WHAT'S THAT?

ALUMINIUM

Cycle makers realised that aluminium could be used to build much lighter bikes back in the 1890s. But it is only recently that aluminium frames have become as reliable as steel with the introduction of new alloys, oversize tubing and heat treatments. Aluminium alloy tubing is relatively cheap, resulting in a lower price for aluminium frames. However there are only a few custom framebuilders working with aluminium. The best aluminium alloys in heat treated state are about half as strong as the best steel alloys. Aluminium has a modulus of elasticity only one third that of steel. The first frames used the same tube diameters as steel ones and were whippy. Aluminium, unlike steel, starts to lose its strength from the first moment that a load is applied. Modern alloys have extended the fatigue life considerably and oversize tubing has ensured that fatigue strength should not be a problem. Aluminium is about one third the weight of steel.

ALLOY

A material with metallic properties which is composed of two or more chemical elements of which at least one is a metal. They are not chemically combined but are thoroughly mixed when in the molten state. Their properties are superior to pure metals.

BOTTOM BRACKET HEIGHT

...is measured from the centre of the bottom bracket to the ground when the bike is perfectly vertical. It has to be high enough for the pedals not to touch the ground when cornering. For smaller riders, on touring or city bike frames it needs to be as low as possible in order that a foot can easily be put on the ground. On a track or road frame, pedal clearance is more important. The exact distance will depend on crank length but with average length (170mm) cranks 10.5" (26.5cm) is about right.

CUSTOMCAZZA

To help you through the process of buying a custom bike we needed a guinea pig, someone who would set a suitable problem for the builder to solve. After all, you don't turn up at the frame builder and say "copy this off-the-peg design for me" you get him to build a bike for YOU and you alone. With most male riders in the office already blatting around on their own bikes who better than Caroline 'Cazza' Griffiths, **CT**'s intrepid Assistant Editor?

Do you have it in a smaller size?

Buying a custom built bike. It's a bit like buying an bespoke suit. It says; "I fit you – I was made for you."

To me, the idea sounded great – I've always felt rather ill at ease on a 'man's bike', what with my arms stretched out so far that sometimes even going round a corner forced my heart into my mouth. There are the usual phrases bandied about the office about bikes not being suitable for women; "too long in the top tube," and "not enough height at the front," but it's not until you ride a few different bikes that you start to make sense of the true meaning of these pearls of wisdom.

Women's specific design

So then I tried a women's specific design (see the GT Ricochet test in **CT** September) and what a difference. I suddenly felt at home – ready for anything, just about. Then the bubble burst. Whilst on a particularly hilly cycling holiday a riding buddy saw me suffering and suggested I try her bike – a top of the range Gary Fisher – admittedly it was a small men's frame and I felt a bit out of sorts on it but it was so light and graceful – suddenly I felt like Dawn French next to Darcy Bussie. It was time for a change.

Lightness isn't everything

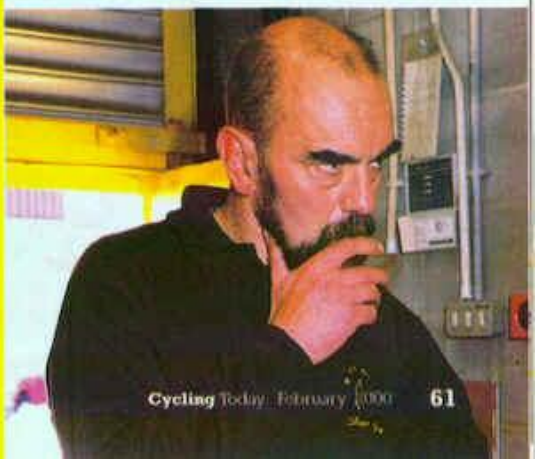
Well, it was to me. I looked at a few bikes and realised that the weight saved in wheels and frame make a considerable difference when lugging your bike uphill. Looking at the bikes we tested in the women's specific design test, they all rode really well and fulfilled a tight budget constraint which is fine if you are starting out, but to get the weight below 25lbs (which seems to be the norm for 'serious' cross country bikes) you simply have to spend more dosh.

But what to buy?

It struck me that if I wanted to spend between £1200 and £1500 on a bike there weren't any women's specific designs available with a really decent spec. So I'd have to settle for a men's frame and adapt it to suit me – not ideal as after spending an initial sum I'd probably have to spend a few hundred pounds extra to get it right (stem, bars, saddle etc.) – it's a dilemma, one that requires careful planning.

Dr. Dave

That's when someone suggested a custom built frame. So I phoned Dave Yates who has been building mountain and road bikes for over 23 years – an impressive CV and hopefully someone who could solve all my problems...



