The overall look is one of balance

Now that we are nearing the conclusion of the design aspect of the racing frame, it's time to step back and take a look at the bicycle as a whole.

Any man-made object, whether it is an airplane, an automobile or a boat, will, if it is well designed, have a balanced look from an artistic point of view as well as being functional. The bicycle is no different.

The bicycle frame is nothing more than a device for holding all the various components together to make a complete machine. Therefore, the shape of the frame has a direct effect on the shape of the complete bicycle. But even a well-designed frame will not make the complete bike look right if it is too big or too small for the rider, or if the choice and positioning of components is wrong.

If you look at a "tuggo" bike belonging to a non-enthusiast it probably looks a mess. The frame will often be too big for the rider, so the saddle is too low while the handlebars are too high and tipped at a peculiar angle—you have probably seen this type of thing often. Now take a look at the photo of the racing machine. This is a well-balanced bicycle. Note the amount of seat pin showing and the height of the saddle in relation to the handlebars. One reason for this balanced look is that the amount of seat pin showing is approximately the same as the handlebar stem length. It is purely coincidental that it turns out this way, but, like I said, anything that is well designed will look balanced.

A Question of Balance

The bicycle shown has a 22-inch frame. A larger model would have more seat pin showing, a smaller one less, and the stem length would in general also increase or decrease with the size of the frame used. So, bicycles throughout the size range will have the same balanced look. Many small bicycles never look right because the frames are built like chopped down large frames, using the same angles.

Notice in the photo that the saddle is central on the seat pin and the handlebar stem is not down to its limit. There is range for slight position adjustment for each rider who needs the same basic frame size.

Also note that the front part of the handlebars is directly over the front wheel center, which is something I mentioned in last month's article.

Some people think that for a bicycle to be well-balanced it should have the same distance between the rear wheel and seat tube and the front wheel and down tube. This is not necessarily so, because to achieve this the framebuilder would have to alter angles and tube lengths which are far more important.

The balanced look is simply that the bicycle looks right. You can see a bike like this and imagine the rider sitting on it, putting power to the pedals. The machine becomes an extension of the rider.

In cycle racing the psychological aspect is very important—if the bicycle looks right, there is a good chance that it will feel right.

Measurement Table

In the adjoining table I have summarized all the various tube lengths, angles, etc. The frame size is based on the two-thirds inside leg measurement mentioned in my first article (*Velo-news*, Oct. 13, 1978), together with the other relevant angles and measurements plus recommended handlebar stem length. You may think this is a bit like writing the same horoscope for everyone born under the same star sign, but it is difficult to generalize. The table is based on my own experience. I realize it will not be right for everyone but it is a good place to start, especially for the person just taking up serious cycling.

Choice of handlebars is also important. There is a wide range of shapes and sizes now available. They can be categorized into deep, medium, or shallow drop. Your bike shop will be able to help you choose.

Deep bars are for large bikes, say 23-inch and over, while shallow bars are for bikes under 21-inches. There is no hard and fast rule for choosing handlebars, it is a matter of common sense, feel and position. The width of the handlebars should be the same as that of your shoulders, making your arms parallel when viewed from the front.

Getting back to the frame...If your budget is limited to an off-the-wall or second-hand frame it may not have the exact angles or tube lengths shown in the table. In this case make sure that the frame size (seat tube length) is right for your leg measurement. This is the most important consideration. But if the top tube turns out longer or shorter than the one shown in the table, then alter the stem length so that the combined top tube and stem lengths are the same as listed here. This may not be a perfect set-up, but it will be an adequate compromise.

The table applies to road frames. For track or criterium bikes the frames generally need to be one degree steeper in the head and seat angles. Providing that the top tube length is the same, this means that your upper body will be in the same position (handlebars perhaps slightly lower), but your whole body will be further forward in relation to the pedals. This is a position more suited to flat-out-all-the-way racing.

In concluding the design aspect of the racing frame I will touch on some of the other details which make up the full specification of the frame.

Chainstay Length

Obviously, the shorter the chainstays the more rigid they are; it is easier to bend a long stick than a short one. Also, shorter stays emerge from the bottom bracket at a wider angle whch also makes for stiffer construction.

However, chainstays should not be so short that you cannot get your back wheel in or out without deflating the tire. Also, gears will not work too well if the stays are very short, because of greater chain misalignment.

Sixteen inches from the center of the bottom bracket to the center of the rear wheel spindle is a good chainstay length. This can vary slightly with the seat tube angle; as the seat tube steepens it moves away from the rear wheel. I usually make my chainstays such a length that the minimum gap between rear wheel and seat tube is one centimeter (with the largest section tires). This works out at slightly more or less than 16-inch chainstays.

