Seitzinger Racing Ink!

Senior Construction Manual

Illustration and Text by David Seitzinger

This manual was last updated in early 1997 and no further revisions will be made. Since 1997, many rules have changed, and some of the techniques described in this manual may no longer be legal. Plans for Senior (Masters) division racers referred to in this manual are no longer available.

Contents

For my team:

Bob and Sheila
Jaclyn
Mom and Dad

Thanks for your hard work
and dedication.

Where's This Guy Coming From?

Allow me to introduce myself. My name is David Seitzinger and my family and I have been involved in derby since 1979. I competed in more than 100 different races over a nine year period. Seven of those years being in the senior (masters) division. I went to the All-American twice as the Erie, PA, Junior and Senior champ of 1983 and 1984 and then went on to compete in six NDR national championships with my best finish being a second place in the 1991 nationals in Omaha, Nebraska. In between nationals, I did a lot of rally racing where I became the Keystone Champion, the NDR points champion, and I even won a special award from Derby Tech for "winning more races in 1988 than anyone else."

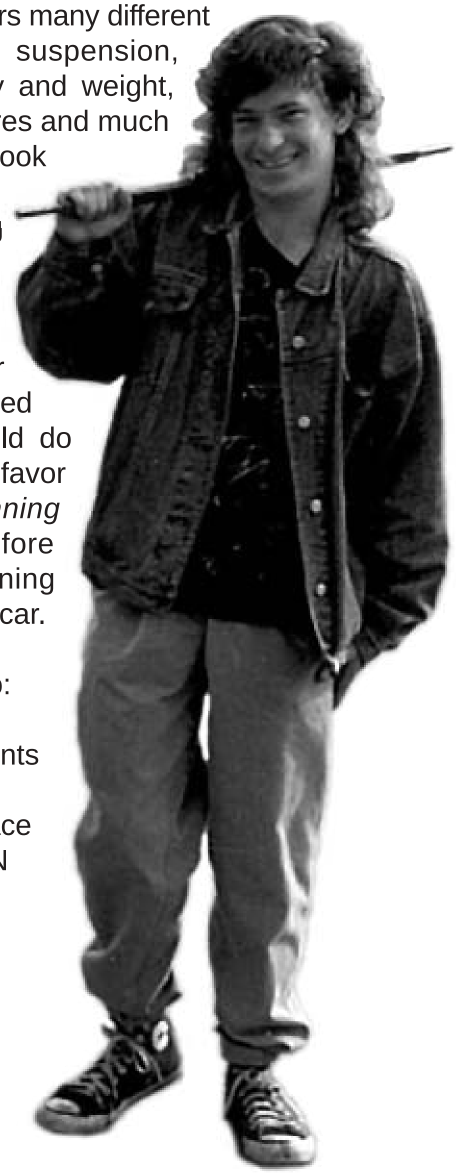
After my retirement as a driver, I teamed up with Jaclyn Messersmith and her family, of Myerstown, PA. Jaclyn's driving skills proved to be unmatched as she competed in the All-American in the Junior and Senior divisions, and then went on to win two Keystone championships, three NDR points championships, three World Derby Challenge points championships, and a lot of rallies along the way. Finally, in 1995 Jaclyn won the greatest race there is, as she became the Senior Division NDR National Champion in Saginaw, Michigan.

This manual is laid out so that things like steering, brakes, and airfoils are discussed before construction. This may seem backwards to some, but as an Industrial Design student, I was taught that there are a hundred different ways to accomplish any task, but planning ahead was the key to accomplishing that task. In derby, nothing could be more true. Building a derby car is no different than building a house or a piece of furniture. The project must be completely planned out (on paper) before you start building. Planning ahead will save you a lot of time because you'll be much less likely to have to repeat steps. Certainly, there will be always be some changes along the way, but a good

builder will know what type of axle mounts will be used in the car, and the location of the steering pulleys before he or she even buys their wood.

Over the many years that I've been in derby, I've seen and tried lots of different sticking methods, axle mounts, materials and more. I am in no way saying that the methods shown in this manual are the *only* good ways to accomplish each task, but I have tried to show some of the quickest and easiest building techniques that I have either used myself or come across from other experienced and successful derby builders. I have designed this manual to give you a basic understanding of how to build a safe and competitive derby car. I encourage you to improve upon what is shown here, and to explore other building techniques that may be more appropriate for your individual situation.

Obviously we all build derby cars to race them, and everyone wants their racer to be faster than the rest. While my emphasis in this manual is on simple and easy construction, I will also try to touch base on what I think is important in terms of speed. Still, discussing how to make a car fast is a whole book in itself. Fortunately for us, that book has already been written by David Fulton. I highly recommend his book, *Winning Ingredients*. David's book covers many different topics including suspension, alignment, energy and weight, race day procedures and much more. David's book goes into much detail, explaining what's important and how to achieve it. I think everyone (whether they are experienced or a novice) would do themselves a big favor by reading *Winning Ingredients* before they start designing and building their car.



Send $25.00 to:

Winning Ingredients
David Fulton
7126 Halden Place
Indianapolis, IN
46214

Jaclyn Messersmith
The 1995 NDR
National Champion

Inside A Typical Senior (Masters) Car

Before you begin designing and building your racer, you'll need to have a clear understanding of the final product. Figure 1.1 shows cut-away views of a typical sit-up and laydown car. Remember that your car won't look exactly like the ones shown in the drawings, because all derby cars are different.

Power Bird vs. Morning Dove in the 1995 All-American finals

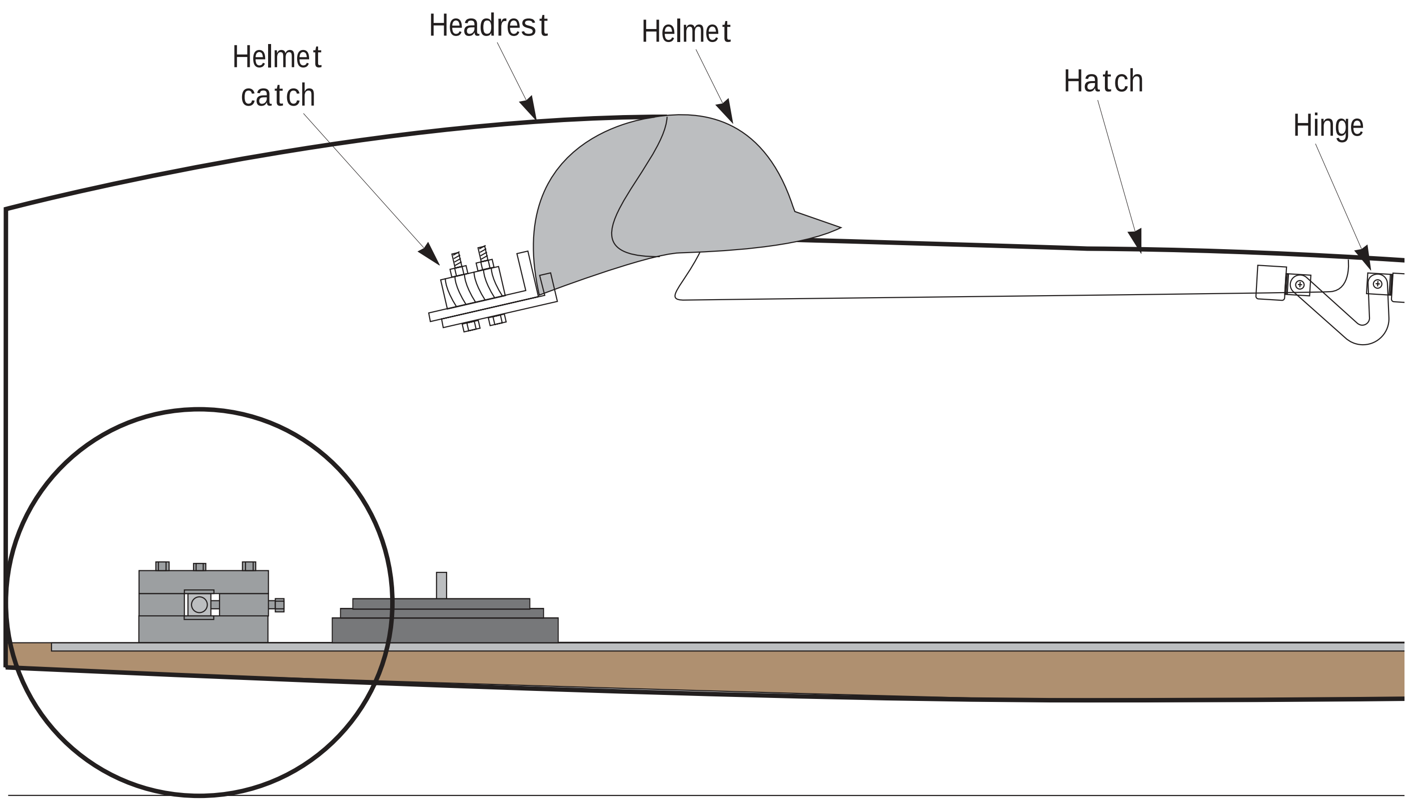
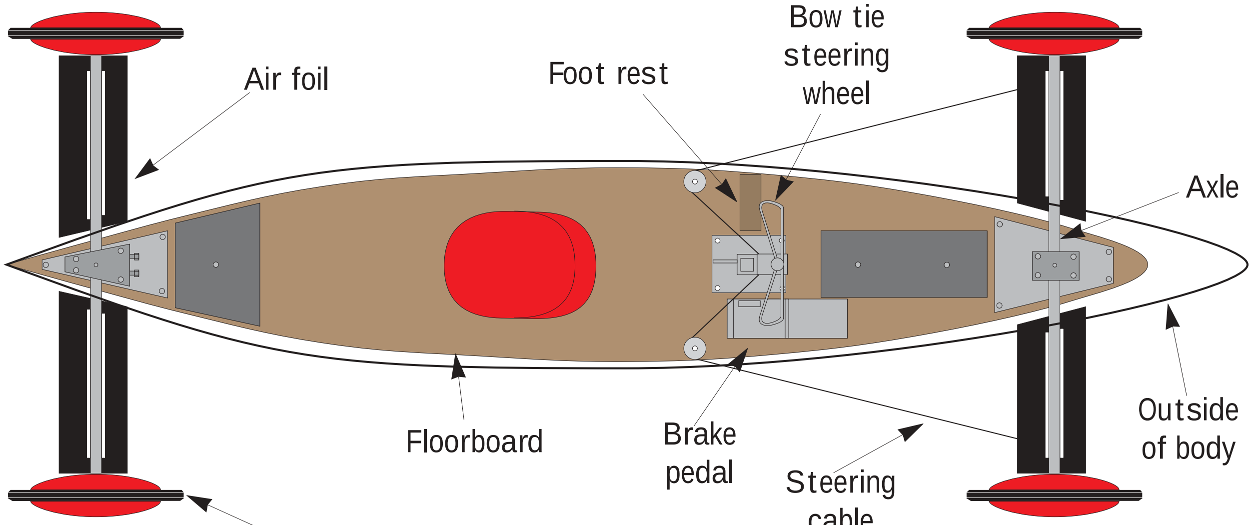
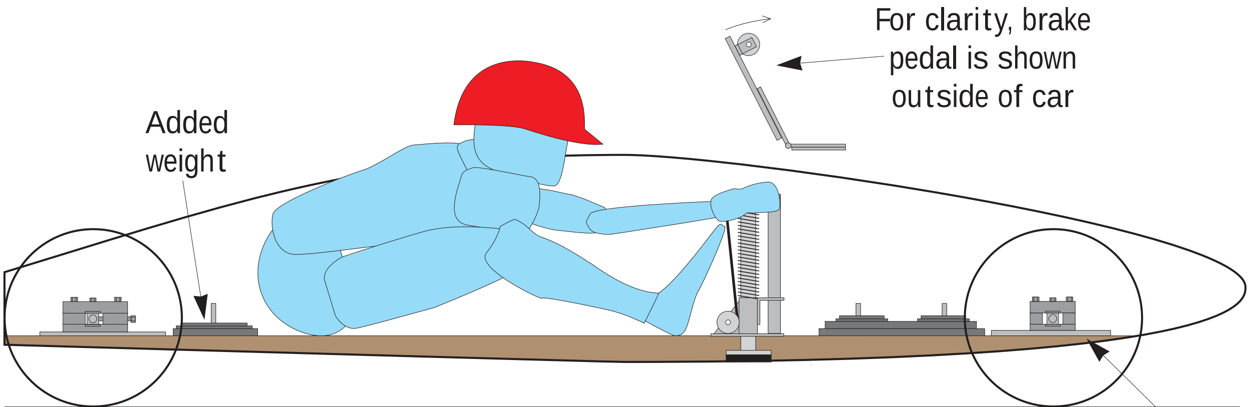
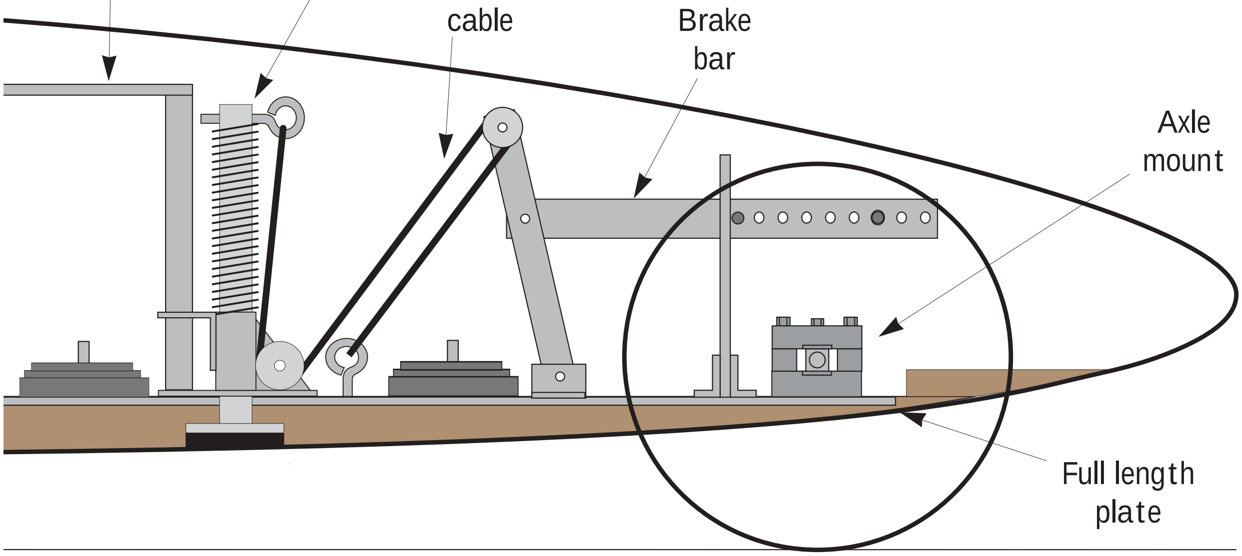


Figure 1.1
Typical Racers







Understanding The Purchased Plans

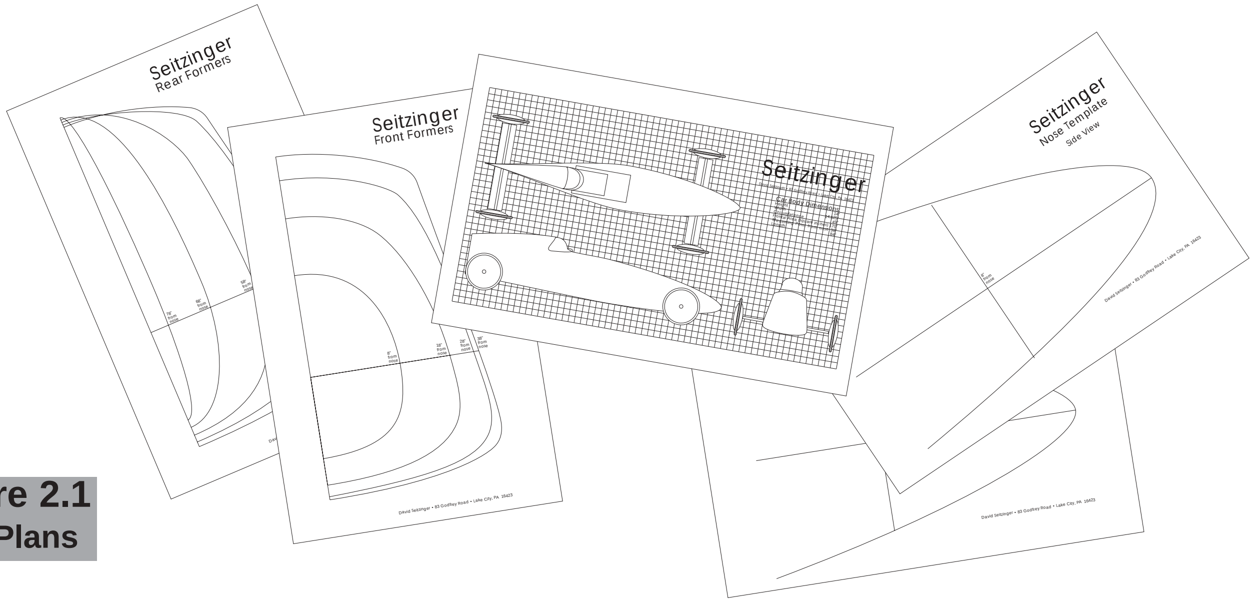
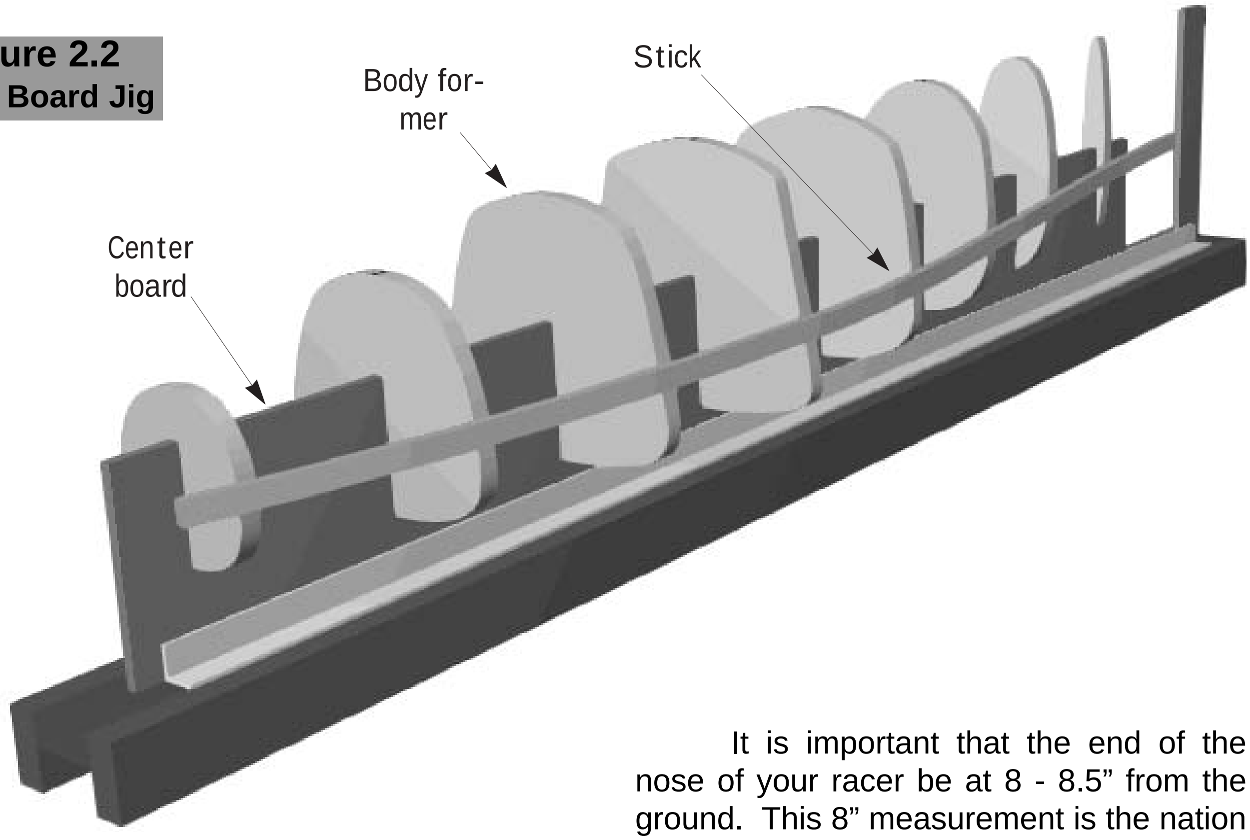


Figure 2.1
The Plans

The plans you have purchased should include five pages of drawings similar to those in Figure 2.1. There is a page with a top, side and front view of the car along with two full size front and rear body former drawings and two nose templates. The body former drawings are half sections of the car looking from the front. These formers will be doubled, transferred to wood, and placed on a Ridge Board Jig, where the car body will be “sticked”. The process of “sticking” is very simple and will be discussed in detail in the construction section, but basically all you have to do is bend small wooden sticks over the solid body formers. Figure 2.2 shows the Ridge Board Jig with the body formers in place and the first stick attached.

