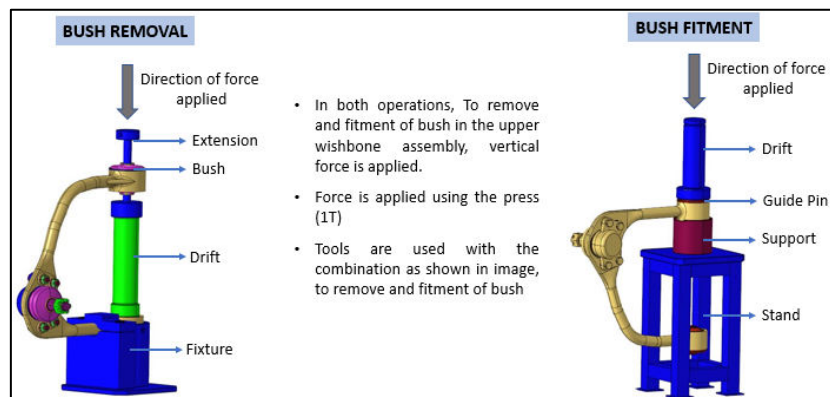


Fig 5 Boundary Condition and Forces

Material:

Steel is used by human since many years. Later alloying of steel was started to enhance the mechanical properties of steel like hardness, strength, toughness, elasticity etc. Also, different hardening methods were developed to increase

strength and toughness of steels. For development of mechanical puller EN9, EN19 and EN47 alloy steels are studied. All these steels have high tensile strength and toughness. These materials are studied and compared for chemical composition and mechanical properties.

- EN9 - It is a medium carbon steel used for engineering applications.
- EN19 - It is an alloy steel used in machining tools and auto industry.
- EN47 - EN47 is a steel alloy also known as spring steel.

Knowledge Domains:

- Product development
- Concurrent engineering
- Concept development
- Product models
- Product architecture
- Detail design

FEA results: -

Optistruct software is used for FEA analysis. Load cases are applied as per actual force is applied while fitment and removal of bush from suspension. Accordingly, material is applied while designing the tool. For designing the tools, EN9 material is selected. Different iterations are carried out for removal and fitment of bush from suspension assembly and result are showcased as below.

