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# Motorised Skateboard–Deck Analysis

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**Abstract—***This paper consists of design and stress analysis of a skateboard considering the loading conditions. The loading conditions include load of a normal human who is the rider and the front and rear impact conditions which would induce bending stresses throughout the fibres of the skateboard deck.*
*The design of the skateboard is done on the latest designing software, Autodesk Inventor 2013 and the stress analysis is also done on the same software.*
*The main reason behind choosing this software was its capability to support both 3-d modelling as well as stress analysis functions in the same interface, which is not available in any other major software.*

## 1. INTRODUCTION

A **s**kateboard is a type of equipment used primarily for the activity of skateboarding. It usually consists of a specially designed Maplewood or Bamboo wood board combined with a polyurethane coating used for making smoother slides and stronger durability.

It is propelled by pushing with one foot while the other remains on the board, or by pumping one's legs in structures such as a bowl. A skateboard can also be used by simply standing on the deck while on a downward slope and allowing gravity to propel the board and rider.

## 2. LITERATURE REVIEW

The concept of auto- riding boards is not new. The MotoBoard- a weedwacker engine- was created by a skateboarder in the mid-70s. But with the advent of modern battery technology and electric motors, the ease of riding has increased, with new equipments coming up that are portable and require less manpower. These skateboard have controls on the deck, which help to start, accelerate and apply brakes to the board.

## 3. OBJECTIVE

For our paper, we wanted to redesign an assembly with the intentions of creating a new and improved product that will reduce manual labor for the user and be profitable for the corporation at the same time. The product that we redesigned was a Motorised Skateboard assembly. It uses power from a dc battery to run an electric motor, which provides the torque to rotate the wheels and move the skateboard.

Our aspiration in drafting this design was to:
1. To design a deck with increased durability and better performance.
2. Minimize manual labor by incorporating a fully motorized transmission system.
3. Make the design attractive and distinctive.
4. Attain the above objectives at minimum costs

## 4. STRESS ANALYSIS

**Stress analysis** is a covering method to determine the stresses and strains in materials and structures subjected to forces or loads.
Stress analysis adopts the macroscopic view of materials characteristic of continuum mechanics, namely that all properties of materials are homogeneous at small enough scales. Thus, even the smallest particle considered in stress analysis still contains an enormous number of atoms, and its properties are averages of the properties of those atoms.

## 5. STRESS ANALYSIS OF THE DECK

Stress analysis of the deck is done on the Autodesk Inventor 2013 by dividing the deck into small meshes of tetragonal sections assuming that

1. The material is homogeneous throughout

2. The mesh are of equal size

The stress analysis is done considering the following forces:
1. The load of the rider

2. Reaction from truck arrangement

**Table 1: Material(s)**

| Name | Wood (Bamboo) | |
|---|---|---|
| General | Mass Density | 0.57 g/cm^3 |
| | Yield Strength | 54 MPa |
| | Ultimate Tensile Strength | 6.4 MPa |
| Stress | Young's Modulus | 10.7 GPa |
| | Poisson's Ratio | 0.424 ul |
| | Shear Modulus | 3.75702 GPa |
| Stress Thermal | Expansion Coefficient | 0.0000045 ul/c |
| | Thermal Conductivity | 0.15 W/( m K ) |
| | Specific Heat | 1200 J/( kg c ) |

**Table 2: Force 1**

| Load Type | Force |
|---|---|
| Magnitude | 250.000 N |
| Vector X | 0.000 N |
| Vector Y | 250.000 N |

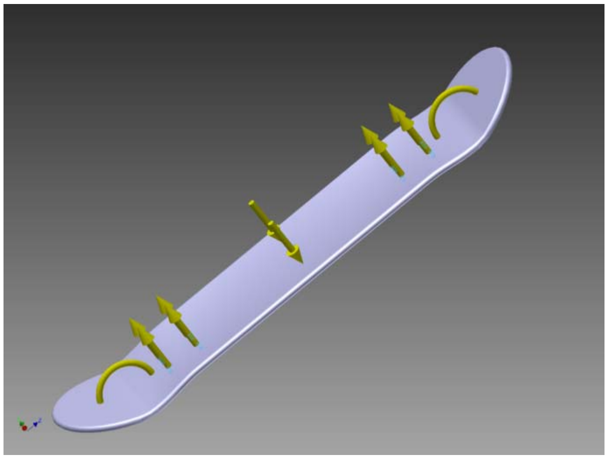

**Fig. 1: Loading**

**Table 3: Force 2**

| Load Type | Force |
|---|---|
| Magnitude | 1000.000 N |
| Vector X | 78.802 N |
| Vector Y | -996.878 N |
| Vector Z | 4.993 N |

