STILL AND PERFECT EXAMINATION OF CHAISSIS WITH FEA

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ABSTRACT

The hybrid superposition method that combined finite element static and Eigen value analysis with flexible multi body dynamic analysis Johansson et al. (1) presented a method for complete vehicle analysis based on FE-technique used for analysis of complete vehicle features such as vehicle dynamics and durability.

The truck industry has experienced a high demand in market especially in Malaysia where by the economic growths are very significantly changed from time to time. performances and transportations efficiency. The mode shapes of the truck chassis at certain natural frequencies are very important to determine the mounting point of the components like engine, suspension, transmission and more.

Keywords: Truck, Chassis, Axles, Suspension, Power train and Trailer.

INTRODUCTION

This paper presents the vehicle models that have been developed almost the same appearance since the models developed in 20 or 30 years ago. This is a major challenge to truck manufactures to improve and optimize their vehicle designs in order to meet the market demand and at the same time improve the vehicles durability and performance.

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LITERATURE REVIEW

Yaşar kahraman et al - For more strength and reliable frame of the trucks, all manufacturers are trying to produce strong and cumbersome chassis. Every strength increase of the chassis by adding beams and structural elements makes the whole frame heavier and more expensive Initially, the most important part of the frame design is, the chassis reliability and safety. When decreasing the thickness of the sections the optimal design criteria should have been considered. For making a cheap truck frame might cause a destructive accident results and fatality. To make a reliable and inexpensive design thickness and cost optimization should be examined with details. For understanding the robustness of the chassis or vehicle body by the strength tests of the members and whole frame, different studies were widely carried out as it is mentioned below.

Roslan Abd. Rahman - as a truck travels along the road, the truck chassis is excited by dynamic forces induced by the road roughness, engine, transmission and more. The vibration of the chassis will also cause high stress concentrations at certain locations, fatigue of the structure, loosening of mechanical joints, and creation of noise and vehicle discomfort. The mode shapes of the truck chassis at certain natural frequencies are very important to determine the mounting point of the components like engine, suspension, transmission and more.

Finite Element-based vehicle analysis has become an important part of the development process for many of vehicle features.

Romulo.et al - proposed the hybrid superposition method that combined finite element static and Eigen value analysis with flexible multi body dynamic analysis Johansson et al. (1) presented a method for complete vehicle analysis based on FE-technique used for analysis of complete vehicle features such as vehicle dynamics and durability.

C.Karaoglu et al - introduced an improved procedure which is based on the modal stresses of FEMBS hybrid structures. in case of when stepping the block zigzag i.e., with one rear wheel side the right side When stepping the block with both rear wheels.

OBJECTIVES

To determine the torsion stiffness and static and dynamic mode shape of the truck chassis by using torsion testing, modal analysis and finite To improve the static and dynamic behaviour To develop a new truck chassis.

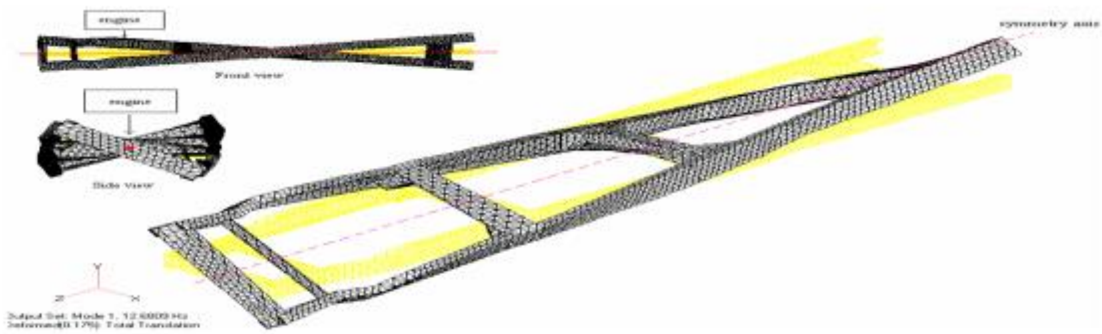
TRUCK CHASSIS

Towards the middle is a top hat cross member to provide space for mounting of the gear box.