1 The frame design process starts with talking about what the bike will be used for, taking your old bike to the builders on your first visit is essential for the designer to get an idea of what you've been riding and if you've got into any bad habits.

2 Sizing up the frame and looking at how you sit on the bike takes plenty of time, pedalling backwards for ages so that the position of your legs in relation to the rest of the body can be fully appreciated. Some builders use complicated mathematical equations and drawings to reach the final design for you, others just have a feel for what will be right – either way, several dimensions will be decided upon, stem length and saddle height can be determined too.

WHAT'S THAT?

CRANK LENGTH

...is measured from the centre of the bottom bracket spindle hole to the centre of the pedal thread. If you're going to the trouble of getting a custom frame, getting the crank length right is the first step. The correct crank length is related to your leg length. Between 20% and 21% of your inner leg length measured from crotch to floor is about right as crank length. Riders with 31-32" inside legs are fine with 170mm long cranks. Everyone else needs either shorter or longer cranks.

DROPOUT WIDTH

...is the width between the inside faces of the rear dropouts. Most road bike frames are 130mm and mountain bikes 135mm. Touring bikes vary but 135mm allows the wheels to be less heavily dished and thus stronger. Tandems are normally 140 or 145mm between the dropouts

horizontal dropouts

vertical dropouts

DROPOUTS

...are the thick slotted plates that the bike's wheels fasten to at the bottom of the front forks and rear of the rear triangle. There are two main styles of rear dropout; vertical and horizontal. Vertical dropouts have vertical or near vertical slots. Wheel replacement is very easy but no wheel adjustment is possible when a wheel is buckled in an accident. Horizontal dropouts allow for a little adjustment with a buckled wheel and are advised for touring bikes.

FANCY CUT LUGS

...are where the lug's edges are shaped ornately. Many claims have been made that they distribute the stresses more evenly or that they allow less heat to be used during brazing. These are all fallacies, but they can look very nice. Len Phipps (0181 524 8501) can cut fancy lugs to your design. Hetchins, Bates, Mercian, Bob Jackson and Trevor Jarvis all offer frames with ornate lugs.

FATIGUE

...is the phenomenon in materials that leads to breakage under repeated stresses. Fatigue has a maximum value less than the tensile strength of the material. It is one of the most common causes of frame failure.

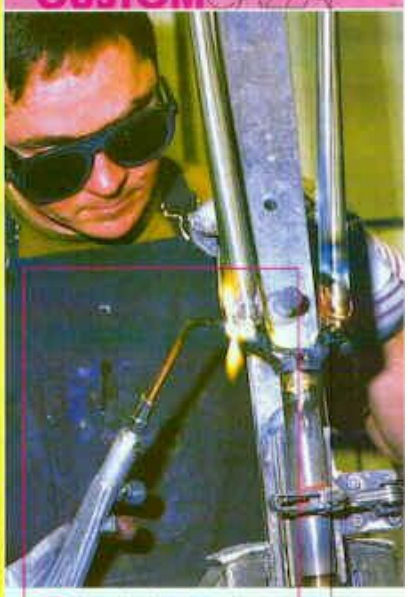
WHAT'S THAT?

FILLET BRAZING
...is a method of joining two steel surfaces together by flowing a non-ferrous metal between them at high temperature without the use of lugs. It is a bit like soldering but at a much higher temperature, normally on bike frames between 700 and 900°C. Fillet brazing offers a better fatigue life than tig welding but it's not as good as a brazed joint with lugs. It has a wonderful smooth one piece appearance. Care is needed to ensure that not too much heat is used building up the fillets.

FORK OFFSET
...is the distance between a line taken through the centre line of the head tube and the dropout at a right angle. It, together with the head angle, is one of the primary determinants of the stability of a bicycle frame. To achieve a more stable handling frame, fork offset, contrary to common sense, needs to be shortened.

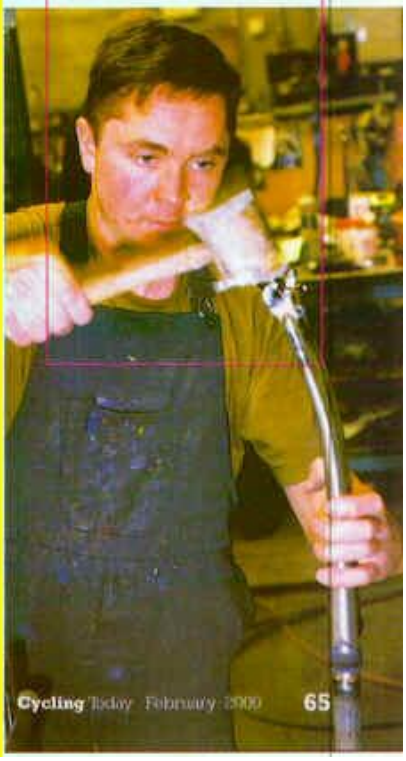
FRAME SIZE
Most frames are sized by the length of the seat tube. This is measured from the centre of the bottom bracket shell to either the centre line or top of the top tube. It is perhaps the least important dimension. Standover height is more important as is top tube length, bottom bracket height, handlebar height and the front centre dimension.

