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CONE-HEAD

The biggest innovation in helmet design in 40 years is heading home

Q ueensland inventor Don Morgan claimed the 2007 New Inventor of the Year prize on ABC TV's show *The New Inventors* with his Cone-head helmet liner design. Said to reduce impact energy by up to 20%, it has been 15 years of hard toil and knockbacks for Don.

Now, American helmet brand Kali is launching its Prana MX helmet – which incorporates the Cone-head crumple-zone design – next February through Australia and New Zealand. Don's journey as an inventor of the Cone-head liner for helmets began in the mid-1980s at the QLD Institute of Technology. He was a member of a research project investigating the effectiveness of motorcycle and bicycle helmets.

Looking at helmets involved in fatal crashes, the team noted that the foam liner showed little or no evidence of damage or crushing, leading them to the conclusion that the liners in helmets were too stiff, and that they should be made from low-density foam.

"In the early 1990s, my eldest daughter was learning to ride a bicycle. When I looked at her helmet and pressed my thumb against the foam liner I was shocked that it was hard as a brick. That went against every bit of research that I had been doing, which was to make the foam softer."

A key feature of the Cone-head is that it has five different zones that each feature cones with different densities to better protect different parts of the skull based on Don's extensive research findings.

Kali's Composite Fusion Plus design incorporates cones of different foam densities within the EPS/shell connection. As energy is transferred from the shell to foam during impact, the unique cones collapse first, directing the energy laterally within the foam instead of linearly down to the rider's head. This disperses the impact energy over a greater area, allowing the use of softer foam to better protect the rider.

"Some of my early designs included low-density strips sandwiched within the

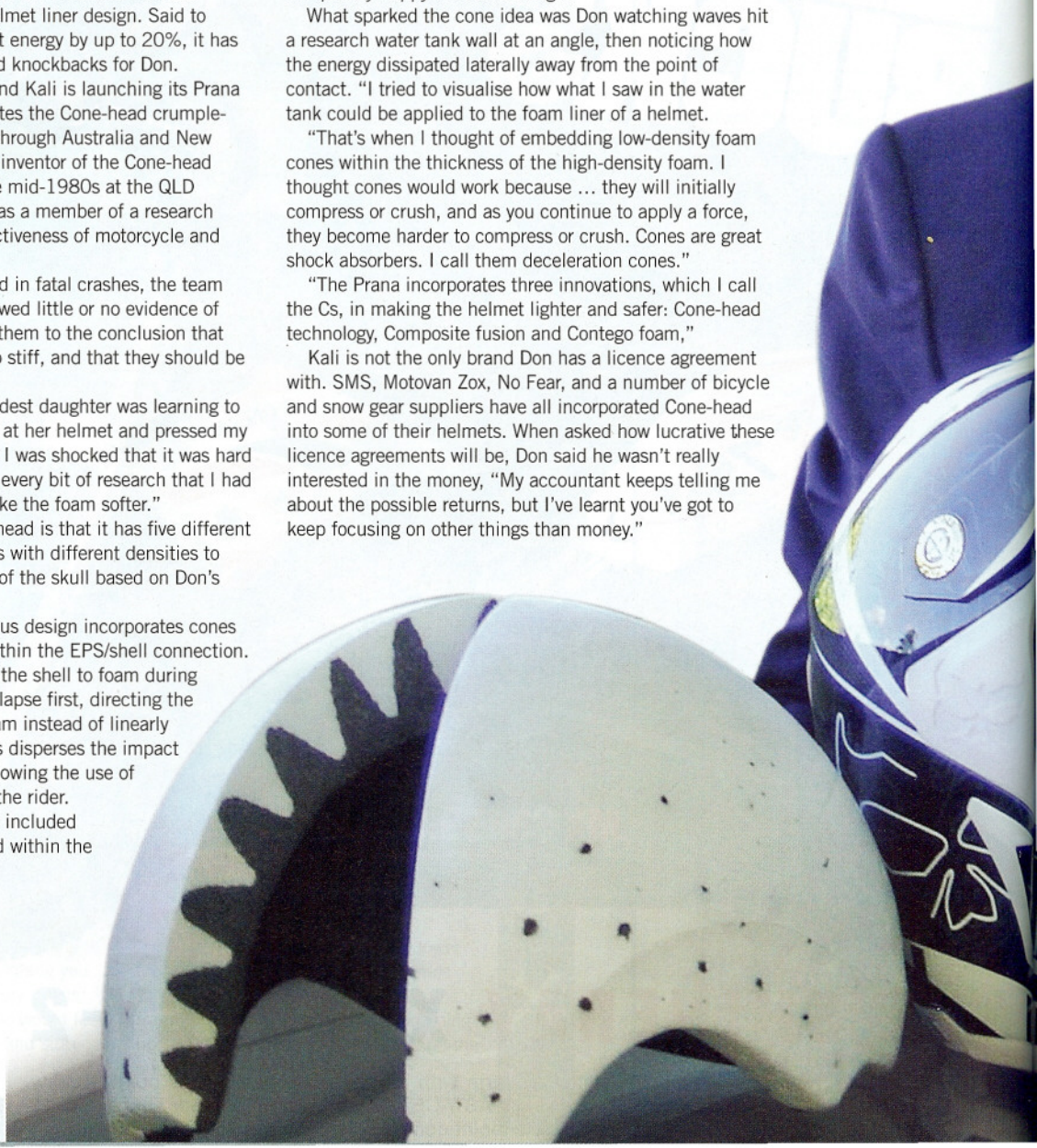
thickness of the high density foam and low density cylinders embedded into the thickness of the liner, but I was never completely happy with that design."

