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Analyzing the Edges of a Snowboard

ETM 498 – Senior Project II

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Abstract— The purpose of this project was to explore the different possible shapes of a snowboard's cutting edge. The focus of this will be how these edges affect the snowboard during turning, or "carving." The Magne-traction is a new snowboard that uses a new edge design that claims to provide greater traction, especially during hard or icy conditions. This project attempts to reverse engineering the Magne-traction and a traditional snowboard in SolidWorks to create CAD models of each design. This project explores the physics and theory behind these different designs by testing them in static and flow simulations using the finite element analysis tools in SolidWorks. These CAD models were used to create physical models using a waterjet machine; the models were created from 6061T aluminum sheet metal. A test fixture was created and trials were conducted to test the snowboard to find the location and magnitude of the forces acting along the edge of the board.

Keywords- *magne-traction, snowboard, edge design, static testing*

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I. Introduction

Innovation is encouraged by competition because companies are always trying to gain an edge over an opponent. Therefore, research is always being done to create new products or to improve a current product. Sports are an excellent example of innovations in physics and dynamics, and it is a place where athletes are always willing to try new things in order to gain an advantage over opponents. In sports such as American football or hockey, there is standard equipment issued to every player. But in certain sports, such as snowboarding, the equipment can be customized to a rider's preferences.

Snowboarding is becoming an increasingly popular sport, with many people enjoying it at the professional and amateur level. As people's size and preference vary, there are different kinds of snowboards that are most suitable for their purposes. The invention of the snowboard is credited to Tom Sims in 1963 (1), and it was meant to simulate a skateboard for snow. Over the years, it has improved with bindings, metal edges, and became an official Olympic Sport in 1994. In 2000, there were 4.3 million American snowboarders, and that number increased by 30% to 6.1 million American snowboarders by 2010 (2). Figure 1 shows a diagram of a typical snowboard.

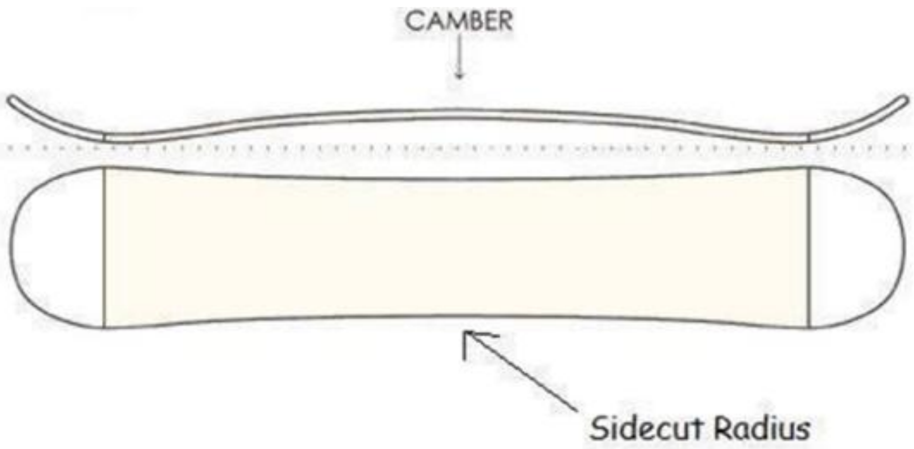


Figure 1 ((Evo.com, Rocker Guide, 2013)

Most of the variation in a snowboard is in the stiffness, length, or the camber (curvature) of the snowboard. The main shape of the modern snowboard has changed very little since its invention, but Lib Technologies has created a new design called the "Magne-traction" which claims to create more traction and give the rider more control with the serrated edge on its board (3).

This paper's focus is on creating physical models of a typical snowboard and the Magne-traction and then conducting tests to compare the two boards – both analytically and with physical testing. A static test was designed and implemented to test the edges of a typical snowboard and the Magne-traction.

a) Statement of Work:

The scope of this project is primarily focused on analyzing and comparing a standard snowboard to a snowboard with serrated edges. This project was broken into two semesters of work and ten tasks. They are listed below:

SENIOR PROJECT I

Task 1: Investigate and research possible topics

Task 2: Choose topic

Task 3: Research literature on chosen topic (Narrow scope)

Task 4: Topic proposal and budget

Task 5: Build CAD models of a typical snowboard and a wavy-edged snowboard

SENIOR PROJECT II

Task 6: Use finite element analysis to test the models

Task 7: Create waterjet models

Task 8: Test models using static force

Task 9: Compare testing data with analytical data

Task 10: Create a report including all results and work done

b) Status - Tasks Completed:

Task 1: Many topics were looked at, and research was done on four on these topics.

Task 2: We choose the topic of analyzing the edges of a snowboard

Task 3: Research was done to find literature that was relevant to the chosen topic and could be used as a guide for this project. The article "The Physics of Snowboarding" was used as a guide for this project (4).

Task 4: A proposal and budget was submitted to Dr. Wei and it was accepted. A proposal was also submitted to the Office of Grants and Funded Research at Central Connecticut State University and funding was granted for this project.

Task 5: The models were modeled in SolidWorks and two designs were finalized: a typical board and a wavy edged board.