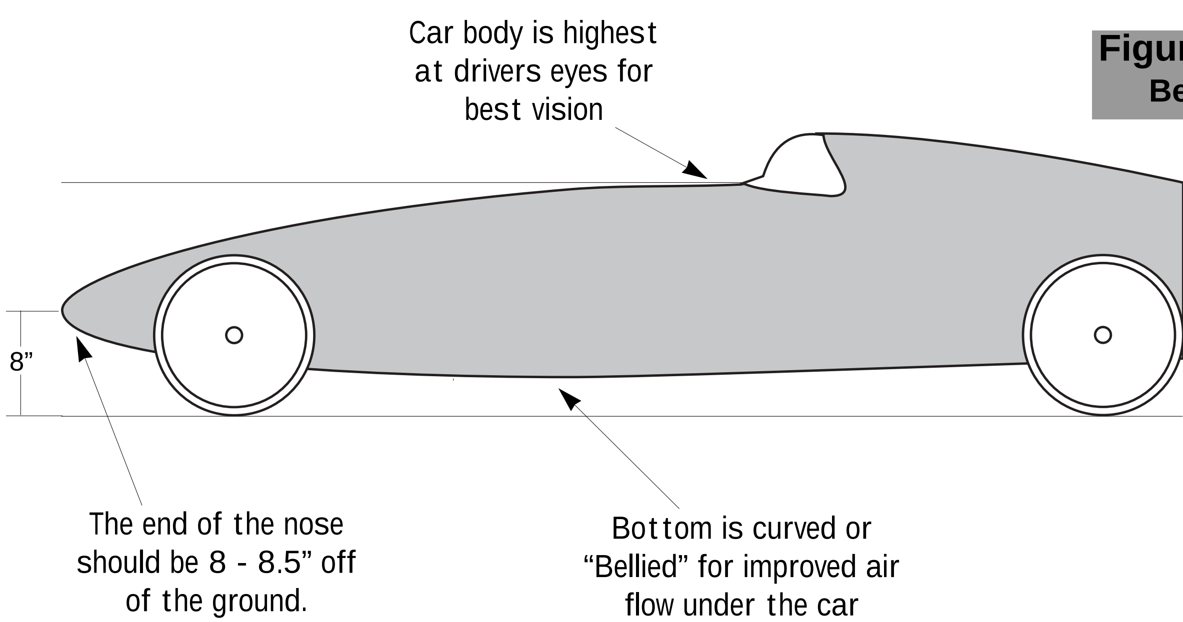
Whether you have purchased sit-up or laydown car plans, you’ll notice that the bottoms of the formers don’t line up in a straight line. This is because the bottom of each car is “bellied”, or curved to be higher at the nose and tail and improve the aerodynamic flow under the car (Figure 2.3). With all laydown car plans you will also find that the top of the car continues to rise all the way to the tail. This continuous wedge improves driver vision by putting his or her eyes at the highest point in front of the helmet.

Figure 2.2
Ridge Board Jig



It is important that the end of the nose of your racer be at 8 - 8.5" from the ground. This 8" measurement is the nation wide standard that all timing lights are set at. If you car's nose is higher or lower than 8 - 8.5" you may be going slightly past the finish line before your car trips the timer.

Figure 2.3
Belly



The Basics (and why)

You should refer to Winning Ingredients for a more detailed explanation of each of these items, especially potential energy. Below is a brief explanation of items which are critical to the speed of a derby car.

Maximum Length- Your car should be as long as the rules allow, because the longer the car is, the higher it's weight is up the hill. More hill means more potential energy for your racer.

Maximum Weight- The combination of car and driver should be at the maximum total weight allowed. The heavier the car is, the more potential energy it will have, and therefore the faster it will go.

Weight Distribution- Except in an extremely unusual situation, it is desirable to have your car a little bit tail heavy. In most forms of racing today, the rules call for balanced weight on each axle, which is more fair for everyone. But, when tail weight is allowed, you can move your car's center of gravity up the hill to increase it's potential energy. By lowering the weight in your car, and keeping the body at the minimum legal ground clearance, you will lower the car's center of gravity, and increase it's potential energy.

Axle Position- Positioning the rear axle at 6" from the tail, and using the minimum legal wheelbase, will move your car's center of gravity up the hill, increasing it's potential energy. The rear axle should also be squared with the front axle to keep the wheels in line.

Streamlining- For slow speed aero-dynamics, such as with a derby car, the nose of your car should be round and the tail should be pointed. The entire car should be smooth with no air gaps and no edges sticking up in the air stream. Details like hatch fits, helmet fits, foam and airfoils will make a big difference.

Structure- The car and all components should be strong. The body and floor-board should not flex, bend, or twist, which wastes energy. To prevent this, the car should be fiberglassed inside and out with several layers of fiberglass mat and/or cloth. Components, such as the axle mounts should also be strong and must be able to withstand twisting, flexing and bumps on the track.

Secure Axles- Not everyone will agree with me on this topic, but in my experience, the car's axles need to be bolted as tight as possible. I also believe that it is a good idea to have "snug" kingpin fits in the axles and axle mounts, to avoid any movement between parts, but there are good running cars that are set up with loosely mounted axles too.

No Loose Parts- All components in the car such as weight, the brake, etc. should be bolted down solid. Nothing should rattle or squeak. Any movement between parts will waste energy.

Designing And Laying Out Your Car

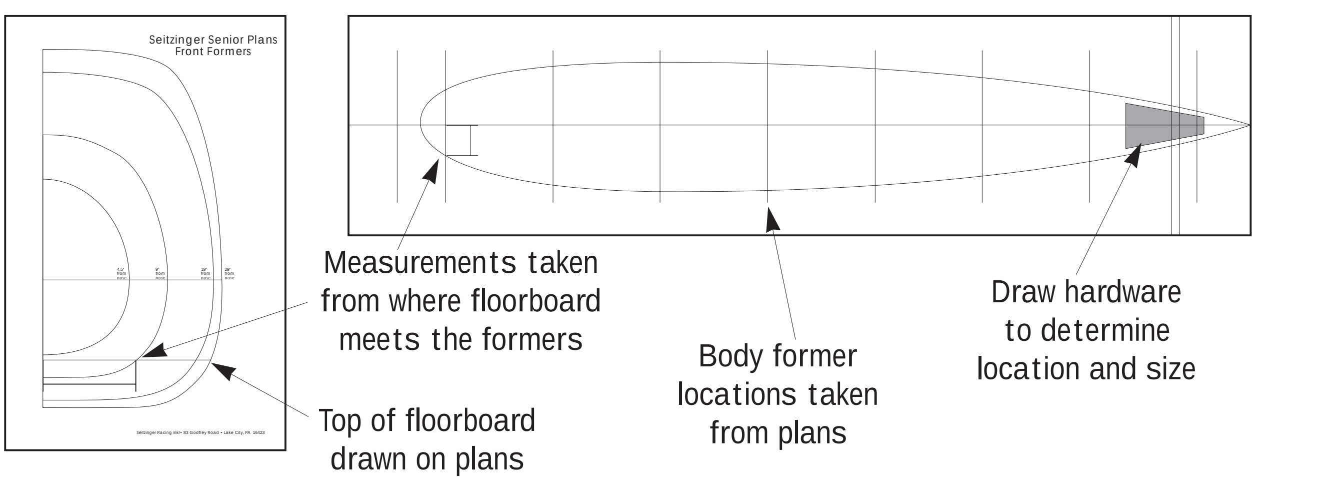
There is a lot more to the design of a car than just the body shape. Each component must be designed, built and positioned to specifically fit the car and driver. It's very important to have everything planned out ahead of time, such as the type of brake, steering and axle mounts you'll be using and where they'll be located. Without proper and thorough planning before you start building, you'll probably find yourself repeating steps, or wishing you would have done something differently. It is very frustrating to find out once the car is built that the steering cables interfere with the brake, or there isn't room to turn a wrench because a weight bolt is in the way. The following several sections will help you decide what components are best for your situation. Think about everything carefully before you start building, and try to keep everything simple. You may have to wait to plan the position of some components, because you may not have the driver's exact position in the car yet. The important thing is that you decide what's going into the car before you start building, so you can determine component size, and the best order to building and installation.

Floorboard Drawing

Before you start building, you should consider making a full size floorboard drawing (Figure 5.1). You could plan everything out directly on the floorboard, but you'll find that having a full size drawing is very helpful for planning and laying out components. You will need a large piece of paper or several pieces taped together and a large drawing surface such as a long table, a hard floor or a wall. Draw a center line down the middle of this paper and mark the position of each former using the numbers on the plans. Take your former drawings and from the very bottom of the largest former, measure up the thickness you plan to make your floorboard. From that point, draw a line parallel to the road which represents the top of the floorboard. Measure the distance from the centerline to the outside edge of the former. Using this measurement and the distance that the former is from the nose, mark a point on your floorboard drawing in the proper position and repeat for all the other formers. Note that depending on your car design, the first former may not rest on the floorboard. This is not an uncommon situation and will be discussed in the section on building a fiberglass nose.

Using a stick, connect the points and trace the curved line. You can now draw in the exact location of the axles and axle mounts, and you'll now be able to use this drawing to help locate and determine the size of the plate, steering, brake, pulleys, cables, weight bolts etc. This drawing should be used throughout the design phase for the size and location of each part. You may also find it helpful to make a side view drawing of the car using the same measuring method.

Figure 5.1
Floorboard Drawing



At this point it's not easy to determine the driver's *exact* position in the car, but you should be able to make a rough guess by measuring off of the formers in the shoulder area which is about five inches from the top of the car for laydown drivers. The driver's weight should now be determined and a few pounds should be added for growth. Weigh a set of axles and wheels, and any other components you have. Make as accurate a guess as possible as to how much weight you have to work with. It's important not to make the car too heavy so that you can add and remove weight and be prepared for any driver growth. A word of warning, many derby builders (including myself) have fallen victim to inaccurate bathroom scales. Mine was 15 pounds off! I've found that digital bathroom scales tend to be more accurate than rotary scales. Most of us will not have access to a professional scale like those used at the races, so allow yourself a little extra weight, just incase. See *Winning Ingredients* for more information on weight planning before you build.

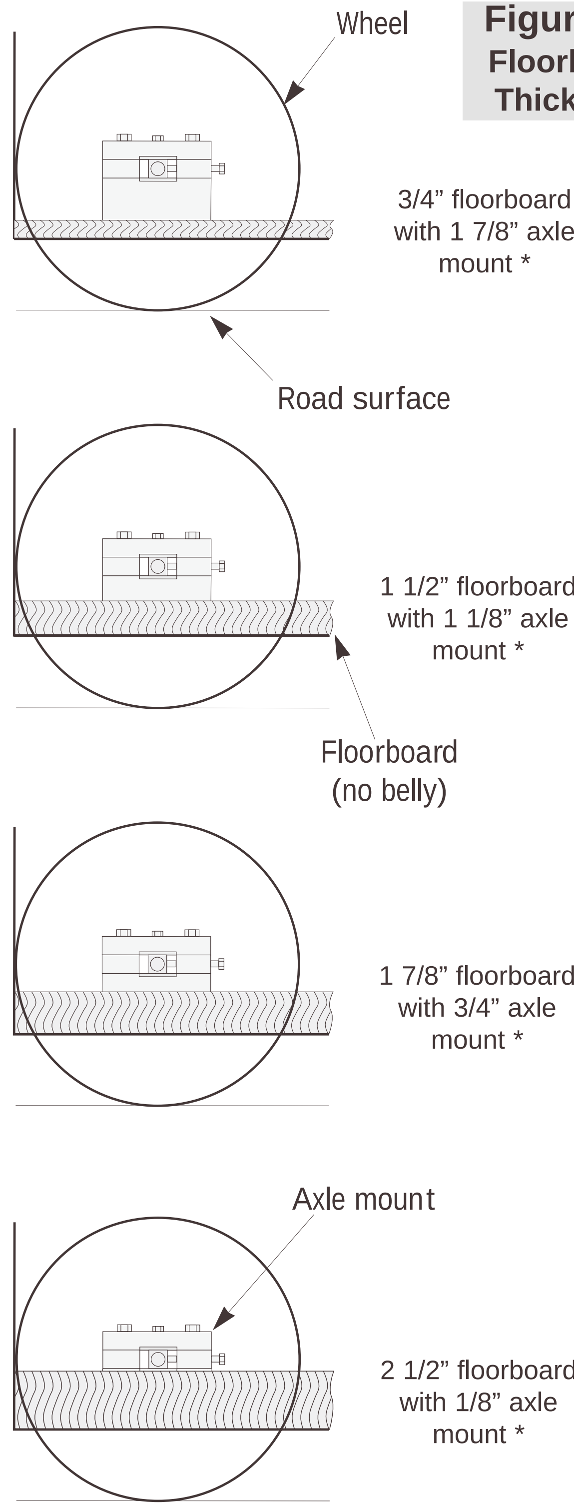
Designing The Floorboard

There are some important decisions that must be made when designing your car's floorboard. First, you'll have to decide how thick the floorboard will be. It's important to figure in the thickness of the floorboard against the thickness of the axle mounts that you plan to use so that the car's ground clearance is legal. You'll also need to decide what method of floorboard lamination you will use, and whether or not you'll be using a metal plate or plates with the floorboard. The key is to first plan what you're going to build, rather than to design the car while you're building it.

Thickness

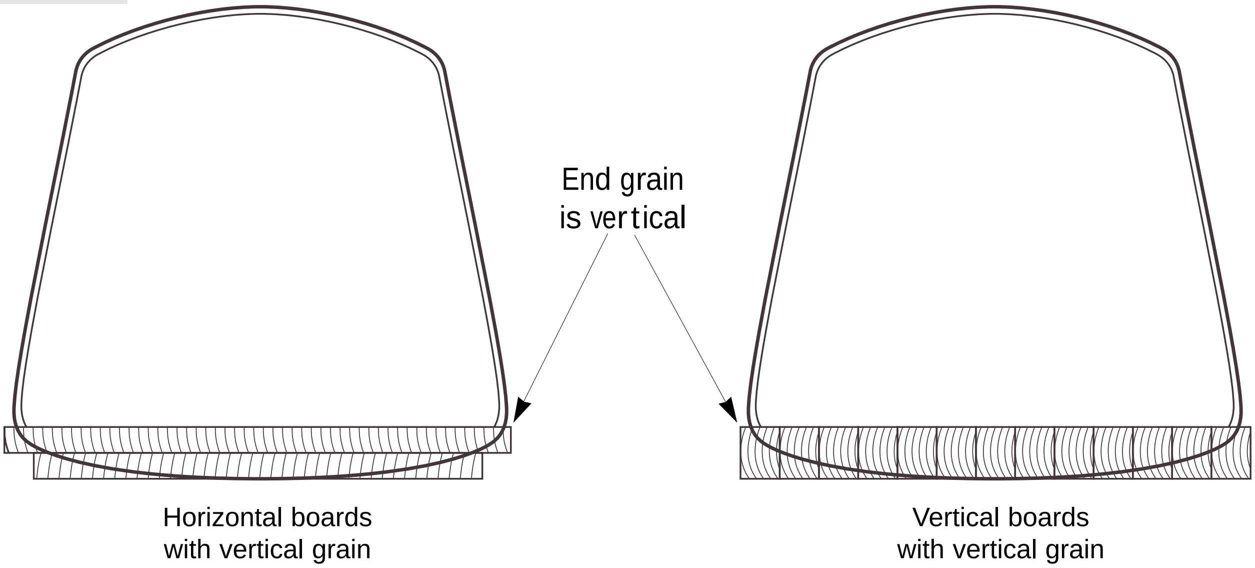
The average floorboard thickness is 1.5". A thin floorboard will lower the driver's center of gravity in the car. A thick floorboard will be stronger, but using a thick floorboard means the driver sits higher, which will raise the car's center of gravity. Thicker floorboards also don't leave much room between the top of the floorboard and the bottom of the axle mounts. For sit-up cars, it's important not to make the floorboard too thick so that the driver can still bend over and have his or her eyes just at the very top of the car. Ground clearance is another important consideration. Before you build your floorboard you should know the thickness of your axle mounts so that the car will end up with the proper ground clearance. When designing this, remember to leave enough thickness for fiberglass, body puddy and paint. You need to be careful when planning this part. One time, a friend of mine built a car with a thick floorboard and thick axle mounts. When the car was finished, he discovered that the ground clearance

Figure 6.1
Floorboard Thickness



* For this figure, axle mount thickness is measured under axle only.

Figure 6.2
Vertical Grain

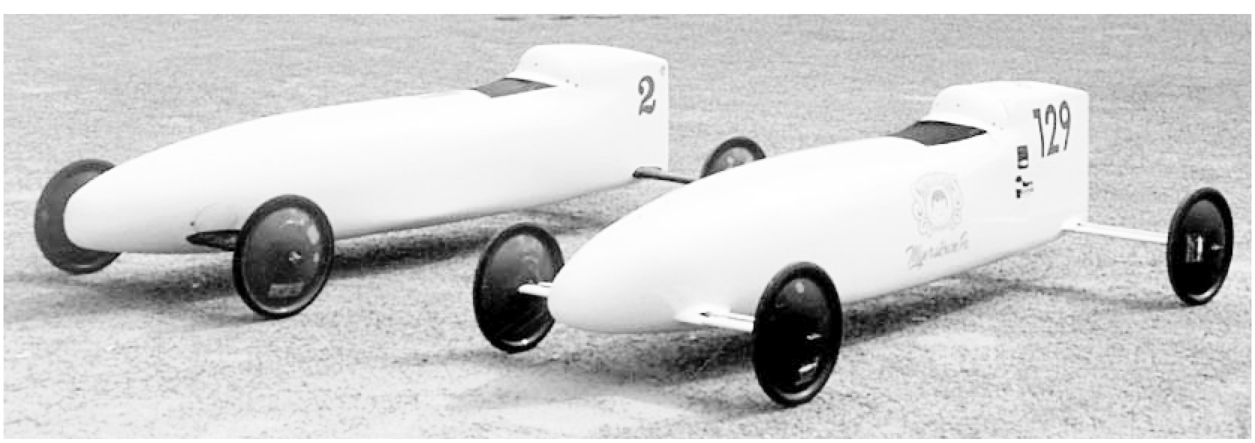


was way too low, and he was told to grind the bottom of his car. The only problem was that the car was already at the minimum legal height, meaning the only possible solution was to build new, thinner axle mounts.

Figure 6.1 shows four examples of axle mount and floorboard thicknesses. They all have a 3" ground clearance, and for clarity, the floorboards have not been rounded (bellied). Keep in mind that a thick floorboard can have a lot of belly, while a thin floorboard can have very little.

Lamination

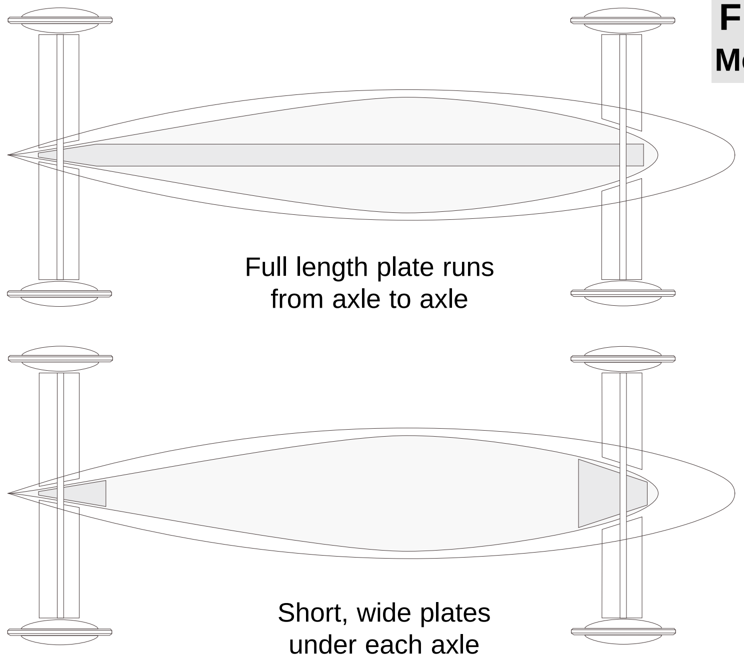
Figure 6.2 shows two common ways of laminating floorboards. The way you laminate your floorboard will depend on how your wood is cut in relation to the grain. It is important that the end grain runs in the vertical direction for a stronger floorboard. When you purchase your wood, look closely at the grain and the size of the boards. Try to picture how you can get the best structure with those particular boards. Later in the construction section of this manual, I'll discuss floorboard lamination in more detail.