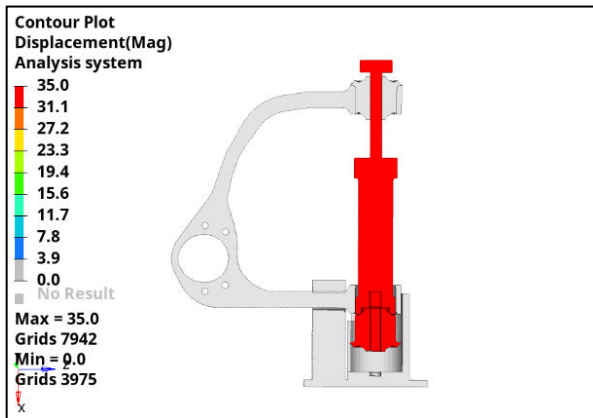


Fig 6 Displacement Plot

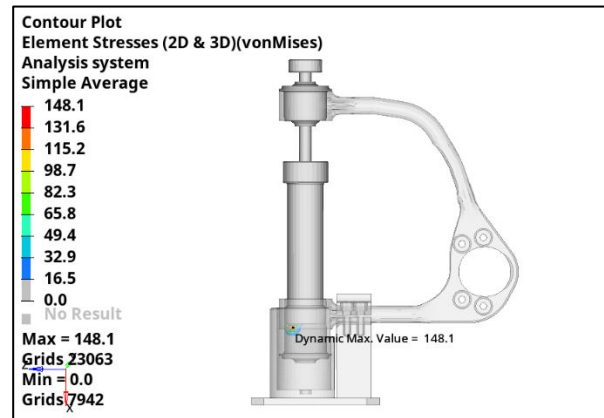


Fig 7 Stress Plot

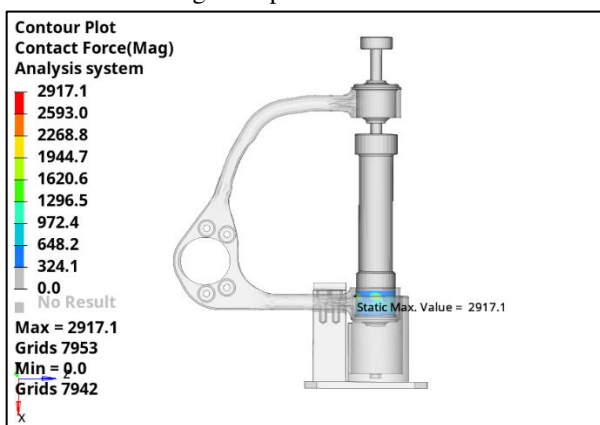


Fig 8 Contact Force Plot

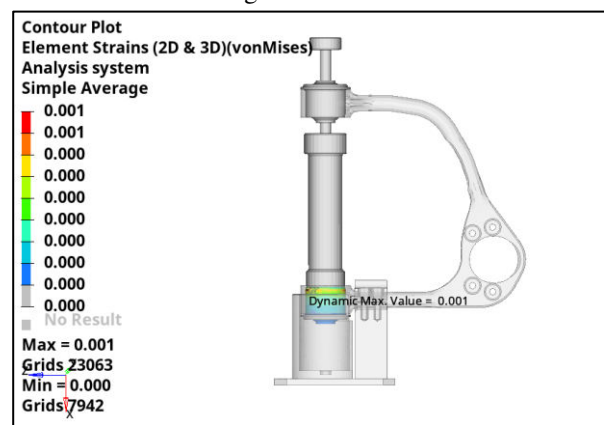


Fig 9 Strain Plot

Optimization and Weight Reduction:

The objective of optimization technique is to minimize the mass of the special application and reduces the cost of production. The special application subjected to tensile load at one end, while using factor of safety and



maximum. Many problems nowadays rely on the trial-and-cut method. This method in return consumes a considerable time to obtain the optimal solution. Optimization is a process of acquiring the best result under given conditions. It plays an important role in machine design as the mechanical components are required to be designed in best optimal manner. While designing a machine component, optimization helps in many ways like reduction of overall material cost, weight reduction, and many such other parameters. General aspects about FEA are, FEA is the most recognized and in use method of solving engineering problems. A model subjected to a FEA analysis is meshed in sub domains of finite dimensions limited by straight-line or curved-lines frontiers. To perform a FEA of a model (structures), meshing of model is needed to perform. Meshing is explained as dividing the model into small fragments or elements, called finite elements. The finite elements are joined to each other through common or shared points. These points in terms of meshing are known as node. The aim of these decisions is either to minimize the effort needed or to maximize the desired output. The procedure of finding the conditions that provides the minimum or maximum value of any function is known as Optimization

V - CONCLUSION

After designing the tools and completing the analysis using various conditions, it concludes that tools designed are suitable for the application. To remove and fitment of bush from suspension assembly, the above-mentioned tools to be used with given combination. This will save the time to replace the bush and also cost to the customer. Bush is also not got damaged while removing from suspension as using the mentioned tools, so it can be reused in service centre. As Stress, displacement, and strain properties are in range of EN9 material, it is selected for manufacturing of tools. Same tool is validated on vehicle suspension, and it has met functional requirements.

REFERENCES

- [1] Krishna, Murali MR. "Finite element topography and shape optimization of a jounce bumper bracket." No. 2002-01-1468. SAE Technical Paper, 2002.
- [2] Deshmukhpatil, Sagar B., Ajit V. Shinde, Omkar R. Pokharkar, and Abhijeet L. Nande. "Design and Analysis of composite leaf spring for four Wheel Vehicle." (2019).
- [3] SKF.(2018) "SKF bearings and mounted products" [online] [Accessed on 19th November 2019]. https://www.skf.com/binaries/pub12/Images/0901d196807026e8-100-700_SKF_bearings_and_mounted_products_2018_tcm_12-314117.pdf
- [4] Campos, Urso, David Hall, John Matthews, Christopher Morgan, Shaurav Alam, and HadiBaghi. "Overview of the Geometric Parameters of a Press-Fit Interlocking Mechanism: Experimental and FEA Analysis of Steel Pipe Joint." In Pipelines 2018: Planning and Design, pp. 406-414. Reston, VA: American Society of Civil Engineers, 2018.
- [5] TabeaTietz. (2020). The Broughton Suspension Bridge and the Resonance Disaster - SciHiBlogSciHi Blog. <http://scihi.org/broughton-suspension-bridge-resonance-disaster/>
- [6] International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 6, June 2015
- [7] The Journal of Advanced Manufacturing Technology (2018) 96.4303-4311 [https://doi.org/10.1007/s11001-018-WO-z](https://doi.org/10.1007/s11001-018-018-WO-z)
- [8] Sai Aditya Pradeep, S. P. (n.d.). Body in White - an overview | ScienceDirect Topics. Retrieved October 7, 2020, from <https://www.sciencedirect.com/topics/engineering/body-in-white>
- [9] Bathe, K.-J. (2016). Introduction to Finite Element Analysis (FEA) or Finite Element Method (FEM) Finite Element Analysis (FEA) or Finite Element Method (FEM). 1065. https://www.engr.uvic.ca/~mech410/lectures/FEA_Theory.pdf
- [10] TabeaTietz. (2020). The Broughton Suspension Bridge and the Resonance Disaster - SciHiBlogSciHi Blog. <http://scihi.org/broughton-suspension-bridge-resonance-disaster/>
- [11] Ramkumar R, Krishnaraju A, Optimization of Material Handling Trolley using Finite Element Analysis. IOSR Journal of Mechanical and civil Engineering (IOSR-JMCE), Volume 13, Issue 6 Ver. V (Nov. - Dec. 2016), PP 137-148



Impact Factor: 8.423



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details