Task 6: The finite element analysis was done in SolidWorks using the Flow Simulation and Static Testing

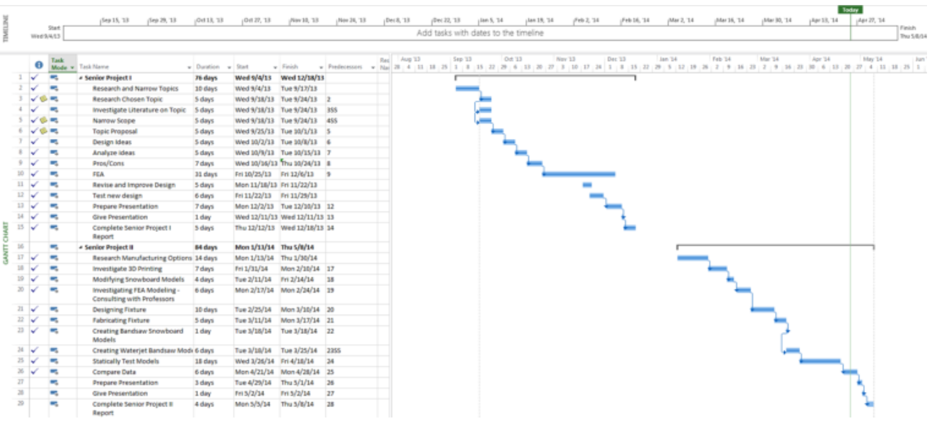
Task 7: The CAD model was used to create 1/4th scale models using a waterjet machine

Task 8: A test fixture was designed and created using the design parameters that were chosen. This test fixture was then used to apply weights to the model snowboard and test data was gathered from the pressure sensors using a multimeter

Task 9: The testing data acquired was compared to the SolidWorks simulations and the hand calculations that were done.

Task 10: A presentation was given before students and faculty on May 2nd, 2014 and this is the complete report of this project.

The Gantt chart below shows the project outline and how much progress has been made.



ISSN: 2321-8169
1437 – 1449

II. Physics and Analysis

As seen in the statement of work, a good portion of this project has been spent researching literature. "The Physics of Snowboarding" has been the main article because it details how a snowboard will act during turning or "carving." In a step-by-step method, it gives an explanation and procedure on how to use the equations that are listed. These equations will be able to calculate the angle of lean, which can be seen in Table 1.

Table 1						
	Degrees	Radians				
Angle of Tilt, ϕ =	35	0.610865		Radius Turn, R_T (ft) =	24.57456	
Slope Angle, α =	25	0.436332		Angle of Lean, θ =	57.80232	Degrees
Equipotential Angle, β =	45	0.785398				
				90 - ϕ =	55	Degrees
Sidecut Radius, R_{SC} (ft) =	30					
Gravity, g (ft/s^2) =	32.2			Will This Slide?	No	
	MPH	FT/S				
Velocity, v =	10	14.66667				

Table 1

Figures 2 and 3 help to illustrate some of the terms in Table 1 (4).

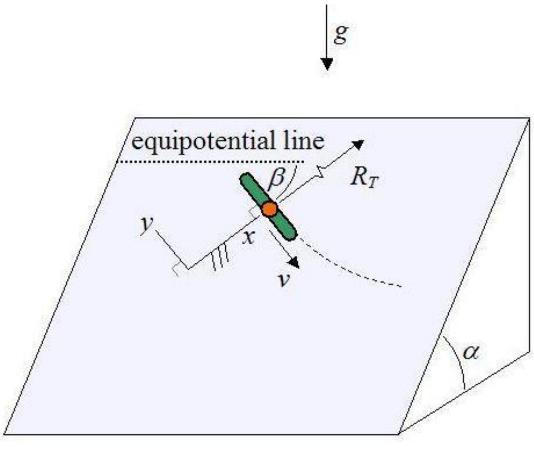


Figure 2

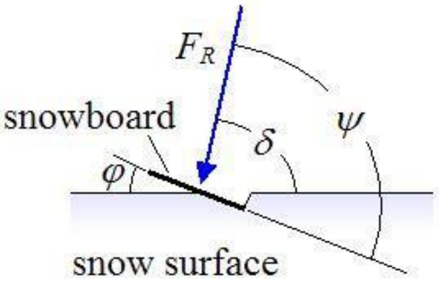


Figure 3

By inputting the information on the left side of Table 1, the calculation will provide the angle of lean and whether the board will be able to effectively carve. The spreadsheet uses the following formula to calculate the turn radius:

$$R_T = R_{SC} \cos\varphi$$

After calculating the sidecut radius, the angle of lean was calculated (4).

 ISSN: 2321-8169
1437 – 1449

$$\tan\theta = \frac{g\cos\alpha}{g\sin\alpha\cos\beta + \frac{v^2}{R_T}}$$

In effective carving, the angle of lean will be higher than the 90 - Angle of Tilt. In this case, the angle of lean (57.80) is higher than 55 and this indicates effective carving. If the angle of lean was less than 55, then the snowboard would likely slip or skid on the snow. “This occurs when the snowboard is tilted on its edge and the exposed base of the board “plows” into the snow head on. Although the skidding can be controlled and the turn successfully executed, it ultimately results in a significant loss of speed, which can be undesirable (4).” Due to this “plowing” through the snow, the board must push the snow forward and this generates a considerable amount of friction. If the board was carving, it would effectively glide through snow on a single edge that encounters very little resistance over the reduced area that has pressure on it. There is also very little resistance when carving because the board is not trying to push, plow or move the snow; therefore, there is very little frictional resistance to the board.

