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THE FRAME GAME

AS A SOLID BASE IS THE CORE OF ANY DECENT FPV RACER, DAVE STOCK MET UP WITH SOME OF THE UK'S MOST INNOVATIVE FRAME DESIGNERS TO FIND OUT WHAT'S REQUIRED TO PRODUCE FUN, TOUGH AND, CRUCIALLY, RACE-WINING FRAMES.



Last month our extended look into the world of first person view racing examined some of the key elements needed to get an FPV drone airborne. Following on from that, we take a more detailed look at racing frames; the home, so to speak, that keeps all the components in the right place, offering a degree of protection when the inevitable crash happens. FPV frames come in all sorts of shapes and sizes, each with its own unique properties and performance traits – but pilots are constantly demanding faster and stronger frames and frame-makers have to keep up.

In the beginning, a glut of cheap and mainly Chinese frames flooded the market performing a 'good enough' job. However, the problem was that those frames were made of a poor material, were flimsy and didn't have the racing specifications demanded of them as the scene developed. Those early frames lacked the refinement that comes with experience and rigorous real-world testing.

Fast forward a year and, as the FPV scene expands and competition calls for race-winning frames, pilots emerge with a wealth of flight experience, technical know-how and enough hard-won skill to know what they expect from a frame, and they're not afraid to let the manufacturers know how to improve their products.

When Matt Denham, a UK pilot from Sussex, found issues on the then newly-released Team Black Sheep Gemini hexacopter he took it upon himself to troubleshoot a solution. "Flying

would be a handful when the craft turned," he explains. "I started off drilling holes in the canopy which helped with the airflow and improved the flight characteristics." When others experienced the same issue, Raphael Pirker, owner of Team Black Sheep, started to get interested in what Denham was doing.

This culminated in Pirker taking on board Matt's suggestions and asking him to test other parts and products. "[Pirker] started to ship loads of spare parts to basically play with, crash, bend and modify to look for solutions," says Denham, who now designs a number of frames for the American company Armattan.

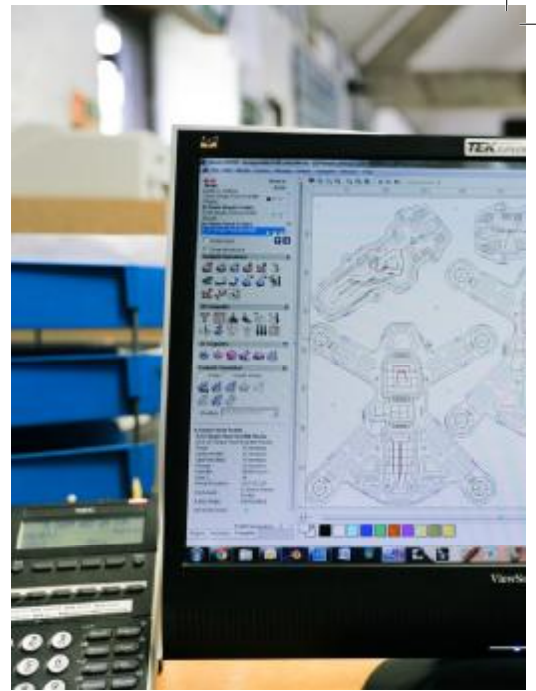
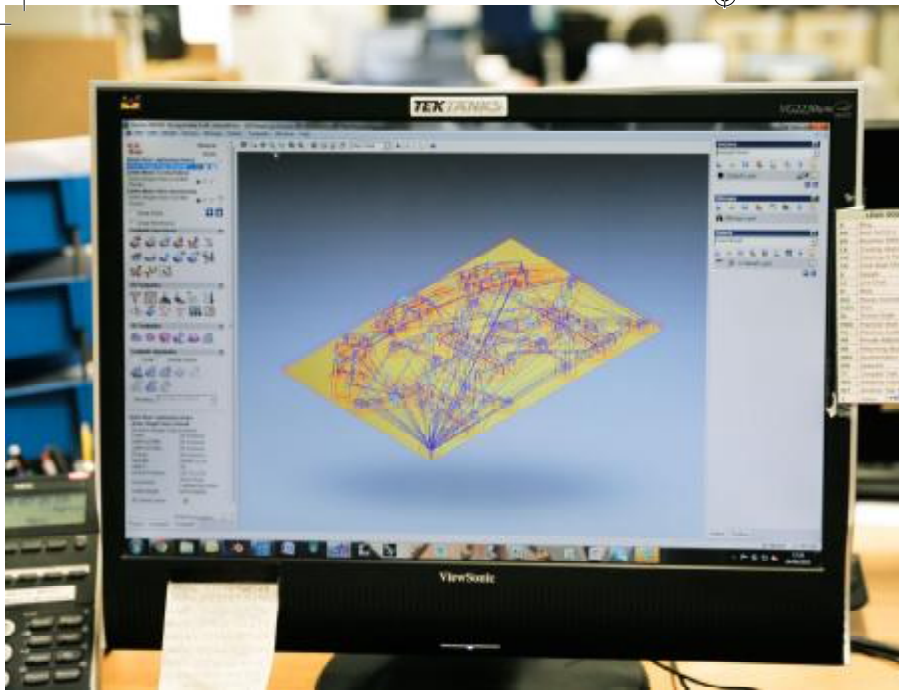
Strength is a key factor in Denham's designs – notable by Armattan's lifetime warranty; the only company to do so on carbon fibre frames.

