SAFETY: DOWN TO THE WIRE

Driver safety often steals the spotlight, but what about the protection of spectators? **Alan Stoddart** discovers that painstaking R&D has led to a spectacular breakthrough

THERE are a few perpetual concerns in motorsport. Priorities that, regardless of the category, the country, the level of competition or the discipline, are always the same. Motorsport engineers are always trying to make parts lighter. They are always trying to make engines more efficient, reducing parasitic losses and maximising the amount of kinetic energy that can be delivered from the limited chemical energy that is poured in as petrol, and they are always trying to make cars as aerodynamic as possible.

Another of these ever-present concerns is safety. Mercifully, the days when driver deaths were constantly in the sports pages are long gone. As the decades have passed, new innovations have been introduced, with Nomex overalls, HANS devices, side impact structures and the Halo all playing their part in helping drivers to routinely walk away from even the most brutal-looking crashes.

Driver safety is just half the battle, however, with only a cursory look at the British Pathé report on the 1955 Le Mans tragedy highlighting what can go wrong when spectators aren't also properly protected. Of course, the practice of using hay bales to protect those at the sides of racetracks is long gone, but, as crashes like that which injured a marshal standing behind a fence at Bathurst in 2015 demonstrate, there is still more that can be done.

One of the key things, which has only recently been achieved, is having a standardised FIA homologation for debris fencing. This may sound surprising given the litany of tests, approvals and frequent updates to standards that most safety equipment must go through, but this is in part because the FIA struggled to run repeatable tests, making comparisons nigh-on impossible to achieve.

BELOW The high-tensile mesh is four times stronger than conventional chain-link mesh

ABOVE & BELOW The need for a certified homologation system was underlined by Dario Franchitti's IndyCar accident at Houston, Texas, in 2013, where the ferocity of the impact hurled part of the fencing high into a spectator grandstand

LAT USA

At the time, some 11 years ago, the FIA was using an air-powered cannon to fire a wrecking ball at the fences it wanted to test the performance of, but it was unable to ensure that the wrecking ball always hit the fence at the same velocity. To solve this problem, the body sought industry expertise, and turned to Geobrugg, a company that had built its reputation with its natural hazard prevention systems and rockfall barriers.

To help the FIA look into the fences that were used at racetracks at the time, Geobrugg created a test, where a 780 kg steel sphere was shot into a fence at a 90-degree angle, at 65 kilometres an hour. This test simulated the type of force a fence would have to withstand if a Formula 1 car were to get airborne and strike a fence at the end of a run-off area: one of the toughest challenges facing a fence.

At that time, however, Geobrugg realised it was able to do more than test the fences, and saw that by using its own high tensile wire mesh, it could actually produce a better fence than those being tested by the FIA.

"So that was really the start of our whole motorsport R&D process, when the FIA realised that they were not really happy with what was out there and there was an opportunity to make better performing debris fences," explains Geobrugg motorsport director Jochen Braunwarth.

The company's research and development paid off, and three years after the initial approach from the FIA, Geobrugg had a product that convincingly passed the test it was originally contracted to implement. The company was then free to take its new, FIA-tested, debris fence to market.

"So I was very happy, and Geobrugg was very happy, but when we approached racetracks, nobody wanted to buy our system, because nobody was able to relate the steel sphere test that we had passed, with the real world," Braunwarth says.

"They just said 'Oh the testing you did is great, but we have the guidelines and we manufacture each fence accordingly. It's great your system is able to catch the steel sphere, but we don't have steel spheres flying around the circuit."

These rebuttals made Geobrugg and the FIA realise that they needed to conduct a test more representative of the kinds of accidents that drivers have in races. As such, the FIA came up with a test in which a 1,000 kg car is fired at 120 kph at the debris fence at a 20-degree angle. The fence must not deform further than three metres, and no significantly-sized pieces of debris should make it through the fence.

Geobrugg's high tensile mesh fencing also passed this new, tougher, test. But more importantly, it demonstrated to circuit owners why it was so important and what could go wrong if the incorrect fence was used.