The spreadsheet calculation shown above ensures that if the angles and velocities above are chosen that the board will successfully carve. The values inputted into Table 1 were the forces and angles that were also used in the SolidWorks simulations. Figure 4 shows pictures of the CAD models:

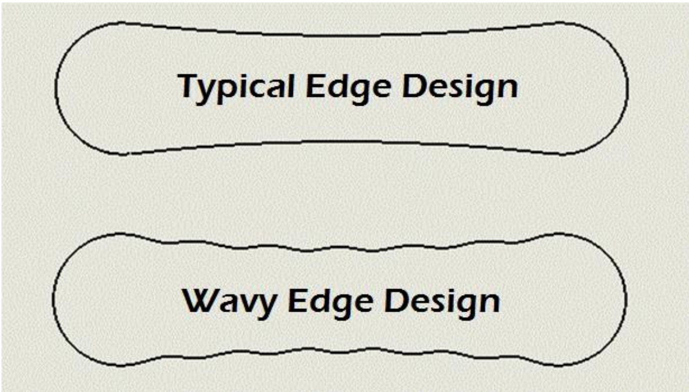


Figure 4

The serrated edge on the wavy board is the only difference between the models. The main sidecut radius (Shown in Figure 1) of the serrated edge is the same as the straight edged board, but there are seven smaller bumps along the edge. These bumps or “waves” will contact along the same radius as the typical board.

While the straight edged board is carving, the snowboard will bend due to the force applied by the weight of the rider. While this happens, the board will conform to the slope of the mountain such that the whole side of the board will be in contact at once; this effectively acts as one large contact point. This can be seen in Figure 5.

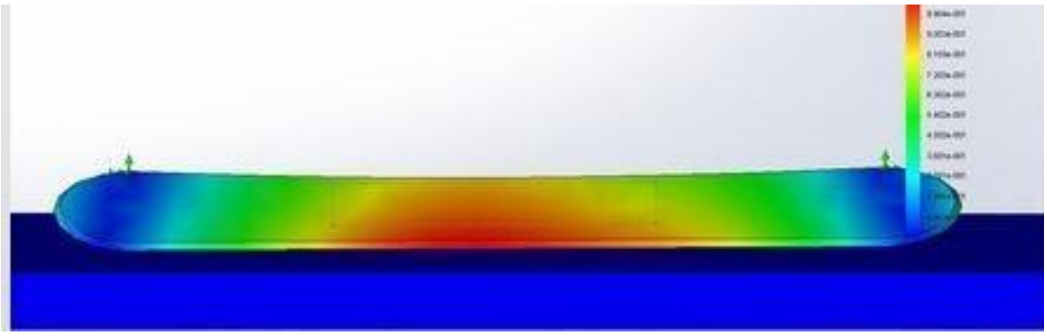


Figure 5

This is beneficial to the rider because it creates a lot of surface contact with the snow, resulting in additional traction. Having only one contact point can create difficult situation in icy conditions; the snowboard edge can lose its grip and give out, resulting in the rider falling. The Magne-traction board has a different approach by creating multiple bumps along each edge which creates multiple contact points. These points have two purposes: First, to help slice through the snow and particularly the ice and harder surfaces. Secondly, in a slippery situation if one of the contact points were to give out, the other points still have a good chance of being able to give some traction and control to the rider. Figures 6 and 7, respectively, show the stress concentration on a straight edge and a serrated edge.

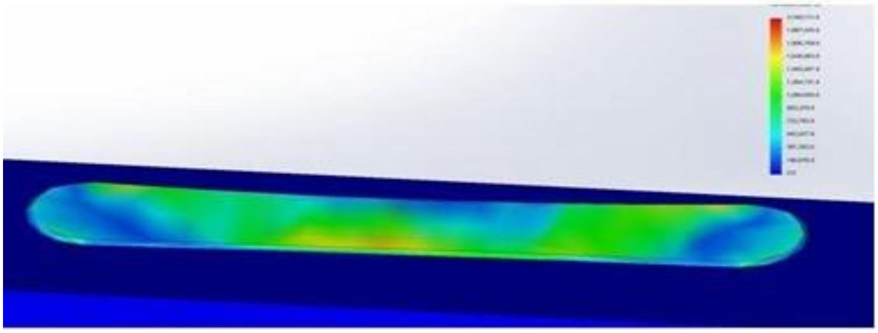


Figure 6

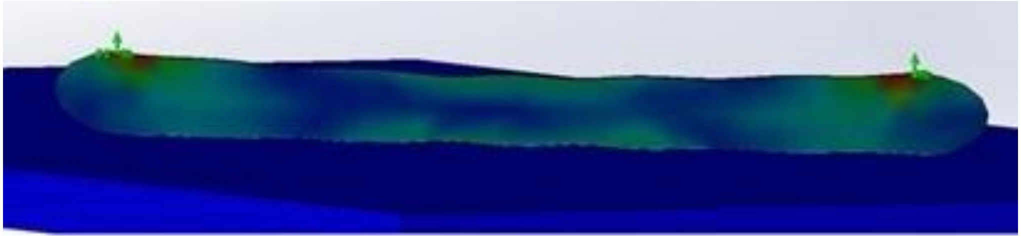


Figure 7

Figure 6 shows a relatively uniform load along the entire edge which helps to reinforce the concept of the edge acting as one edge. Figure 7 is slightly harder to see, but it does show higher stress levels along the bumps along the edge. There have been some difficulties with supporting the board in the testing, which resulted in stress concentrations where the supports were, but the forces still noticeably acted upon the bumps in the serrated edge.

These CAD models were also tested against a slope in a flow simulation. Figure 8 and 9 show still pictures of the setup while the simulation was being done.