"I want something people can crash and get straight back up time and time again" he says, and other pilots agree. "A broken frame will spell the end of a session and that's no fun" added Richard Hartley, an FPV pilot from Portsmouth, UK.

BREAKING = BAD

For Stefan Mirfin, owner of Thug frames – a UK brand which embodies the attitude and style of skateboard and snowboarding culture – toughness is paramount. "I'm a flyer, first and foremost, and I've broken enough of my own gear to know what it's like," he says. "I'm looking for a nice amount of durability, although concrete always wins in the end," he adds with a smile.

"The people who are breaking frames are the ones flying them extremely hard, and they're the ones I want to be breaking them, as we quickly discover where the weak points are"



Mirfin puts a lot of effort into researching, tweaking and specifying materials that will create the toughest frame possible and, whilst he was a very early adopter of the 3D printer especially in his early frames, it's carbon fibre that provides the right balance of strength and weight these days. "It's not very hard to draw a frame," he explains. "It's knowing your materials – that's where the expertise comes in. Over the last year we've moved from using twill fibre to a heavier press classic monofibre".

It's this heavier press that allows more carbon to be laid down in thinner sheets. To illustrate the advantage he shows us the latest version next to an older, much thicker example. "They're about equal strength," he assures us, and that's not all. "There's as much strength in the small tweaks, too."

Carbon fibre has lines, or grain, much like the grain of a tree, and weak points can occur along these. For the latest version of the popular THuG180, Mirfin looked at all of the joining angles and grain, and considered the forces being applied. "There isn't an angle here that isn't thought about; everything has been tweaked to try and take the angle off and improve strength," he explains.

Mirfin's range is constantly evolving. He's on version 5 of the THuG180 already, and older lines are discontinued to make way for improved designs. "If I think of a better way to do something I'm going to do it, even if I think I've only improved it by a nanobit." Although he's careful not to alienate older customers, adding: "I try to keep the basic bolt pattern the same, so people can swap the plates around."

This makes old and new frames compatible and endlessly customisable – or "a bit Meccano-y" as Mirfin puts it. His on-site production facility means older parts can be printed quickly to order, and new ideas or designs can be created and tested quickly. "I can design, cut and prototype within 24 hours," he says, though he's keen to point out he's also constantly staying on top of quality control. "I oversee what I do; it's got my name on it. The brand is me."

FOSSIL FUELLED

Carbon frames are popular in the FPV world, and you'd be forgiven for thinking that all frames were made of the sleek, black,

ubiquitous material. However, in early 2015, born from a sequence of happy coincidences, Fossils Stuff's Gravity 250 was launched. For company owner Martin Rye it was the depressing list of non-descript, cheap and flimsy-looking 250 frames from China that got him thinking "there's got to be another way". Meanwhile Rye's CNC machine, used for his day job producing water, waste and fuel tanks for marine applications, was regularly sitting unused. "So I designed a 250 and blow me the bloody thing flew," he explains, still surprised at his debut success.