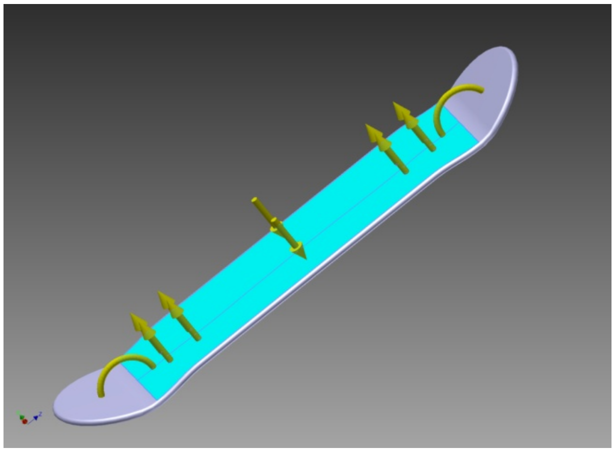

**Fig. 2: Load Distribution**

**Table 4: Moment 1**

| Load Type | Moment |
|---|---|
| Magnitude | 14250.000 N mm |
| Vector X | -14250.000 N mm |
| Vector Y | 0.000 N mm |

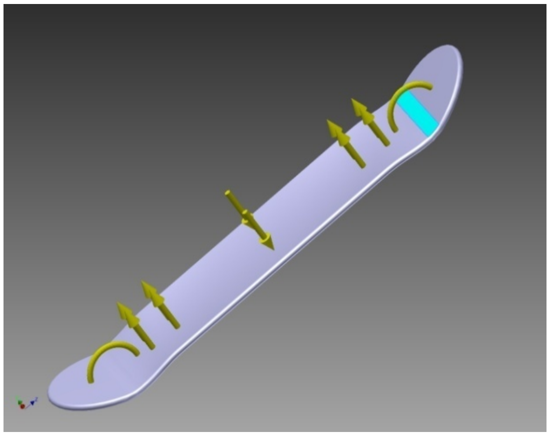

**Fig. 3: Moment 1**

**Table 5: Moment 2**

| Load Type | Moment |
|---|---|
| Magnitude | 14250.000 N mm |
| Vector X | 14250.000 N mm |
| Vector Y | 0.000 N mm |

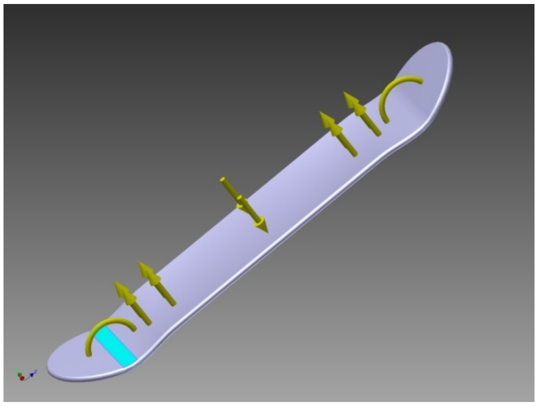

**Fig. 4: Moment 2**

**Table 6: Result Summary**

| Name | Minimum | Maximum |
|---|---|---|
| Volume | 1500030 mm^3 | |
| Mass | 0.85502 kg | |
| Von Mises Stress | 0.00413309 MPa | 34.6645 MPa |
| 1st Principal Stress | -33.3027 MPa | 56.5614 MPa |
| 3rd Principal Stress | -66.236 MPa | 30.082 MPa |
| Displacement | 0 mm | 0.854198 mm |
| Safety Factor | 1.55779 ul | 15 ul |
| 22Stress XX | -44.9378 MPa | 40.641 MPa |
| Stress XY | -12.4747 MPa | 14.0097 MPa |
| Stress XZ | -8.61797 MPa | 8.61675 MPa |
| Stress YY | -41.1191 MPa | 36.7893 MPa |
| Stress YZ | -13.2708 MPa | 13.1128 MPa |
| Stress ZZ | -52.0673 MPa | 46.0496 MPa |
| X Displacement | -0.0157256 mm | 0.01926 mm |