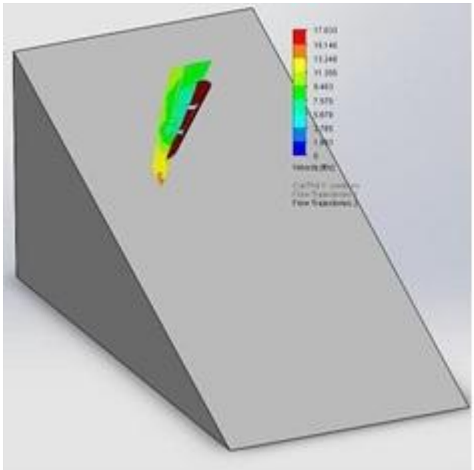


Figure 8

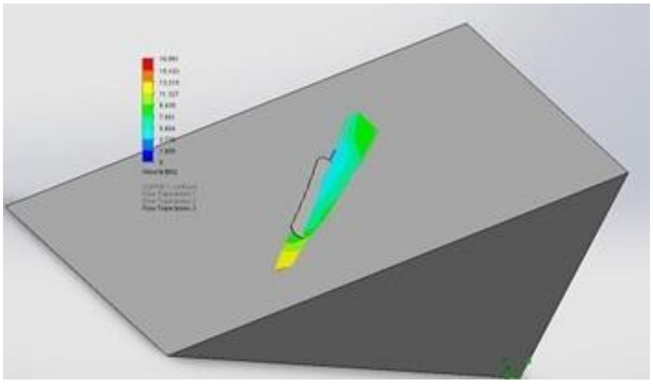


Figure 9

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Volume: 2 Issue: 6 1437 – 1449

Figure 8 shows the straight edged board while having the flow simulation take place, and Figure 9 shows the setup of the serrated edged board being tested. In snowboarding, the board would be moving down the mountain at a certain velocity and vector and it would be moving through the snow. These values were shown in Table 1, with the velocity being 14.67 ft/s at a 45 degree angle. During a flow simulation though, the fluid needs to move against a stationary object; the board. Therefore, we set up the test to have the fluid run at the specified velocity against a stationary board in the opposite direction of which the snowboard would actually be moving. This simulates the board moving through the snow.

While we are still looking at the data that was accumulated during testing, there were some obvious differences in flow around or near the edge of the snowboard. For the traditional snowboard, the flow would reach the board, and it would go around the ends of the board. This is because the board is in complete contact with the slope and there is no room for the snow to go under the board. Using the information from the flow simulations and the results given by the static finite element analysis conducted in SolidWorks, the straight edged board will have more pressure along the edge. Because the Magne-traction design is not in complete contact with the slope, the fluid more easily passed underneath the high points in the board. This will result in less pressure on the edge as a whole, but there will be additional pressure on the bumps that dig into the snow due to their smaller area.

The final area of comparison between a typical snowboard and the wavy edge design was to look at the contact area pressure of each board as the typical loads where applied. Since the wavy edge of the snowboard has less area contacting the snow or ice we assume that to will create a greater pressure on the snow or ice which will be beneficial in digging the board in deeper when the conditions are icy. The test was done analytically using SolidWorks simulations. The same loads and boundary conditions were used as in the displacement simulation, only the goal was changed to see how contact pressure changed between designs.

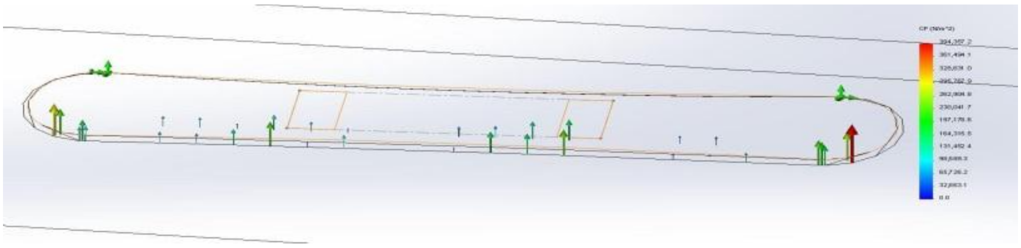

Figure 10

Figure 10 shows the contact pressures on the typical snowboard when the edge is bent into the snow during a turn. The arrows represent the magnitude of the contact pressure at each point. The simulation's purpose was most importantly to focus on the relative magnitude and location of the forces that would be applied to the edge of the board. In Figure 10, the load is generally compromised of small and medium loads spread across the entire edge of the board; the distribution of pressures is somewhat even across the edge. This is in stark contrast to Figure 11, which shows the contact pressure from the wavy edged board.

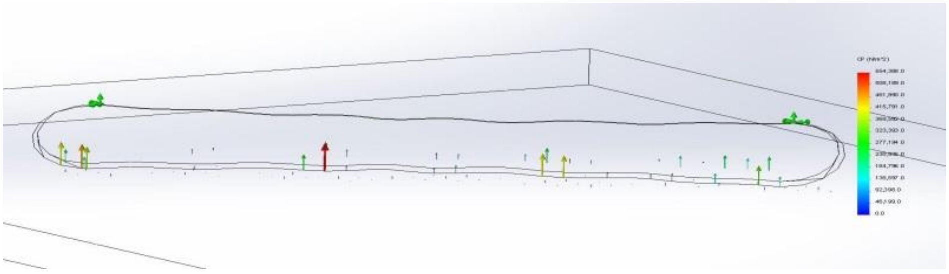

Figure 11

The pressure on the wavy edge is localized at the contact points across the snowboard. The pressures of highest magnitude are at the two closest contact points to where the rider's weight would be acting on the edge. The magnitudes of the other pressures also occur singularly at the specified contact points, which were expected since these were the only points that should be contacting the snow. This supports the idea that the same amount of force applied to the wavy design will become more concentrated at certain contact points, creating a greater force applied at those points; this will increase the chance that the greater force will be able to penetrate hard-packed snow or ice to create additional traction.

III. PROCEDURE

Before making the models or being able to test them, a fixture had to be designed and created in order to conduct testing. The design was drawn up in SolidWorks and can be seen in Figure 12. The purpose of this fixture was to model snowboarding conditions as closely as possible. The fixture needed to be able to apply a load to a snowboard that would be acting on the sidecut radius of the snowboard edge similar to the way that a rider's weight would be applied through his legs. While a rider's feet would be secured to a board through boots and bindings, the wooden dowels were secured to our models by using a screw to fasten the

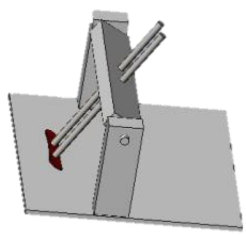

Figure 12

ISSN: 2321-8169
1437 – 1449

board to the dowels at the correct corresponding location.

