Overhead Guard Cube Drop Test

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ABSTRACT

The importance of forklift is very high in material handling procedures. Forklifts are very commonly used in warehouse, farms, shipping yards, construction sites for lifting various objects, assemblies and even liquids filled tanks. The safety of the operator is the most important factor to be considered while designing of the forklift. The operator must be safe inside the guard cage. Different criteria can be defined for testing of the forklift guard cage.

Most of the accidents occur because of overhead falling on the operator. Hence a protective structure is must for any material handling machinery. Overhead guard is a critical component in the Forklift Truck, must meet the strict requirements of deformations as per the ISO standards for driving safety. In this paper the review of various white papers and codes is done to find the procedure for designing the safe and optimized protective structure also called as overhead guard.

Keyword: **-** forklift, overhead guard, finite element analysis, falling objects protective structure, safety standards

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1. Introduction:

The operator cabin can be subjected to crash fall from top. So, it is necessary that structure should be robust enough. Intent of this paper is to review different methodologies and procedures for design a save and robust design. To protect the operator for following down object from height and to obtain his safety by performing different physical test for Forklift Overhead Guard such as lumber and Cube drop ISO test. Overhead guard is a critical component in the Fork Lift Truck, has to meet the strict requirements of deformations as per the ISO standards for driving safety. The overhead guard shall extend over the operator when in the normal operating position as defined.

2. FEA

In the analysis it is assumed that, two bottom faces of the vertical beams are fixed as they are connected directly to the vehicle. For the loading, One Block is falling from 1600mm having weight 7Kg. The blocks are non-deformable. Surface-to-surface type contact interface was used for the contact between the Overhead guard and the block. This type was selected in order to prevent penetration of the block's internal nodes as they could be in contact with the overhead guard during the simulation procedure overhead guard structure was constraint to bottom of vertical beams (Solid body). Bottom face of this solid body was fixed in all direction to avoid its movement in space.

We have analyzed the drop test for different iterations of overhead guard. For the iteration 02, the amount of deflection is within the safe limit. If the deflection value goes beyond 20 mm then criteria of the ISO standard is not fulfilled.

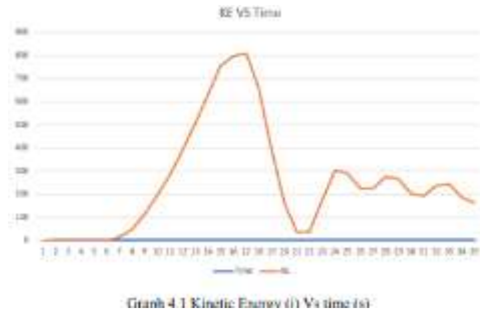

Fig.01 Kinetic Energy V/S Time

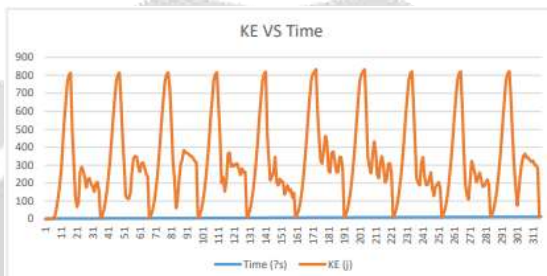

Fig.02 Kinetic Energy V/S Time

3.Experimentation

This test method is intended for use in evaluating the capability of a container to withstand the sudden shock resulting from a free fall, or to evaluate the capability of a container and its inner packing to protect its contents during the sudden shock resulting from a free fall. This test method may also be used to compare the performance of different package designs. This test method may also permit observation of the progressive failure of a container and the damage to its contents. This test method covers procedures for the drop testing of loaded boxes, cylindrical containers, and bags and sacks by the free-fall method.

4. Results

For the testing, we have the setup of hanging rope with 45 kg weight attached to it. It was placed at 1.5-meter height. And then we have dropped the weight using quick release mechanism.
Before Test: - The height of the top face of the frame is at 1020 mm from the ground.
After Test: - After drop test the distance of the top face of the frame and ground is 997.4mm.
i.e. after drop test the frame was deflected 22.6mm downwards.

5. Results and Discussion

We have manufactured and tested existing model for overhead guard. As per the FEA result the max deformation of the frame is 22.73 mm and using actual results the deformation is 22.6mm. Therefore, we can state that the FEA results and actual results are comparable. After the impact, the values for deflection and stresses are in acceptable limit. There by impact testing of the overhead guard we have validated the results with FEA.

Load case	Y Direction Deformation ISO Standard Criteria (mm)	Y Directional Deformation (mm)	Criteria
Existing Model (with single cube drop)	20	22.73	Fail
Iteration 01 (with ten cube drop)	20	28.77	Fail
Iteration 02(with ten cube drop)	20	14.52	Pass

6. Conclusion

Using FEA we have calculated the total deformation & stresses on the overhead guard for drop test. For its validation we have manufactured the similar structure and tested it by creating similar boundary conditions as specified in FEA software. Form the observation we have validated the FEA results and actual testing results. Total deformation we have observed after actual drop test was 22.6mm. To reduce this deformation value, we optimized the frame and arrange the frame structure in such a way that it will reduce stress as well as deflection of the members. We have designed two new structures in design software and performed finite element analysis on them. For the ITR 2 design, we got minimum deflection as 14.52mm.

7. References

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