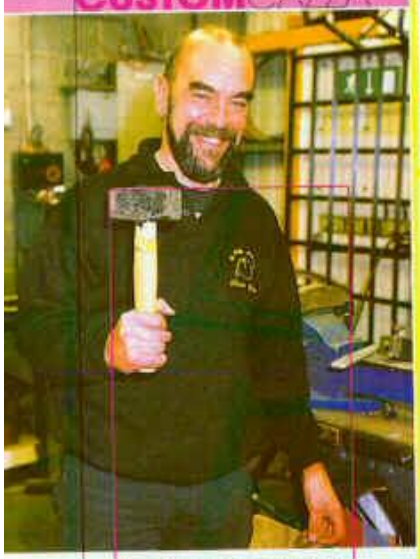
FRAME STIFFNESS
...is considered by many riders to be a desirable characteristic. Frame stiffness first has to be defined. It is the resistance of the bottom bracket to be bent sideways or the amount the frame flex. Doubling the tube diameter will double the weight but will also increase the stiffness by a factor of nearly 8.



3 Then the frame can be started. Forks can be built to suit the frame and if you're using suspension the head and seat angles suitably adjusted to cope with the travel and type of position that is preferred. In my case, suspension forks and an upright position for flat cross country bars and bar ends. With road frames, builders often supply steel forks with a steel frame although aftermarket carbon fibre forks seem to be more popular these days.

4 Framebuilding is still a hands on activity though and every part of the frame has had several hours of close personal attention, getting forks to handle properly takes care and experience.



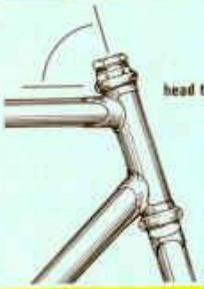


5 Dave was really helpful and explained why he was building my bike in the way he felt best, this is essential if you are to be happy with the end result. If you know more you definitely appreciate the final outcome, he suggested that my saddle was too low and the bars were too far away... he also had a very large hammer for precision adjustments.

6 Builders all have their preferences for building frames, some will spend hours setting up huge jigs and welding equipment and others use the more tactile way of assembling the frame in a vice from the component tubes and saving the jig work for later on in the process.

WHAT'S THAT?

HEAD TUBE ANGLE
...is the angle between the head tube and a horizontal line. It affects how quickly the bike responds to steering input.



head tube angle

JIG BUILDING
Frames can be built in one large jig, or small jigs are used to hold together one joint at a time. They are then checked for alignment on a master jig or surface table after each stage. Others will use a large jig to hold the frame whilst the joints are tacked together before brazing them properly out of the jig. Building from a jig is probably a little more foolproof than freehand building but still needs care. Forks are always built in a jig.

LUG
A socket that forms the junction between two or more tubes. It acts as a form of external butting. The strength of the joint depends on the accuracy of the tube mitring which is hidden by the lugs, the fit of the lug and the skill of the builder. The lugs used in frames can be made in one of two ways; pressed or investment cast. The type of lug used does not affect the stiffness of a frame. Good pressed lugs will improve the fatigue life of a frame built with ultra thin gauge tubing. But investment cast bottom brackets are generally preferred as their threads are better formed and stronger. Lugged frames offer the best fatigue life especially if silver solder is used in place of braze – most will have a pretty much indefinite life. Lugs are only made in a limited number of angles and this limits the possibilities of deviating from a standard design.

lugged frame

MICRO FRAMES
...feature smaller than conventional sized seat tubes. The top tube length remains the same. Top tubes are generally horizontal. Micro frames are generally used for time trials or pursuits.

WHAT'S THAT?

MITRING
...is where the tube ends are shaped to form around another tube or tube end. The strength of the joint between two tubes depends on them fitting each other very closely. Brazing depends on capillary action to draw the brass in and hold the tubes together so the space between the tubes should be almost too small to see. Mitring can be done by two methods – hacksaw and file or lathe/milling machine with a hole saw. Using a lathe or milling machine is particularly quick if there are a number of tubes to be cut at the same angle. However, both methods depend on care for an accurate joint.

