No barrier to safety

Swiss racer Natacha Gachnang earlier this year survived one of the highest-speed head-on impacts ever recorded. For that, she can thank FIA Institute research on High Speed Barriers.

Between the gloss of a post-event press release and the hard facts of an accident investigation lies a remarkable tale of survival for a racing driver, Natacha Gachnang, who owes her life to some of the world's most advanced motor sport safety systems.

At Abu Dhabi's Yas Marina circuit on 16 April this year, Gachnang, racing a Ford GT in the inaugural round of the FIA's GT1 World Championship series, suffered a rear brake failure that resulted in her losing control of her car at 180mph. Despite enduring a head-on impact seconds later at more than 115mph, she suffered injuries no more severe than a broken right leg and her team's subsequent press release wished her a "speedy recovery" and "looked forward to her return to the cockpit".

The cause of Gachnang's accident was a leak in the rear brake circuit that forced her suddenly to push the brake pedal much harder than usual when she attempted to slow down at the end of the straight before Turn 8, the fastest part of the circuit. In pushing it so hard, she simultaneously pushed on the accelerator pedal, so while the car's front wheels locked up with excess braking force, the driven rear wheels were still pushing it forward at full power. Film of the incident shows the Ford GT powering on beyond the turn-in point for Turn 8, with its front wheels locked and pouring tyre smoke. Gachnang's Ford makes no attempt to negotiate the corner and drives at high speed across the escape road and into the first of three layers of High Speed Barrier. The car spears into them like a bullet into a sack of oats and as the car slows on impact, the barriers are dragged around it, precisely as they are designed to, in order to dissipate the energy of the collision. After the impact, the circuit marshals reversed the car from the barrier before carefully extricating the driver. Gachnang, fortunately, was conscious and was flown to hospital as soon as she was removed from the vehicle.

The extent of the damage to her car revealed how fortunate she had been not only to survive, but also to be able to contemplate a swift return to racing: the front of the Ford had been virtually obliterated by the impact and while its cockpit area was largely intact, it seemed to a casual observer almost impossible that anyone could have emerged alive from such a heavily damaged vehicle. Her survival owes a huge amount to research into High Speed Barriers undertaken by the FIA Institute. Now in place at a number of the world's major circuits, such as Yas Island, Monza, and the Singapore Street Circuit, to name but three, HSBs are contributing to making accidents that previously would have been considered fatal, survivable.

FIA Institute research has been led by Hubert Gramling, working closely with barrier manufacturers TecPro and Alpina (also noted for making ski-race barriers) and the latest HSB design works on the principle of momentum transfer, as opposed to energy absorption (as seen with the traditional armco-behind-tyre-barrier arrangement).

Familiar examples of momentum transfer are the 'Newton's balls' desktop toys, or snooker balls, which behave with the same principle as the HSB when impacted. As footage of Gachnang's accident shows, the triple layers of HSB are deflected considerably when the Ford hits them, but the car is slowed to a standstill within 5 metres. FIA Institute research indicates that had Gachnang hit a conventional barrier in the same way, the accident may not have been survivable, as the impact would have imparted more energy than a tyres-plus-armco barrier would have been able to absorb. But the principle of momentum transfer ensured Gachnang's car was slowed with a deceleration not higher than 40g and not lower than 20g for the entire 5 metres – a remarkable feat. It was, in technical terms, a 'perfect' deceleration. The car's Accident Data Recorder (ADRs being another FIA Institute initiative) provided data that translated into a so-called 'square wave' – in lay-man's terms it proved the science that had gone into the development of HSBs had worked precisely as intended.

Among the sophisticated and extensively researched parts of the HSB are joints between each individual element of barrier: these have to be strong enough to maintain the link from one element to another in the event of a crash and thus allow the principle of momentum transfer to apply; but also need to be compliant so as not to break under the shock loading event. Establishing the optimal composition of these joints has required specific research.

So with the efficacy of HSB dramatically proven, why not have them lining every corner of every circuit? One reason is the space they take up – they would be impossible to use at Monaco, for example. Another is that they're not required at every type of corner. "HSBs are in place at the corners where they're needed for Formula One," says Andy Mellor, FIA Institute Research Director.

The press release issued by Natacha Gachnang's team a day after her accident drew attention to the "safety and security devices on the vehicle" that helped her "avoid the worst". And while it's true that Gachnang's HANS device and the Ford's crashworthy chassis and fire-resistant components contributed in no small part to this motor sport safety success story, the release might, more accurately, have drawn attention to the remarkable life-saving properties of the High Speed Barrier. ✖