Metal Plates

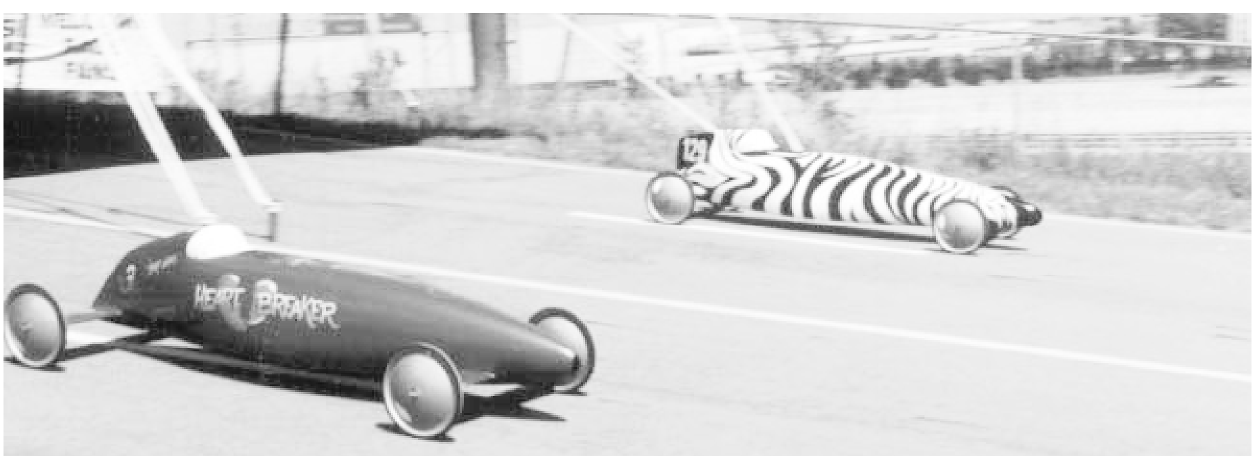
For years now, many derby builders have been using metal plates in their floorboards to mount the axles, steering and brake to. Having a plate in the floorboard does not necessarily make the car faster, but it acts as a hard, flat and straight surface to mount the components to. Metal plates also provide low weight in the car. Figure 6.3 shows the two common plate configurations being used today.

Figure 6.3
Metal Plates



A full length plate is a plate that runs from axle to axle. It can be flush with the top, or buried inside of the floorboard. You must plan your car's weight very carefully when using a full length plate. I can't tell you how many people have miscalculated the weight of a car when using a full length plate, and ended up having to perform major surgery on their car to correct the error. The other common plate configuration is to use short mounting plates under each axle. These plates are usually wide and sit on top of the floorboard, although they can also be flush with the top or buried inside the floorboard. Careful weight planning is also important here.

In general, derby builders use either steel or aluminum for their plates, whether they are short or full length. Both metals provide a good, solid surface to mount components to. Steel is heavy which is good for helping get the car up to total weight. Aluminum is much lighter



Jackie Messersmith's Zebra 60 in the semi-final heat of the 1995 NDR National Championship than steel, which is usually better for a heavier driver. I have personally used both aluminum and steel, and had much success with both of them. On two different occasions, I was using short mounting plates, and found it necessary to use steel for one end of the car and aluminum for the other, in order to keep the car's weight balanced.

Metal plates are convenient for mounting purposes and low weight, but are in no way necessary to make a car fast. There have been quite a few top running cars in the past that did not use metal plates. I know of one car in particular that had no metal in it at all, and placed in the top eight at both the All-American and the NDR Championship in the same year. The addition of a full length metal plate will do very little to stiffen the floorboard. It has been a popular misconception in derby that full length plates do this. A plate's real use in derby is to provide a surface to mount the axles to. As an example, when I built Jackie Messersmiths Zebra 60, (the 1995 NDR National Champion) I did not use a full length plate. I simply put a short steel plate at each end of the floorboard for mounting the axles.

An experienced builder once told me that he'd rather put twenty pounds of fiberglass in his car (for strength) than to use a twenty pound plate. That statement makes a lot of sense, because pound for pound, fiberglass is stronger than steel. I'm not trying to detour you from using plates. I just want to make it clear that a fast car does not require a metal plate. Also keep in mind that if a plate is not mounted properly in a car, it could do more harm than good. I'll discuss how to securely mount a plate in the construction section of this manual.

Axle Mounts

In the suspension chapter of *Winning Ingredients*, you'll find a wide variety of axle mounts, ranging from floppy-loose to super solid-tight. That chapter does an excellent job of explaining each type of mount and what they're trying to accomplish. I'm now going to show six different mounts that I've used in some form over the years. I've been successful with all of these mounts, and I wouldn't be afraid to use any one of them today. All of them are relatively easy to build with basic materials and no machining. It's important that you understand that there are a lot of different types of mounts that can run well, and each type will probably have many different variations that may also work. Before looking at these axle mounts, I want you to understand what it is that I'm trying to accomplish with these mounts and why.

What's Really Important?

(In no particular order)

• The way you mount the axles must not waste energy. *Winning Ingredients* does a good job of explaining energy and how it is used, but in a nutshell, anything that moves, bends, twists, bounces, rattles, squishes or squeaks will waste energy. I suggest you stay away from springs, bearings, diving boards (spring boards) and rubber.

• Your axle mounts must be strong and simple. Weak mounts, or mounts with a lot of tiny parts, usually don't hold up and may flex or bend, wasting energy.

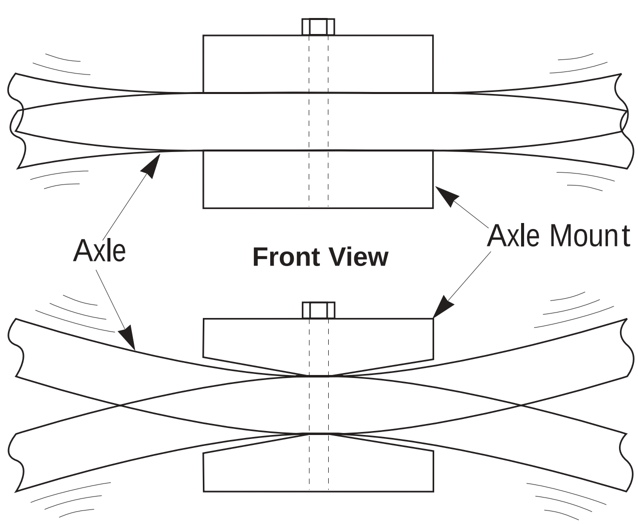
• I only have experience running axles that were bolted *very tight*. Since I have no experience with loose axles, I'm not qualified to recommend that type of set up, however I know that it is possible to make loosely mounted axles run well. You won't see this, as often as tightly mounted axles, but I encourage you to experiment for yourself.

• Your axles should be held with a *minimum* amount of metal contact. *What does that mean?* Well, I'm not sure that anyone fully understands the reason for this, but one theory is that when a car is rolling, it's axles flex up and down from the center where they are held. The more the axles flex (and just the axles, not the body, floorboard or kingpins) the faster the racer seems to go. Another theory is that there is less friction with less contact.

Understanding Minimum Axle Contact

In Figure 7.1 we are looking at two separate front views of an axle in it's mount. Looking at the first axle and mount, you can see the exaggerated flexing of the axle as if the car were racing. Notice how the axle can only flex from beyond where it is held by the mount. In the lower drawing, the mount has been relieved so that the axle is only held in the very center. Now the axle has more flex because of minimum axle contact.

Figure 7.1
Minimum Axle Contact



Materials

Listed below are some materials that are good for building axle mounts, which you shouldn't have much trouble acquiring. Look in your Yellow Pages under *Industrial Suppliers or Metal* for local distributors of high grade bolts, washers, aluminum and steel.

Quality Kingpins - All the bolts in the car should be high quality, but the kingpins should be especially good. For my kingpins I try to use the smoothest, straightest bolts that I can find which are usually grade 8 or higher.

Cut Axles - Old cut derby axles are probably the most convenient materials to use for building axle mounts. They already have a flat, smooth, straight surface, and they provide you with a 3/4" dimension that will match your axles perfectly.

Metal Angles - Metal angles are great too. I like to use cut pieces of angles for attaching the threaded rods that align the rear axle. They may also come in handy when building the brake.

Metal Plates and Blocks - For larger mounts you may want to use bigger pieces of steel. Plates are convenient because they are flat and straight and can be cut to shape.

Washers - I try to use as few little parts as possible, but in some cases using a couple of "little parts" such as high quality washers can save a lot of work. You might consider using high quality washers as an alternative to relieving axle mounts for minimum axle contact. If washers are used, they should be high quality, hard steel which is very flat and straight. You probably won't find good washers in a hardware store. You'll have better luck with an industrial supplier or a speciality bearing shop.

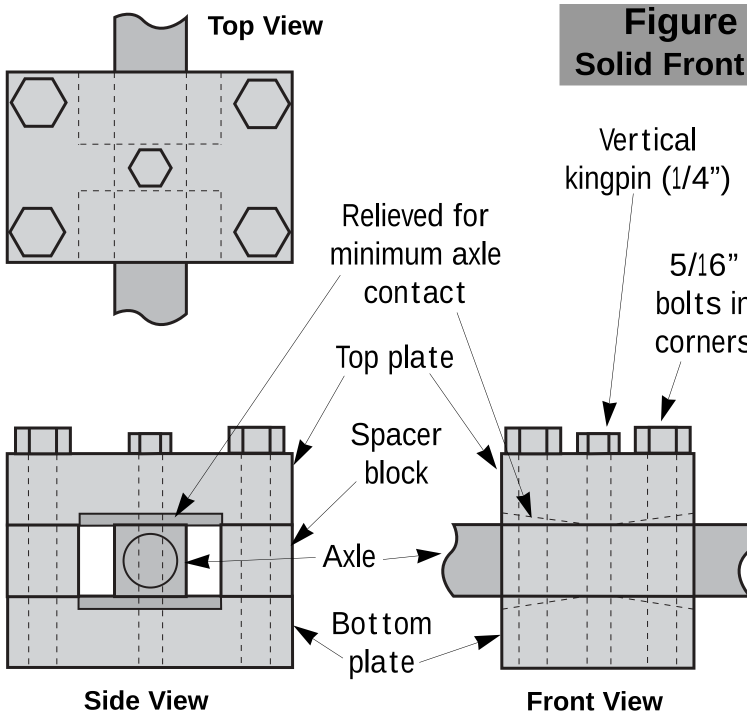
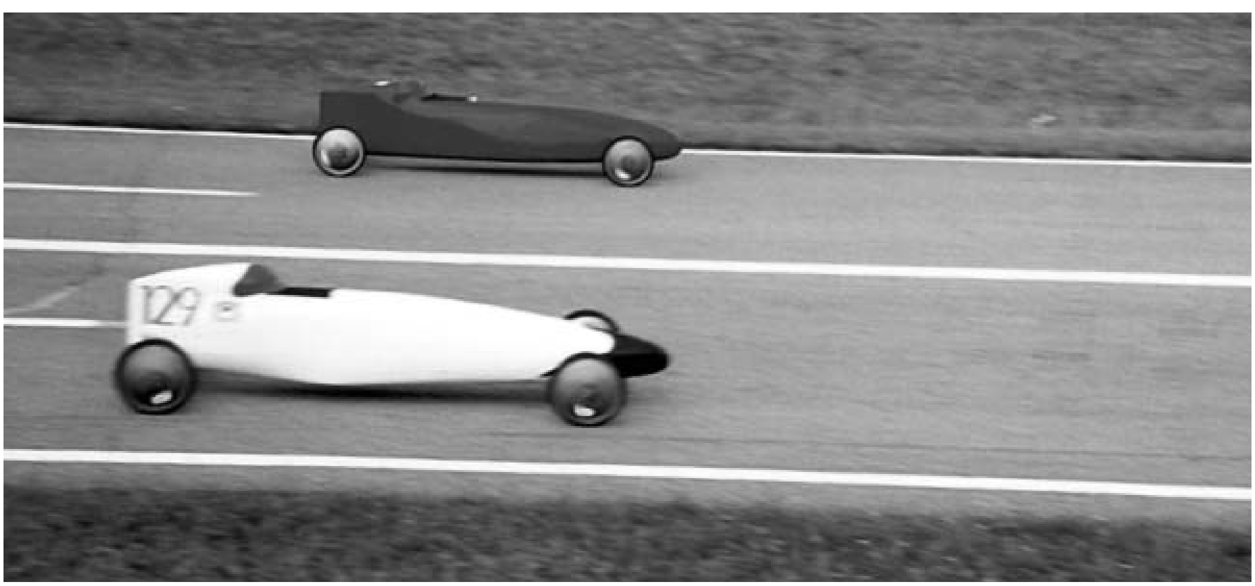


Figure 7.2
Solid Front Mount

Thrust Washers are excellent for derby because they are hard, flat, highly polished and come in a variety of sizes. They are designed to be used on both sides of a thrust bearing. I don't recommend using bearings with your axle mounts, but thrust washers are a good choice.

Solid Axle Mounts

You may have heard of the type of axle mounts in Figures 7.2 through 7.6 referred to as "Stiff Mounts", or "H Blocks". Regardless of what you call them, these axle mounts are designed to hold the axle very tight, allowing for steering, but they will prevent any

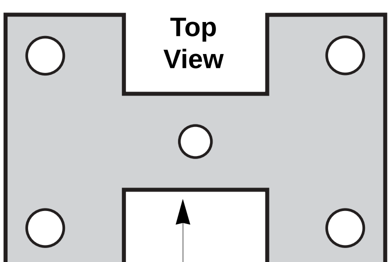


movement or bending of the kingpin such as in a Stock car setup. If built properly, a solid axle mount will sandwich the axle and compress it slightly. You'll find that these mounts are very strong and reliable. They do the job of holding the axles very tight with several bolts, and still maintain minimum axle contact.

Figure 7.2 shows a solid front axle mount. As you can see, it's a very simple set of four steel blocks with a vertical kingpin and four 5/16" bolts. The dimensions of this mount are up to you. The entire mount can be as wide as you want, with as many bolts as you like, holding it tight. The thickness of the top and bottom plates are also up to you. I prefer to have a 3/4" thick top plate, and the bottom plate is thick enough to give the car the minimum ground clearance allowed. The two spacer blocks should be as thick or slightly thinner than the axle itself. To make building this mount easier, consider using two cut pieces of an old derby axle as the spacer blocks.

It is important to relieve both the top and bottom plates for minimum axle contact. To do this, I scribe some guide lines on the steel and then use a bench grinder and a sharp metal file to relieve the metal. Some people like to cut some of the steel away to reduce the amount of metal they will have to relieve (Figure 7.3). For another good solid axle mount that is trying to accomplish the same thing, see David Fulton's book, *Winning Ingredients*, Figure 12-19.

Figure 7.3
Cut Metal



The top and bottom plates could be cut to resemble an "H" (thus the term "H" Block). This would lessen (or eliminate) the amount of metal that would have to be relieved for minimum axle contact.

The solid rear axle mount in Figure 7.4 is very similar to the front mount in Figure 7.2. All the same principles that applied to the front apply to the rear. The only difference is that we want the rear axle to be held straight instead of pivoting for steering. To hold the axle straight, use two bolts that will be turned up against the axle, or two long threaded rods through the axle. If threaded rods going through the axle are used, they should be long so they don't restrict axle deflection.

Figure 7.5 shows a solid rear axle mount which demonstrates how threaded

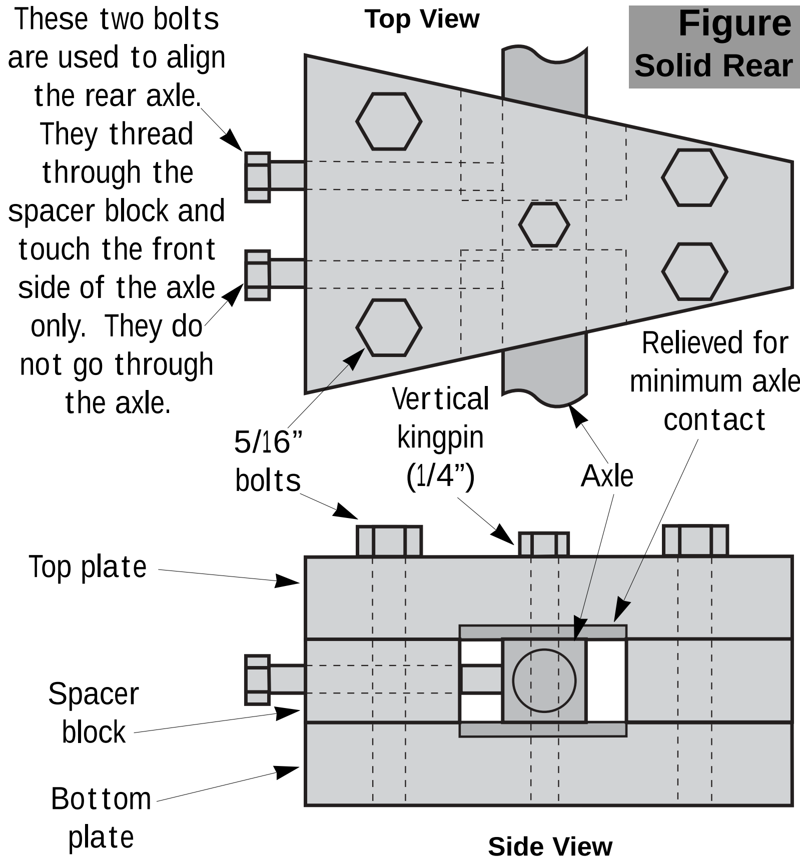


Figure 7.4
Solid Rear Mount

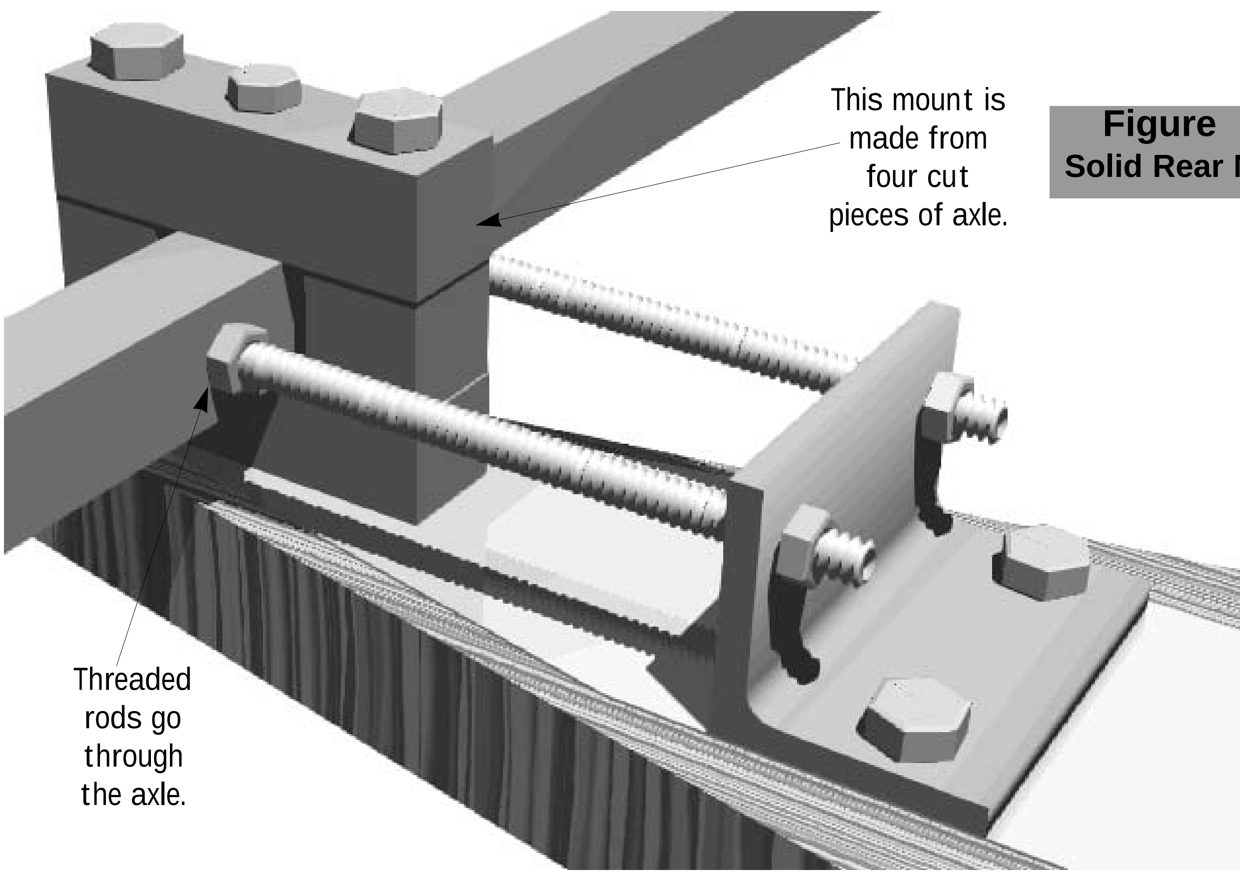
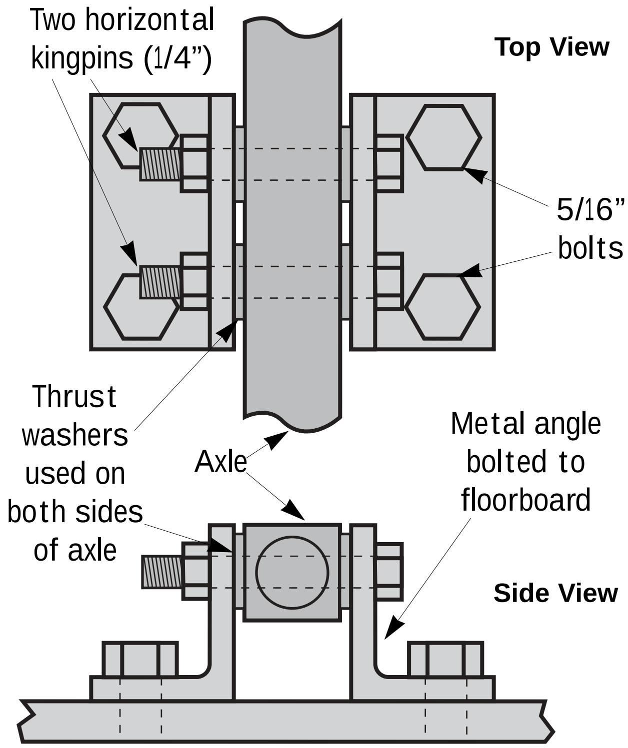