What's more, safety wasn't the only improvement offered by Geobrugg's new fencing. The fences would, after all, be no use if they protected spectators, but only by ruining their experience of the race. So, thanks to all the extensive testing, what Geobrugg was able to achieve was to make a debris fence with 50 cm cable spacing rather than a 25 cm cable spacing, which meant that the new fencing had less of an impact on the view of the racing than other types of fences.

The new fencing offered tracks other benefits too. Potential weak points, like camera openings or gaps in fencings, can be thought out and designed in from the start. After all, even a Class 1 circuit is likely to only need camera openings once or twice a year; the rest of the time, they are a liability. So, in Geobrugg's new fences, the openings can be closed to look after the marshals and spectators behind them.

> *"You absorb the energy of the impact by deformation and transferring it to a different area"*

It is part of a well thought out system and not merely an ad-hoc addition.

"We had good safety because of the tests, and we had good visibility of the racetracks, and at that point the Circuit of the Americas decided to use our system. Then Sochi decided to use our system for their entire circuit," says Braunwarth

"But there were still only guidelines as to debris fences. So, as you might imagine, in different countries everybody interpreted the guidelines ▶


ABOVE & BELOW Testing times: bespoke tests were devised, including a steel sphere (above) and 1,000 kg car (below) being fired at the debris fence at specific angles



differently, so you ended up with entirely different systems out there in Australia compared to America, compared to Europe. For us this made it very difficult to compete as there was no real base of comparison."

This was a problem for the FIA, which wanted to make certain that facilities around the world all met the same high standard. The obvious solution was to adopt the method used in ensuring every driver's race suits, helmets and harnesses were identically suitable: performance-based testing. This homologation standard guarantees that for the first time, debris fences, whether at a permanent facility like COTA or for a temporary street circuit, such as the upcoming Hanoi track, both demonstrably meet a level of performance deemed acceptable by the FIA.

This is critical, particularly given the way large construction projects are usually handled. In most instances when a circuit is being built, the first priorities are for things like the architecture, while debris fences are usually one of the last pieces of the puzzle, and an area where money has often needed to be saved. As such, circuit builders would go to a local steel workshop and try to assemble something that may have appeared suitable, but didn't actually perform as required. Geobrugg's fences are, after all, deceptively complex.

"The key element is the mesh," explains Braunwarth. "It is a high tensile mesh which is four times stronger than the conventional chain-link mesh. When put into the system together with the cables and the posts and the foundations, it all works together during the impact. The impact transfers force to the cables, which transfers loads to the poles and then to the foundation.

"So you are able to absorb the energy of the impact by deformation and transferring it to a different area. If you have one element failing, if for example the cable fails and you don't activate the lifting out of the foundation, you are unable to burn the energy. This all starts with the activation of the mesh."

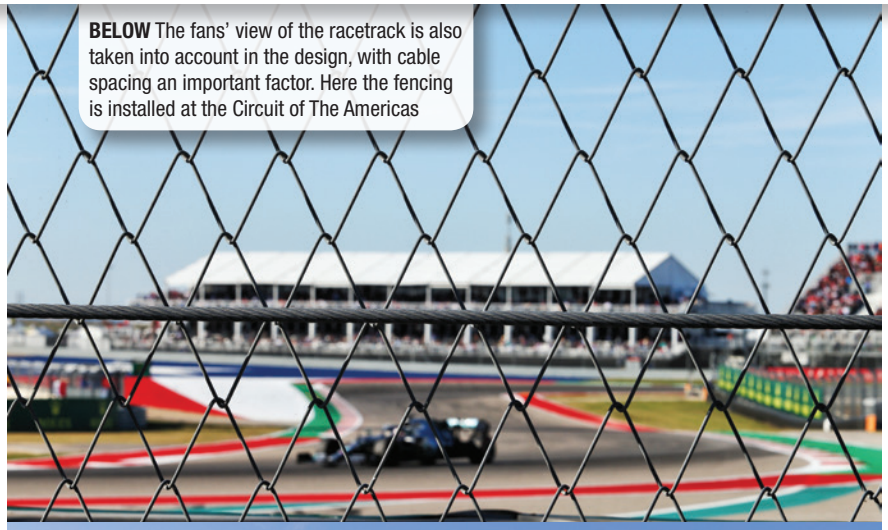
> *"Surprisingly, the first to use the FIA homologated fences were private test tracks"*