Around the same time, FPV pilot Chris Weston noticed that a new frame maker had popped up right in his neighbourhood – he and Rye live a short car drive from each other in Alton, Hampshire – and a few phone calls later a formidable team was born. "We got on really well and that's where it all started, really," says Rye. After giving Weston a frame to test, Chris' advice and feedback was incorporated into Rye's designs and the Gravity MK1 was born.

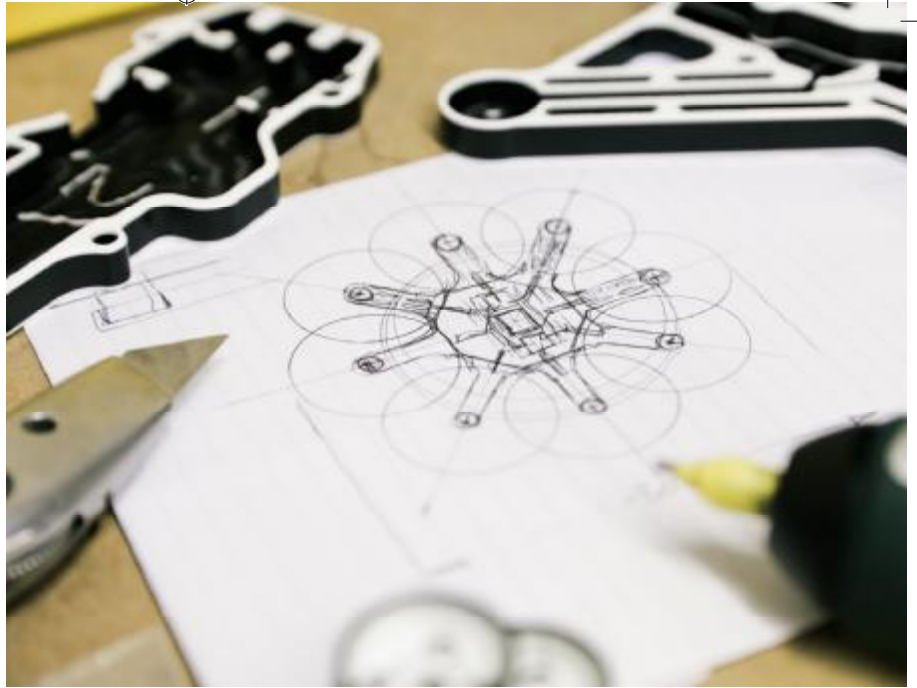
To produce the frame Rye looked no further than his own storeroom. "We had a load of

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surplus material in the warehouse from a job; sheets and sheets of black and yellow composite HDPE plastic," he tells us. The material gave the already unusual frame its distinctive colour but had another advantage, too – it was incredibly strong.

"It's almost certainly stronger than carbon," says Rye, "that's where we came up with the idea to do a lifetime warranty." So far he's only had about 10 returns, "and it's lowering all the





time". However, Martin adds that getting a broken frame back isn't necessarily seen as a negative: "The people who are breaking them are the ones flying them extremely hard, and they're the ones I want to be breaking them as we quickly discover where the weak points are." The bottom line is that each broken frame helps him design something even tougher.

PILOT LIGHTS

To get more real-world feedback frame-makers have begun sponsoring racing teams, supplying them with frames and parts. Not only does this ensure the companies' names and frames are on the flightline, it also provides easy access to pilots, ready and eager to test the newest design to destruction, generating useful data and advice for the design team.

"Without their feedback I'd be totally stuffed really," says Rye whose Team Fossil pilots include Chris Weston, Tony Marchant, Jonny Banton and Simon Martinez. Mirfin, who also sponsors a team, agrees. "They do a lot of testing, mainly to get a good feel for durability versus weight. They'll say 'change this, tweak that' and I'll listen, tweaking the things to how I like it, of course."

For Fossil in particular getting good feedback is essential right now as the company is currently testing an innovative new FPV frame called the Event Horizon. The design is inspired, in looks at least (and the name), by science-fiction. "I'm a bit of a sci-fi nut," Martin admits before explaining how the idea was to start messing around with aerodynamics on a 280 frame to try and achieve speed advantages.