Another test condition that needed to be met was the angle of tilt on the board during carving. The test parameters specified in Table 1 call out for an angle of tilt of 35°. The test fixture's crossbar, which secures the wooden dowels, is adjustable to allow for any angle. Therefore, the crossbar can be set to any desired angle using a level angle, and then the nuts can be tightened on the outside of the side-beams to prevent the angle from changing during testing. Figure 13 shows the final test fixture.

Figure 13

Based upon the configuration of the test fixture, a free-body diagram (FBD) was created to identify what percent of the force was being transferred to the edge of the board, and what percentage of the force was supported by the test fixture due to the angle of the crossbar. The total weight acting upon the wooden dowels was the weight of the dowels and of the metal weights – this resulted in 52 lbs. of force acting in the downward direction. But the FBD moves its axis by 35° to make the results more easily understandable. Any force acting along the X-direction is force that will be transferred to the edge of the snowboard; any force acting along the Y-direction is force that will be supported by the test fixture's crossbar. The FBD is shown in Figure 14.

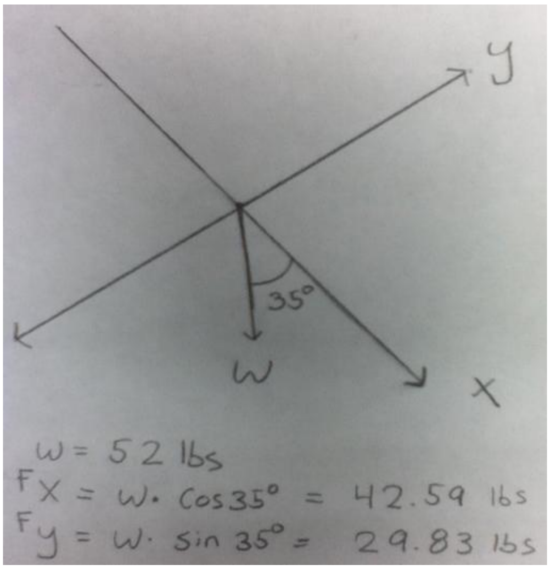

Figure 14

Here is a list of the supplies necessary to conduct this test:

- Fixture
- 7 Flexiforce sensors
- Clear tape
- Scale Snowboard Models – Typical Edge and Wavy Edge Designs
- 4 Ten-Pound Weights
- 2 Five-Pound Weights
- Digital Multi-Meter
- Angle level

ISSN: 2321-8169
1437 – 1449

The procedure for testing is described below.

EDGE FORCE TEST

1. Attach board to dowels with wood screws and washer
2. Set angle of fixture to 35 degrees using angle level (Figure 15)

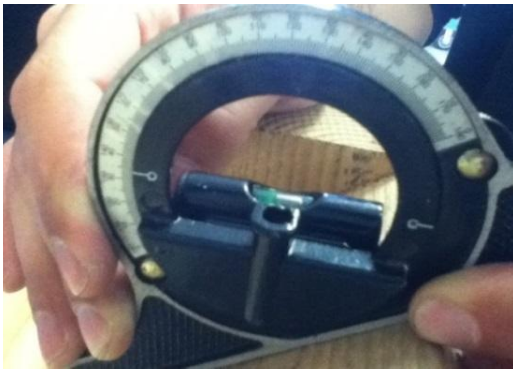

Figure 15

3. Manually apply force to dowels until edge of snowboard fully contacts base plate
4. Mark edge of board with pencil
5. Place sensors along edge where wavy board contacts base plate
6. Tape sensors down with clear tape (Figure 16)

