A Correlation Of Intensity Gripping Capabilities Of Paper And Steel design Subjected To Continuous Breakdown below Free Decreasing Objects

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Abstract

Associate degree inverted drinking cup of zero.26 millimeter thickness was subjected to deformation below a freely decreasing steel ball at a rate of two.77 m/sec. The distorted options of the drinking cup were measured. The dynamic loading event was simulated victimization piecewise linear malleability material model in LSDYNA. distorted form of the drinking cup in finite component model matched closely with experimental results with ignorable little discrepancies. The drinking cup was able to absorb all the K.E. of the decreasing steel ball for the higher than mentioned decreasing speed and also the ball didn't bounce of the cavity generated by the impact. In LSDYNA an identical size steel cup was conjointly subjected to a freely decreasing ball with same speed and also the intensity absorbed was compared to the intensity absorbed by the drinking cup. it absolutely was found that below similar conditions a drinking cup would bear a big continuous breakdown and absorb all the intensity of the decreasing object.

Keywords: Continuous Failure, Paper Cups, Piecewise Linear malleability, LSDYNA, Intensity Absorbed.

Introduction

Relying upon true wherever the protection of a decreasing object or the target material or each could also be searched for, the injury caused to the materials (impactor & target) depends on several variables like form, size, velocity, of impact. the main target of this analysis is on the low rate decreasing objects wherever the higher than mentioned objectives would be explored. The applications of this analysis could also be useful however not restricted to know the impact of a decreasing rock on the body of associate degree automobile, the aircraft landing of a eggbeater

on a tough surface or the injury caused to a fragile product by merely decreasing on a manufactory floor. In cases wherever the injury is inevitable it'd be sought-after in several cases that the breakdown of the half ought to follow a continual continuous order. this could be of nice significance once the protection of occupants in a very automotive crash is that the objective. Another objective is to explore the materials which can follow continuous breakdown on impact.

Experimental

1. Procedures

The paper cups chosen to hold out the breakdown experiments. The dimensions of the drinking cup subjected to decreasing hundreds are the thickness of the drinking cup body was zero.26 mm. the bottom and bottom ring were zero.29 and 0.69 millimeter thick. The drinking cup seam had a thickness of concerning zero.50 mm.

Tests were performed at five, ten and twenty mm/min loading rates. A typical engineering stress-strain curve derived from the tensile tests at twenty mm/min is shown. From this information actuality stress-strain values were calculated to be employed in finite component simulations. The density (844 kg/m³) of the paper material into account was measured and also the Poisson's quantitative relation (0.182) was conjointly determined through an experiment victimization 2 strain gages glued at 90° on the tensile specimens. looking on the water content the fabric properties of paper could vary considerably [1]. There has been loads of dialogue concerning establishing the modulus of elasticity of paper within the literature [2], however within the gift studies because the focus was upon rather thicker section of paper accustomed manufacture paper cups the inessential complications and details relating to this material are avoided. the fabric properties were established within the controlled temperature and wetness conditions.

Droptests

The drop tests were conducted by cathartic a steel ball of thirty eight millimeter diameter from a height of zero.76 meters on the highest of inverted drinking cup. The injury caused to the paper cups . because it may be seen that the K.E. of the ball is totally absorbed by the paper cups and also the solid steel ball involves rest within the cavity generated thanks to the impact. In gift analysis the rate of a freely decreasing steel ball before striking the bottom was ascertained to be of the order of two.77 m/sec once discharged from a height of zero.76 meters. an information recorder was set at

one thousand cycle and strain signals were recorded once the ball hit versatile strain gauge posts organized vertically at a distance of one hundred millimeter apart. The measured speed was recorded as two.77 mm/m sec that provides a worth of two.77 m/sec.

Finite component Analysis

The drinking cup model was generated in ANSYS/LSDYNA version nine.0. The higher than shown cup was discretised into 4-node skinny shell parts with Belytschko-Tsay formulation. 10-node solid polyhedron parts were accustomed mesh the steel ball. the fabric model for the steel ball was thought of to be rigid and undeformable. the colours show the distinction within the thickness of assorted elements of the model. the image on the proper shows the distorted model when sixty milli seconds (m sec). all told simulations as in experimental work the steel ball was born on to the cup structure at a location offset five millimeter from the centre of the cup.

Plastic Strain Variation

The total strain accumulation among sixty m sec in drinking cup happens in a very gradual manner because the steel ball settles down into the new generated drinking cup cavity. however just in case of steel cup the steel ball bounces back from the surface among five m sec that leaves terribly bit of plastic strain into the steel cup body. additional straining wouldn't be potential because the ball is not any a lot of in-tuned with the target surface.

Internal intensity The drinking cup was shapely as 3 elements consisting of body of the cup, the cup flat base, and also the base ring. the inner intensity of the 3 elements at the collision event. The circular flat base is that the half that's subjected to direct impact before different elements. the inner intensity during this portion of the cup thus will increase in steps thanks to high vibrations. As a results of sequent deformation of the flat base the body of the cup is that the second half that undergoes deformation. the inner intensity of the body of the drinking cup undergoes a gradual increase of internal intensity and when twenty five milliseconds it stabilizes.

Conclusions

Inverted paper cups were subjected to freely decreasing steel ball of zero.22 kg mass. The decreasing height was adjusted such solely needed quantity of harm was achieved. The impact loading event was simulated victimization LSDYNA and a awfully sensible correlation between the experiment and also the finite component model was obtained. Simulation was perennial on a steel cup and also the K.E. absorption capabilities of the 2 cups were compared. Breakdownmethod was closely studied and following conclusions were created.

1. below controlled conditions of velocities and geometrical shapes the paper cups were able to absorb all the K.E. of a freely decreasing steel ball for restricted quantity of deformation within the paper cups.
2. Simulation work showed a awfully shut agreement with the experimental proof and results were valid for the extent of deformation.
3. Simulations were perennial with steel cups because the target material wherever it absolutely was found that although the steel cups were way stronger than the paper cups however their capability of intensity absorption[9,10] was below the paper cups as a result of when the impact, the steel ball preserved a number of its K.E. and bounced back.
4. Following the process and its validation by finite component analysis the structural elements may be designed that will offer needed quantity of continuousbreakdownand absorb the K.E. of decreasing objects effectively.
5. Correlation of intensity absorption capability of steel and paper cups showed that {in case|just just in case} of paper cups a delayed time to soak up all the K.E. was achieved that was 5 times higher than in case of steel cup.

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