SCOPE

Simulation and experimental work on the existing truck chassis. Correlation of simulation and experimental results. Development of new truck chassis.

MOUNTING LOCATION OF COMPONENTS ON THE CHASSIS



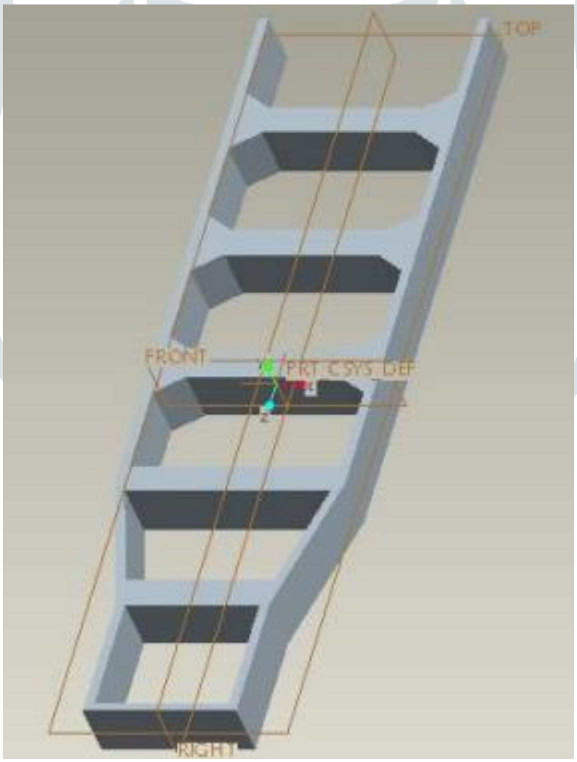
Mounting location of engine and transmission on the chassis.

The mounting location of the suspension is suitable because the excitation from the suspension input motion can be reduced for the vertical bending mode.

No.	Components	Weight (kg)	Load (N)	Position from origin(mm)
1	Cab	125	1226	4183
2	Engine	50	490	3875
3	Engine	100	981	3523
4	Cab	125	1226	3216
5	Gear box	50	490	2873
6	Pay load	417	4088	2873
7	Fuel tank	40	392	2433
8	Pay load	417	4088	2150
9	Chassis weight	200	1962	2150
10	Fuel tank	40	392	2023
11	Exhaust	20	196	1805
12	Pay load	417	4088	1710
13	Pay load	417	4088	1080
14	Pay load	417	4088	450
15	Pay load	417	4088	0

Weights and forces of components and positions along the chassis

TRUCK CHASSIS MODELING



Modeling of truck chassis.

DESIGN OF CHASSIS EXPERIMENT

TAGUCHI DESIGN

Taguchi proposed several approaches to experimental designs that are sometimes called "Taguchi Methods." These methods utilize two-, three-, four-, five-, and mixedlevel fractional factorial designs.

DESIGN OF EXPERIMENT

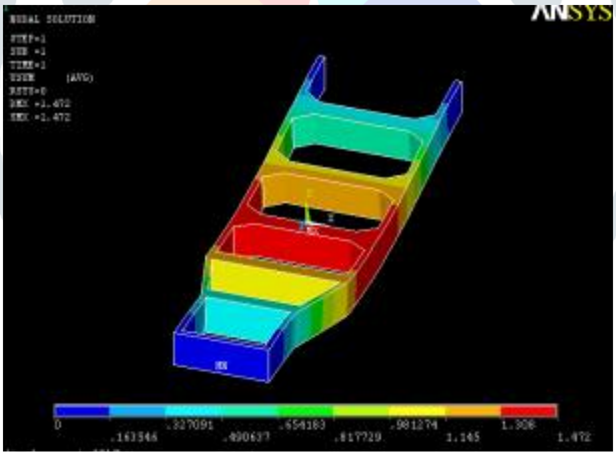
L16 (4 2) orthogonal array is selected and the values are given in table accordingly nine experiments are carried out to study the effect of machining input parameters. The conditions for selection of orthogonal array used in the experiment are: Degree of freedom for factors: levels – 1 DOF for OA: No of trials-1 DOF of L9 orthogonal array: 16-1 = 15 The orthogonal array is selected based on the following conditions. ∑ DOFi ≤ DOF of OA, number of factors: i = 1 to n For 2 factors and 4 levels L16 orthogonal array is used.