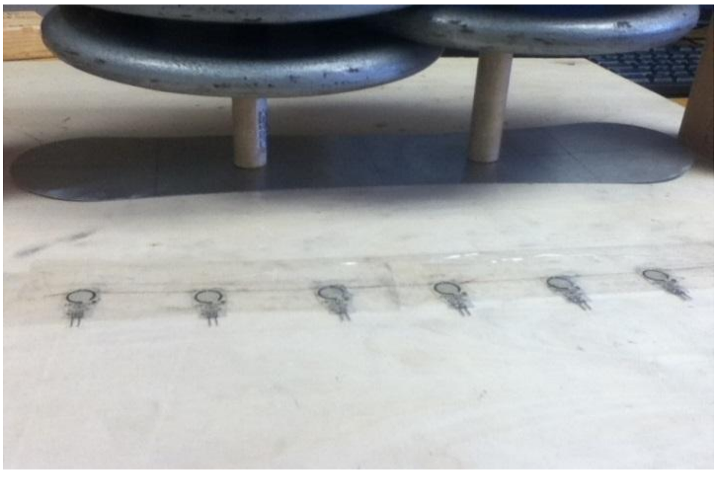

Figure 16

7. Remove dowels from fixture and evenly distribute 50 pounds between the two dowels (Figure 17)

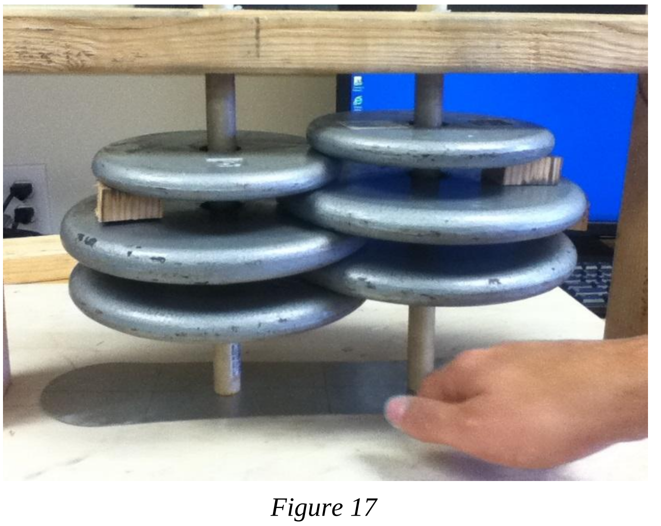

Figure 17

ISSN: 2321-8169
1437 – 1449

8. Re-Insert dowels placing edge of snowboard along line of sensors (Figure 18)

Figure 18

9. Using a multimeter, measure resistance at each sensor and record
10. Repeat Steps 7-9 five times and calculate averages
11. Repeat Steps 7-10 for other type of snowboard model and record in

IV. Results and Discussion

Before conducting testing, the FlexiForce sensors needed to be calibrated and broken in as according to the FlexiForce User Manual (6). The sensors are pressure sensors made by (Tekscan); pressure sensors work by having infinite resistance while there is no force acting upon it. When more force is applied to the sensor, the sensor will offer less resistance to flow. Therefore, the lower values for resistance actually mean that there was more force acting on those sensors.

The process for calibrating and breaking in the sensors was to apply a known force to the sensors and to measure the resistance of the sensor using a multimeter. The calibration testing applied force in increments of 5lbs up to a total of 50 lbs. After doing this, a graph was created of force vs resistance; this can be seen in Figure 19 and it shows the three trials done on Sensor #3 to calibrate it.

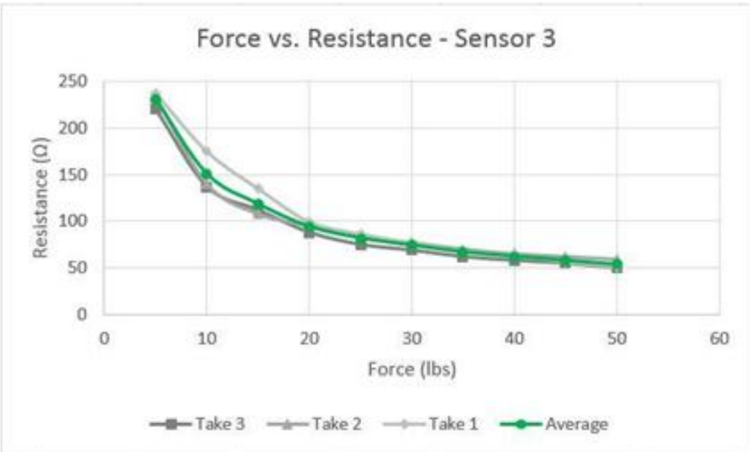

Figure 19

The resistance (R), was then converted into conductance (G) using the following relationship: G= 1/R. A graph was then created of force vs conductance in Figure 20.

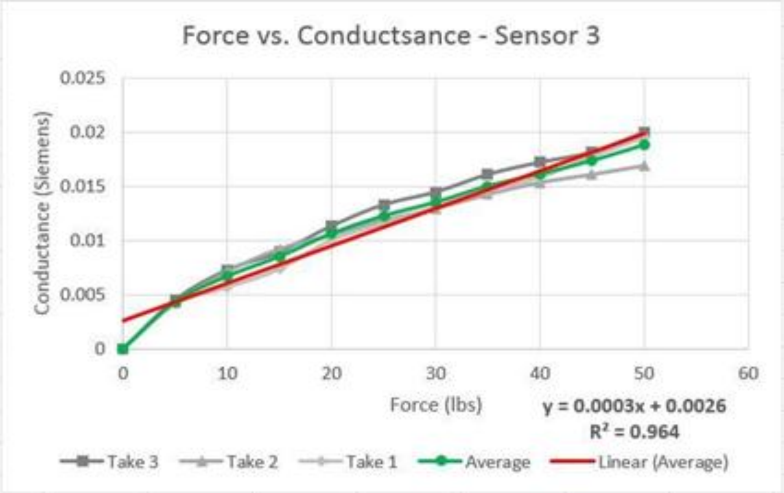

Figure 20

When the force is graphed against the conductance, it creates a relatively uniform straight line, and following the procedure outlined in the FlexiForce User Manual, the equation of a line was found. The equation of the line is written in the bottom right of Figure 20, $y = 0.0003x + 0.0026$, where conductance inputted is y, and the corresponding force will be x.

As a summary, a known amount of force is applied to the snowboard edge which acts upon the sensors; the distribution of the force is unknown. This force will press upon the sensors and decrease the resistance at these individual sensors. This resistance is measured using a multimeter and converted into conductance. The conductance is then converted into a corresponding force based upon the equation found through calibration. The purpose of this testing is to find the force distribution along the edge of the snowboard.

Testing was done according to the procedure described above and the results were put into a spreadsheet. There were five trials conducted for each snowboard design and the results for the typical and wavy edged boards can be seen in Tables 2 and 3, respectively.

