IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 19, Issue 2 Ser. I (Mar. – Apr. 2022), PP 39-42
www.iosrjournals.org

Drop Test Simulation in SolidWorks

Mir Hayder[1], Ellison Burns[2] and James Livingston[2]
[1]*(Department of Engineering Technology, Savannah State University, USA)*
[2]*(Civil Engineering Technology (undergrad student), Savannah State University, USA*

Abstract:
In this study, a drop test analysis of a cell phone was conducted by SolidWorks simulation software. The main purpose was to determine the stress due to impact and produce animation of the cell phone when it fell and hit the ground. At first, five parts, front camera, outer shell, glass screen, home button, and back camera of an i-Phone, were created in SolidWorks according to specific dimensions as part files and then assembled to develop the model for the study. The materials selected for the phone shell and home button was 7079 AL-alloy, and for the other three parts was glass. The simulation parameters were: drop height as 6 feet, gravitational acceleration as 9.81 m/s^2, friction coefficient as 0, and solution time after impact as 25 micro sec. Simulations were conducted for three impact angles, 90°, 0°, 45°. Results show that for impact angle 90°, the maximum stress is developed on the lower end of the phone. The stress is uniformly distributed over the phone for an impact angle of 0°. Results were not conclusive for the inclined angle of impact, so more studies are needed to conduced to investigate the effect of impact. Future studies are recommended for different drop heights and floor with friction.

***Key Word**: Drop Test; SolidWorks Simulation; Impact Angle, Stress.*

Date of Submission: 01-03-2022 Date of Acceptance: 12-03-2022

I. Introduction

In today's world, almost everyone owns a cellular device. No matter what type of phone it is, everyone drops it. In this study, the authors tried to determine where the maximum and minimum amount of stresses occur on the phone when it hits the ground. The authors also planned to create some animations of stress when the phone hits the ground at different angles from a specific height. The simulations were carried out in SolidWorks simulation software.

The two major objectives of this study are to:
1. Determine the stress developed on a phone being dropped from 6 feet in a SolidWorks Simulation, and
2. Analyze the different effects of dropping the phone at different angles by comparing the animated videos.

II. Simulation Software

The drop test simulation of the cell phone was conducted by SolidWorks Simulation [1]. SolidWorks is a Windows-based three-dimensional Mechanical CAD (Computer Aided Design) program. This software is currently used by over two million engineers and designers at more than 165,000 companies all over the world [2]. SolidWorks Simulation software, embedded within SolidWorks, is a powerful computational design validation tool that shows engineers how their design will behave as physical objects, and thus helps making decision to improve quality [3]. Within the software there is a drop test simulation program which tells us where the stress, strain, and displacement is at any point on the object.

Creating an object in SolidWorks usually begins with a 2D sketch. The sketch can be started in several ways; one can use geometry such as points, circles, lines, rectangles, and arcs. Upon creation, one can better define the size and location by adding smart dimensions to the object. Relations can also be added to the sketch to define features such as tangency, concentricity, parallelism, and perpendicularity. The shape can be made 3D in multiple ways for example the extrude tool, revolved boss-base, etc.

III. Parts an Assembled Model

After doing several trial runs, it was decided to start making the phone parts, which consists of 5 components: (1) outer shell, (2) front glass, (3) home button, (4) back camera, and (5) front camera. The dimensions of each of the components are shown Figure 1.