"When quads are flying at their optimum angle, up to 60 degrees from the horizontal, there is a huge amount of cross-sectional area hitting the wind," Rye explains. "I was holding a Gravity one day and I thought 'why don't we flip this on to its side through 90 degrees?' Everything is still contained but the



cross-sectional area has been reduced. You've now got a thin knife going through the air." To complete the design Martin then added thin, tubular carbon arms for the motors, keeping a low profile aesthetic and reducing the surface area further.

"It's definitely quicker and probably just as balanced as the original Gravity," Rye says of the new frame but, as with all new products, testing has thrown up some issues: "It wobbles," test pilot Tony Marchant pointed out, referring to a yaw problem when flying at speed. "It's too unstable, but it is fast," he admits. "You could win races, if you could tame it."

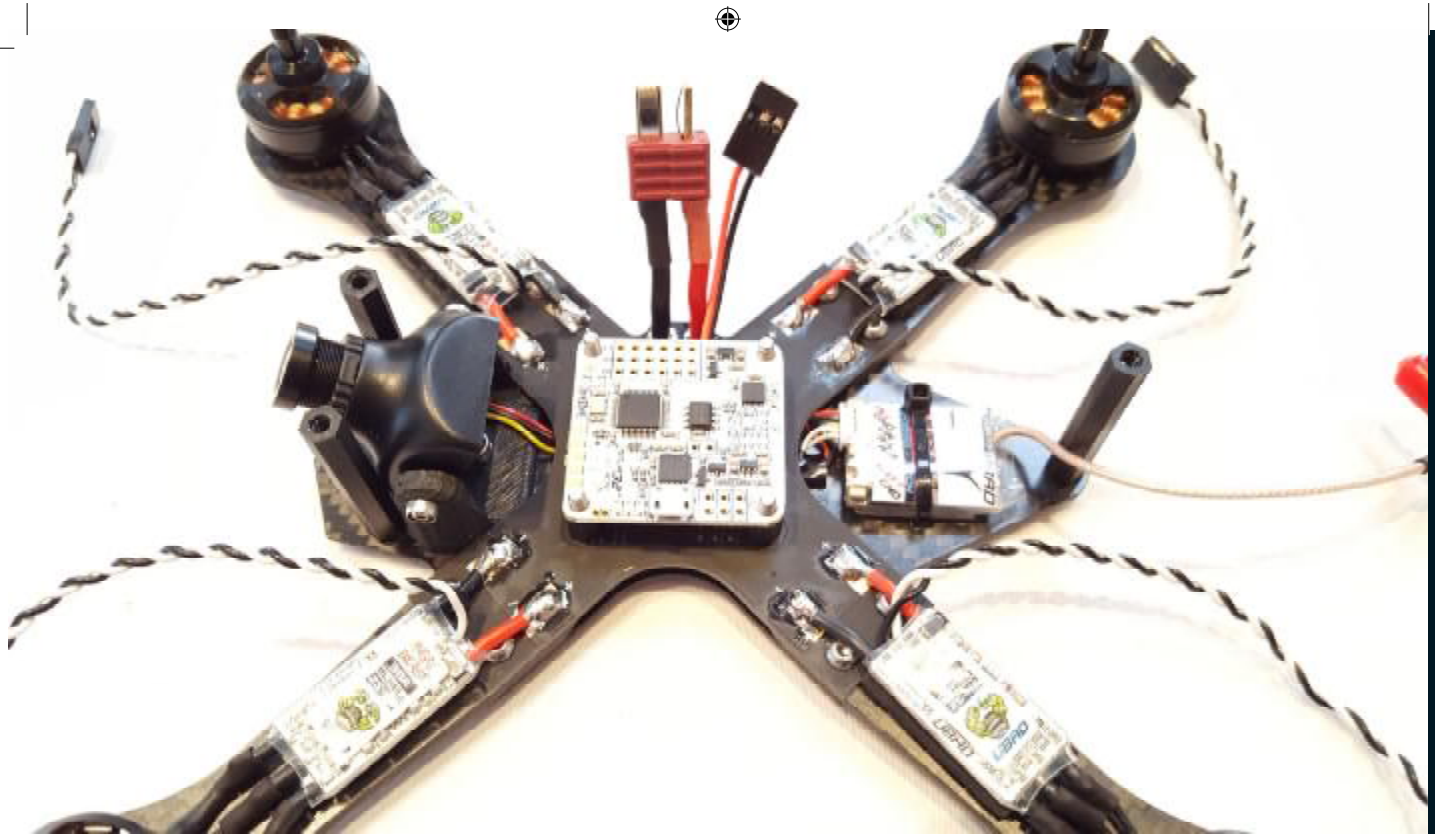
Matt Denham suggests that this could be due to a disrupted airflow on the new frame causing the rear propellers to stall slightly but Rye is cautious. "Maybe because the sides are flat and the props are too close to the body it's causing problems, but it could be anything." At the moment it's an isolated incident – none of the other test pilots are seeing these problems – and for Martin it's too early to be concerned:

"It's not really been out there enough, we just need more packs through it."

It's this sort of feedback that refines quality products and, with in-house testing and production facilities, it's possible to make a change and be flying a modified frame the next day. "I think that's a huge advantage," Rye says. Whilst commercially Martin is keen to get the new product out and onto the shelves, he refuses to ship a sub-standard product. "It'd be lovely to get it through the door next week, but we're not going to be doing that until we're absolutely convinced that it's okay." So, for now, eager pilots will have to continue waiting.

THE X FACTOR

Thug's latest incarnation, the 180 THuGPiG launched in December last year, takes a different track, following the current trend towards X frames: small 180 frames shaped in an X configuration where both axis are equal in length. X frames have become popular among FPV pilots as they offer better racing



qualities with reduced weight, better balance and stronger rigidity. "They're faster and more agile," says Mirfin, owing to equally balanced axis and centrally stacked components that offer a tight centre of gravity.

Perhaps most notably it's their low weight that gets top pilots most excited. "Whilst a heavier frame is good for freestyle, carrying the weight into the next move, it's less good for racing," says Luke Bannister, the racing pilot best known by his handle, BanniUK. "X frames require less power to thrust over objects," adds Simon Cope, another UK pilot, "and hence have more agility and ability to deliver power".

Companies such as Black Bolt are touting power ratios of 12-to-1 on its XBR220 frame and this market is growing. Already Thug, Blackout, Black Bolt and Armattan have responded, although Fossils Stuff is yet to enter the 180 or X frame market. "We're looking at a few things," says Rye, explaining that he is in talks with Francis Harris, another pilot on the UK scene, about another new frame collaboration.

Interestingly, however, individual pilots have started designing X frames of their own rather than buying off the shelf from established producers. For Tom Stanton, a racing pilot from Berkshire in the UK, it was a drive to gain a competitive advantage. He told us it was finding "a specific race machine to have an advantage over other top pilots" that led to him creating his own "TSX" frame.

"As a racer myself, I wanted something fast and very minimal," Tom explains. Having three of the best UK pilots as friends and testing buddies helped, too, as he enlisted Brett Collis, Gary Kent and Luke Bannister to put the



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frame through its paces. "The TSX is light, it's fast and I just loved the design," says Bannister. "I can still win competitions even with the added weight of a GoPro," he says, referring to his recent success at the UK Drone Show.

In fact, that particular race was dominated by Tom's TSX frames. "Luke Bannister took the win on both days with his TSX250," says Stanton, in a race where three out of four finalists were flying a TSX. "I believe the verdict on the frame was clear," Stanton notes, clearly pleased with his frames' performance over the weekend.

"People say that frames are just frames but this is simply not true," explains Brett Collis, one of the UK's best pilots. And as more and more enthusiasts enter the scene and competitive racing increases, pilots will continue to demand frames that suit their needs – and frame makers must respond quickly or be left behind. "The industry evolves so quickly, we're always playing catch up," Mirfin admits.

And it seems that the best way to create a product that a pilot wants to use is to make sure there's a pilot on hand to tell you what you are doing right, or, more importantly, wrong.



MEET THE MAKERS: FOSSILS STUFF

www.fossilsstuff.com

Martin Rye also owns Tektanks, a company specialising in custom-built water, waste and marine diesel fuel tanks for the marine environment. Working predominantly with composite plastics, Martin turned his machinery, materials and experience to frame-making in late 2014.

MATERIAL: Composite HDPE plastic
LOCATION: Alton, Hampshire, UK
CURRENT FRAME RANGE: Gravity 250, Gravity 280