Resistance (Ω) - Typical Snowboard Design							
	Sensor #1	Sensor #2	Sensor #3	Sensor #4	Sensor #5	Sensor #6	Sensor #7
Trial 1	800	272	220	280	162	256	290
Trial 2	760	260	189	288	155	236	330
Trial 3	660	252	250	268	180	250	390
Trial 4	565	211	195	267	186	270	343
Trial 5	570	216	206	255	158	205	315
Average	671	242.2	212	271.6	168.2	243.4	333.6

Table 2

Resistance (Ω) - Wavy Snowboard Design							
	Sensor #1	Sensor #2	Sensor #3	Sensor #4	Sensor #5	Sensor #6	Sensor #7
Trial 1	440	189	163	470	144	197	1000
Trial 2	455	141	201	439	180	230	620
Trial 3	465	173	152	483	195	248	980
Trial 4	480	218	160	480	150	209	950
Trial 5	480	240	165	401	137	185	850
Average	464	192.2	168.2	454.6	161.2	213.8	880

Table 3

It is important to remember that the more force a sensor receives, the lower the resistance it will offer. The force being applied to the board is supposed to simulate the force caused by the weight of the rider being transferred through the rider's legs. The rider's legs would be in the middle of the two edges, but the front leg would be close to Sensor #3 while the rear leg would be closest to Sensor #5. Our testing was set up to try to simulate this by our placement of the dowels in the same locations. Figure 21 shows the location of each sensor along the edge of a snowboard. Knowing this, it makes sense that the lowest resistance (largest amount of force) was received at Sensors #3 and #5.

ISSN: 2321-8169
1437 – 1449

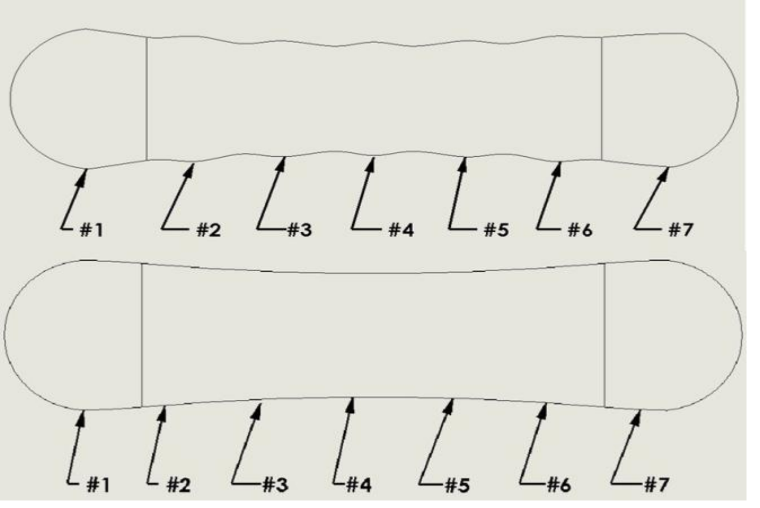

Figure 21

The resistance values in Tables 2 and 3 were then converted into conductance, which are seen in Tables 4 and 5.

Conductance (Siemens) - Typical Snowboard Design							
	Sensor #1	Sensor #2	Sensor #3	Sensor #4	Sensor #5	Sensor #6	Sensor #7
Trial 1	0.0013	0.0037	0.0045	0.0036	0.0062	0.0039	0.0034
Trial 2	0.0013	0.0038	0.0053	0.0035	0.0065	0.0042	0.0030
Trial 3	0.0015	0.0040	0.0040	0.0037	0.0056	0.0040	0.0026
Trial 4	0.0018	0.0047	0.0051	0.0037	0.0054	0.0037	0.0029
Trial 5	0.0018	0.0046	0.0049	0.0039	0.0063	0.0049	0.0032
Average	0.0015	0.0042	0.0048	0.0037	0.0060	0.0041	0.0030

Table 4

Conductance (Siemens) - Wavy Snowboard Design							
	Sensor #1	Sensor #2	Sensor #3	Sensor #4	Sensor #5	Sensor #6	Sensor #7
Trial 1	0.0023	0.0053	0.0061	0.0021	0.0069	0.0051	0.0010
Trial 2	0.0022	0.0071	0.0050	0.0023	0.0056	0.0043	0.0016
Trial 3	0.0022	0.0058	0.0066	0.0021	0.0051	0.0040	0.0010
Trial 4	0.0021	0.0046	0.0063	0.0021	0.0067	0.0048	0.0011
Trial 5	0.0021	0.0042	0.0061	0.0025	0.0073	0.0054	0.0012
Average	0.0022	0.0054	0.0060	0.0022	0.0063	0.0047	0.0012

Table 5

Using the equation found in Figure 20, the conductance was converted into a corresponding force. The force distribution for the typical edge design can be seen in Table 6.

Corresponding Weight (lbs) - Typical Snowboard Design								
	Sensor #1	Sensor #2	Sensor #3	Sensor #4	Sensor #5	Sensor #6	Sensor #7	Total Weight
Trial 1	-4.50	3.59	6.48	3.24	11.91	4.35	2.83	27.90
Trial 2	-4.28	4.15	8.97	2.91	12.84	5.46	1.43	31.48
Trial 3	-3.62	4.56	4.67	3.77	9.85	4.67	-0.12	23.78
Trial 4	-2.77	7.13	8.43	3.82	9.25	3.68	1.05	30.59
Trial 5	-2.82	6.77	7.51	4.41	12.43	7.59	1.92	37.81
Average	-3.60	5.24	7.21	3.63	11.26	5.15	1.42	30.31

Table 6

The force distribution for the wavy edge design is given in Table 7.