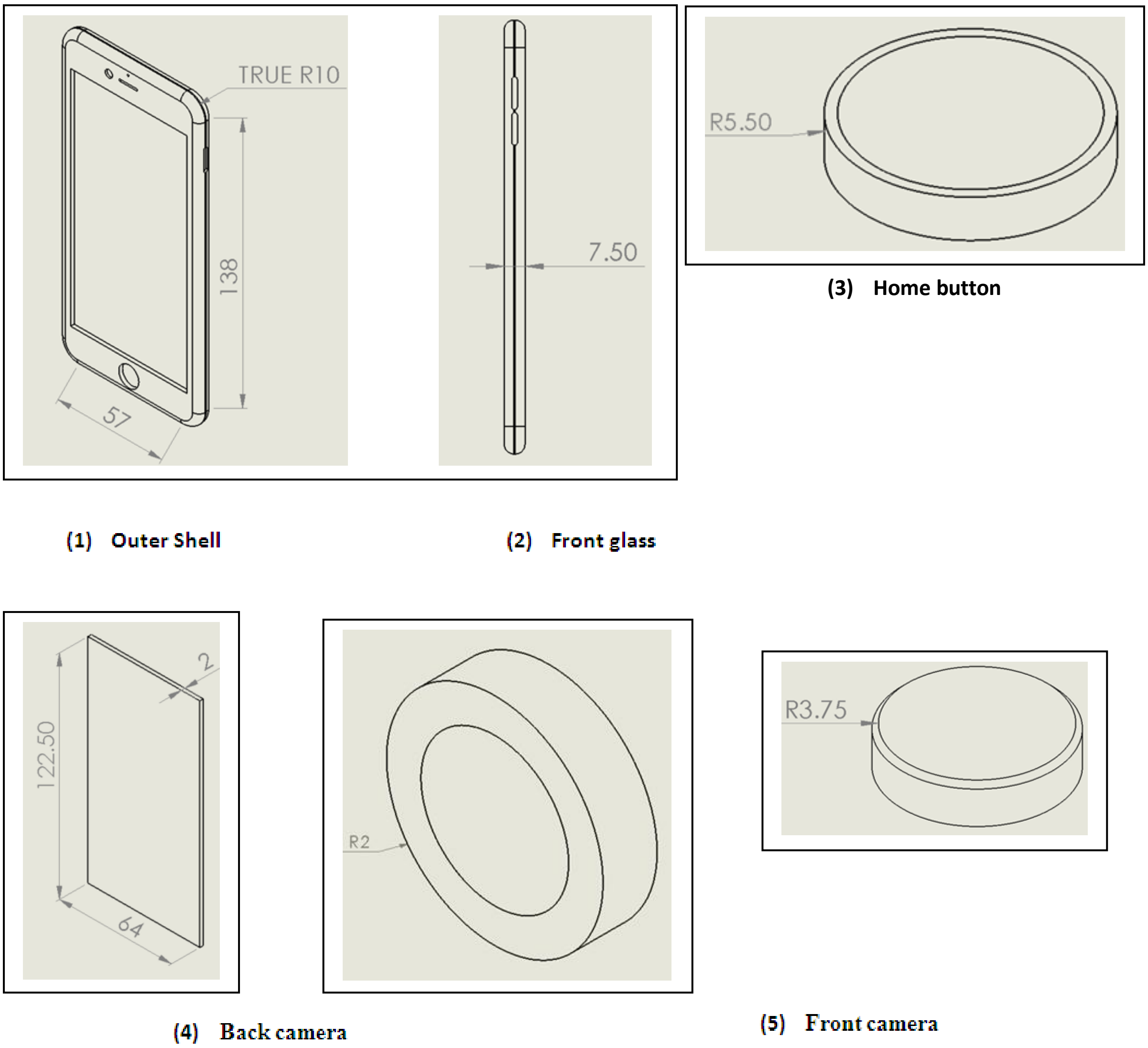

Figure 1: Dimensions of (1) outer shell, (2) front glass, (3) home button, (4) Back camera, and (5) front camera of the model. All dimensions are in mm.

After creating the three separate Part files [4] according to the dimensions as shown in Figure 1, an assembly file was prepared for SolidWorks simulation. The assembly file of the cell phone is shown in Figure 2.

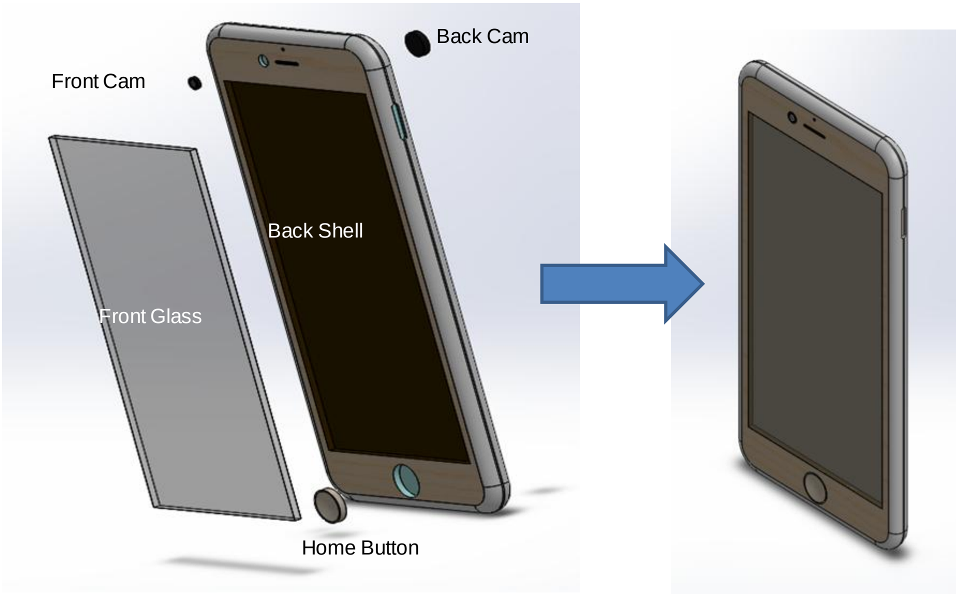

Figure 2: Assembly view of the cell phone

IV. Simulation Parameters

Below are the simulation steps followed to conduct the analysis:

1. Creating a drop test study: the first job is to create a model consisting of a number of part files to perform the analysis.
2. Applying material: next it is required to assign material for each of the part files of the model to include their physical properties.
3. Applying fixtures: it is important to add fixers to the model to produce an exact replica to represent the way the physical model is held.
4. Applying loads: various loads need to be added to represent the forces acting on the model.
5. Mesh the model: using finite element method, then the model is broken into small elements.
6. Running the study: after the meshing is complete, simulation is run to produce results.
7. Analyzing the result: finally, results are interpreted to provide a physical understanding.