Figure 7.5
Solid Rear Mount

Figure 7.6
Solid Rear Mount



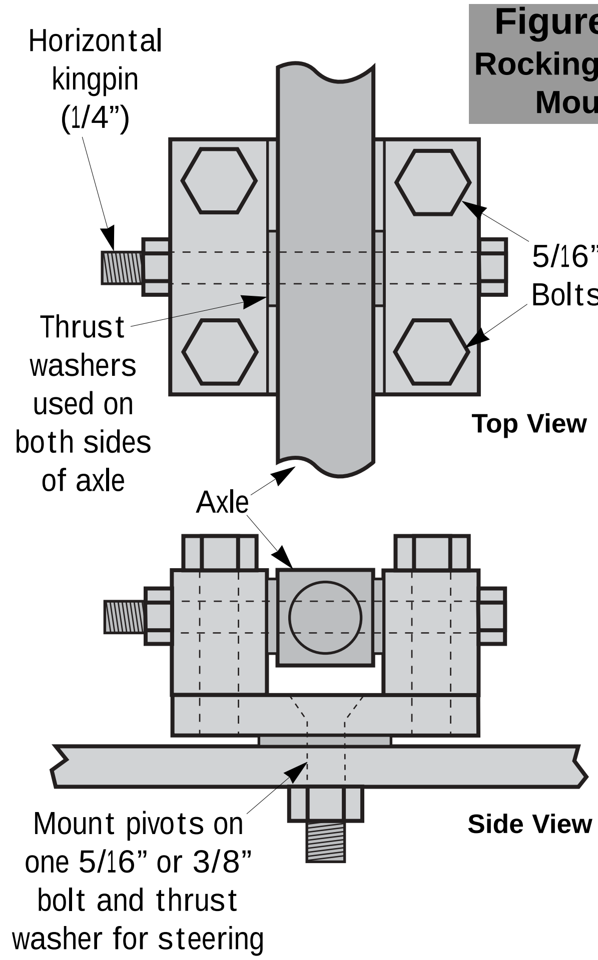
rods that go through the axle should be long so they don’t restrict axle deflection. The current rules say that these rods must be 1/4” in diameter or smaller. This mount is made from four pieces of a cut derby axle and one short metal angle. This same solid mount could also be used as a front mount if the threaded rods were removed.

In Figure 7.6 we are looking at a simple, but very effective solid rear axle mount. This mount uses two horizontal kingpins with four thrust washers and two metal angles. The thinking behind this mount is that the axle is free to deflect in between the kingpins, and still remains solid. This mount could easily be made into a front mount by using a small plate, a large pivoting bolt and a thrust washer as is done is Figure 7.7.

Rocking Axle Mounts

Figure 7.7 shows a rocking front axle mount that uses a horizontal kingpin. This mount will allow the axle to pivot vertically and eliminate cross bind while still holding the axle with a minimum amount of metal contact. The mount is held to the floorboard with a single, large (5/16” or 3/8”) bolt and is spaced with a large thrust washer. This bolt will allow the axle mount to steer. When using a mount like this, You can adjust the tightness of the rock with one bolt. The result can be anywhere from a firm rocking action to a loose, floppy movement. By eliminating the single pivoting bolt, this mount could also be used in the rear of your car.

Figure 7.7
Rocking Front Mount



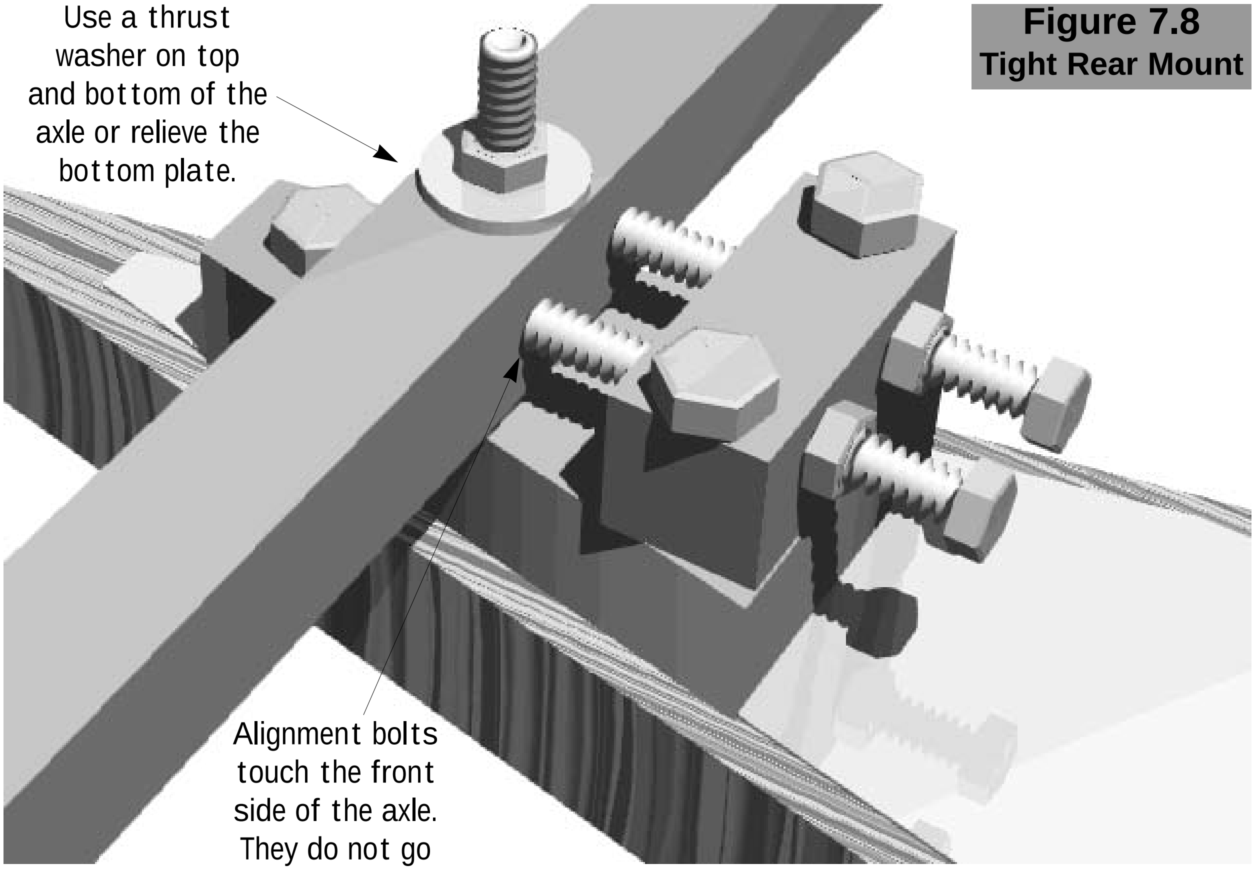


Figure 7.8
Tight Rear Mount

The horizontal kingpin mounts in Figures 7.6 and 7.7 are very similar to each other, even though one is solid, and one is rocking. Figure 7.6 uses metal angles, and Figure 7.7 uses metal blocks. You could use either angles or blocks for both of these mounts and get the same result. Both could be used in the front or rear of the car, and with a little careful planning, you could build one mount that could accommodate both the solid and rocking setups. You would simply need to drill three horizontal kingpin holes in the angles or blocks instead of one hole for the mount in Figure 7.7 or two for the mount in Figure 7.6.

Tight (but Flexing) Axle Mounts

In Figure 7.8 we are looking at a rear axle mount that is somewhere between a solid and a rocking mount, so we'll call it a *tight* axle mount. This setup is similar to what is used in a stock car, only this mount uses stronger and more reliable materials. When the car goes over an uneven surface on the track, the kingpin in this mount will flex slightly, allowing the axle to rock. The mount is built using a bottom plate and a piece of cut axle. The bottom plate can either be relieved for minimum axle contact, or a thrust washer can be used in between the axle and plate.

Two alignment bolts are used in this tight mount that thread through the cut piece of axle and only touch the front side of the axle to hold it square. Threaded rods for alignment that go through the axle could be used instead, but they should be long so they don't restrict axle deflection as shown in Figure 7.5. All the bolts in this mount should be as tight as possible. The two alignment bolts, however should not put much back pressure on the axle at all. They should be just tight enough to hold the axle square.

Some Final Thoughts on Axle Mounts

Your axle mounts should be made out of steel and not aluminum. Aluminum is fine for full length or short plates in the floorboard, but the mounts themselves should be made from steel. Your axle mounts will be under a lot of stress, so you're better off using steel for added strength.

I have talked about bolting your axles tight, but keep in mind that tight is tight enough. Over the years I have seen a lot of people turning the wrenches so hard that they break bolts. That's ridiculous! You can feel when the bolts are tight, so don't risk breaking anything, because you won't make the car any faster. If you plan on running the axles very tight, then remember that it helps to use several bolts instead of just using one bolt, the kingpin, to hold everything together.

When you do your final assembly before you go racing, you should polish and lubricate all axle contact areas. Make sure there is no rust or small nicks at the mounting areas of the axle or axle mount. I like to gently buff these surfaces, and the kingpins, to make sure they're all smooth. Once everything is polished, you should lubricate these mounting surfaces to reduce friction. I suggest you use grease instead of oil or petroleum jelly since the grease will hold up in the heat and last longer.

I want everyone to understand that these are not the only good axle mounts out there. There are many good axle mounts being used today that are very efficient and reliable. Some are similar to the mounts I've drawn, and others are very different. I encourage you to use these mounts as a basis in designing your own. You should base the size, shape and weight of your mounts to fit your particular car. Remember to design the thickness of your mounts and floor-board so that your car will have the minimum legal ground clearance.

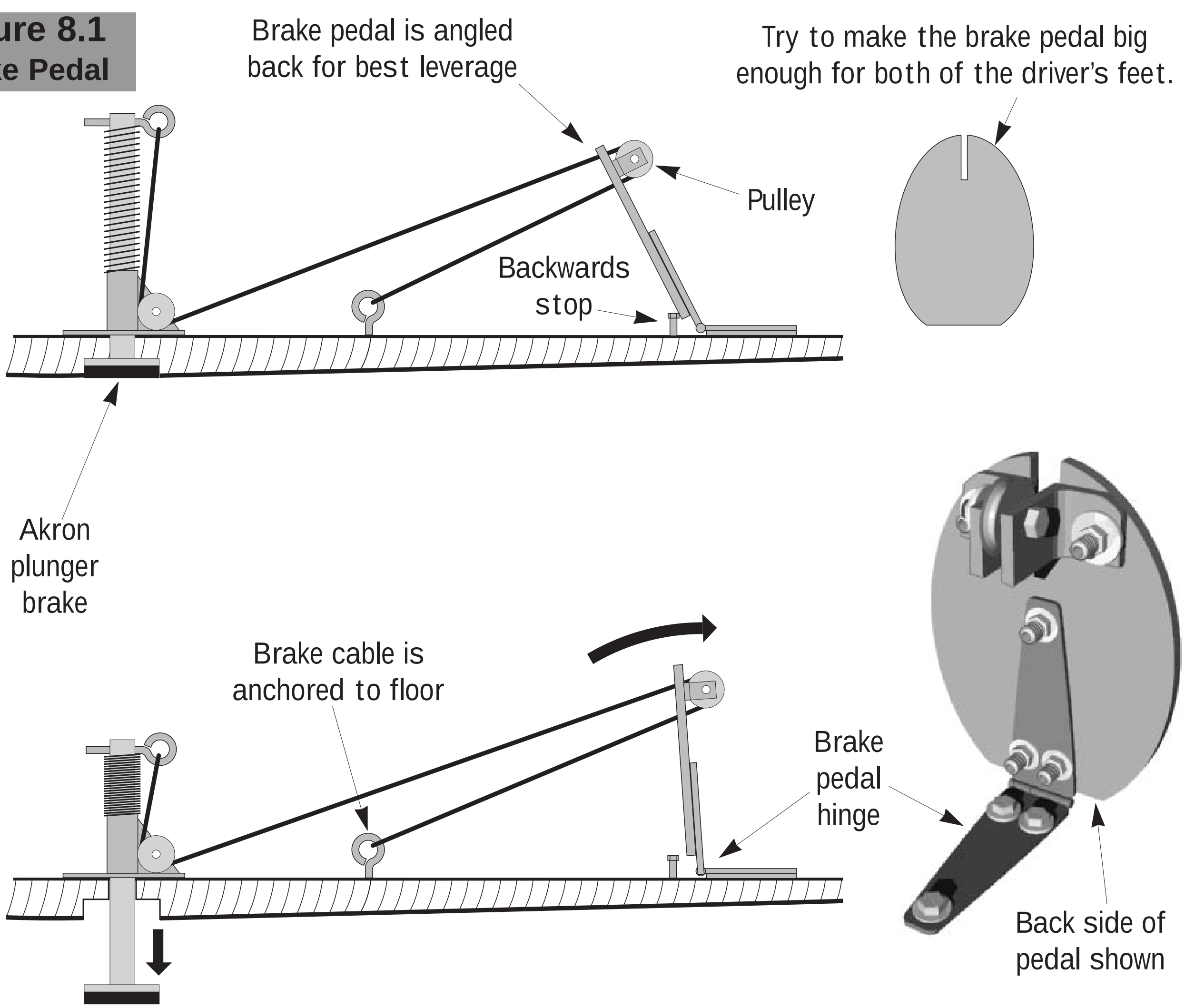
You may be wondering which of the six mounts shown is the fastest. I can't say that any one is faster than the others. I have confidence in all of them, otherwise I wouldn't have put them in this manual. I have personally used some variation of each one of the mounts shown, and I've won rallies with all of them. They are all strong, efficient and reliable, and any one would be a good choice to put in your car.

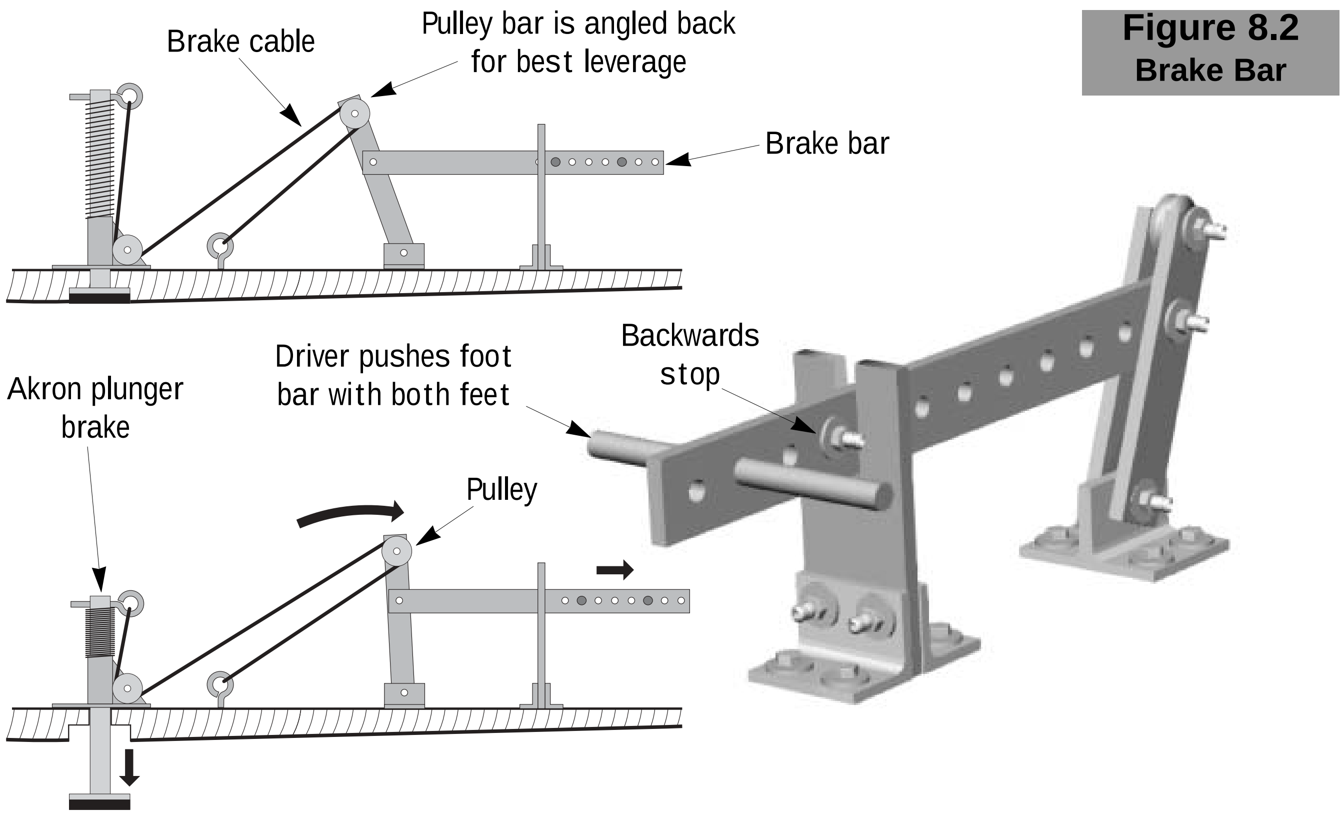
Brake Time!

The brake is probably the most important part of the car. Obviously it's very important to have a safe, reliable brake, but it also has to be functional for a driver with limited foot room in the car. The position of the driver's feet in the car is also a determining factor in the type of brake to be used. In this section, two different brake designs will be shown, which both work on the principal of a two-to-one ratio.

