The up-front story on good handling

Watching a criterium race this summer on a tight 600-yard circuit, I witnessed a crash caused by a rider attacking just before a corner. He charged to the front of the bunch and his speed took him from the inside of the corner to the outside, bringing down half the field. Luckily there were no serious injuries but it did spoil a good race.

This accident was partly caused by bad riding—the bunch had taken the correct line, swinging wide before the corner and then cutting in, whereas the rider causing the accident had attacked up the inside, taking the corner too fast and too tight. But directly contributing to the smash-up was the design of his frame; a better design may have gotten him out of the difficulty caused by his error of judgement.

I had a look at his bike after the accident and noticed that it had a very steep head angle and fairly long fork rake. A machine with a frame like this will never handle well on corners. So why was it built this way? In many such cases the customer asks the frame-builder for such a design because of a theory that has been with us for a number of years: A bicycle with a steep head angle is more lively and will go faster in a sprint.

In this particular case the frame was a fairly small one, which would normally result in the steep head angle bringing the front wheel too close to the down tube, causing severe pedal overlap. To prevent this the builder had used a long fork rake to lengthen the front end. It all added up to a poor handling bike.

Head Angle Theory

I get customers writing to me saying that they want a lively bike, but not so lively that it will throw them off when not paying attention. Any bicycle that throws its rider off because of the slightest error is not lively, just badly designed.

So what about this theory of steep head angles being more lively. How did it originate?

Back in the early 1950s when I started racing, frames were built with very long top tubes and short handlebar stems were used. Head angles were usually about 73 degrees as today, but with a very long fork rake—as much as three inches in some cases.

In a situation like this the bike feels "dead" and unresponsive because the front wheel is way out in front of the handlebars. When the rider on such a frame gets out of the saddle to wind up a sprint, he tends to move the bike from side to side to a greater or lesser degree according to his style of riding, and with the rider's weight well behind the front wheel this leads to a feeling of instability. A rider cannot, of course, make a maximum effort feeling unstable.

Framebuilders then found that by making the head angle steeper the bike felt livelier because the front wheel was more under the rider's weight.

However, the same effect could have been achieved by leaving the head angle the same, shortening the fork rake, and using a longer handlebar stem. But this would have meant making a shorter top tube, which may have meant altering the seat angle, and so the whole design of the frame would have been altered. Sudden drastic changes in anything are not readily accepted, let alone frame-building. It has to be a slow process of evolution.

Front Wheel Position

Let's look further into the relationship of the rider's weight to the front wheel.

Imagine you are sitting on the top of a gate and are swinging from side to side. If you sit on the end of the gate farthest away from the hinge post you will swing in a large arc. If you move your weight closer to the hinge post you will move in a smaller arc. Because the hinge post is fixed, you will be moving only in a horizontal plane.

Imagine further that the post is itself hinged at the bottom so that it can move in a vertical plane. If you now swing on the gate you will move both sideways and up and down, and you will feel very unsafe.

Now put yourself in the same situation on your bicycle. Imagine that you are out of the saddle, sprinting, and throwing the bike from side to side. (Now before I go any further let me make it quite clear that I am not suggesting that this is the way you should ride your bike, so I hope I do not get letters from coaches complaining that I am teaching you bad habits. But however steady a rider is, there is always a slight tendency to sway from side to side when out of the saddle.)

Your arms and shoulders can cope quite easily with the bike moving in an arc in the vertical plane. Horizontal movement is a different matter. Getting back to our example, the point where the front wheel contacts the road is like the hinged gate. If your weight is directly over this point there is no movement in the horizontal plane, but there will be if your weight is away from (behind) this point.

Proper Stem Length

This is why I said in a previous article that your bike will handle better with a long handlebar stem. Ideally, a road bike's stem length should be such that the front part of the handlebars (the part where the brake levers clip on) is directly over the wheel hub because, of course, the hub is directly above the point where the wheel contacts the ground.

With the handlebars in this position, a good handling compromise is reached. When you are out of the saddle holding onto the brake lever hoods, your weight will be slightly in front of the hub; if you are out of the saddle with hands on the drops, your weight will be only slightly behind the hub. Both positions will feel good and help prevent horizontal wheel movement.

If, however, we are talking about track bikes or bikes designed purely for criteriums, where you ride on the drops of the handlebars all the time, the head angle can be made steeper so that the point where you hold on the handlebars is directly above the wheel center.

Of course it is very important that your handlebar stem is also the correct length to give you a good riding position. But if your frame is well designed then the top tube length will allow a stem length which is correct for your position *and* correct for good handling. Top tube lengths were dealt with in the previous article.

Holding the Line

To get back to head angles, you can see by all this that it is not necessary to have a very steep head to have a lively bike. A shallower angle will make for a bike that will go around corners quickly and safely, and also one that will hold a straight line.

So remember this if you are thinking of a track bike. The banking on a track has the effect of making the turns into a straight line, so it is most important that the bike *will* hold a straight line.

I have seen even world class kilometer riders, in the 1976 Olympics for example, fighting to control their bikes because of too steep head angles. One rider even came right off the track and crashed. When riding an event, all the rider's energy should be going into propelling the machine forward, not into efforts to control the bike.

As far as I am concerned, the best head angles are 73 degrees for the road, 74 for the track and for some criterium and time trial bikes, 75 for bikes used only on very steep tracks such as six-day indoor tracks. The absolute rule is never steeper than 74 degrees for the road and never steeper than 75 for the track. Remember that the fork rake gets shorter as the head angle gets steeper in order to maintain the same handling characteristics.

The Graph Below

This is shown in the graph on this page. As you see, the "ideal handling characteristics" line is on the side of "oversteer." This is because when you are cornering at speed the centrifugal force is pushing you wide, and slight oversteer is desirable to counteract this. For a touring bicycle, ridden at much slower speeds, the ideal handling line would be nearer the neutral line (approximately halfway between the neutral and racing lines).

Well, I have spent the entire article this month talking about head angles, but it is a subject which I think is very important and cannot be covered in a few paragraphs. When I make a statement I like to explain my reasons, unlike many writers who say angles should be such and such, giving no reason other than they have always been so. I hope that if you have any questions on this discussion you'll write to me in care of *Velo-news*.

Left to consider are chainstay length, bottom bracket height and wheelbase as I complete the design aspect of the racing bicycle frame. These will be looked into next month, and in future issues I'll talk about the actual construction of the frame.