| | | |
|---|---|---|
| Y Displacement | -0.538963 mm | 0.822962 mm |
| Z Displacement | -0.254823 mm | 0.254798 mm |
| Equivalent Strain | 0.000000371526 ul | 0.00320047 ul |
| 1st Principal Strain | 0.000000293189 ul | 0.00288454 ul |
| 3rd Principal Strain | -0.00357517 ul | -0.000000314814 ul |
| Strain XX | -0.00167292 ul | 0.00148055 ul |
| Strain XY | -0.00166019 ul | 0.00186447 ul |
| Strain XZ | -0.00114692 ul | 0.00114675 ul |
| Strain YY | -0.0012937 ul | 0.00182002 ul |
| Strain YZ | -0.00176613 ul | 0.0017451 ul |
| Strain ZZ | -0.00252644 ul | 0.00173167 ul |

## 6. VON MISES STRESS

According to this theory the elastic failure occurs where the shear strain energy per unit volume in the stressed material reaches a value equal to the shear strain energy per unit volume at the elastic limit point in the simple tension test.

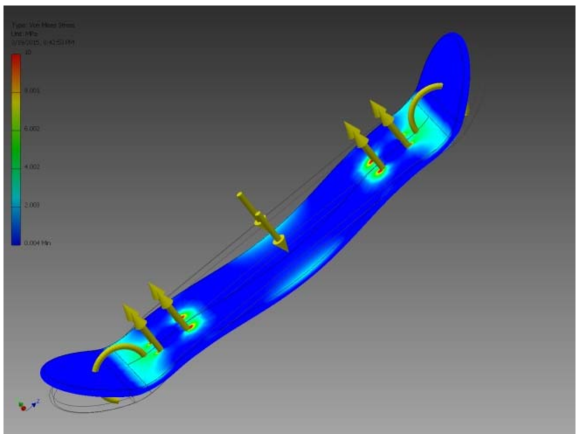

**Fig. 5: Von Mises Stress**

## 7. 3RD PRINCIPAL STRESS

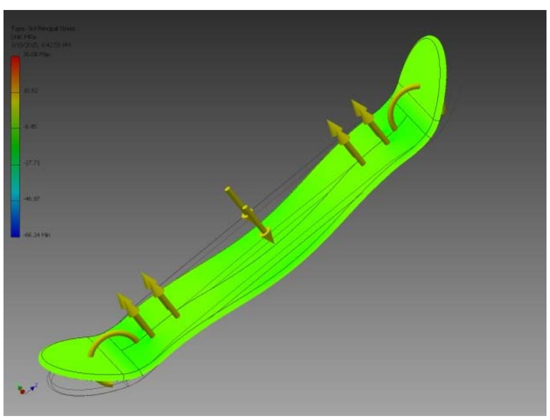

**Fig. 6: 3rd Principal Stress**

## 8. RESULTS AND DISCUSSION

After the analysis of the deck of the skateboard, it was found out that

1.The deck is safe in von Mises stress
2.The deck is safe in 1st principal stress
3.The deck is safe in 3rd principal stress

The analysis of the skateboard shows that the skateboard is safe under all loading conditions and hence is safe. The skateboard can be fabricated if proper funding is provided. The skateboard is safe to travel short distances provided battery of right specifications is attached.

## 9. ACKNOWLEDGEMENT

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## REFERENCES

[1] R. K. Rajput- Theories of Failure, Bending Moments, Principal Stress and Strains
[2] S.S. Rattan- Weight Transfer
[3] http://sites.google.com/johngrimble/vi.entireskateboardassembly - Paper by John Grimble
[4] Autodesk Inventor 2013 Online Tutorial
[5] ( http://www.autodesk.com/view/INVENTOR/2015/ENU )
[6] www.grabcad.com/tutorials