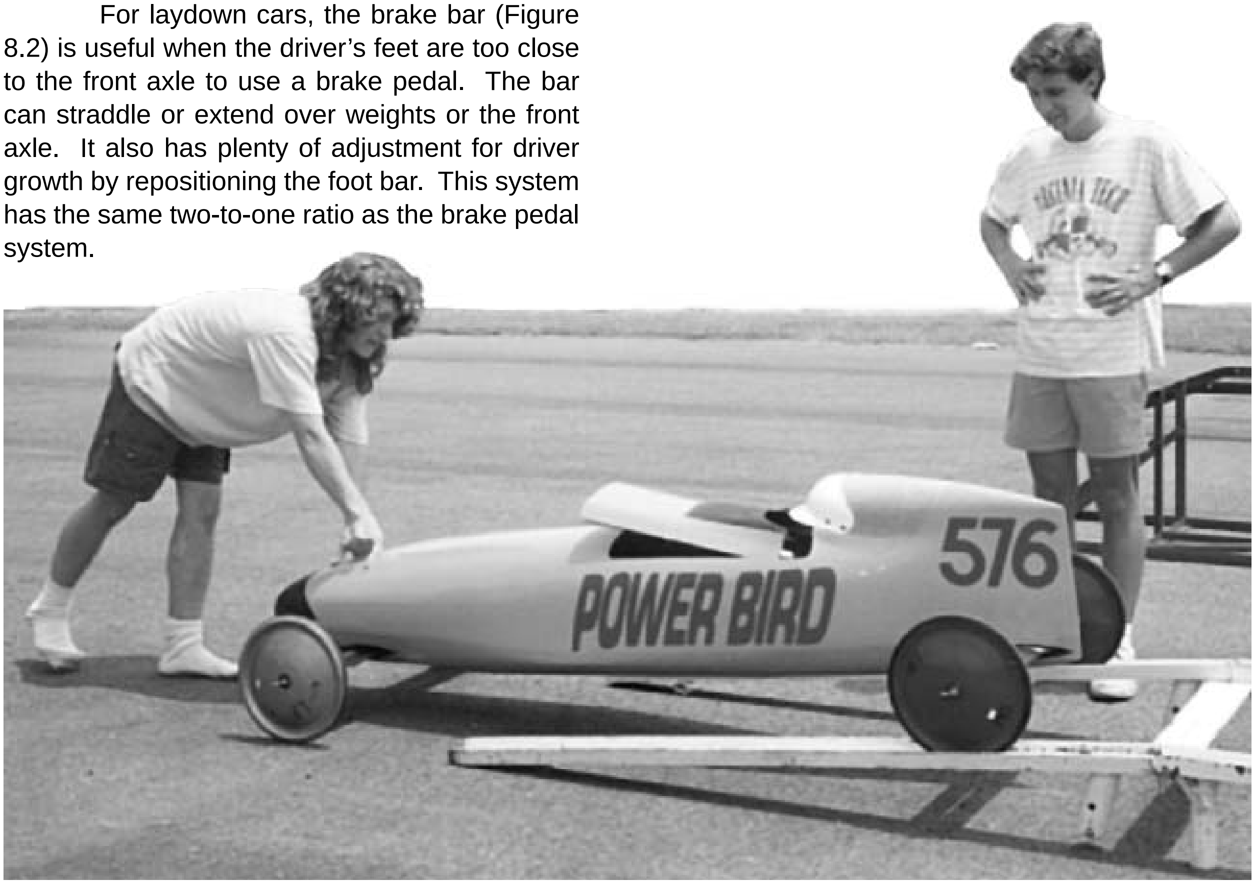
The brake pedal system (Figure 8.1) uses a hinged foot pedal (usually aluminum) that (for laydown cars) gives the driver the advantage of using both feet to apply the brake. For a sit-up car a using this system, a single-foot pedal will be more appropriate, but the design is the same. A pulley will be attached at the top of the front side of the pedal, while the brake cable goes from the top of the brake shaft, around the two pulleys, and will be anchored to the floor. This system provides a two-to-one ratio, where the driver only has to push his or her feet about one and a half inches for the brake shaft to drop three inches. This ratio also increases the resistance on brake, but that shouldn't be a problem for the driver if friction between parts is minimized. It's important to notice that the brake pedal is angled back toward the driver, and when pushed, it is in a near upright position. This will provide much better leverage than if the pedal started in a upright position and was pushed back. The same principle will apply to the brake bar in Figure 8.2.

Figure 8.1
Brake Pedal





For laydown cars, the brake bar (Figure 8.2) is useful when the driver's feet are too close to the front axle to use a brake pedal. The bar can straddle or extend over weights or the front axle. It also has plenty of adjustment for driver growth by repositioning the foot bar. This system has the same two-to-one ratio as the brake pedal system.



Steering Systems

When laying out your car's hardware, be sure to plan the steering carefully. It's easy to overlook the location of a pulley, or end up with lead in the path of the cables. Figure 9.1 shows a car with typical locations for the steering wheel, cables, pulleys, and cable adjusters. Remember to avoid cable deflection, and always keep the cables running parallel to the axles.

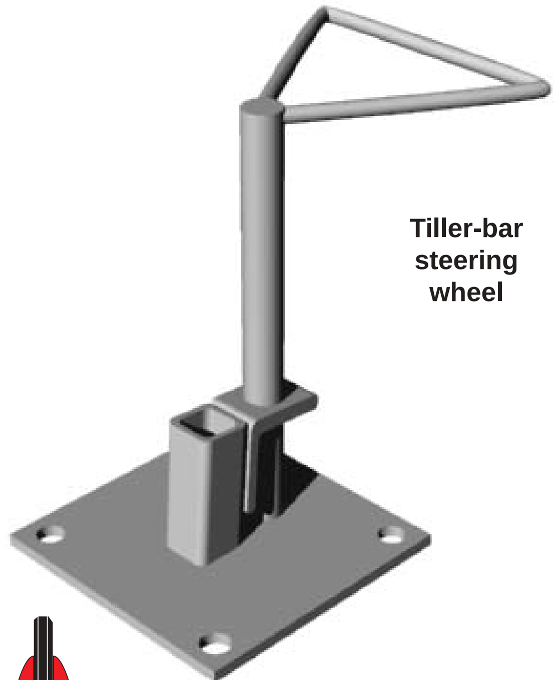
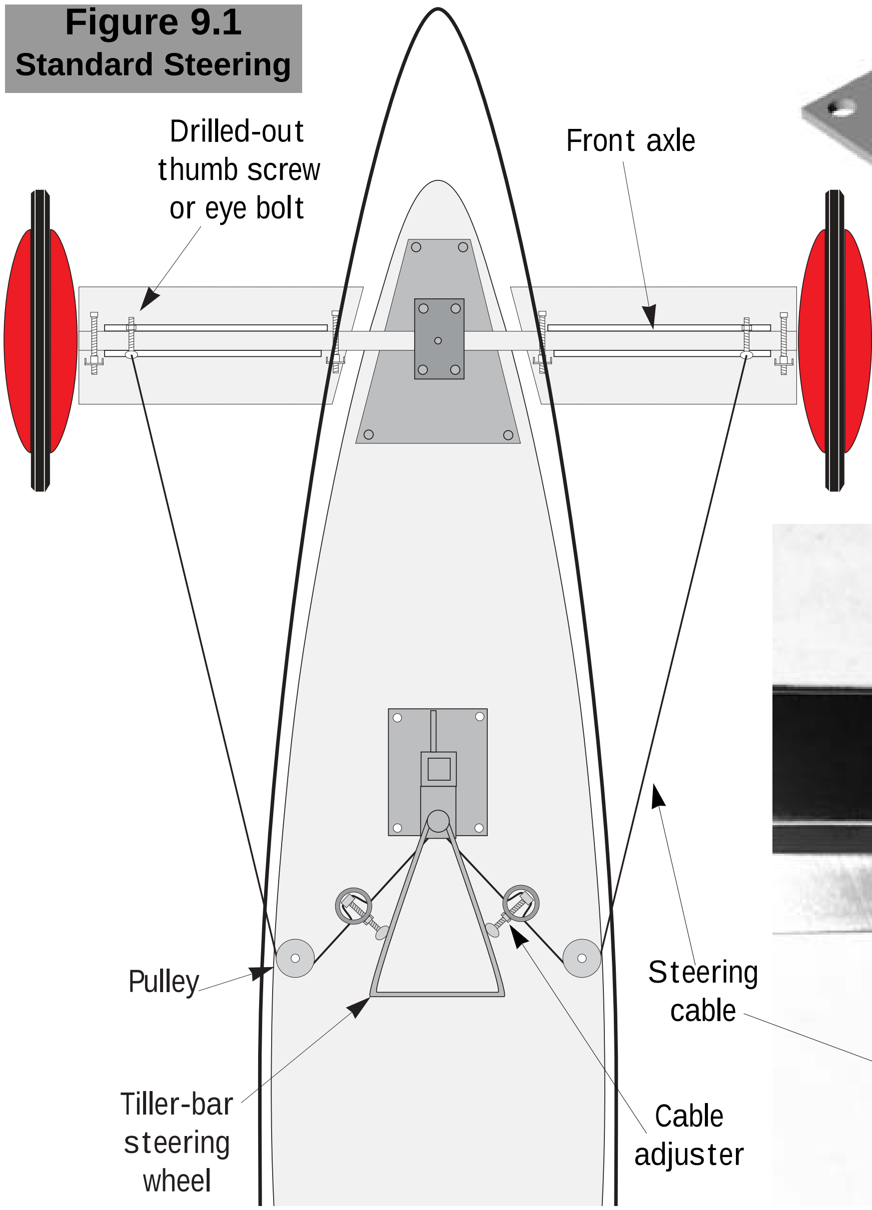


Figure 9.1
Standard Steering



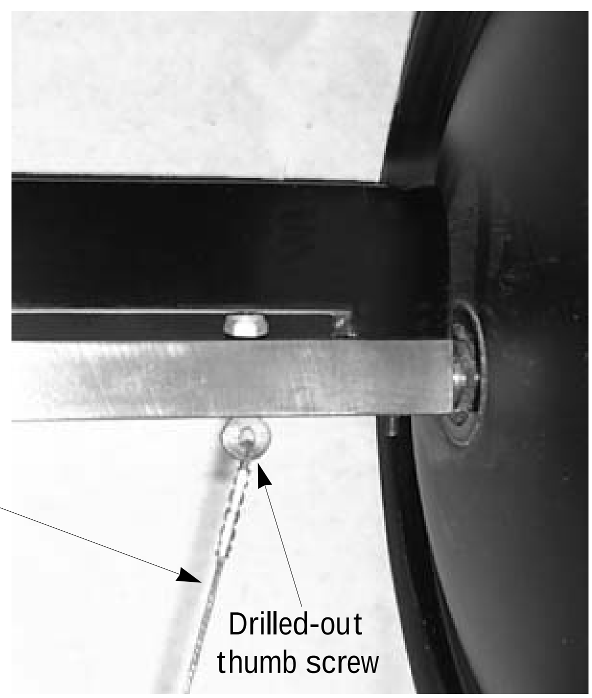
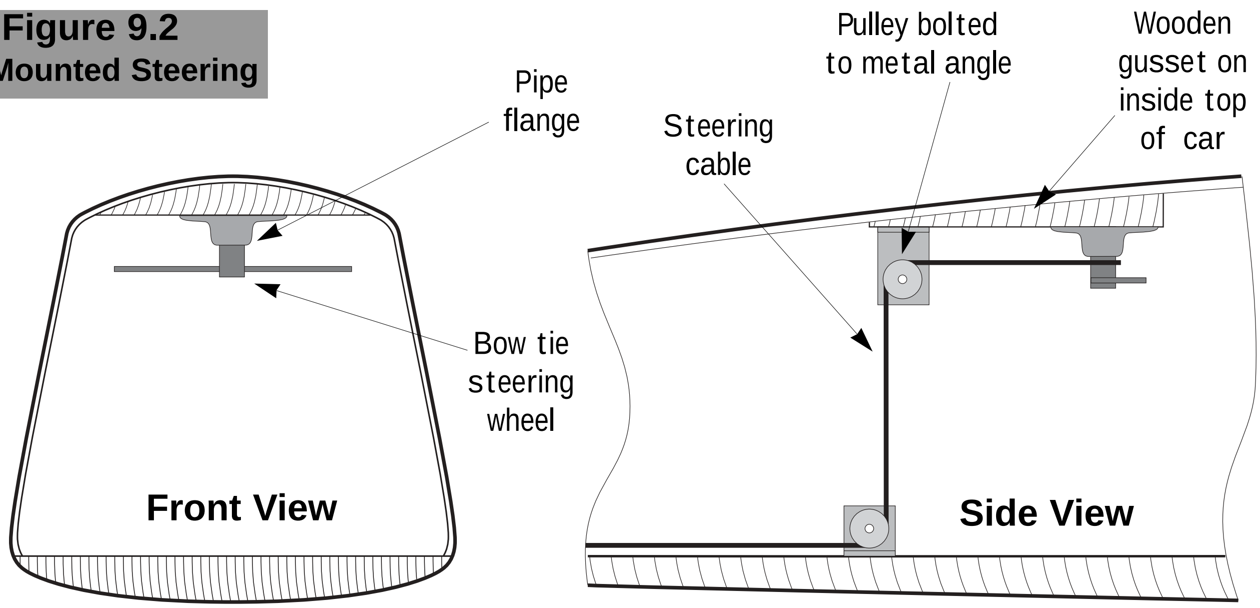
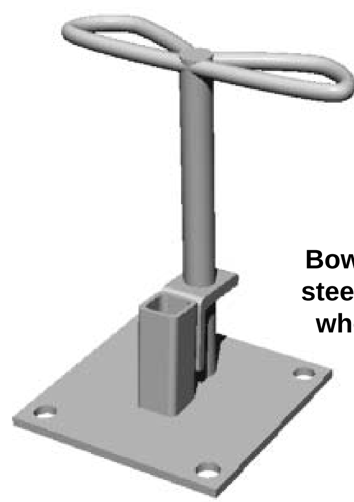


Figure 9.2
Top Mounted Steering



Steering Wheels

The last time I checked, Akron had two types of steering wheels available. For sit-up cars I recommend the bow tie wheel which is also used in stock cars. For lay-down seniors, it is important to get the steering shaft away from the crotch of the driver. The shaft can be very dangerous in the event of an accident. Use either the triangular tiler-bar type of steering wheel, or mount a bow tie wheel to the top of the car (Figure 9.2). Also see Figure 20.2.



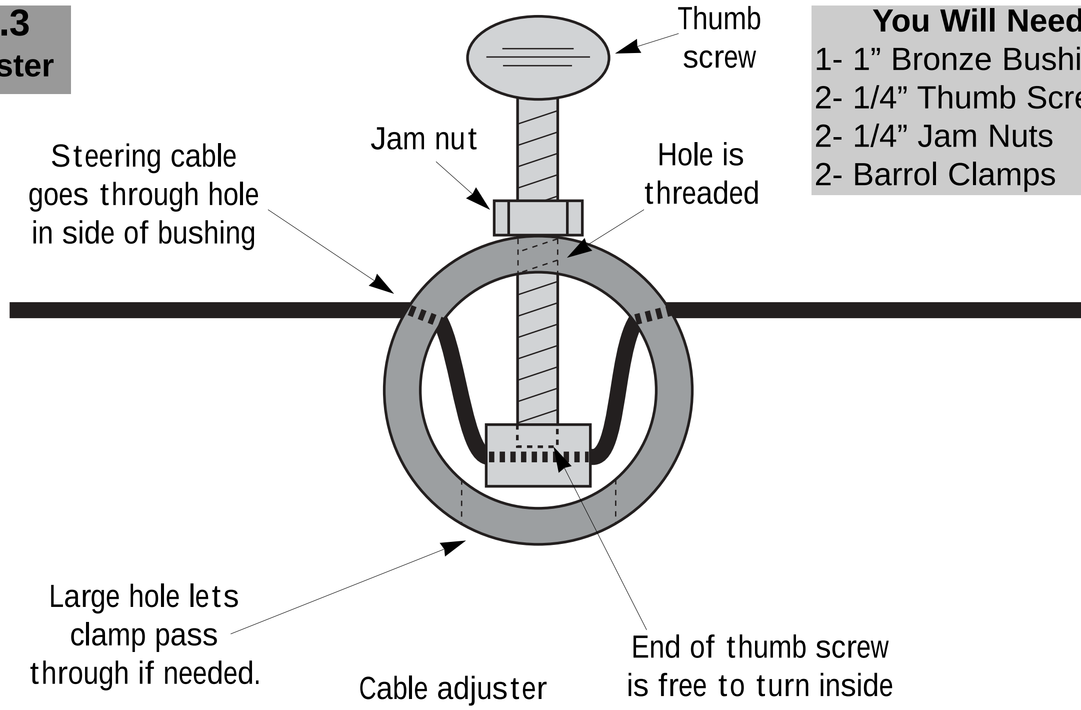
Steering Adjustment

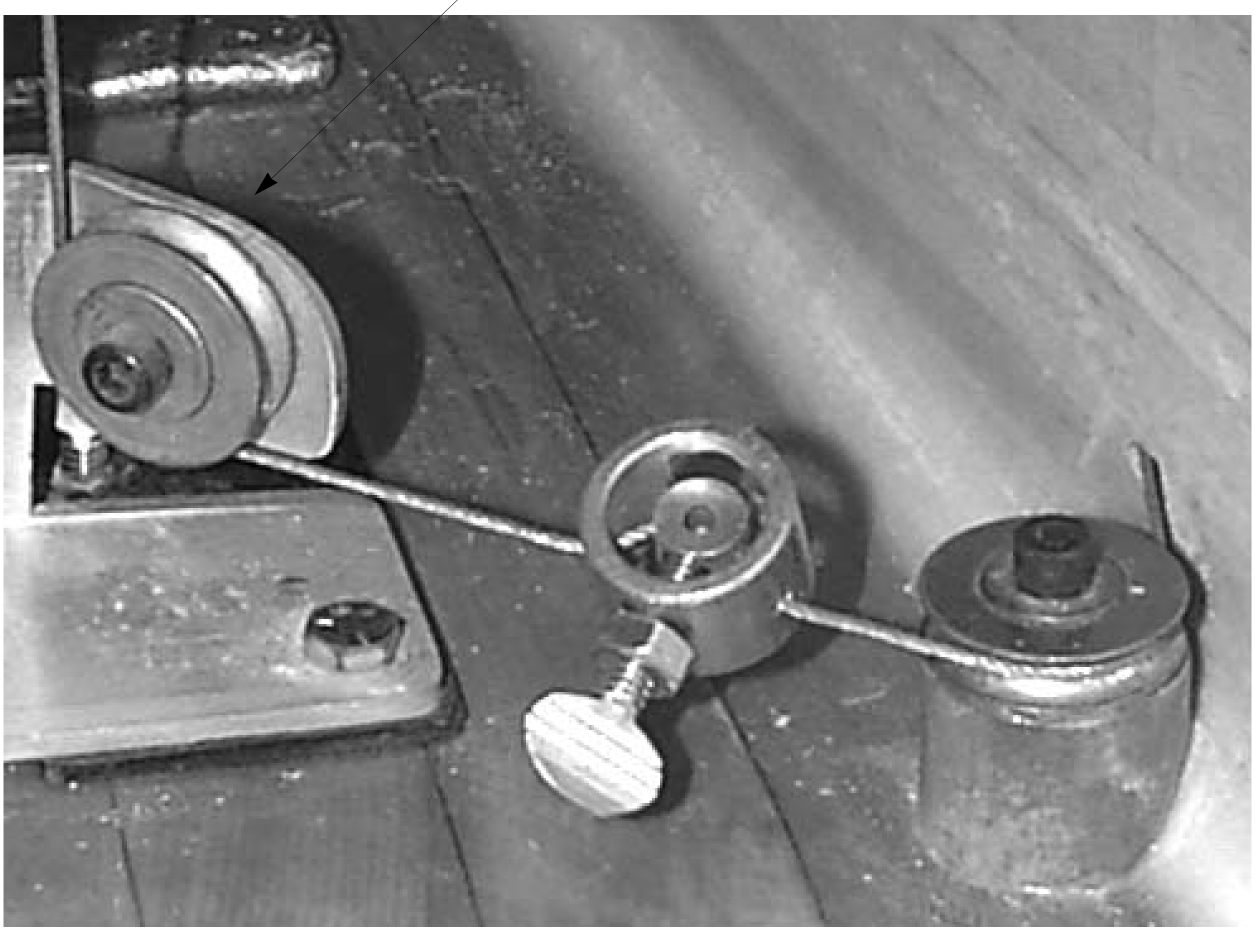
Figure 9.1 shows a simple way to attach the steering cables to the axle using a drilled-out thumb screw. A small eye bolt will also work well here. It is important that the bolts are turned all the way up against the axle to avoid bolt flex when steering. An inside-the-car cable adjustment method will be needed to center the steering and tighten the cables. Small turnbuckles can be used for this, or you can build a low-cost adjuster as in Figure 9.3.

This adjuster is made completely from hardware store parts and will cost only a few dollars. A single 1” bronz bushing can be cut in half to make two adjusters. Drill and tap a hole in the side of the bushing to accept the thumb screw. You can also drill a larger hole in the opposite side to allow for extra adjustment. You will also need to drill (but do not tap) a hole half way into a baroll cable clamp to accept the tip of the thumb screw. The set screw from the cable clamp should be permanently removed.