MODULUS OF ELASTICITY
...describes the physical property that measures the rigidity of material. A material with a high modulus of elasticity is stiffer than one with a lower modulus.

OVERSIZE TUBING
Tubing that is larger in diameter than standard. Standard road and touring bike tubing diameter is 1" for top tube and 1 1/8" for downtube and seat tube. Many road and touring bikes are now using larger diameter tubing, typically with a 1 1/8" top tube and sometimes with a 1 1/4" downtube. Most steel bikes still retain a 1 1/8" seat tube. Almost all mountain bikes use oversize tubing. Oversize tubing makes for a stronger and stiffer frame, though this is not always desirable – thick tubing can produce a very hard ride.

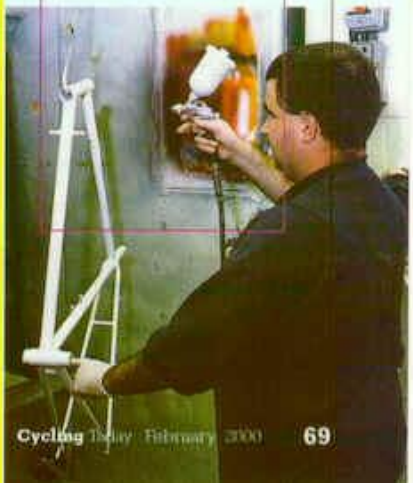
SEAT TUBE ANGLE
...is that between a horizontal line and the seat tube. The seat tube angle determines where you sit in relation to the pedals. About a 6-8cm forwards and backwards variation in position is possible by moving the saddle on the seatpost. A commonly held belief is that a plumbline dropped through your knee should, with your feet on the pedals and cranks horizontal, pass through the centre of the pedal spindle. This is fallacious though it ➤

CUSTOMCAZZA

7 Try finding a 2mm Allen key in this lot...still, it's a lot tidier than my desk.

8 Handbuilding bikes requires plenty of measuring and checking of joints – especially if it's brazed together – so that the end result is spot on.

9 One of the most noticeable improvements that a handbuilt frame will provide is quality of workmanship and an excellent paint finish. Unlike mass produced frames, every stage is done by hand so that care and attention to detail is guaranteed.



WHAT'S THAT?

TIG WELDING
...is a form of electrical welding in which the metals are melted by an electric arc produced from a non-consumable electrode and in which an inert gas is used to shield the surfaces from oxidation. With tig welding it is possible to build frames to any design easily but they must be jig built. It produces a strong frame with a very small heat affected zone. Some research, however, has shown that tig welded joints are not as resistant to fatigue as lugged or fillet brazed joints.

TITANIUM
...weighs less than steel and so offers the promise of lighter frames. Speedwell in Britain made the first titanium frames in the 1970s. Titanium alloys are extremely expensive because titanium is costly to refine. Titanium is tig welded in an inert atmosphere. There are no custom builders in Britain offering titanium as a frame material. Titanium alloys can be as strong as the best steel alloys and welding only reduces the strength a little. Titanium has two thirds the modules of elasticity of steel so the early frames which used standard tube diameters flexed a lot. Modern titanium frames have moderately oversized tube diameters to restore the stiffness lost. Titanium alloys such as 3/2.5v have a better fatigue life than the best steel alloys. Titanium weighs about two thirds as much as steel.

TREKLIP OVERLAP
...is used to describe the situation when the foot (in a clipless pedal) or toeclip touches the front wheel or mudguard when the bars are turned. It's best to avoid this on a frame designed for city cycling or touring or for a beginner by increasing the front centre dimension. This is best achieved by slackening the head tube angle and increasing the fork offset in proportion to achieve the desired trail figure.

TOP TUBE
Larger road bikes and touring frames (above 56cm) will benefit from a 1 1/8" diameter top tube. It improves steering precision.

TOP TUBE LENGTH
...is primarily a function of upper body length and the desired rider position. There are no hard and fast formulae available to calculate top ➤

CUSTOMCAZZA

13 Ritchey Socket dropouts look really neat, something that you have the option to choose when having a frame built for you and the new Shimano Deore nine-speed set up works a treat.

14 Apart from the incredible weight advantage over my old bike, the climbing improvements (which were so noticeable on the first ride) are down to a tight rear triangle and much lighter frame materials. Best of all, this frame is one in a million and it was made just for me!

Price: £599
Dave Yates (see M Steel listing) Shimano Groupset thanks to **Alan@Madison Cycles 0500 295183**
Wheels by Ambrosio from **RSI 0181 965 2510**

HIT: It fits!
MISS: You may have to wait a few weeks during really busy season (springtime!