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A Study of Literature Review on Explicit Analysis of Rollover Protective Structure for On-Road Vehicle by Finite Element Technique

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Abstract: ***A rollover protective structure (ROPS) is an important system for safety of an operator in the vehicles.When the vehicle take turns left or right direction rollover the vehicle due to imbalance of road condition, higher speed and heavy load with high centre of gravity. When the vehicle is rollover, then the operator cannot escape from inside the cabin, injured and sometime death may happen. In this situation, need to provide protection to the operator cabin and safe guard the operator during accidental rollover. The safety of an operator should be ensured by design of rollover protective structure. In this paper represents the review and importance of rollover protective structure as per ISO design standards. To determine the performance behavior of rollover protective structure post, yield and energy absorption capacity. Also determine the non-linear effects on the structure by using numerical technique.***

Keywords: Roll Over Protective Structure, Energy Absorption, Safety, Finite Element Analysis

1. Introduction

Rollover protective structure is the safety device. It is installed on the vehicle for protection of operator, when the vehicle rollover. Further, protection and safety of other mounting several sub-systems on the cabin such as floor, mounting bracket and rail structure. The ROPS structure helps to increase the stiffness, improve the strength and absorption of maximum strain energy to withstand a cabin under various loading conditions and crashes of vehicle applications. The rollover protective structure is designed as per ISO 3471 design standards, manufacture the structure as per the specifications and regulations. The structure should protect machine operator during rollover must be needed for survival space and defined by deflection limiting volume. Apart from protecting the operator, there are thee forces transmitted such as lateral load, vertical load and longitudinal load to absorb certain amount of strain energy. The methodology of conducting experimental test, theoretical calculations and finite element analysis for evaluation. The modal and nonlinear analysis carried out based on the loading and performance requirements.

Rollover protective structure – Tractor

2. Literature Survey

J Karlinski, M Ptak, P Działak, were discussed about structure which protect operator safety of heavy equipment ofan important elements found on different types of machines and used for construction, miningand agriculture equipment's. It is also used for intended to protect the operators from injuries caused by vehicle rollover. This type of structure is to be an integral part of the cabin or an external structure outside the cabin. This methodology has to conduct strength test for protection of structures which uses numerical method for validation.

Himanshu Hiraman Rathod, Sanjay Kumar, Vinit Goe,have studied and investigated about the materials used ROPS structure for design and analysis of thevehicle cabin. This research studies and analysis should be conducted on variable cross section of the tube structure and their skeleton model. The selection of material to be used in automobile& automotive engineering.

D P Thambiratnam, BJ Clark and NJ Perera, have carried out the researchof rollover protective structureis the most viable method for providing protection to occupants during the rollover of heavy vehicles on construction, mining and agriculture sites. These types of safety devices which are commonly fabricated from mild steel hollow sections rely predominantly on plastic deformation of their members. Structure will absorb dynamic energy of the moving vehicles, so that the present performance standards like both in Australia and worldwide adopted testing method to assess the capabilities of a ROPS.

A D Stockton, D H O Neill and C J Hampson, have studied and analyzed the ROPS model by using mechanical software. To increase the strength and stiffness of the structure, particularly for design and energy absorption capacity using finite element method technique. However, versatile and accurate use of finite element analysis can be validated only by extensive physical testing together with adjustments to the FEA package. The physical test requires for ROPS structure and validate with computer based tests.

Rajesh Kumar T, Haridass R, Dhandapani N V, Dinakar M, hadexplain about the impact analysis for two post structure and tests are made by experimental setup and also non-linear structural analysis made by ANSYS software to get the stress and deformation results. The test is subjected tolateral, vertical and longitudinal load calculation as per ISO 3471 standards. If the test results are not meet the standard and recommended values, then need to improve and increase the stiffness of the ROPS structure. So, that introduce gusset support at the top and bottom of the ROPS mounting and get deformation on the transition area with safe design.

Shane Richardson, George Rechnitzer, Tia Orton, Maxwell Shifman, Roger Zou and Steve Crocker,have worked and improved a strong roof to protect the vehicle occupiers. The field experience along with digital and physical dynamic inverted drop test and rollover testing are present in the strong roof vehicles cabin. A dynamic rollover crash tests also a highlighted the insufficient crash worthiness of present original equipment manufacturers roof. To establishedfloatROPS protected the vehicle cabin including rubber cushion and prevented intrusion into the occupant existence space.

M Jayakumar, N V Dhandapani, S Palanisamy, have studied and analyzed the various literatures review. After, a careful analysis of various research studies conducted so for it has been found that sufficient studies have not been conducted on roll over protective structure for off highway equipment especially in explicit non-linear analysis. There is a scope of generating inclusive research information using computer aided engineering simulation by finite element analysis approach.

Syed Khaisar Sardar, Kiran Narkar, D R Panchagade, havediscussed and executed based on the information available in literature and come to a conclusion that rollover accidents in heavy commercial vehicle are violent, which causes greater damage and injury as compared to other type of accidents. During roll over the structure of driver cabin need to sustain as much load as possible to protect the driver, analysis can be done effectively to evaluate the strength of the roof. The results are obtained very close to the results obtained in experimental test. The design has been assessed with 3 design modifications including removing gussets, adding holes and increased thickness of rear support plate. Therefore, the modified design passed the standard ISO 3471.

S Richardson, R H Grzebieta and G Rechnitzer, have research and implementation being done on rollover protection system test. The systemwith test rig actuator would include the evaluation of the rollover trigger sensor systems as well as on board protection devices and vehicle structure as a system test. The proposed test as a development of 1/4 scale structure to validate repeatability prior to the construction of full scale structure.

BJ Clark, DP Thambiratnam and NJ Perera,have used finite element techniquesto carry out dynamic impact simulations on ROPS and that would be characteristic of those encountered during a sideward rollover of an earthmoving vehicle on a slope. The dynamic loads were developed based on conservation of angular momentum principles and energy absorption capacity.

Young D, Grzebieta R H, Rechnitzer G, Bambach M & Richardson S,explained about the research currently being undertaken in regards to analyzing, how injuries occur in rollover crashes is revealing that the principles set out by Hugh De Haven over half a century ago are being violated, while considering the rollover crash worthiness of vehicles particularly larger SUV vehicles. An investigation of the issues concerning rollover crashes and a preliminary statistical analysis on a small group of rollover crashes supports like rollover crashes are particularly hazardous for occupants as injuries resulting from such crashes are overrepresented in regards to frequency of crash categories.

Melvin L and Myers, discussed about all-terrain vehicles overturns cause hundreds of deaths and thousands of injuries per year, a tragic and unintended consequence of these machines entering the market. A major reason for these deaths and injuries in all-terrain vehicle overturns that crush rider. A systematic study is requiredfor the effectiveness of the comfortable ride and safety.

3. Conclusion

In this literature study, evaluation method describes and estimatesare most of the cases under review and investigational outcomes. It is observed that the existing researchers are working various finite element techniques and software packages such as Hyper mesh and ANSYS. The final output of the rollover protective structure by applying various loading conditions and energy absorption capacity to be considered and solved by finite element approach as per ISO standard. The validation is to be done by compared with analytical and experimental results as per the standard procedure.The perdition ofenergy absorption, post structure deformation and stress distribution with in the standard and recommended numerical values of ROPS. If we need to do further design and analyze by using the

concept of deflection limiting volume, testing and validate to fulfill the gap for future scope of research studies and implement on the rollover protective structure.

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