Figure 9.3
Cable Adjuster

You Will Need:
1- 1” Bronze Bushing
2- 1/4” Thumb Screws
2- 1/4” Jam Nuts
2- Barrol Clamps





Wood Selection

For derby, I only have experience using Bass Wood and Douglas Fir. I know, however that there are many other woods being used today with much success. **Bass Wood** is light and flexible which is perfect for sticking a body. It's strong but sands easily and has very clear grain. Bass Wood will also make for a strong but light floorboard. **Douglas Fir** is heavy compared to Bass Wood but fir is a very strong wood. Because of it's weight and strength, Fir is great for floorboards. It's harder to stick a Fir body because Fir doesn't bend as well as Bass Wood, and often splinters. Don't be afraid to mix woods either. For one car, I used Bass Wood for the body and Douglas Fir for the floorboard.

Again, there are many good kinds of wood available. Some other popular woods being used are Stitka Spruce, Sugar Pine, Poplar, Mahagony, Birch and many more. It's not always easy to find the kind of wood you want. I've always used wood that was locally available so that I could hand pick all the boards. The important thing to look for is tight, straight, vertical grain. The wood should also be kiln dried and free of knots.

In order to form the car body you're going to bend small wooden sticks over the body formers. Sticking methods will be discussed later, but for now you need to decide how thick your sticks will be. The most common dimension of sticks is 3/4 x 1/4". Smaller sticks are often used, and sometimes you may even see thicker sticks. The size is up to you, but you need to decide on a dimension so that you can cut your sticks and prepare your formers for that stick size.

Resin and Fiberglass

There are a lot of good resins available today. Price and local availability will probably determine what brand of resin you use. I've used many different types of resin (polyester and epoxy based), and have had success with all of them. Polyester resin is good for derby and is usually less expensive than epoxy-resin. My personal preference, however is West System Epoxy-Resin which is very easy to use and has a long line of compatible thickeners and other products to make your job easier.

It's a good idea to use fiberglass on the inside and outside of your car. I like to use both fiberglass mat and cloth. **Fiberglass cloth** is a tightly woven fabric that is relatively easy to use and is available in several different weights. **Fiberglass mat** is much heavier than cloth, and is made up of small cut pieces of fiberglass which are in a random pattern. Mat is a little harder to use than cloth, but it is thick and using it will allow you to quickly build up a lot of strength.

The latest buzz-word in derby seems to be carbon fiber. **Carbon fiber** (or graphite fiber) is a lot like fiberglass except that it's coal-black, harder to use than fiberglass, and more expensive. The attraction that people have to carbon fiber is that it is stronger than fiberglass. Since carbon fiber is not transparent, it can't be used to cover the inside of the car, but it can be used to cover the outside. The biggest problem with carbon fiber, is that it is very difficult to saturate with resin. I've heard horror stories from several people who have tried to cover the outside of their cars with carbon fiber, and simply couldn't saturate every square inch. Thin carbon fiber shouldn't be too difficult to use, but if the fiber you're using is especially thick, you may want to put it on in small pieces, maybe one foot by one foot. That way you'll be able to concentrate on saturating one small area at a time. Also, a friend of mine who uses carbon fiber in a professional, non-derby situation told me that carbon fiber is not really compatible with polyester resin.

Construction

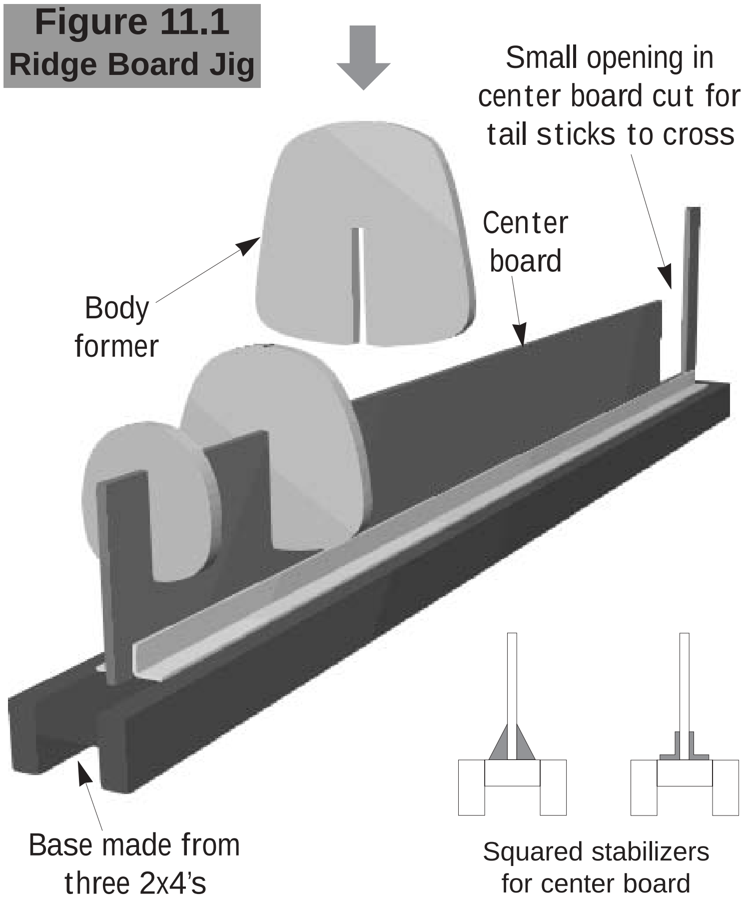
Hopefully, with the help of the last several sections, you have a pretty good idea of how your car will be set up. We'll now move on to the construction of the car and we'll begin with building the car body. Senior car bodies are constructed a lot like wooden canoes. Canoe builders bend small wood strips over solid formers or bulkheads and then cover the wood with canvas or fiberglass. Building a derby car is very similar. In derby we call the process "sticking", and for most people it is the most fun part of building a racer.

Builders of derby cars will use either inside formers or outside formers. Both have advantages and disadvantages, but since I've never built a car using outside formers, I only feel qualified to describe the use of inside formers.

Ridge Board Jig

In order to stick a car body, you'll have to cut out some body formers using the plans you've purchased. You'll need to reduce the formers for the thickness of the sticks, and you'll also need to build a simple jig to hold the formers firmly in place. The former setup shown in Figure 11.1 is called a "Ridge Board Jig", and was originally seen in the old NDR Design and Construction manual. Here, formers are slid onto a center board which is sturdy, straight and maintains very good former alignment. This jig is a very simple design. It is made from three 2x4's, a 3/4" piece of plywood, and some metal angles or squared wooden stabilizers. With this setup, the formers can be slid forward and back along the ridge board and easily adjusted to their exact location.

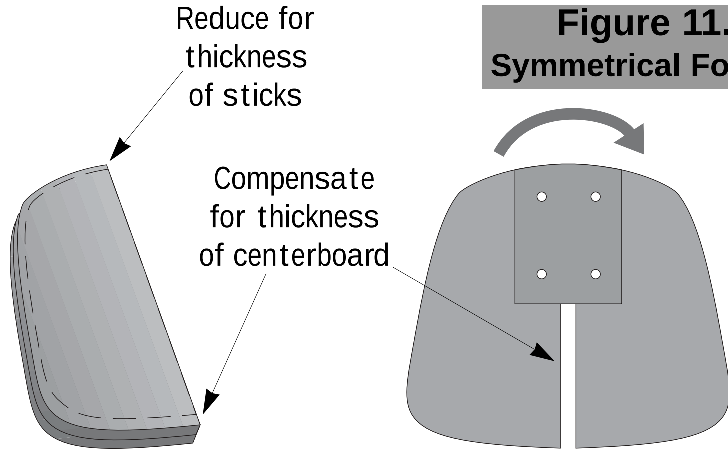
Figure 11.1
Ridge Board Jig



At this point, you need to decide on the thickness of the sticks you'll be using. The most common size is 3/4 x 1/4", but some other popular stick sizes used today are 3/4 x 1/8", 3/4 x 3/8", 1/4x1/4", and so on. Wider sticks (3/4x1/4") will cover the formers quickly, while narrower sticks (1/4x1/4") will bend more easily. You should also decide how thick your floorboard will be so that you know how far down on the formers you can stop sticking.

The former drawings must be reduced the same thickness as the sticks. You should also keep in mind that the sticks will be sanded and then fiberglass will be added. This reduction must be done by scribing a line on the former drawings that is the same thickness as your car's body will be. Do not make this reduction with a photo copier because the reduction will not be accurate or consistent all the way around. Too often, I have seen people build cars that end up wider than intended because the formers were not reduced accurately. This reduction <u>must</u> be done by hand to insure an accurate and consistent reduction. If you are using 1/4" thick sticks, you might try taping two regular pencils together and use them to carefully trace around the formers. Doing this should give you a consistent 1/4" reduction on your formers.

Figure 11.2
Symmetrical Formers



Both sides of former cut and sanded together

Connect both sides of former at top

Formers are usually made from 1/2" or 3/4" plywood. It is important that your formers be as symmetrical as possible. A good way of making symmetrical formers is to make them in two halves (Figure 11.2). First transfer the reduced drawing on to the wood and then attach a second piece of wood to the first using double sided carpet tape or speed screws. You must also compensate for one half of the thickness of the center board. It is a good idea to try and use the straight, factory cut edge of the plywood as the center of your former. You can now cut and sand both halves of the former together to insure symmetry. The formers are then connected

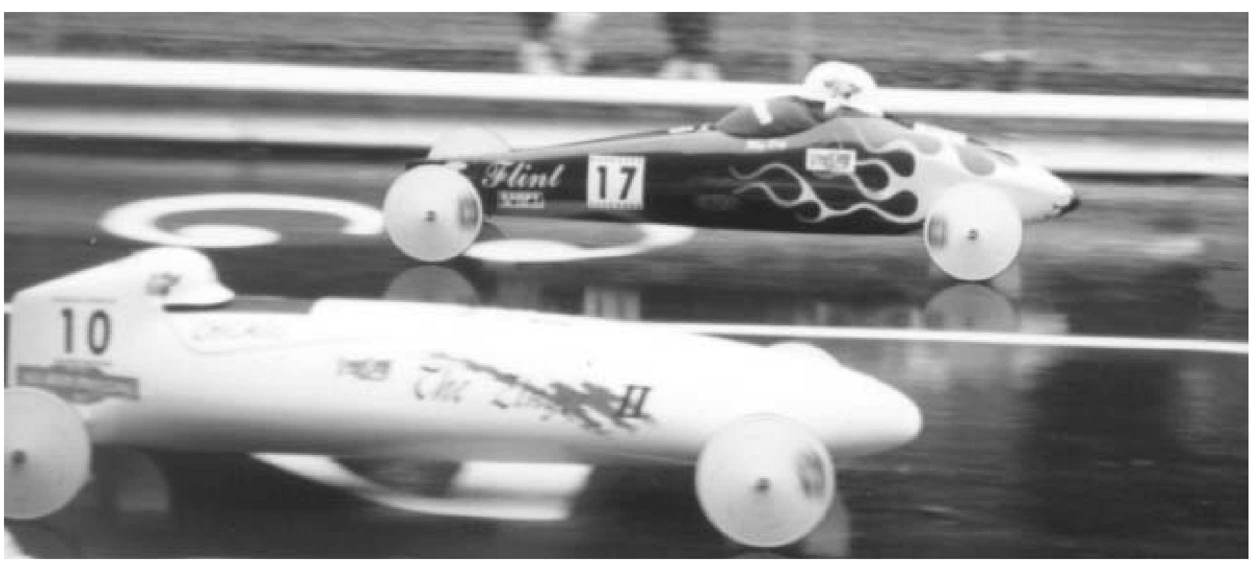
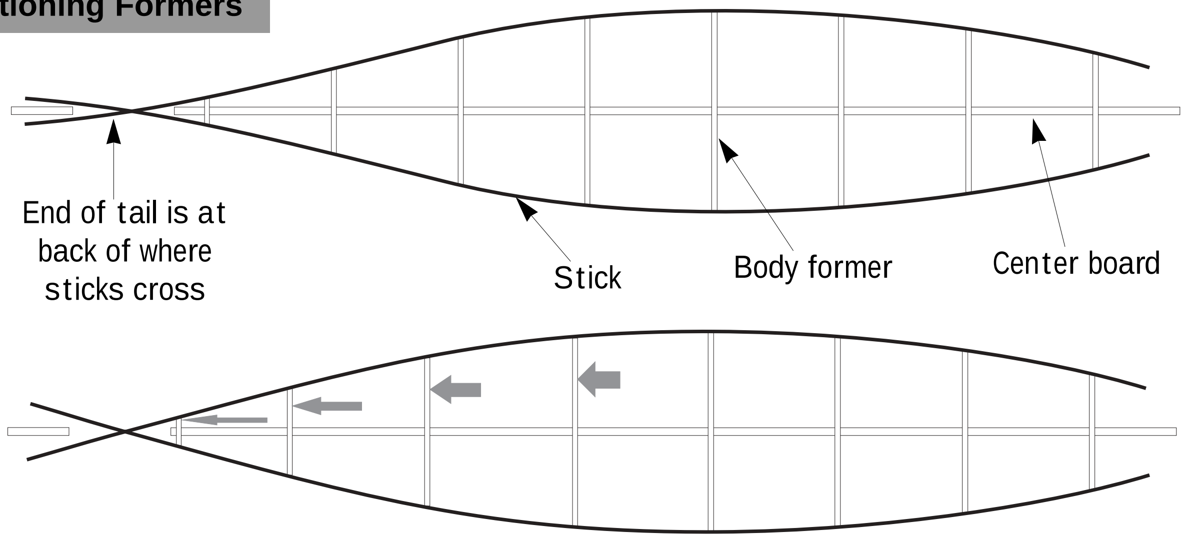


Figure 11.3
Repositioning Formers



Rear formers slid back along ridge board to expand shoulder room (laydown) or hip room (sit-up)

at the top with two small pieces of wood, leaving the thickness of the center board open. It may help to put a temporary spacer between the two former halves while you connect them at the top. The top connecters should also be positioned to act as a stop when the former is slid onto the center board.

When you transfer your former drawings from paper to wood, you will need to also transfer the horizontal line which is five inches from the bottom of the car. You can then use this mark on each former, to line up all the formers at the same height on your center board. You will probably want to draw a line on

these formers which will indicate the top of the floorboard. You can even cut the bottoms of the formers off at this former line, because there is no need to stick past this point.

Establish a line in the middle of the cutout portion of the center board that will represent the tail of the car. This is the area just behind where the sticks cross. From this tail line, measure forward and temporarily position your formers according to the car's plans. Now take a few sticks and temporarily nail them on the sides and top of the formers. The sticks should flow smoothly over all the formers, and should give you a good idea of what the car will look like. If you feel it's necessary, you can slide the formers along the center board and widen the shoulder or hip area (Figure 11.3). Be warned that if you reposition any of the formers, the sticks might not flow over the formers as well, and if the nose formers are repositioned, you will no longer be able to use the nose templates that were provided with your plans.

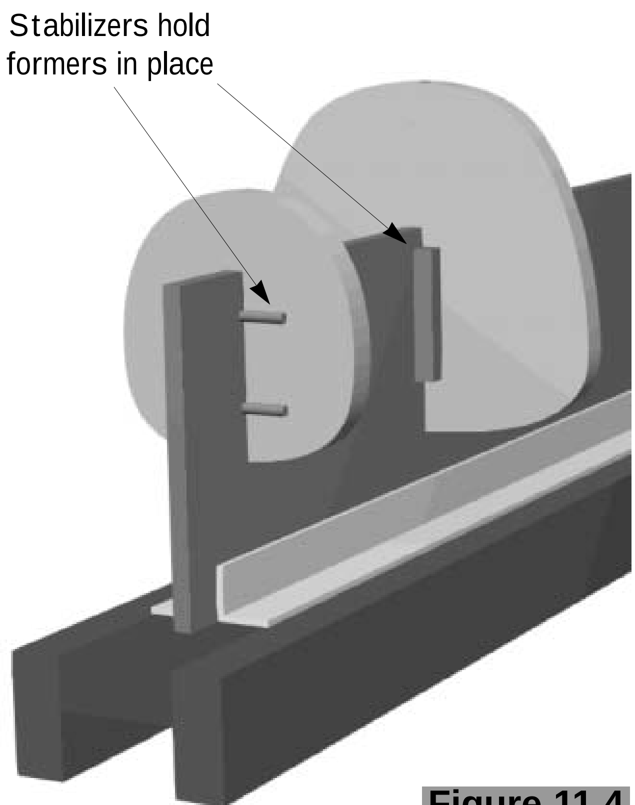


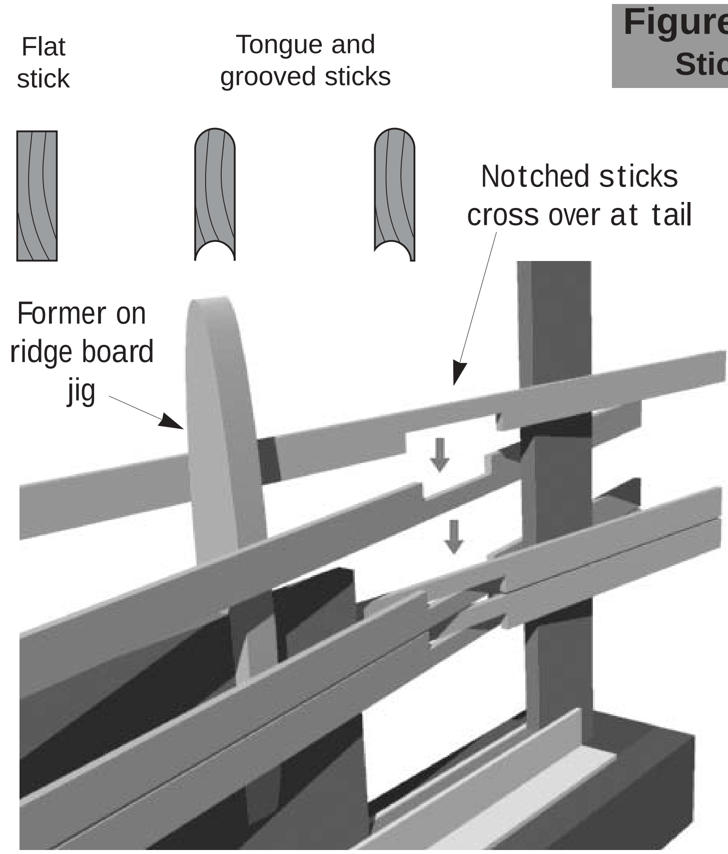
Figure 11.4
Stabilizing Formers

Once you have the formers in their exact position, they all need to be secured to the center board in a way that they will be held firmly but still have the ability to slide straight up and off. This can be done with four squared pieces of wood that are on all sides of the formers and nailed or screwed to the center board. Dowel rods slid through holes that are drilled in the center board can also be used for the same purpose (Figure 11.4). It's also a good idea to put some kind of plastic tape on the outer edges of the formers to prevent your sticks from being glued to the formers.

Sticking The Body

Router bits are available that will cut a tongue and groove in the ends of your sticks. This will allow the sticks to lock together and will give the sticks a better glue joint, but you may find that tongue and grooved sticks won't lay on the formers as well as flat sticks. One method that may help is to cut the groove slightly off center (Figure 12.1). Both flat and tongue and grooved sticks work well. It generally comes down to the builders preference as to which method is easier.

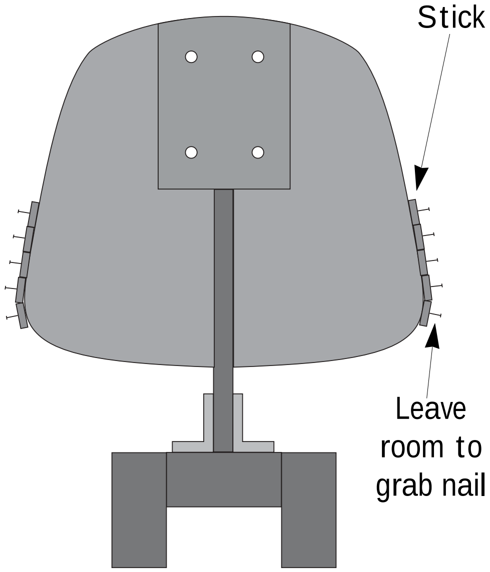
Figure 12.1
Sticks



To maintain a straight, centered tail, allow the sticks to cross over each other by cutting a notch in them (Figure 12.1). This cross-over tail method isn't used by many builders (probably because they've never seen it) but I highly recommend it over other methods. By crossing the sticks, you'll also get a lot of resin or glue in the tail which will increase strength.