What sparked the cone idea was Don watching waves hit a research water tank wall at an angle, then noticing how the energy dissipated laterally away from the point of contact. "I tried to visualise how what I saw in the water tank could be applied to the foam liner of a helmet.

"That's when I thought of embedding low-density foam cones within the thickness of the high-density foam. I thought cones would work because ... they will initially compress or crush, and as you continue to apply a force, they become harder to compress or crush. Cones are great shock absorbers. I call them deceleration cones."

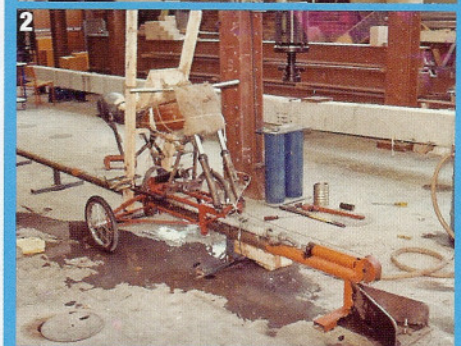
"The Prana incorporates three innovations, which I call the Cs, in making the helmet lighter and safer: Cone-head technology, Composite fusion and Contego foam,"

Kali is not the only brand Don has a licence agreement with. SMS, Motovan Zox, No Fear, and a number of bicycle and snow gear suppliers have all incorporated Cone-head into some of their helmets. When asked how lucrative these licence agreements will be, Don said he wasn't really interested in the money, "My accountant keeps telling me about the possible returns, but I've learnt you've got to keep focusing on other things than money."

