Variations in frame geometry

There's less than meets the eye

By John Schubert

You've often been told that a racing bike's frame dimensions have to be different from those on a touring bike. Without these differences, you're told, the bike is nearly unusable for that purpose.

Not.

You can ignore most (but not all) of what you hear in that regard. Frame design has two goals: (1) Optimize rider position. (2) Optimize bike handling characteristics for a given application.

Rider position changes some, but not very much, between racing and touring. And changing the bike's handling to switch between these uses is not necessarily desirable. Yes, there are exceptions, and personal preference plays an important role. But the "you can't race on that bike" bromide is almost always junk science.

Those of you who own racing bikes are doubting my credibility by now.

"That bike steers so quick it reads my mind," you're thinking. "That's racing geometry."

But the geometry is not the major reason it steers so quickly. Rather, the major reason is because your front wheel has so little mass. With a front wheel around 2 1/2 pounds (compared to maybe four pounds for a touring wheel), the energy required to move that mass by turning the handlebars is much less. Hence, you get quick steering. The steering geometry on many racing bikes is similar to that on touring bikes. Measure it and see.

Let's zip back to the beginning and look at rider position. The rider contacts the bike in three places: feet, saddle and handlebars. Frame dimensions don't measure the exact placement of any of these, since your cranks, pedals, seat post, seat, handlebar stem and handlebars all intervene. However, the measurement to the corresponding points on the frame serves as a surrogate for measuring to the body's actual contact points. As long as components are made to a standardized design, you can compare apples to apples when discussing these "surrogate" measurements.

The measurements that more-or-less determine rider fit are:

- Seat tube length ("frame size")
- Seat tube angle
- Top tube length

Also, you need to know your seat height, measured from the center of your crank spindle to the top of your saddle.

Now, which of these measurements would you change when you went from a touring bike to a racing bike? Certainly not the seat height — legs are legs.

The top tube length? Probably not in road racing. A road racer will want his handlebars about the same distance away as a tourist, but probably lower for aerodynamics. That's why you can adjust the handlebar stem height. In extreme cases, you may want a larger frame size for touring.

(Oh, dear — time for an explanatory footnote. Longer top tubes are standard in mountain bike racing, to stretch the rider into an aerodynamic position — or, as one wag put it, to make the mountain bike just as uncomfortable as the road bike. For example, my race-oriented 18-inch frame Specialized Ground Control has a 22-inch top tube and monster 13-cm handlebar stem. I've seen mountain bike top tubes as long as 23 inches.)

Seat tube angle? Maybe. Cycling coaches often say that you want your butt farther forward on the bike for spinning and sprinting, and farther back for slower, powerful pedal strokes. But equally often, they use the knee-over-the-pedal-spindle ("KOPS") formula and say it applies to all cycling, all the time. I favor the KOPS formula. The distances you move the saddle by changing the seat tube angle are usually small enough to be accommodated by either (a) changing the saddle position in the seat post clamp or (b) moving your butt forward or rearward in the saddle.
An illustration: Take my 28⅛ inches of seat height. High school trigonometry tells us that if I went from a 72 degree seat angle to a 74 degree seat angle, the saddle would move 0.95 inch closer to the handlebars. The seat post clamp and the rider’s butt have at least an inch of variance in them, so most people can make the necessary changes without changing the frame design.

To summarize: if you go from a touring bike to a racing bike, you’ll want your handlebars lower. That’s probably it. And that can usually be accommodated without a whole ‘nuther frame design.

Now: on to the non-cockpit dimensions.

They are:
- Chainstay length.
- Bottom bracket height.
- The steering dimensions: Head tube angle, fork rake and trail. (Trail is a derivative of head angle and rake.)

Chainstay length is a subject people may disagree on. Ultra-long chainstays are recommended in a vain effort to get some of the rear pannier’s mass inside the wheelbase for less-bad handling. But even if you go from ultra-short to ultra-long chainstays — the extremes are about 16 and 18 inches — the pannier is still behind the rear wheel. Today, when we balance our load, putting a substantial chunk of it in the front panniers, these two inches are less critical.

My ideal expedition touring bike would have the longer chainstays, but my ideal weekender bike wouldn’t care. A garden-variety touring bike will handle well with a well-distributed 20 pounds, no matter what its chainstay length.

Bottom bracket height also comes out in the wash for some, but not all, people. Road racing and touring bikes have bottom bracket heights around 10⅓ inches. They are rarely made lower than this.

Some people want a higher bottom bracket for criterium racing — say, 11 inches — so they can better pedal around corners. In all the criteriums I was allowed to enter, no one was a good enough bike handler to take advantage of that. For the top 1000 or 2000 riders in the country, it might actually matter.

Now we get to steering dimensions. If I may oversimplify, head tube angles usually fall within the following ranges:
- Mountain: 70 to 71 degrees
- Touring: 71 to 73 degrees
- Racing: 72 to 75 degrees

There’s overlap among adjoining categories. A 72-degree head angle is fine for either racing or touring. (Some mountain bikes were also made with 72-degree angles, but I deliberately left the extremes off of this tiny chart.) The variation is often due to frame size. Larger frames, with their longer top tubes, have steeper head angles to keep the wheelbase from getting too long. Shorter frames have shallower head angles to keep the wheelbase from getting too short.

Some racing bikes have extremely steep head tube angles (75 degrees and up). I don’t favor those designs. They’re unstable and tippy. And the really good athletes I’ve known don’t like these designs, because their too-quick handling is a distraction in competition. So again, if you want middle-of-the-road handling, the same steering geometry will serve for both racing and touring.

In theory, you can own one bike with two sets of wheels, and use the bike well in either application. In practice, few people do that. There are good reasons for owning an additional bike for an additional purpose, but for most riders, frame geometry isn’t one of them.

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