BALANCE ACHIEVEMENT PART THREE:

WEIGHTS AND PERCENTAGES

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Percentages Part 3 of 3: Left Side

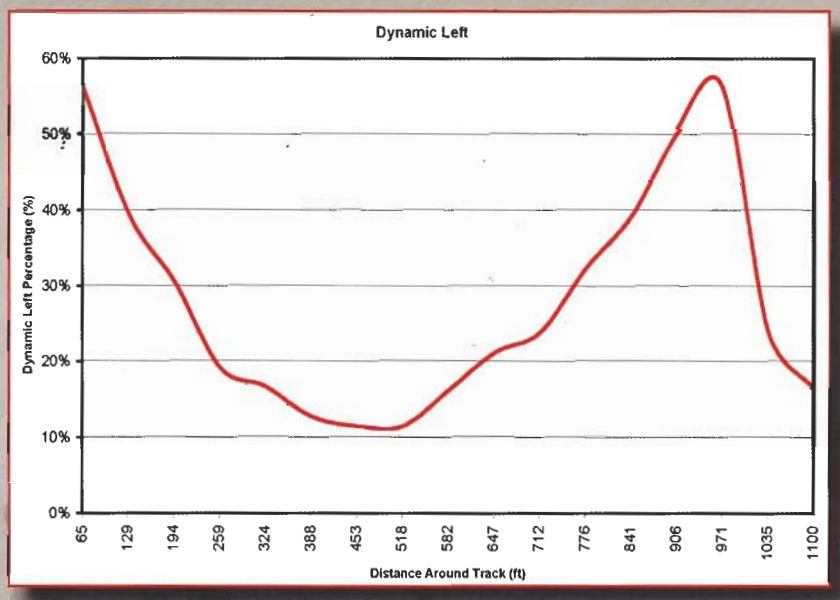
Over the last few months we've been looking at the percents that we all spend so much time talking about and obsessing over. We started by looking at how we calculate the percentages, how we can calculate wheel weights if we know what percentages we want and some common wheel weight relationships that some seek after. Next, we looked in depth at nose weight percentages; we talked about what things cause different karts to work best with different nose weight ranges, what typical ranges are and we looked in depth at what effects more and less nose weight can have on a kart in attempt to help identify how we might best use it as an adjustment. The next topic in our discussion on percentages is left side percentage. This is a relevant topic nowadays given that many karters are tending to run more than they did a few years ago. In this article we'll be taking an in depth look at left side weight; what it does, what things affect it and how we can use it to our advantage.


Track banking will have an effect on left side weight

All right, let's get started… We'll begin with looking at what left side does. In short, and quite obviously, it helps control the balance of work shared between the left and right side tires. It makes sense that as we add weight to the left two tires then at every point on the track those tires will produce more grip and the right side tires will produce less. Given this, all we need to do if we want the left side tires to work harder is to run more left and if we want them to work less or for the right side tires to work harder we reduce left. Somehow it turns out not to be quite this simple. Also, how do we know if we need the left side tires to do more or less work? In order to understand what effect changing left will have we need to bring back a few concepts we've discussed in past articles as well as introducing a new one or two. You may recall that tires have what is called "load sensitivity". Just in case you didn't get the previous article we'll go through it again. In order to explain this let's look at the rear of a kart only and lets assume we're running identical tires and rims on the inside and outside. In this situation the rear of the kart will produce the most grip and least rolling resistance with both tires loaded exactly the same. For our purposes here let's say that each tire is loaded with 100 pounds of weight (50% left) and is able to produce 150 pounds of lateral force. The resultant is 200 pounds of total weight and 300 pounds of total lateral force generating capability. Now let's increase the left side percentage to 60% so that the left tire sees 120 pounds of weight and the right tire sees 80 pounds. When we do this, the left tire's ability to produce grip will go up and the right tire's ability to produce grip will go down. What is not obvious is that the left tire's ability to make grip will not go up as quickly as the right side tire's ability will go down. In our example the left tire may now be able to produce 156 pounds of lateral force and the right tire 136 pounds. If we add things up we see that the weight carried by the two tires is 200 pounds whether the left percentage is 50% or 60%. However, the lateral force generating ability with 50% is 300 pounds but with 60% left it is only 292 pounds. From this we can see that if the two tires are completely identical then they work most efficiently when they're both loaded the same. On a kart we don't run the same tires on the inside and out but the principle holds

true: there is some left percentage which will optimally load the left and right tires so that grip is maximized and rolling resistance minimized.