The following simulation parameters were applied to the present analysis:

Materials: iPhone Shell: 7079 AL-alloy
iPhone screen: glass
iPhone Camera (front and back): Glass
iPhone buttons: 7079 al-alloy
Drop Height: 6 feet
Drop angles: 90°, 0°, 45°
Floor is frictionless
Gravitational acceleration: 9.81 m/s^2
Solution time after impact: 25 micro sec

V. Results and Discussions

What happens and how stresses act on the phone when it drops and makes contact with the ground at (1) 0^0 with the ground (horizontal), (2) 90^0 with the ground (vertical), and (3) 45^0 with the ground were the major goals of the study. With that aim, animations for 0.25 microseconds after the impact for three impact angles were analyzed.

The animations revealed different phenomena for all three situations; 0^0 angle yielded uniformly distributed stress throughout the phone, whereas for 90^0 angle higher stress was on the first surface of impact. No conclusive animations were revealed for 45^0 impact angle. The sample plots of stress devilment in the phone at three different situations are shown in Figure 3.

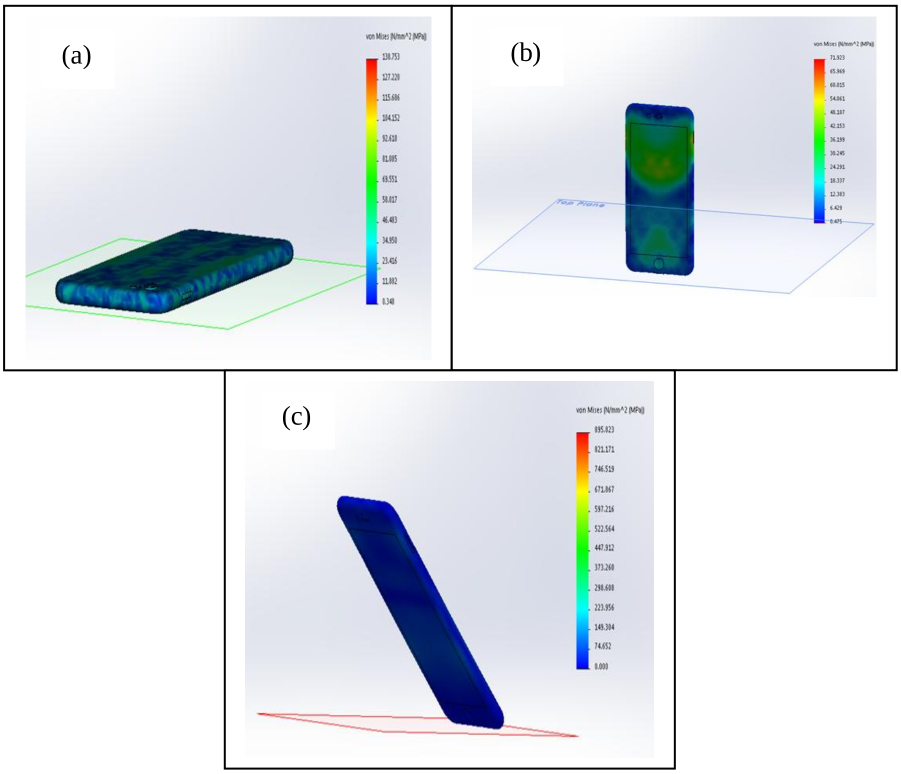

Figure 3: Sample stress development plots for impact angles of (a) 0^0, (b) 90^0, and 45^0.

VI. Conclusions and future studies

The animations of dropping the iPhone from 6 feet at different angles with a frictionless floor, for the most part, resulted in a different distribution of stress on the phone:

1. For impact angle 90°, the maximum stress is developed on the higher end of the phone.
2. The stress is uniformly distributed over the phone for an impact angle of 0°.
3. Results were not conclusive for the inclined angle of impact, so more studies are needed to conducted to investigate the effect of impact.

Based on the results obtained in the present study, the plans to conduct some future studies, which will include:

1. Simulation with different drop heights
2. Simulations with floor with friction
3. Simulation with different phone types

Acknowledgement

The authors like to acknowledge the support of Savannah State University's SURT under PSALSMP Program, funded by NSF.

References

[1]. Dassault Systèmes SolidWorks Corporation. SolidWorks Simulation Professional Training Booklet. 2013.
[2]. https://www.3ds.com/products-services/solidworks/ (March 23,2020)
[3]. Dassault Systèmes SolidWorks Corporation. SolidWorks Simulation Essential Training Booklet. 2013.
[4]. Tran, P. SolidWorks 2020 Basic Tools – Getting Started with Parts, Assemblies and Drawing, SDC Publications. 2019

Mir Hayder, et. al. "Drop Test Simulation in SolidWorks". *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)*, 19(2), 2022, pp. 39-42.