To ensure that all the pieces are correctly installed, and that the fences can offer life-saving protection, whenever the Swiss firm works on a construction project, like the upcoming Hanoi racetrack, it starts by getting drawings from the architect, which allow it to construct a layout design. This enables Geobrugg to work out exactly how many barrier blocks it needs, and how many fence panels and the section lengths, before working very closely with the designer to ensure that all the requirements in terms of the debris fences are met.

This is in stark contrast to the past, where the process often saw local steel workshops arrive at the track with a selection of material, and instead of following a meticulous plan, simply assemble it there and then. This lack of design for the construction side meant there ended up being differences in performance across a single project, let alone different projects across the world.

Performance-based homologation is also important for another reason. It allows traceability.

Every fence that is erected by Geobrugg, is labelled and registered with the FIA. This shows not only that the fence is up ▶



BELOW The fans' view of the racetrack is also taken into account in the design, with cable spacing an important factor. Here the fencing is installed at the Circuit of The Americas

ABOVE The safety bar is set high and, crucially, repeatable whether at permanent facilities or temporary tracks. Here the system is installed at Spa

to the new standards required by the FIA, but it also ensures there is traceability and accountability. By doing this, the FIA can be sure that if there is a problem with a fence, all similar enclosures across the world can be identified and either replaced or upgraded because they can easily be found. Presently, if there is a problem or a weakness with a fence, it isn't easy to find where else identical systems may be installed, meaning that the same, perhaps easily-solved problem, could continue to be an issue elsewhere in the world, long after the initial failing is discovered.

The model for mandating 3501-2017 and 3502-2018 homologated fences, will be similar to that of the Halo, with a phased introduction starting at the top levels and then being adopted further and further down. This means that currently, only new Grade 1 facilities are required to have the homologated fences, but this requirement will extend to an increasing number of facilities over the coming years.

Significant, however, is the fact that there is, in some form, an FIA homologation at all, which has led to its deployment in some unexpected places.

"Soon after the standards were published a lot of test tracks approached, like Fiat Chrysler in Italy, and Porsche, Bosch and Daimler. They said that for them, a track is a working place, and that their responsibility is to make sure it is a safe environment for people to work. So what better option for them is there than to say, 'Okay, this is the standard debris fence, it is homologated by the FIA, it is the maximum I can do to provide my employees with a safe jobsite'," recalls Braunwarth.

"So, perhaps surprisingly, the first project we did with the FIA labelling was for Daimler at one of their test sites, in Immendingen, which is a brand new facility, and then it was one for VW and then the same for Fiat Chrysler. So even though we started the work for Grade 1 facilities, the first tracks to use the FIA homologated fences are private test tracks."

Another surprising early adopter is country clubs. Wealthy individuals pay the membership fee to the club, which might cost $250,000 a year, and then at weekends take their families to the racetracks to enjoy the motorsport. If something were to happen to one of these spectators, it would be impossible to explain that, despite the very high membership fee they paid, the club used a non-tested debris fence to protect them, when there was a proven alternative readily available.

Fences aren't the only area of focus for the FIA, though, with the same problems of variation and traceability being pertinent for any number of other parts of a racetrack, from light panels, to paint, to race control. These might seem relatively insignificant compared to the major leaps in safety from the past, such as the mandating of seatbelts in 1972, or the introduction of crash tests in 1985, but there is still progress to be made. After all, wherever there is a chance someone can be hurt participating in motorsport, there are still opportunities left for improvement. RT

ABOVE Every fence erected by Geobrugg is labelled and registered with the FIA for traceability