Wooden Berms

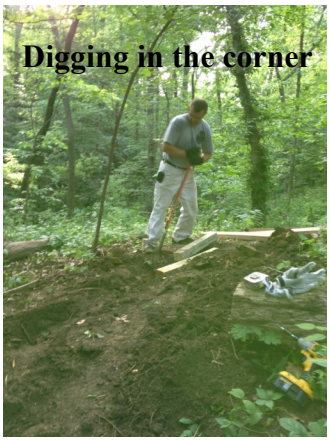
How we did it.

Over the Edge- Copper Harbor, Michigan

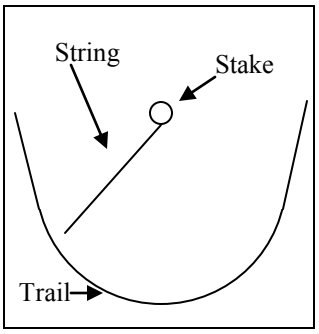
Disclaimer– This is a rundown of how we came up with a layout for a wooden berm at Sunderbruch Park (Sunder) in Davenport Iowa. This is not intended to say this is the only way to do it, but there is very little info online about wooden berm designs and so I'm throwing this out in the hopes that others will build some so I can come and ride them. **This presumes construction knowledge**.

As part of the Friends of Off Road Cycling (FORC) trail crew for Sunder, we had laid out a great extension for Jubilee trail within the park. City Parks Dept had approved the extension as part of the "2 Year Plan for Trail Work and Repairs" that was submitted last year. One problem- we needed a cornered bridge. We thought if we could berm it, too… well, yeah, why wouldn't you? We'd ridden Over the Edge trail in Copper Harbor and the wall rides at Keystone, Winter Park etc, etc, etc. So we have some experience riding them, but no experience in trying to match wall angle, turn radius with the anticipated speed.

Because the pin flags stop at the ravine edge and start on the other side at 135 degrees in the other direction, we couldn't just ride it and get a feel for it. I've been stopping and measuring wall rides and wooden berms for years and so I was starting to get the idea and due to my job I have some experience taking various load paths into consideration. Here's how we pulled it off.



1st- we put in the trail leading up to the left hand corner **before** the proposed bermed bridge. This helped let us get a feel for what speed and what we would be looking at as an entrance to it. The result? There was NO WAY we were gonna have any speed at the bermed bridge because the 70 degree left hand corner right before the bermed bridge was too sharp, and with the terrain, no way to widen it enough. Solution, build a left hand wooden berm that turns 70 degrees and ends 5 feet before the 135 degree turn right hand bermed bridge. We were gonna need more lumber…



So I started working on the left hand berm design. When we laid out the trail leading up to it, we kept it pretty flowy with lots of turns. We knew this left was going to be tight and we didn't want to create a skid row right before the corner. In many instances you can put a wooden berm in place of a corner that already works and it will let you go faster. Not an option here– too tight. **I took a shovel and turned the dirt over in as big a radius as I thought I could get** keeping in mind that by building a wooden berm I could effectively widen the radius because the bikes would be up to 4 feet above the ground, and by angling the whole thing slightly down hill, we could maintain or gain speed through the last 2/3rds of the corner for use on the bigger berm 5 feet after this one. Then I **placed a stake in the middle of the turn and tied a string to it so that I could use that to measure the radius.** I had to move the stake several times until I got it centered just right, and I ended up with a radius of about 14 feet.

Ok– I got the radius. Now I need to determine speed. Running down the trail with my arms held out like I'm holding handle bars, (don't laugh, this is an actual trail building technique to help get a feel for the trail!) I felt like I was running pretty fast– but that is riding really slow. I've got a REAL bad knee right now, so I'm running about 8-10 miles an hour. I'd like to make the berm ok for peeps going fairly slow and I REALLY want to make sure good riders can RAIL this thing and not have the wheels slip upward.