ORTHOGONAL ARRAY

The degrees of freedom are defined as the number of comparisons between machining parameters that need to be made to determine which level is better and specifically how much better it is. For example, a three-level machining parameter counts for two degrees of freedom. The degrees of freedom associated with interaction between two machining parameters are given by the product of the degrees of freedom for the two machining parameters.

RESULTS AND DISCUSSION

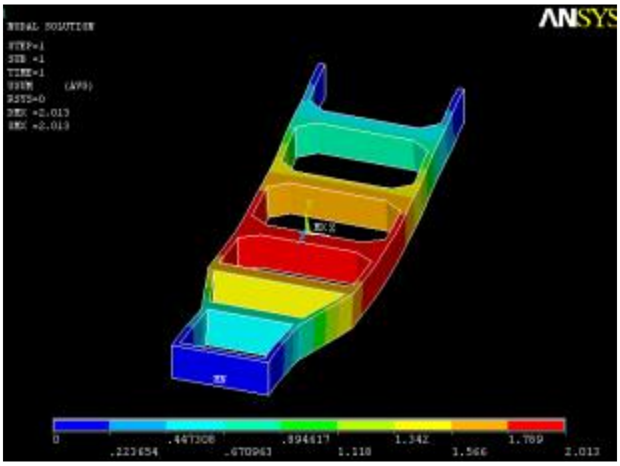
From the displacement nodal solution of the truck chassis, the following comparison between load and displacement is explained. In the first stage for the load of 12KN the maximum displacement is on the front axial with 1.47mm,for the second with the load 14KN,the displacement is localized at the front axial but more to the centre of the chassis with maximum of 1.717mm.in the third case for the load of 15KN,the displacement is at the extreme loads of the chassis but the maximum displacement is localized at the center part of the chassis with 1.84mm at the fourth case with load 16KN,the displacement occurs at the both the end of the chassis front and back axial with 2.013mm.from the above discussion it is concluded that though the load is increased in KN but the displacement of the chassis for which the material selected is increased very slightly (i.e. in more values)



Total displacement results behavior for the load of 12KN sectioned truck chassis.

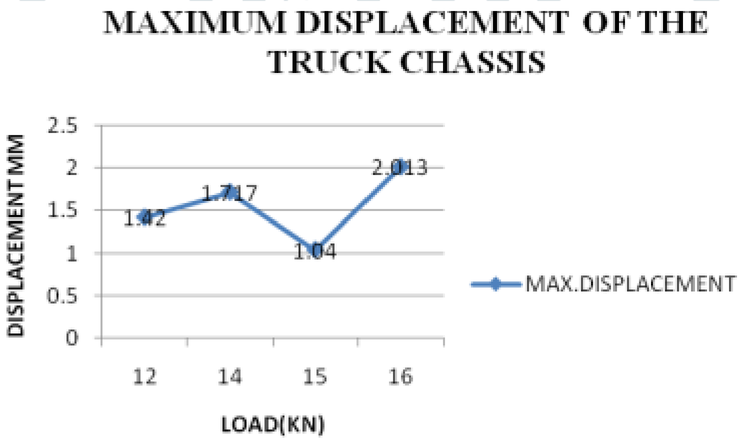
The global vibration displacement variations of maximum to minimum for load 12KN. The maximum displacement occurs in center of the truck chassis 1.472 mm. The minimum displacement occurs in front and back axial of the truck chassis 0.1634mm translation experienced by both ends of the chassis. The displacement of the truck chassis is the global vibration while the others are local vibration. The global vibration displacement variations of maximum to minimum for load 14KN. The maximum displacement occurs in center and front axial of the truck chassis 1. 717mm.The minimum displacement occur in back axial of the truck chassis 0. 19083mm.translation experienced by center of the chassis.