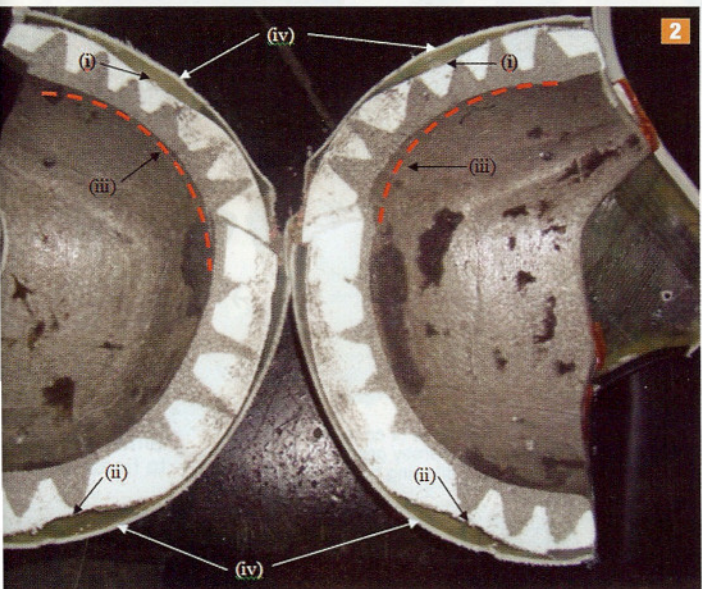
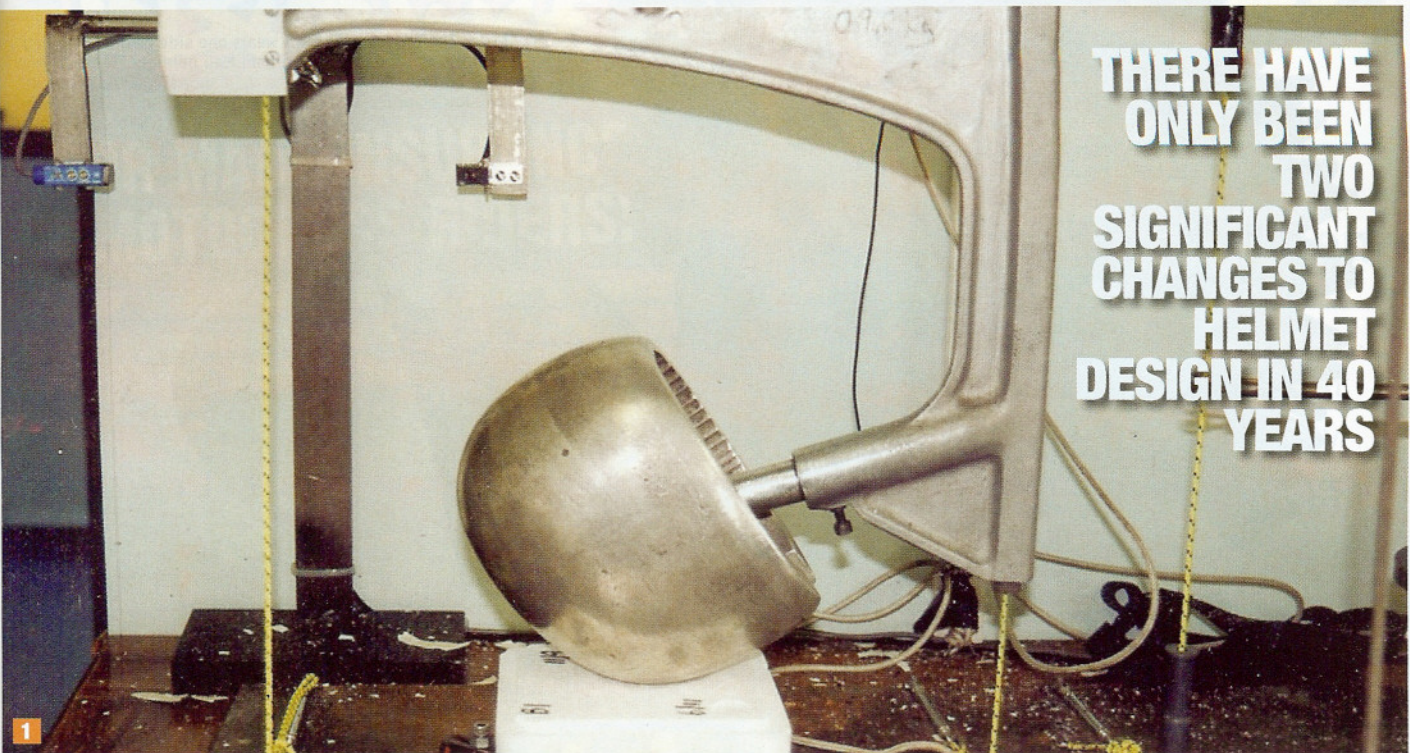