You will attach the sticks to the formers using finishing nails, serrated nails, heavy duty staples, or wood screws (for stubborn sticks), and each

Figure 12.2
Start Sticking



Always stick both sides of body evenly

stick will be glued to the next. Try to leave the head of each nail sticking up enough so that you can remove them easily after the car is fully sticked (Figure 12.2). If you use staples you can make the job of removing them easier by stapling over a wire at each former. Then the wire can be pulled up, which will release one half of each staple. The entire staple can then be easily removed with pliers.

Most builders start sticking at the middle sides of the formers (centered on the nose), but it's all right to start at the top or bottom if you want. It's important that you stick both sides evenly, so the sticks come up and meet at the top. The nose and tail sections will close up faster than the center of the car, so to fill in the middle, you'll either have to taper your sticks, or cut them to fit (Figure 12.3). As you are sticking, make sure that each stick is bonded to the next using yellow wood glue or resin.

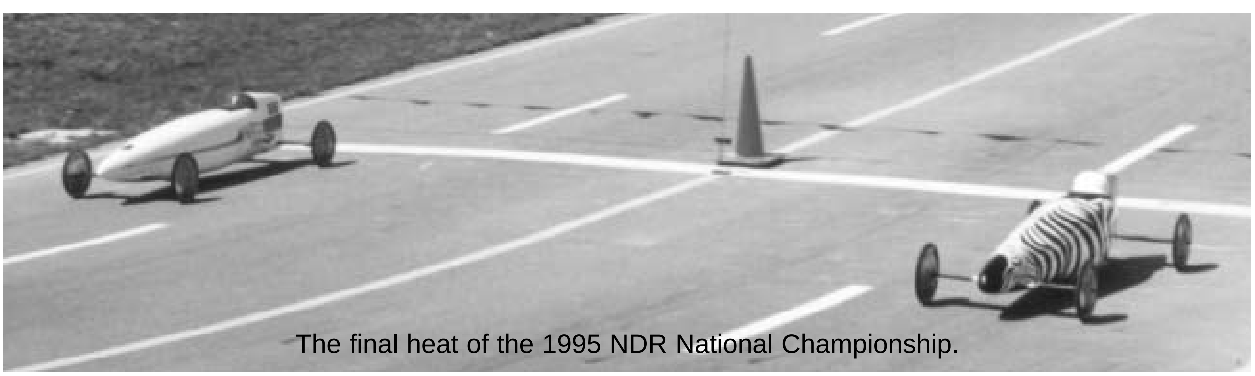
If you're sticking a car with sharp corners, such as the Stork 50, you should begin your sticks at the points, and let them follow the corner of the other formers to the nose and tail (Figure 12.4).

Tapered Sticks

Some builders like all their sticks to run the full length of the car. Tapering sticks tends to take a little bit of time, but you'll find that they lay on the formers very easily and you avoid having to cut and fit the ends. To taper your sticks, you simply cut or sand each stick into a wedge shape (Figure 12.3).

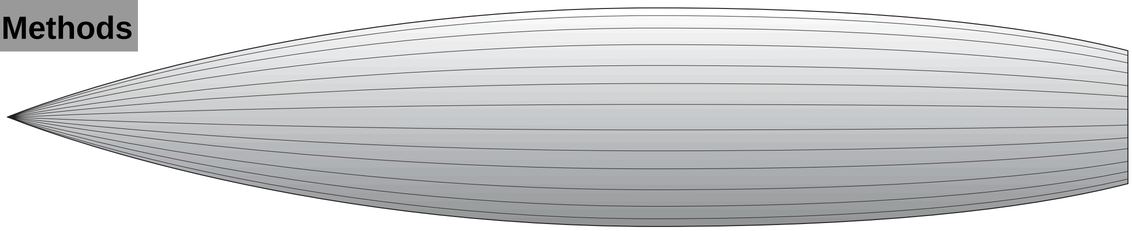
Full Width Sticks

It's a little harder to lay full width sticks on the formers, but you may find that it is a faster method than tapering each stick. Some of the sticks will run the full length of the car, but the nose and tail will close quickly, and you will have to fit the rest of the sticks to the top of the car (Figure 12.3).

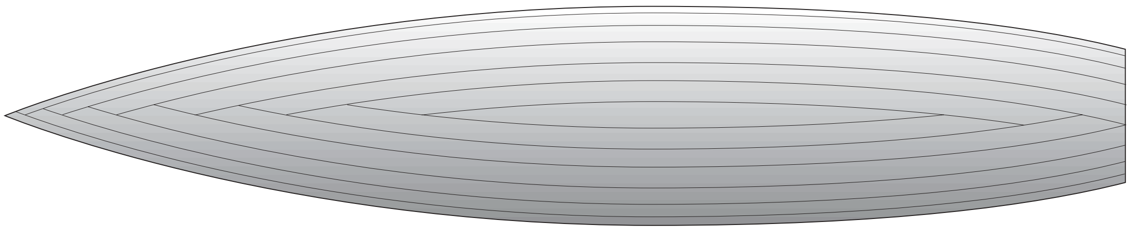


The final heat of the 1995 NDR National Championship.

Figure 12.3
Sticking Methods



Full length tapered sticks



Full width fitted sticks

Once you have your car body fully sticked and the glue has had plenty of time to dry, carefully pull the nails, screws and/or staples, but don't remove the body from the formers or the ridge board. The body is very fragile at this point, so be careful. With the body still on the formers, you should carefully sand down the high spots and fiberglass the outside. I like to use a lot of fiberglass on the inside and outside of my cars for reinforcement. I feel this is a very critical area that most people overlook. If the overall structure of the car is weak, then it will flex and twist all the way down the hill, which will waste energy. Consider using extra fiberglass in the weaker areas of the car such as the axle mounting areas and the hatch (cockpit) area. For the bulk of the fiberglassing, I use several layers of fiberglass mat which is thicker and heavier than fiberglass cloth. When I have all the layers of mat in place and still wet, I then use one layer of fiberglass cloth to cover and smooth out the mat.

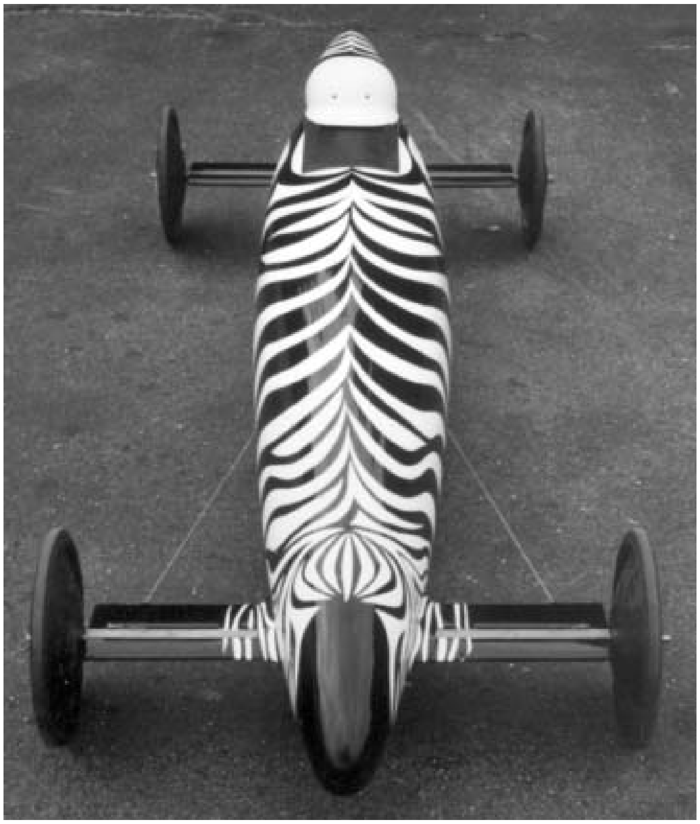
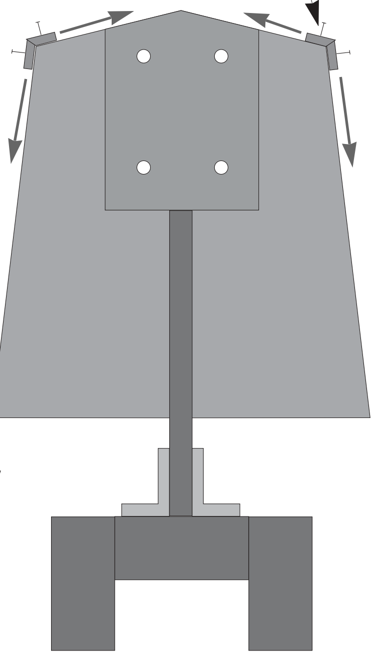


Figure 12.4
Sticking the Stork



With the outside body now fiberglassed, cut off the excess sticks at the nose and tail and gently slide the body and the formers straight up and off of the ridge board. When the formers are removed, the inside of the body should then be sanded and fiberglassed. There's a good chance that the body will distort a little bit when the formers are removed. This is a common occurrence, and is not a problem. Simply take a dimension from the bottom of the largest former and cut a small piece of wood to act as a temporary spreader at the bottom of the body while you fiberglass the inside. You should also cut a spreader for the nose or leave the first nose former in place. Later when you glue the body on to the floorboard, you can use these spreaders again if needed, or you can use the main body former, and first nose former.

When you are applying fiberglass, it's important that you either apply all the layers in one session, or you sand between layers to insure a strong bond. When resin cures, it forms a wax like film on the surface. If this film is not washed and sanded off then you will weaken the bond between layers. If you have an area where the fiberglass is not laying as smoothly as you'd like, and the resin is still wet, try covering the stubborn area with plastic food wrap. With the plastic on, you can smooth the area out with your hands and get a pretty clean surface. When the resin is dry, the plastic wrap will peel off easily, revealing a clean, smooth fiberglass finish.

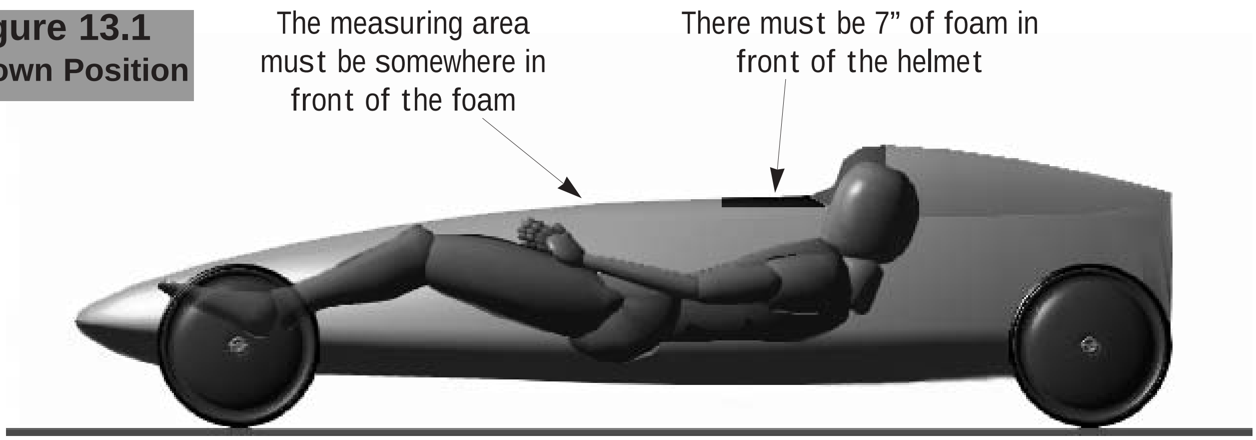
Driver Test Fit

You will now want to establish the driver's position in the car so you can double check the position of the steering and brake on your floorboard drawing. To do this, the driver will have to get in the car body even though there is no floorboard yet. In most cases, this will be difficult. It's very important that someone help the driver to feel relaxed and as comfortable as possible. The driver is always nervous the first few times he or she gets in a car, and in this case, the car isn't even finished, and that makes it even harder. The driver will be in a very unnatural position, so don't panic if the driver can't fit yet. Also, make sure that the inside of the car is smooth, and does not have any exposed fiberglass or sharp edges.

Laydown Car

You will need to cut a face opening in the body for the driver to stick his or her head through. I wouldn't recommend cutting the hatch until the body is glued on to the floorboard, because cutting the hatch sometimes causes the body to distort. When cutting the face opening, remember that the seven inches of foam in front of the helmet must be behind the measuring point of the car. You should check the most recent rule book before cutting this face opening. With the driver on a the floor and in racing position as shown in Figure 13.1, gently slide the car body over the driver. Since there is no hatch opening or floorboard, the driver probably won't be able to get into the exact driving position, but he or she should try to get as close as they can.

Figure 13.1
Laydown Position

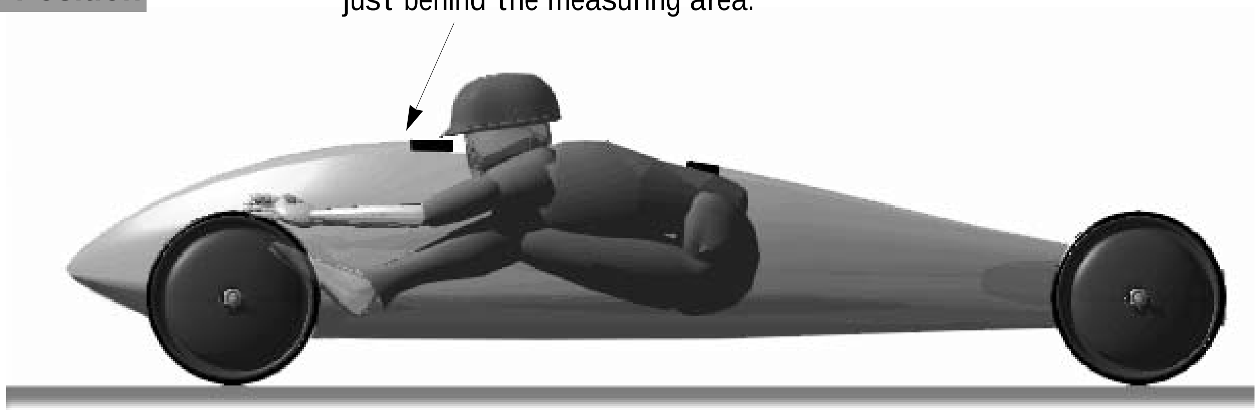


Now you should mark the exact location of the drivers hands, feet, head and shoulders and uses this information to update your full size floorboard drawing and locate your hardware.

Sit-Up Car

You will need to check the current rules on Sit-up cars for foam and cockpit opening locations and dimensions in relation to the measuring area. In most cases, the front of the cockpit opening will be just two or three inches behind the measuring area. In the end, you will want to have the smallest cockpit that the driver can comfortably get in and out of. Once you've established the location of the cockpit opening, I suggest you cut the smallest sized cockpit that the rules allow. Realistically, I don't think any kid can fit in that small a hatch, but that's a good place to start. Now, with the body on the ground and spread properly, have the driver try to fit through the opening and get into racing position. If the cockpit is too small, have the driver sit on the floor in racing position as in Figure 13.2, and gently slide the car body over him or her. Take all the measurements necessary for hardware locations, and then see if the driver can get out of the car through the cockpit opening. If it's still too small (and it probably is), you can slowly cut the cockpit opening bigger, but you might want to wait until the body is glued onto the floorboard to reduce any body distortion.

Figure 13.2
Sit-up Position

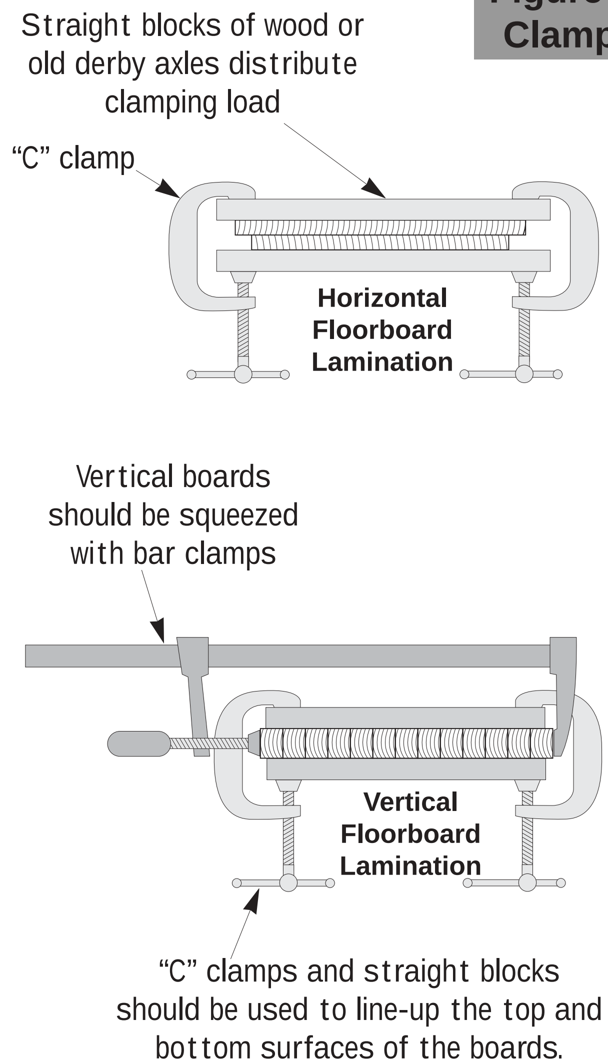


Laminating The Floorboard

The wood for your floorboard will be laminated in the horizontal or vertical direction, depending on the wood grain. I suggest you use a good quality resin for gluing the boards together. For best results, you should wet with resin all the surfaces to be joined, and you might consider adding a thin layer of thickened resin between the boards. The thick resin will help to fill any gaps between the boards. There are special resin thickeners available for tasks such as this, or you could use chopped strands of fiberglass.

Once the boards are wetted, you should clamp them together tightly. To keep everything straight, and to distribute the clamping pressure, I like to use some straight pieces of wood or old derby axles (Figure 14.1). Be sure to put some plastic food wrap or waxed paper down on the floorboard so that the clamps don't stick to the wood.

Figure 14.1 Clamping



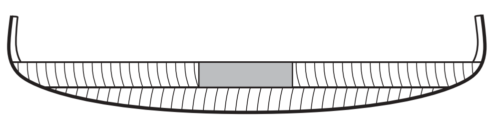
Jackie Ginter and her Pelican 60 finished in a strong second place in the 1995 All-American Soap Box Derby.

Installing Metal Plates

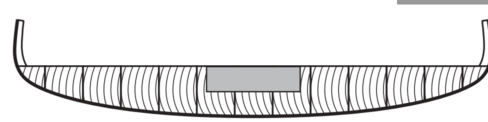
If you are using a plate in the floorboard, it is critical that it be mounted securely. It's common for plates that are not mounted properly to break loose from the floorboard, which will waste energy and slow the car down. Plates should not only be glued to the floorboard with resin, but there should also be numerous bolts throughout the plate to hold it firmly in place. Plates can be on top of the floorboard, flush with the top or even buried inside the floorboard. Figure 15.1 shows several plate and floorboard configurations, where the plate size and thickness of floorboard are all the same. As you can see, there are many different ways of laminating wood and installing plates. The important thing will be to bond the plate solidly and permanently to the wood.

Figure 15.2 shows how a plate should be bolted to the floorboard. I recommend bolting a plate down whether you set the plate on top of the floorboard as in Figure 15.2 or if it's flush with the top or buried in side the floorboard (Figure 15.1). The bolts are countersunk in the plate, and drilled through the wood. The floorboard is then turned over, and a larger hole bored out. When you install the plate, you will glue it to the floorboard and then use a wide washer and a nut to hold it in place. The large holes will then be filled with resin and smoothed over. For short plates, you should at least use one bolt in each corner to hold the plate in place. With a full length plate, you should bolt the plate down with two bolts about every ten inches (Figure 15.3).

Figure 15.1
Plates

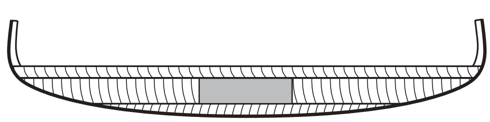


In this example, the plate is flush with the top of the floorboard. The two top boards are the same thickness as the plate, and are laminated on both sides of it.

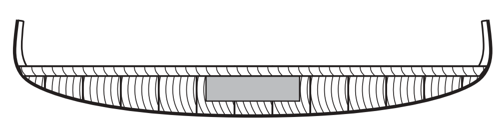


Here, a groove has been routed into the floorboard, and the plate is set inside, making it flush with the top of the floorboard.

Front view of floorboard and plate



This plate is buried inside the floorboard with two boards of equal thickness laminated on either side.



A groove has been routed out to accept this plate and a board is laminated on top to bury the plate.