Corresponding Weight (lbs) - Wavy Snowboard Design								
	Sensor #1	Sensor #2	Sensor #3	Sensor #4	Sensor #5	Sensor #6	Sensor #7	Total Weight
Trial 1	-1.09	8.97	11.78	-1.57	14.48	8.25	-5.33	35.49
Trial 2	-1.34	14.97	7.92	-1.07	9.85	5.83	-3.29	32.86
Trial 3	-1.50	10.60	13.26	-1.77	8.43	4.77	-5.27	28.54
Trial 4	-1.72	6.62	12.17	-1.72	13.56	7.28	-5.16	31.03
Trial 5	-1.72	5.22	11.54	-0.35	15.66	9.35	-4.75	34.95
Average	-1.47	9.28	11.33	-1.30	12.40	7.10	-4.76	32.57

Table 7

It is interesting to see the differences in force distribution – particularly the values that were highlighted in red. These values are negative forces – which is impossible in this situation. The reason for these negative values is due to equation used found in the calibration testing; if there was such a small force that it did not reduce the resistance in the sensor, then it may have shown up as a negative force. Since this is not actually possible, we assumed these values were close to zero and set them to zero; Tables 8 and 9 show the results without the negative values. Any value above 7.5lbs was highlighted in green to show the highest forces.

Corresponding Weight (lbs) - Typical Snowboard Design								
	Sensor #1	Sensor #2	Sensor #3	Sensor #4	Sensor #5	Sensor #6	Sensor #7	Total Weight
Trial 1	0.00	3.59	6.48	3.24	11.91	4.35	2.83	32.40
Trial 2	0.00	4.15	8.97	2.91	12.84	5.46	1.43	35.76
Trial 3	0.00	4.56	4.67	3.77	9.85	4.67	0.00	27.52
Trial 4	0.00	7.13	8.43	3.82	9.25	3.68	1.05	33.36
Trial 5	0.00	6.77	7.51	4.41	12.43	7.59	1.92	40.62
Average	0.00	5.24	7.21	3.63	11.26	5.15	1.45	33.93

Table 8

Corresponding Weight (lbs) - Wavy Snowboard Design								
	Sensor #1	Sensor #2	Sensor #3	Sensor #4	Sensor #5	Sensor #6	Sensor #7	Total Weight
Trial 1	0.00	8.97	11.78	0.00	14.48	8.25	0.00	43.49
Trial 2	0.00	14.97	7.92	0.00	9.85	5.83	0.00	38.57
Trial 3	0.00	10.60	13.26	0.00	8.43	4.77	0.00	37.07
Trial 4	0.00	6.62	12.17	0.00	13.56	7.28	0.00	39.63
Trial 5	0.00	5.22	11.54	0.00	15.66	9.35	0.00	41.77
Average	0.00	9.28	11.33	0.00	12.40	7.10	0.00	40.10

Table 9

While the calculated force that should be acting along the edge of the board was 42.59 lbs., it is not realistic to expect all of that force acting upon the sensors because some of the board may have contacted the wood on the base. This would be more prominent in the typical board in which the whole edge of the board was even – some of it upon the sensors and some upon the wood. This was less prominent in the wavy edged design with 94% of the force acting upon the sensors.

The more important values are the forces acting upon Sensors #3 and #5; Table 10 shows the comparison more concisely. There is more force on both Sensor #3 and #5 on the wavy design – accounting for 55.7% of the total calculated weight along the edge. This means that the force will be more localized and create a higher pressure at those apex points. This additional concentrated pressure will allow the edge to have a greater chance of penetrating hard-packed snow or ice leading to greater traction.

Average Force on Specified Sensor			
Typical (lbs)		Wavy (lbs)	
Sensor #3	Sensor #5	Sensor #3	Sensor #5
7.21	11.26	11.33	12.40
% of Calculated Force on Sensors:			
Typical (%)		Wavy (%)	
Sensor #3	Sensor #5	Sensor #3	Sensor #5
16.93	26.44	26.60	29.11

Table 10

V. DIRECTION FOR FUTURE WORK

There are many directions this project can go from here. One of them may be experimenting with the size, number and placement of the waves on the snowboard. Also the way the snow and ice flows around the wavy edge board in comparison to the typical snowboard may merit further investigation.

By changing the number of waves less contacts points can be created and that would cause even more force to concentrate at the points giving a better grip but also putting more stress on the board's edges. By adding more waves the board may have less force at the now increased number of contact points but the distribution of those forces could be beneficial to the rider if they are adding more traction closer to the feet of the rider If the size of the waves were changed it may be possible to get a more even distribution of forces throughout each of the contact points which may or may not be beneficial. Changing the location of the waves may have the same effect as changing the sizes.

The original flow simulations using SolidWorks did not produce any calculable results but we believe further testing and live wind tunnel testing may show performance differences in the wavy edge board because of its ability to allow snow to travel through the gaps created by the waves on its edge. Where a typical snow board does not allow any snow or ice to travel under the board and forces it all to exit out of the rear of the board.

VI. CONCLUSION

All of the goals for this project were successfully met; the project was broken up into ten tasks that helped guide the project toward the goal of analyzing and comparing the edges of two different snowboard edge designs. Research and analysis was done on both edge designs, and a hypotheses were created. The most important hypothesis assumed that the board would have more force acting upon the apex points on the wavy edge design and that this would allow for the edge to cut into hard-packed snow or ice more effectively. The first step to proving this was creating CAD models and doing Finite Element Analysis testing. After this, solid models were created, a test fixture was designed, and the models were tested. The results that were obtained agreed with the FEA analysis and the hand calculations very closely. Since this was the case, it helped to more strongly reinforce the original hypothesis that the wavy edged board would provide additional traction to the rider.

This project still has room for future work if desired – we initially wanted to conduct flow tests using a wind tunnel but were never able to. This was the only task that we initially set out to accomplish that we were not able to do. Other than this, all of the goals that we set out to accomplish were completed and the testing agreed with the analysis very coherently. This project was very successful and was able to use many concepts that we learned during our college careers. This project allowed us to see a project from start to finish, from an idea to fruition. We were able to design a method for testing, gather results and use these results to confirm our original hypotheses. Therefore, it was a successful project.

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