1. Cone-head came from research Don (left) started in the mid-80s
2. The impact test rig Don and the Queensland Institute of Technology used
3. Setting the rig up for another impact test



THERE HAVE ONLY BEEN TWO SIGNIFICANT CHANGES TO HELMET DESIGN IN 40 YEARS



RAISING STANDARDS

Don has some strong opinions on helmet design based on nearly 30 years of research. "There have been only two real significant changes to the design of helmets since the introduction of the full-face helmet 40 years ago: my Cone-head foam liner and the Phillips Head Protection System (PHPS) to protect the brain from the dangers of rotation. To put it bluntly, apart from these two innovations, helmets are still pretty much in the dark ages and have not kept up with modern thinking and development.

"For example, cars had crumple zones years ago. The motor vehicle industry is very progressive with developing new passive and active safety measures. This situation is not entirely the fault of the helmet manufacturers since they must manufacture helmets to meet the rigid demands of outdated helmet standards."

"The current standards (Snell, European, Australian and other world standards) are very out-dated. For example, the testing of a helmet to the Australian or New Zealand standards requires a helmet to be attached to a hard magnesium headform (same shape as an average adult skull) and dropped through a height of 1.8m onto to a hard flat or hemispherical steel anvil.

"The problem is there is nothing realistic about this test. This is the main reason why helmet liners are too hard and stiff and do not effectively absorb an impact force. The standards should be using a humanoid headform which has similar bio-mechanical properties as a human head, which should be dropped onto different real-life impacting surfaces, such as car pillars, bonnets, or bitumen road and concrete gutters. In fact, I have used these objects in my own empirical research.

"New standards along these lines would encourage helmet manufacturers to be more innovative in improving helmet designs by using new, absorbing materials and configuring the liner to better absorb impacts, like Cone-head. Europe has moved to improve its helmet standards – I hope the others follow."

1. Another test rig for helmet safety, this one measuring blunt force, while others aim to pierce the shell
 2. A Cone-head helmet, cut in half, to show how the innovative foam liner accepts impact, rather than passing it on to the wearer. You can clearly see how the liner has separated from the hard shell and deformed, soaking up the trauma and leaving the rider with a bad headache, rather than massive head injuries



Main: The model on the left wears one side of the Cone-head liner, as used in the American Kali helmets. The cut-away section on the white liner on the right shows how the high- and low-compression foam comes together in the Cone-head
 1. Don Morgan (l) with Norman Cheng (r)
 2. Kali helmet founder, Brad Waldron

OZ NO-GO ZONE

It was Don's dream for Cone-head to be established in Australia, but the idea never got traction with private investors or government.

After being rejected for a funding grant three times by the QLD government, Don says that props for bringing the idea to fruition must go to Doctor Philip Cheng and his son Norman Cheng who head up Strategic Sports Helmets, one of Asia's largest manufacturers. Frustrated with the lack of response in Australia, in 2004 Don simply Google-searched 'helmets' and came up with the website to Strategic Sports Helmets.

He sent them an email outlining his idea and research credentials, and within 30 minutes he had a reply. "That was the start of Cone-head becoming a reality thanks to the innovative attitude of the Chengs. They deserve much of the credit for helping make the idea happen, and helping me develop it. Their quick response to my email was a good sign and I eventually signed a licence agreement with them."

What followed were many trips to Hong Kong that ultimately led to a meeting with Brad Waldron, founder of US helmet brand Kali. "I met Brad at a dinner hosted by the Chengs, and I explained the Cone-head idea to him. You could see he was immediately interested, and then he challenged me on various aspects of the concept which was great. After that, I was confident that I would have a relationship with Brad and Kali, and that's how it turned out.

"Brad had the idea of fusing the liner with the EPS which made a lot of sense because sometimes the bonding isn't consistently strong, and separation can also take place. The Chengs had developed Contego foam, which would really advance the Cone-head idea as well. The two innovations came together."

