Virginia Tech students' research could give the Beach Boys a new surfing song

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Michael Porter, a graduate engineering student at Virginia Tech, conducts some of his research on how to improve the composition of material that is used in surfboards. Credit: Virginia Tech student photo

Surfers in Hawaii had better beware. Four Virginia Tech engineering science and mechanics (ESM) students have completed "Surf Green" for their senior design project, and conclude that they can technically improve the surfboard's performance.

The Beach Boys may have sung about surfing but this team of ESM students decided to "quantify the feel of surfing," something only engineers would try to do.

Michael Porter and Stephanie Salmons, both of Virginia Beach, Va., Matthew Dunham of Pleasantville, N.Y., and Nandan Shah of Midlothain, Va., worked with their faculty adviser, Jack Lesko, professor of ESM, for a year, submitting a final report at the end of 2007.

"Mike Porter lead the effort and completed most of the work this summer while living out of his van and driving up and down the east coast this summer in search of waves," Lesko smiled. He added that the project lasted beyond the spring semester because the surfboards were in his lab in Norris Hall and inaccessible to the students for weeks after the Virginia Tech tragedy last April.

"So, beyond the very good technical work, there is a good bit of character and fortitude exhibited by these students that I would like to acknowledge. I am just honored to be a small part of the lives of these talented students," he added.

The students focused on three different surfboard constructions of the same shape and size to compare the affects of material composition on the mechanical performance of surfboards. For the comparison, the team said they followed "a theory of surfboard mechanics (that is) analogous to the beam theory of solid mechanics."

They attached strain gages to the surface of each surfboard to determine the response or material deformation of each board while testing in and out of the water – surfing each board to establish feel, while static testing to verify mechanical properties.

The students decided it was a particularly appropriate time to study the composition of surfboards because Clark Foam, a California based manufacturer and distributor of nearly 90 percent of the world's materials for surfboards, ceased its production. "As a result, traditional polyurethane foam surfboards became scarce and new technologies began to emerge," the students said.

A wide variety of new eco-friendly surfboard constructions appeared on the marketplace, and consequently, surfers, manufacturers, and retailers are beginning to experience the pros and cons of the various material compositions.

"However, without numerical evidence to clarify the mechanical performance of these new materials, the future of the surfboard industry is reliant solely on word-of-mouth and marketing strategies," they added.

"We want to assist surf culture, providing the knowledge necessary for board selection and design," the engineering students said.

In their testing, they named the different surfboards Gnarly, Tubular, and Righteous. Porter conducted various field tests with the equipment, "all in the interest of finding engineering solutions," his adviser Lesko joked. Each board "had" to be tested for roughly one hour to ensure at least two similar waves were caught.

With Porter riding the boards, he then developed plots of converted strain while he was surfing, duckdiving (the primary means used to pass through a crashing wave), and paddling. Although the latter is "not a very exciting part of surfing, anywhere from 50 to 90 percent of surfing is paddling. Paddling, especially in strong currents, big waves, or rough weather, is most responsible for depleting a surfer's energy," the team said. Thus, a board that enables a smooth, easy paddle is more beneficial.

The students also developed data for the jump from tensile strain to compressive strain. They learned which board experienced the most shearing strain or torsion when surfing.

Based on their mechanical response findings, the students justified in their findings why each board may ride with more or less speed, stability, and response. They also predicted which boards are ideal for what types of waves and riding.

Gnarly performed best of the three in choppy and bumpy conditions because of its stability. Gnarly was the king of speeding through fast racy sections.

Tubular, on the other hand, managed steep drops better than the other boards. The students believed this was probably related to its superior longitudinal flex properties, since it is able to deform to fit the shape of the wave face. However, once the initial drop was made and the board was turned down the line, board Tubular lost speed.

The students concluded that Righteous performed fairly consistently in all surf conditions. It did not tend to bounce in messy surf; although, it would wobble from side-to-side some. Righteous did not tend to pearl or nose dive on steep waves; although, this could be related to its increased rocker. And, it did not seem to lose speed while pumping; probably because it flexes less lengthwise than board Tubular.

However, the major flaw of board Righteous, they added, was related to its poor torsional stiffness properties. When making turns, especially the first bottom turn, Righteous tended to lose its edge and "slide out" from under the surfer.

As with most research, the students left open the idea that "more is needed" including the internal geometry, and they may have to ride a few more waves before they are completely finished with this project.

Source: Virginia Tech