Okay, hopefully load sensitivity makes sense at this point but now let's apply this to a whole kart. What this means is that there is some optimal left percentage that will make the most grip and the least drag for any given set of tires. If we run more left than optimal then we will make less grip and if we run less left than optimal then we will make less grip. Finally, because our right side tires are larger than our lefts, the penalty for overloading them will tend to be not quite as high as overloading the left side tires, although due to the high lateral forces at which a kart can operate, it's difficult to overload the left side tires. At this point it may be tempting to come to the conclusion that we just need to pick the optimum left for the apex and then the kart will fly. The truth is that if we did this the kart would run through the apex extremely fast. It is also true that in order to optimize the tire loadings for a 1.5 lateral G apex we'd need to be running somewhere on the order of 80 to 90% left; not something anyone does. But why is this? Why aren't we optimizing our karts to fly through the apex or is there something wrong with our physics? There's nothing wrong with our physics but there are a few other things we need to consider. The first is that although we always think about the apex when we think about lateral Gs, the truth is that the kart has to turn-in, get to the apex and get off the corner in addition to running through the apex. The accompanying chart shows the percentage of weight being carried by the left side tires at any given distance around the track (this graph depicts real data). You will note that we start at the end of the frontstraight with approximately 56% left side and progress into turns one and two, down the back straight and finally through turns three and four. One thing that can be seen very quickly is that the amount of weight on the left side tires is constantly changing and that it is at any given value for only a few feet. This constant change is one reason why we can't simply optimize our left percentage around the apex. The other reason is that at any given point in the corner the kart must be able to generate enough lateral force to keep from sliding. We know that if we run 80 to 90% left side weight the kart will be the quickest through the apex but what will happen getting to the apex and then getting off the corner? As we saw earlier, there is some optimum balance of left and right side tire loadings which will generate maximum grip and that as we move away from that point the kart will make less bite. We also mentioned that the reduction of grip resulting from overloading the left side tires is greater than that of overloading the right side tires. So then, if we optimize our left side percentage for the apex then what will happen is that the kart will be unable to generate enough grip to allow the kart to turn down into the corner to get it to the lateral forces that it sees at the apex. Even if we could get it to the apex the kart wouldn't be able to generate enough lateral force center off to keep from sliding.



Okay, so we understand that we can use left percentage to optimize the total grip of the kart and that we cannot optimize it around the apex only - although we are often tempted to think of it that way. What you may not have caught is that there is some point in the corner that our total grip is maximized as long as we're running more than 50% left, and at locations in the corner where the lateral Gs are higher that the right side tires are overloaded and other places where the lateral g's are lower left side tires are overloaded. All of this comes together to show us that there is a particular point in each corner where our kart's overall grip is maximized and our overall rolling resistance is minimized. So then, we've currently got two things that we can do with left: 1) we can set the point on the track at which the grip is maximized and the rolling resistance is minimized and 2) we can effect the total grip available with additional left side weight and typically make more grip in the higher G loaded portions of the corner. Although these two things are typically the most critical aspects of setting left percentage there are a couple of other ones that can come up as well. The first is that there are a few high grip situations where we must run enough left to keep the kart from turning over. The main place this comes up is on very tight, high speed pavement tracks and coke syrup - especially coke syrup. Under these types of conditions, if we ran "normal" left side percentages the karts would tend to turn over with only the normal cornering forces experienced. The next item that constrains us at times with respect to left side is that it is sometimes possible to put so much left on a kart that the chassis simply goes dead. What we mean by this is that there is so much preload on the left side tires that it never unloads enough for the chassis to actually flex and if the chassis isn't flexing then it cannot move weight around as it is designed to and thus, it can't respond or work like it needs to.

We've now set a practical maximum (kart doesn't go dead) and minimum (kart doesn't turn over) left side and have also

identified two of the more important parameters which we will use left percentage to tune (maximum grip/minimum rolling resistance point and overall grip). Now let's focus in a little finer so that we can better identify how we tune left side to help the kart. As we have mentioned previously, we will use the overall left side percentage to help tune the amount of total bite available to the kart in the higher G loaded portions of the corner. Before we go any further let me say this: left side cannot overcome having the wrong tires on the kart. If our tires are incapable of making enough grip then more left probably won't make much difference. If, however, our tires are pretty close to what they need to be then we can sometimes help our kart make a little more bite by adding more left. This can help to settle it if it's a bit twitchy or help it carry more speed through the apex. The other way we can use left to help our karts has to do with setting the point on the track where our tires are best optimized. This may not be obvious but the location which is most critical to making speed for most karts on most tracks is to get them to accelerate off the corner. The reason for this is that if the kart will run off the corner well then it can carry that speed all the way down the straightaway. Given this and the fact that we run the majority of our weight on the two rear tires, the dynamic balance between them is crucial. If we feel we need to move this optimum point a little earlier in the corner then we may accomplish this by running a bit more left and if we feel that we need to move it closer to the corners' exits then we can run a little less left. We must realize, though, that we can also use crossweight to move this optimal point of the two rear tires. In fact, we more often use cross to set this balance point while using left to set the kart's overall bite but left can be used to change it nonetheless.

One thing that is interesting to me that has occurred over the last few years is that left side percentages have been going up slightly. For a time it seemed that much over 55%, even on the hardest, fastest tracks in the country would be too much but then, as the newer tires came out and the tracks didn't seem to make so much bite the left started to creep up. What was actually going on is that the tire manufacturers got the tires to roll so freely and make so little bite that karters couldn't get enough bite to navigate the corners as well as was necessary to run the best. Slowly people started running a bit more left side weight and the karts responded by making more speed, responding better to adjustments. This is a good example of how we have used more left to help our karts make more bite.

Just to summarize things once more, more left can help us make more bite but too much left can cause the chassis to go dead. Additionally, we must run enough left to keep the left side tires on the ground. Finally, we use left along with cross to control the optimal balance point between the LR and RR at corner exit to maximum corner exit speed and acceleration. If you've been having trouble getting your kart to make enough bite to really work well, it may be time to explore what left side percentage can do for you. Next time we'll look at cross but until then have fun!