Frame size critical to good position

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Racing bicycle design

During the years I have spent frame-building in England I have made a study of the design of the racing bicycle. I have been fortunate during this period to have built frames for many top British riders, some competing at international level. I have been able to draw on the experiences of these riders, along with my own racing experience, to improve my knowledge of design and construction.

In the past I have written articles for *Cycling* in England. One of these articles was translated into French and reprinted in *L'Officiel du Cycle*. I am pleased to have the opportunity to write a series about racing bicycle design for *Velo-news*. And now, down to business.

The racing bicycle has three main functions to perform:

1. It should allow you to sit in such a position that you can pedal with maximum efficiency.

2. It should allow the power that you develop to be transmitted directly to the rear wheel.

3. It should handle in such a way that you can take corners with a minimum of slowing down, but with maximum safety. Also, the machine should remain stable and hold a straight line when you are putting in maximum effort, as in sprinting.

All three of these functions are directly affected by the design and construction of the frame, making it the most important component part of the bicycle.

In these next several issues I will go through these three main racing cycle functions and deal with all the aspects which affect them, starting with the rider's position.

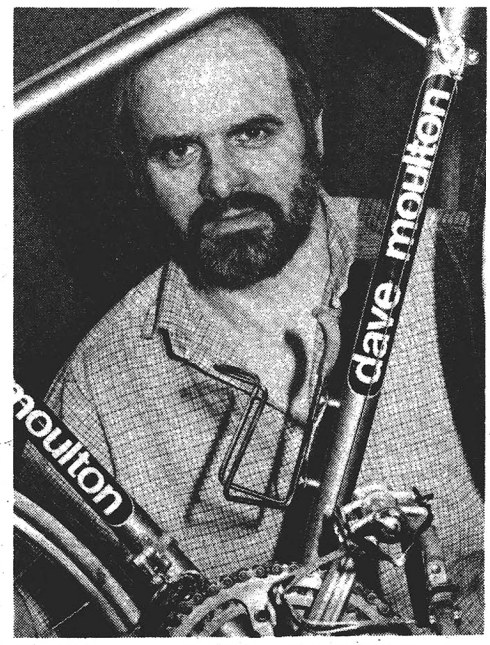
Proper Riding Position

The position of the rider is of course affected by saddle height and the choice of handlebars and stem and their position. But unless the frame is right you will never achieve a good position.

First of all, what position are we trying to achieve? Starting at the feet and working upwards:

—The ball of the foot should be directly over the pedal spindle.

—The center of the knee (knee joint) should be as near as possible directly over the pedal spindle when the cranks



Englishman DAVE MOULTON has ridden, built and written about racing cycles during the past 26 years and now he'll be sharing his expertise with U.S. riders. His series on racing bike design will continue through the Velo-news fall and winter issues. (J.M. Mullaney photo)

are horizontal with the pedal on the downward stroke. The position of the knee can vary with your height and leg length, as I will explain later.

—The saddle height should be such that your knee is not stretched straight when the pedal is at its lowest point. If it is straight with the heel on the pedal spindle then it should be right when you put your foot into the clip.

—Because wind resistance is the biggest factor against speed, your upper body must be in a low aerodynamic position with the back horizontal.

—Finally, your hands should be in a low position and elbows should be bent to act as shock absorbers between the road and upper body. Most importantly, your arms should not be stretched out too far in front.

When you are making an effort, your legs are thrusting downward with more power than the actual body weight. Therefore, the arms act as an anchor holding your upper body in position. The arms should be in direct opposition to the downward thrust of the legs.

The power from your arms is transmitted through your shoulder and back muscles. If arms are stretched out too far in front this puts a strain on the back, and is one of the main causes of back discomfort.

No Magic Formula

Having said what your riding position should be, how do you achieve this position?

I cannot offer any magic mathematical formula whereby armed with a tape measure you can measure up your body and work out the perfect frame with all the various tube lengths and angles. If there is one thing a framebuilder learns it is that there is no such thing as the "average" person. If you had a hundred people all of the same height it would be unlikely that you would find two with all other measurements the same.

If you sorted out those with the same leg length, they might have different length thigh and lower leg measurements, as well as different arm lengths. Not to mention different weights and general builds.

What you can do when choosing a frame is to get one that will give you plenty of scope for adjustment. The saddle can be moved up and down, of course, and also there is fore and aft adjustment. What you don't want is to have to put the saddle as far back or as far forward as it will go.

In the same way the position of your upper body and arms is affected by the height of the handlebars and the length of stem. So it is important that the frame is not too big or you will not be able to get your handlebars low enough in relation to your saddle height. Your bicycle will handle better with a fairly

long stem, so your top tube will need to be a length that will permit a long stem to be used.

Calculating Frame Size

The first and most important measurement of the frame is the seat tube length or frame size.

I always calculate this by saying frame size equals two-thirds of inside leg measurement (measured from crotch to floor without shoes). Thus a rider with a 33-inch inside leg needs a 22-inch frame, and a 30-inch inside leg a 20-inch frame.

I find that this is a better method of calculating frame size than saying inside leg less 10 inches, as this method presupposes that everyone needs the same amount of seat pin to be showing, which is not so.

Tall people are not scaled up models of short people. A tall person will have longer legs in relation to his body length. Also, his arms will be longer and because this is so his handlebars will need to be lower in relation to his saddle height, resulting in more seat pin showing.

One important note here. This two-thirds method works using the English method of measuring frames; that is, from the center of the bottom bracket to the *top* of the seat lug. If you are measuring your frame by the Continental method (from the center of the bottom bracket to the center of the top tube) you will need to subtract the appropriate difference. This is approximately three-quarters of an inch or 2cm.

If you are a young rider still growing, and you are buying a new frame, allow for a frame size that is slightly bigger than you need or you may find that you have quickly grown out of it.

Shown in the sketch are two riders, short rider superimposed on tall rider. The tall rider sits back, thrusting the pedals forward and downward. His arms are forward and downward in direct opposition to his legs.

The short rider sits more forward. His legs thrust downward and again his arms are in opposition to the legs.

The sketch also shows that in both cases the head angle remains constant while the seat angle is made steeper for the smaller frame, allowing the top tube to be made shorter.

Traditionalists will say that you cannot have a head angle more shallow than the seat angle, but there is no evidence scientific or otherwise to prove that theory. In fact, when it comes to design of the racing bicycle tradition has done much to hamper progress.

In my next article I will write about frame angles, in particular the head angle and how this affects the steering and handling of the bicycle.