The global vibration displacement variations of maximum to minimum for load 15KN. The maximum displacement occurs in center and front axial of the truck chassis 1.84mm.the minimum displacement occurs in back axial of the truck chassis 0. 204432mm.maximum translation experienced by center of the chassis. Minimum translation experienced by front and back axial of the chassis.



Total displacement results behaviour for the load of 16KN sectioned truck chassis

The global vibration displacement variations of maximum to minimum for load 16KN. The maximum displacement occurs in center and front axial of the truck chassis 2.013mm.the minimum displacement occurs in back axial of the truck chassis 0. 22364mm.maximum translation experienced by center of the chassis. Minimum translation experienced by front and back axial of the chassis.



Maximum displacement of the truck chassis

The maximum displacement of the truck chassis to compare load and maximum displacement load slightly with increase to maximum value load at16 KN.the displacement curve minimum increase at all load condition but minimum variations at all load.the result shows the when load increses the displacement increased.

STRESS ANALYSIS OF TRUCK CHASSIS

The other region has less stress value, below 12KN.

The stress counter and deformation pattern of the chassis asymmetrical 12 KN loading of the truck chassis are the global vibration while the others are local vibration. The global vibration stress contour variations of maximum to minimum for load 12KN. The maximum stress occurs in front and rear axial of the truck chassis 0.468x107 .the minimum displacement occurs in center axial of the truck chassis 173. 997mm.maximum translation experienced by rear axial of the chassis. Minimum translation experienced by front and center axial of the chassis.

Serial No	Natural frequency HZ	Displacement MM	High stress area KN/MM²	Deformation MM
1	7.21	1.472	$0.468x10^7$	$0.25\ x10^{-3}$
2	7.49	1.717	$0.547\ x10^7$	$0.29\ x\ 10^{-3}$
3	10.66	1.84	$0.586\ x10^7$	$0.310x10^{-3}$
4	12.54	2.013	$0.708\ x10^7$	$0.410\ x10^{-3}$

Design matrix

EXPERIMENTAL RESULTS

From the series of 16 experiments we can find the natural frequency, displacement, high stress area, deformation.

Serial No	Mass Density ,ρ kg/m³	Load KN	Natural frequency HZ	Displacement MM	High stress area KN/MM²	Deformation MM
1	7798	12	7.21	1.472	$0.468x10^7$	$0.25\ x10^{-3}$
2	7798	14	7.49	1.717	$0.547\ x10^7$	$0.29\ x\ 10^{-3}$
3	7798	14	10.66	1.84	$0.586\ x10^7$	$0.310x10^{-3}$
4	7798	16	12.54	2.013	$0.708\ x10^7$	$0.410\ x10^{-3}$

Experimental results

CONCLUSION

The analyses are processed in the static and structural condition to improve the existing chassis performance such as the torsion stiffness, strength and dynamic behavior due to dynamic load. The results obtained are able to present the static and dynamics motion of the truck chassis which include the natural frequency, mode shapes and damping value. The following conclusions were obtained: The experimental data is used to validate a finite element model and the updated model represents the real structure of the chassis. The improvement structures and supports to the existing chassis satisfy the customer's requirement such as cost, reliability, conformability and better performance. Thickness of a 7mm truck chassis section profiles can transport a load about 16ton, with a 1mm bending. For the linear static analysis, the stress distribution and deformation profile of the truck chassis subjected to two loading conditions truck components loading and asymmetrical loading has been determined. It is concluded that the Maximum stress occurred at the mounting brackets of the suspension system is directly proportional to the maximum translation occurred at the location where the symmetry and asymmetry load is acting. The maximum displacement of the truck chassis is 16KN while the maximum translation is 2.013mm. This maximum displacement and translation observed are predicted for the chassis material with suitable yield strength and the tolerance.

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