Bottom Bracket Height

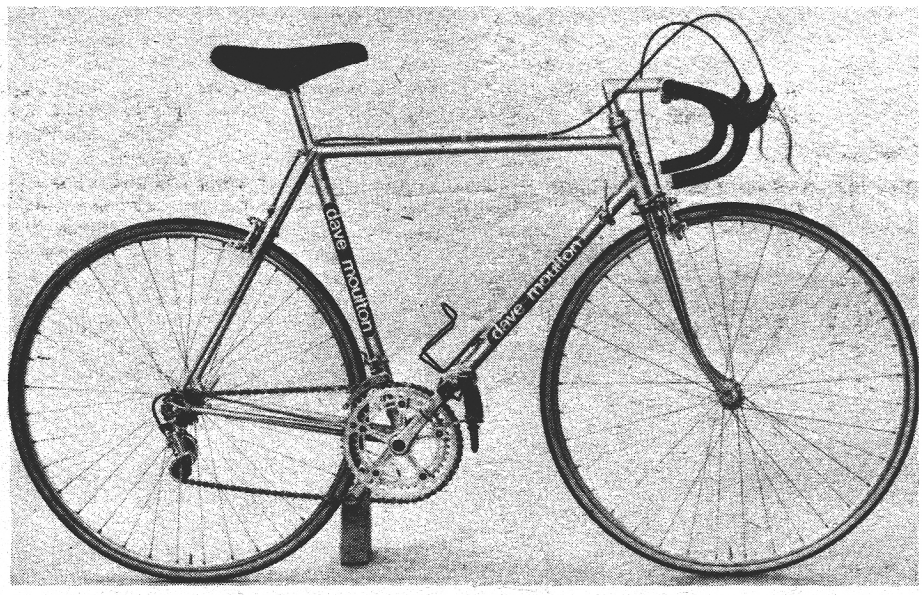
Bottom bracket height is measured from the center of the bracket to the ground. The lower the bottom bracket the lower the center of gravity of the machine and rider. The limiting factor is the danger of pedals catching the road when pedaling through corners. But bear in mind what I have said previously about a good-handling machine—it will not have to be leaned so much on the corners, so there is less danger of the pedals catching.

Ten-and-a-half inches is the usual minimum bottom bracket height for a road frame. This gives stability while allowing the rider to sit low and take maximum shelter from other riders. The road racer will freewheel around corners, so catching a pedal is not such a problem. For the criterium rider who needs to pedal out of corners before he has straightened up, 10.75 inches would be a better bottom bracket height.

The track rider who has to contend with banking may go as high as 11.25 inches for the very steep indoor tracks.

dave moulton

Racing bicycle design



The DAVE MOULTON racing bike embodies all of the various framebuilding beliefs of the author, who strives for a balanced and functional machine. (J.M. Mullaney photo)

Inside leg (crotch to floor without shoes in inches)	Seat tube (inches)	Top tube (inches)	Seat angle	Handlebar stem length (centimeters)
36	24	22.5	73	14
35.25	23.5	22.5	73	13
34.5	23	22.25	73½	12.5
33.75	22.5	22	74	12
33	22	21.75	74	11.5
32.25	21.5	21.5	74½	11
31.5	21	21	75	10.5
30.75	20.5	20.75	76	10
30	20	20.5	76	9.5
29.25	19.5	20.25	76½*	9
28.5	19	20	76½*	8

Head angle 73° Fork rake 1¼"

*On very small frames the head angle will have to be made more shallow to lengthen wheelbase.

Wheelbase

I have left this measurement for last because it is the least important measurement of all. Perhaps you are surprised that I should say this, because I know that many riders and some framebuilders place great importance on the wheelbase, even to the point of obsession. So why do I feel the way I do? Simply because in order to achieve a specific wheelbase (measured wheel center to center) some other measurement or angle has to be altered to produce it. I have already stressed the importance of seat angle, top tube length, head angle and fork rake, and to a lesser degree the chainstay length, so one measurement must be left to vary, and that can only be the wheelbase.

Front centers (center of bottom bracket to front wheel center) should be around 23 inches, which will allow the toe clip to clear the front wheel. On the smallest frames with very short top tubes, the framebuilder will have no choice but to make the head angle shallower and the fork rake longer in order to achieve the correct front centers. Generally speaking if you follow the specification shown in the table, the wheelbase will work out to around 38.5 inches for the road, slightly less for the track.

This is plenty short enough. It is true that the ultra-short-wheelbase machine feels lively, but this has nothing to do with the actual wheelbase. It's just that the shorter the machine the more rigid it is, because the tubes of the frame are shorter. But there is a limit to how short you can go before the bicycle becomes difficult to handle. One of the rules of good frame design is never go to extremes.

That closes the design aspect of the racing bicycle frame. Next issue I will write about the construction of the frame and choice of materials.