Online, I found HyperPhysics.com (Max Speed on Banked Roadway) where I also discovered I needed to know the friction coefficient of a bike tire on wood. (I will keep this simple, I promise.) After a lot more searching, I found a couple of sites that went through different processes to tell me the friction coefficient is .3, but that I should use half that for planning. Other sights recommend about .17—.19 .

The "friction Coefficient" is basically how well the tires stick to the wood- preventing slippage. The higher the number, the less slippery. **I enter all of this info into the website** using a Friction Coefficient of .15. I used a radius of between 12 ft (at the dirt part on the bottom) and 16 feet (at the top) because the radius will change depending how far up the berm you go. **I run this a few times and got an indication that 45 degrees might work.** Then I changed the friction coefficient to .01. I wanted to find out to find out what the "ideal" speed would be at various distances up the wall. Basically I set friction at .01 (REALLY slippery) because I wanted to know at what speed could we go around the berm without the tires slipping down or sliding up if the berm was covered in Crisco oil. If I get this, then I can figure out the difference in speed adding the friction back in to get a high and low range. (Note for nerds– I didn't want to get into centripetal forces here because that makes most people fall asleep.)

Using a 45 degree angle and a 12 foot radius with no friction, I get about 13.5 miles per hour. Cool. To double check the real world speeds, I jumped the friction up to .3. with the same radius and angles I figure a bike going as slow as 6 mph should be ok on the shortest part of the wall/edge of the dirt where the radius is tightest, and a bike going as fast as 21 should be able to hold the higher line. I decide to go with a 45 degree angle.

So we start packing lumber, setting posts and measuring everything 4 and 5 times. I quickly see I'm going to need to keep the sections about 5-7 feet long. I dig down because I want to bury the inside of the berm so that there is a small dirt berm in the inside that transfers nicely to the wooden berm when its done. I like to make things so most people can ride them, with easy lines and intimidating lines. I get the 1st section in, and it looks REALLY steep. Uh-oh. I go back through all the wood berm pictures I've got, redo the math 5 times, and decide to trust it- 45 degrees.

I start the wood slightly outside of the actual radius and use STRAIGHT pieces of lumber to bring it into the trail at a slight angle allowing riders to go up the wood at a point just before the radius begins. It looks like a corner due to the decking being cut in a round shape, but the underlying wood in the 1st 2 sections is straight. I also started the 1st section flatter (about 25 degree angle) and brought it up to a 45 degree angle by the end of the 1st section.

Me, Fester and a couple other doods added a couple more sections. I measure where I've got the inner and upper radius's set and mark the string on the post so I can measure to keep the radius even all the way around and only relax the radius into straight lumber again when the corner reaches the point that it lines up with the exit trail.

At this point, we were getting really concerned about speed. Some felt we would never get enough speed to rail this line because it's WAAY TOO steep. **Sticking with the math** (and how do you explain all of this standing in the woods?) I was afraid making the up trail straighter and faster would result in people shooting off of the top. We didn't argue per se, but several of us lost a nights sleep. Only one thing to do. Finish it and ride it!

So we head out the next day after work on a mission– finish it up, and YAH MON!!!! ITS BUTTA BAABEE!! Smooth transition going in, moderate speed will keep you on the wood all the way around, it's 40 feet long, between 4-5 ft tall and you gain speed all the way through it!! We're relieved. It worked out so well the up trail can be flowy OR straight and the berm corner is good either way!!!

Time to start on the bermed bridge**. I use the same technique for setting the radius and angle to match the anticipated speed**. Radius on the BERMED part was larger (about 19-22 feet) and you're moving faster. After entering it all into the Hyper Physics website, I decide to go with a 35 degree angle. We wanted the flat decking to be about 4 feet wide for less skilled riders, so we set 1 row of posts at a radius of about 15.5 ft (we use 2" hardwood decking– it can overhang some) and a 2nd row at a 22 ft radius . The end sections will run straight until it meets the radius and then the transition from straight to curved will be made.

Because this bridge drops about 5 feet over the 55 foot length, **I hung a string- from where we wanted the ENDS of the bridge to be- across the ravine, that went straight from the top of the height of the decking on each side.** This is the "deck height" string. Pull this string tight. **Set the height of where the radius string attaches to the center stake LEVEL with the CENTER of the deck height string.** As you take the radius string around the corner, you can pull it tight, barely touch it to the deck height string and THAT is how high you need to set posts, runners etc to get proper height for EACH post as you drop elevation. Each set of posts should lined up with the radius string.

As we put the runners from the front post to the back post, we measured as we went and **attached a flat board where the radius of the berm is.** This way we can mark where the flat deck stops and the angled deck starts as it goes around.

We decided to leave the berm about 3 feet tall all the way to the exit. Not sure if we'll be able to ride it that far, but it looks cool and if we can– we get rewarded with a "hip drop" to the trail.

The members of FORC answered the call for help and I cannot thank them enough. A lot of people helped with the hauling of lumber through the woods, cutting, fitting, cutting some more, assembly– this is a HUGE project and should not be taken on unless you have ample people willing to volunteer or several years to finish it.

We built a 4 foot long exit ramp for riders using the flat part, and we filled in the uphill side of the ramp/berm corner with dirt to make a transition for dropping off of the end of the berm to the dirt trail. PHEW! Finally done. Now the moment of truth...

I grab a bike, go to the top of the trail section and head back down. Hit the 1st berm, and its great… but I already knew that. Coming off of that berm, I'm rolling into the bermed bridge at a moderate speed, not overly fast. Pick my transition point and up on the berm I go. Heading around, keep going. ALL THE WAY TO THE END… OFF THE DROP, TRANSITION IS SMOOTH… IT WORKS!!!!! WOOOHOOO!!!

Thus commenced a celebration where we rode it 100 times. Top speed was 19.4 MPH the 1st night, and at no time did anyone feel they were being pushed to the outside. For kicks, one rider rode the flat part slowly and another rider passed him on the berm. We stood on the edge of the flat part in the middle of the berm and other doods rode the berm around us. A couple of less experienced riders played on it and had no trouble rolling onto and off of the bermed parts as needed while they experimented.

We marked the inner radius and cut it in a more rounded shape to give it a finished look. We did the same to the upper edge, and then painted an orange stripe around the top 2 inches of BOTH berms. There is a couple of places I will add some bracing. Hardwood, rough cut lumber is HEAVY. This extra weight must be taken into account when building supports.

We spent the rest of the weekend getting the rest of the trail opened up. Once open, almost everyone who rides this is amazed at how intimidating it looks and yet how easy it is to hold your line, all the way to the end if you decide to. Having to do the 12 inch "hip-drop" has caused more trouble than the berm and we may bench it back enough to allow less skilled riders to just go straight off of it without having to do a hip action off of the end.

Me and a couple buddies rode around the mayor at the media event that followed– even made the evening news!

When building wooden berms where you don't have a corner already in place, you MUST get an idea of an average speed, set the radius and the angle so the average speed is "ideal"- the speed that you could do it with zero friction. As you hit it with higher and lower speeds, there is a large margin where the berm will work. A 35 degree angle is such that you can ALMOST stop on it without sliding off, and a 45 degree angle REALLY holds you well if you are going fast. A smaller radius will affect the needed angle more than speed. Going from a 16 foot radius at 20 miles per hour to an 8 foot radius at 20 miles per hour will cause your angle to go from 35 degrees to almost 90 degrees!

The total length of this is about 105 feet, with a 4-5 foot section of dirt between them. The tallest boards on the bermed bridge are almost 7 feet. This took a standard crapload of wood and 50 pounds of 3 1/8 inch exterior deck screws. These screws maintain a large center through the threads so the shear points are stronger. Be carful you don't use normal screws, as most screws get very thin on the threaded part and have almost no shear strength. (Oh, and a standard crapload is about 1.2 times a metric crapload ;-)

Many wooden berms are put in as obstacles and aren't really needed to maintain flow. If you're doing one, put it where it's needed. Now go build something for me to come ride– Vibrato