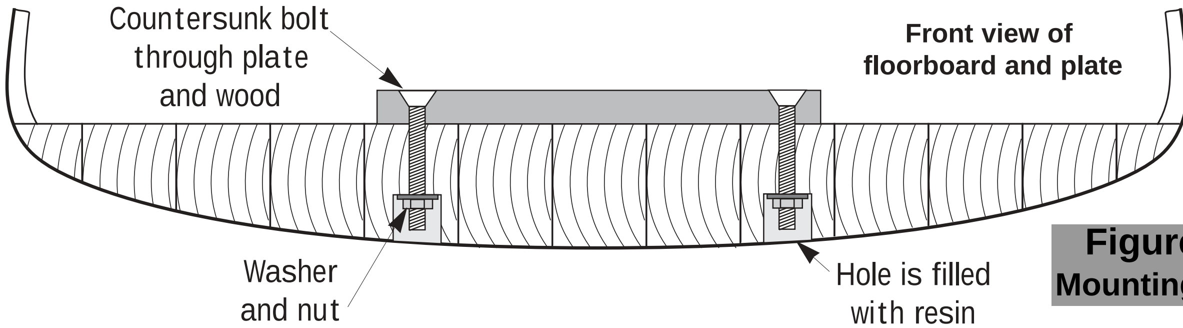


Figure 15.2
Mounting a Plate

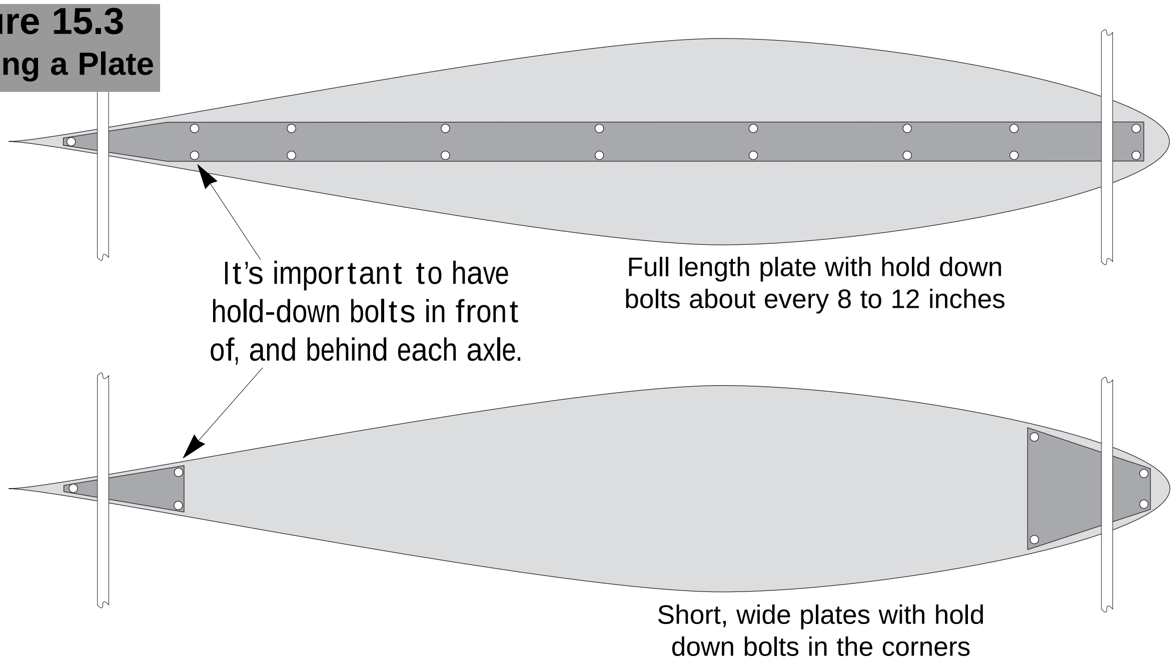
Before you install a plate, you should have all the necessary holes drilled and tapped to accept the bolts for steering, brake, axle mounts etc. I recommend you drill a vertical kingpin hole in the plate and floorboard at each axle location even if you don't plan on using these holes with your axle mounts.

One year my dad and I built a car that was going to have a horizontal kingpin in the rear and a vertical kingpin in the front. We used a small full length plate in that car and we didn't drill a rear kingpin hole since we didn't think we would ever use one. Well, we were wrong. After the car was finished and painted, we decided that we wanted to run a vertical kingpin in the rear. You can just imagine how hard it was to drill an accurate kingpin hole in a finished car.

Once your plate is drilled and ready to be installed in the floorboard, you will need to prepare the surface of the plate so that it will bond to the wood. Make sure that any oil, dirt or rust is cleaned off, and then roughen all the bonding surfaces with a course disc grinder. You will want to protect the holes that are not being used to hold the plate in place from being filled with resin when the plate is installed. Some builders like to fill these holes with melted candle wax. Others put a small pieces of tape over the holes to keep the resin out.

The way you install your plate is similar to laminating wood. You will first wet-out the bonding surface of the wood and the plate with unthickened resin. Then mix up a batch of thickened resin using available thickeners or chopped

Figure 15.3
Mounting a Plate



fiberglass strands and cover the bonding area of the wood where the plate will be placed. Now set the plate in place and push all the hold down bolts through the holes. From the bottom side of the floorboard, put each washer and nut in place and tighten all the bolts. Scrape away all the excess resin from the top surface of the floorboard and allow the resin to dry. Later, turn the floorboard over and fill all the large holes with resin.

Joining The Body And Floorboard

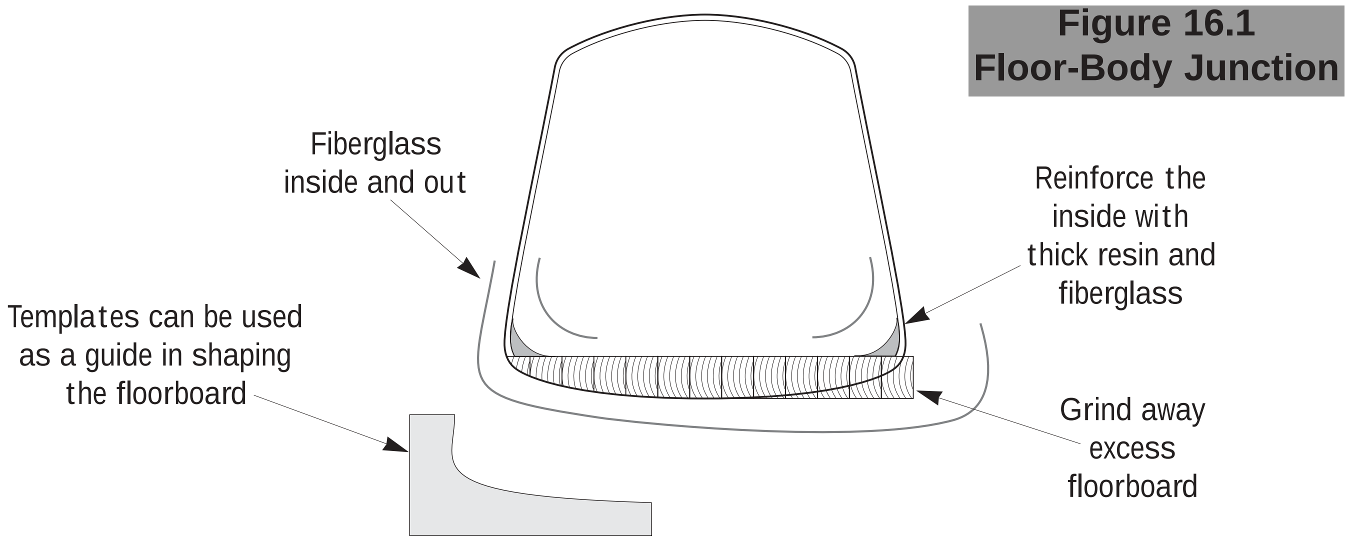
Before you attach the body to the floorboard, you should mount all your hardware, install the axles and test the steering and brake to make sure everything works properly. You want to make sure everything is OK now, because it's very hard to make a change once the body is attached.

As you get ready to glue the body on, make sure the car is spread to it's proper width and double check the overall height of the body and floorboard together. Take some time and make sure that the body is straight and squared to the floorboard. Nobody likes a crooked car. You should also make sure that the body is set so that the highest point of the body is right in front of the foam. See Figure 2.3 in the design section.

It's a good idea to use some mechanical fasteners to hold the body in place while the resin dries. These can simply be wood screws or little metal brackets. Many years ago, a friend of mine put some lead weights on top of his car body to hold it down while it was being glued to the floorboard. He did not use anything to mechanically hold the body in place. Not realizing how slippery resin can be, the next morning after the resin had set up, he found that the body had slid about two inches off center. As you can imagine, he learned his lesson the hard way, and was not very happy about it.

The body should be glued on the same way you would laminate a floorboard. Both bonding surfaces should be wetted with resin, and layer of thickened resin should be used in between the

The original Power Bird before the floorboard was shaped and bellied.

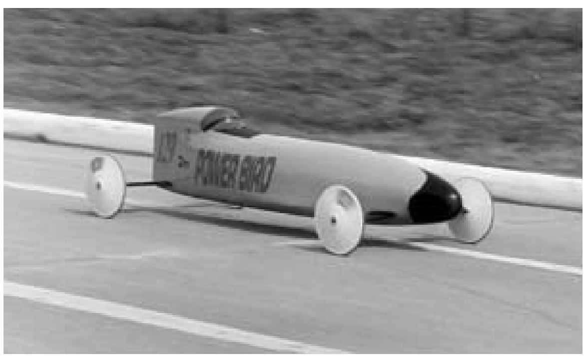


body and floorboard to fill any gaps. Use your fasteners to hold the body in place and scrape up any excess resin that has squeezed out.

After the body is on the floorboard you can safely cut the hatch if you're building a laydown car. Now you should reinforce the the floor-body junction with thick resin and fiberglass. It's best to do this while the top of the car is open and before you've built the nose. Lay in a smooth fillet of thick resin on the inside of the car and then cover the area with fiberglass. After that sets up you can shape the bottom of the car to match the body. It may help to cut out some card-board templates using the original plans. You'll probably have a lot of wood to shape, so try using a hand held power planer for rough shaping, and disc sander for smoother shaping. The final sanding should then be done by hand before the bottom of the car is fiber-glassed (Figure 16.1).

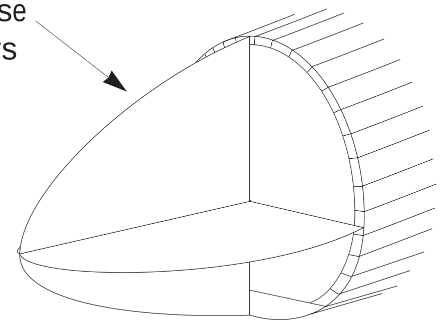
The Nose

The nose of your car will be formed out of foam and covered with fiberglass. I like to start my fiberglass nose as close to the first body former location as possible. To do this, you should cut strait, any extra lengths of sticks or floorboard that's beyond the first body former. You're now going to need the full size nose drawings that came with your plans. These drawings should be transferred on to some cardboard or heavy poster board and attached to the front of the car (Figure 17.1). It may help to put the first body former back inside the car and use it to hold the nose formers in place.



Carefully position the nose formers so that when finished, the total length of the car will be exactly 84", and the end of the nose will be 8" off of the ground when the car is on it's wheels. Also, be very careful and make sure that the nose is straight, otherwise your racer might resemble a banana! Now, glue four blocks of rigid, sandable foam in the four open quadrants of the nose. When the glue is dry, carefully sand the foam until it is flush with the cardboard nose formers and the overall shape blends in smoothly with the rest of the car. The foam should then be coated with some type of separator such as car wax, petrolium jelly, or vegetable shortening. You will

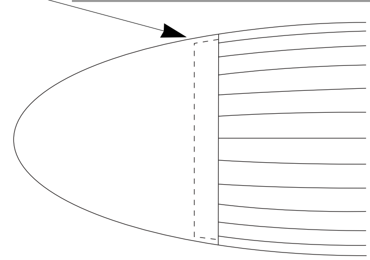
Figure 17.1
Nose Formers



then cover the foam and about two inches of the car body with at least two layers of fiberglass (Figure 17.2). You might also want to grind a small grove where the wood and the nose meet for an extra layer of fiberglass. Finally, reaching through the front hatch, dig the foam and cardboard out from inside. Clean and sand the inside surface to remove the seperator, and add more fiberglass to the inside if necessary. Be sure that you add some extra thickness of fiberglass or resin to the inside tip of the nose incase the car is long and you have to shave the end of the nose.

Note: Some resins have been known to melt certain types of foam, especially white styrofoam. Be sure to make a test the compatibilty first.

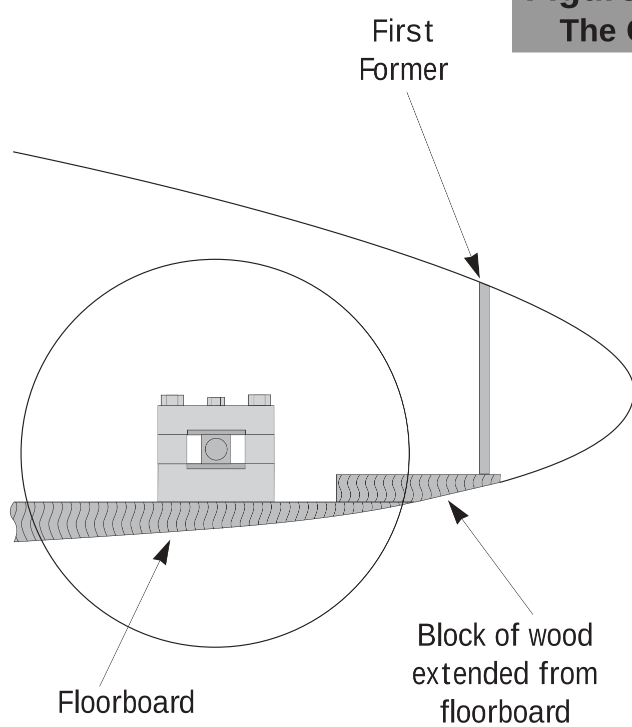
Figure 17.2
Fiberglass Nose

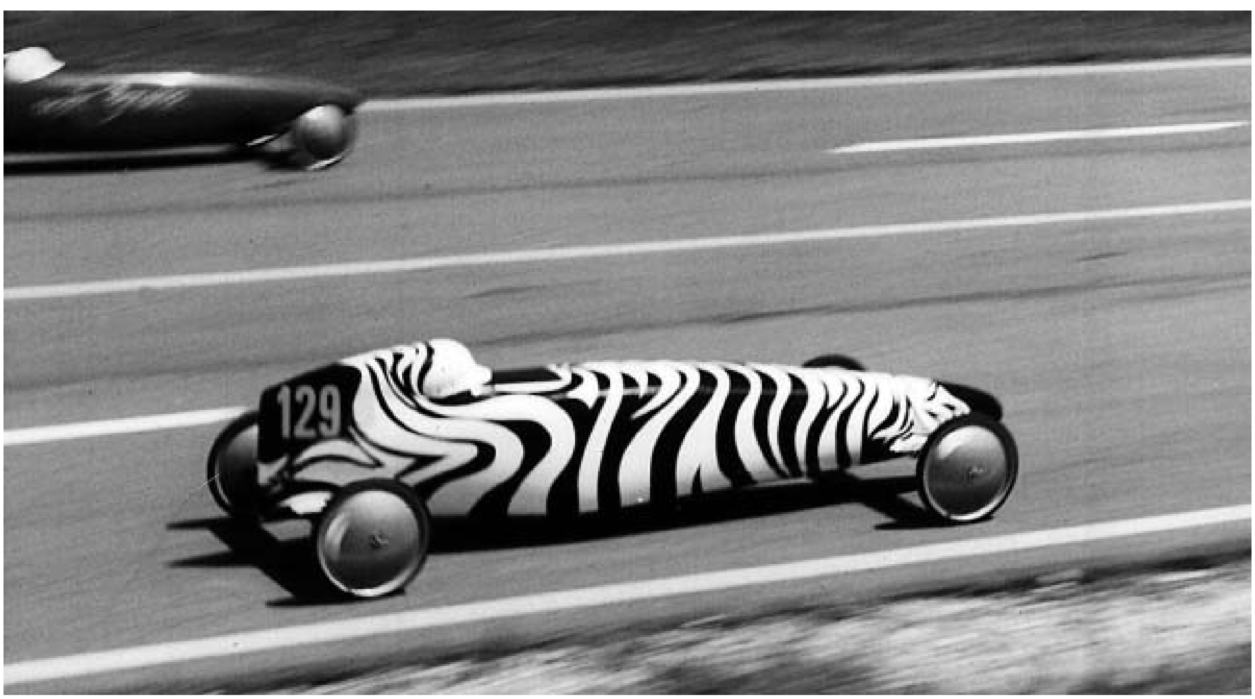


The Gap Under The Nose

With some car designs, the first and second formers may not sit on the top of the floorboard. This is a common situation where you are left with a gap to fill between the floorboard and the bottom of the nose. The quickest and easiest way to fix this is to attach a block of wood or sandable foam to the top of the floorboard and extend it out toward the nose (Figure 18.1). This can then be shaped just like with the rest of the floorboard, and will be covered with fiberglass. If foam is used, it can then be removed from the inside once the fiberglass has set.

Figure 18.1
The Gap





Headrest

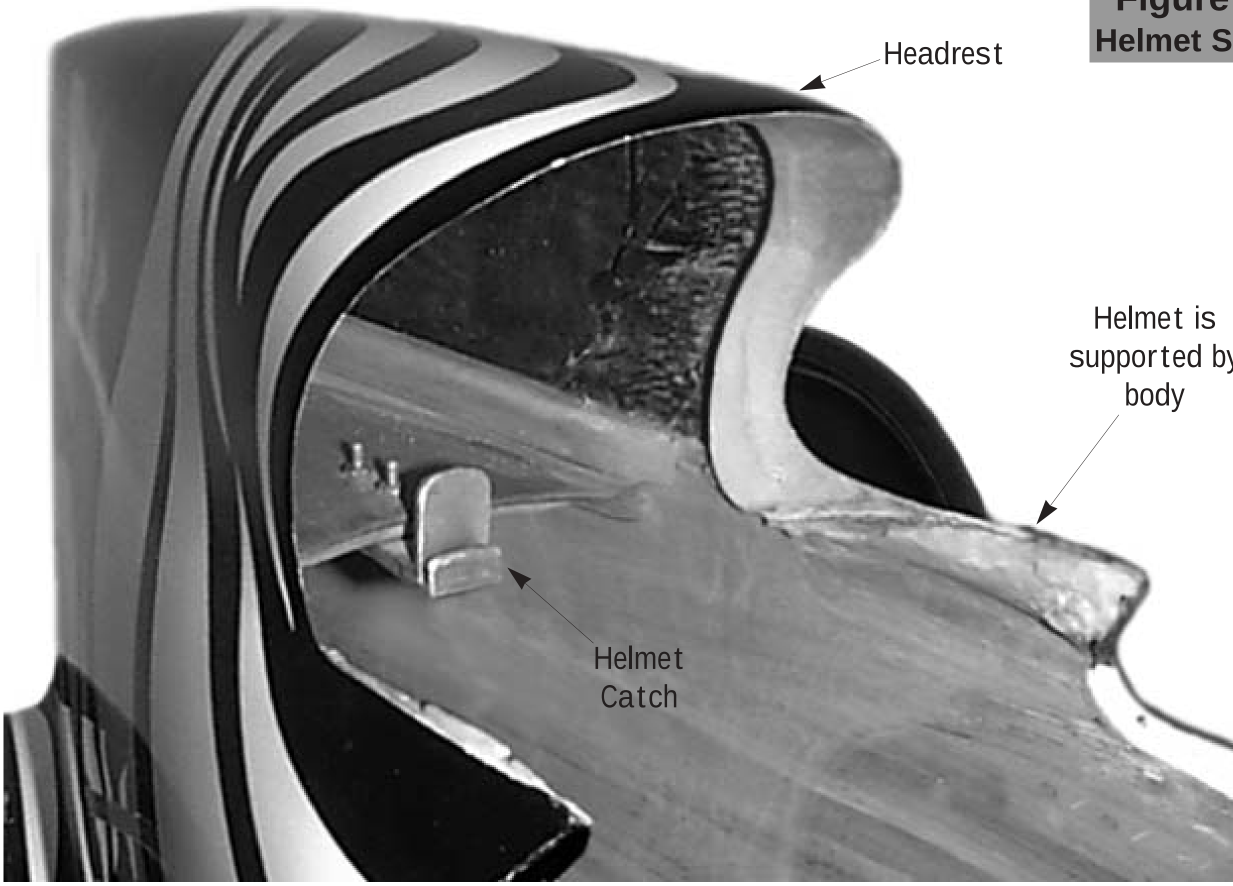
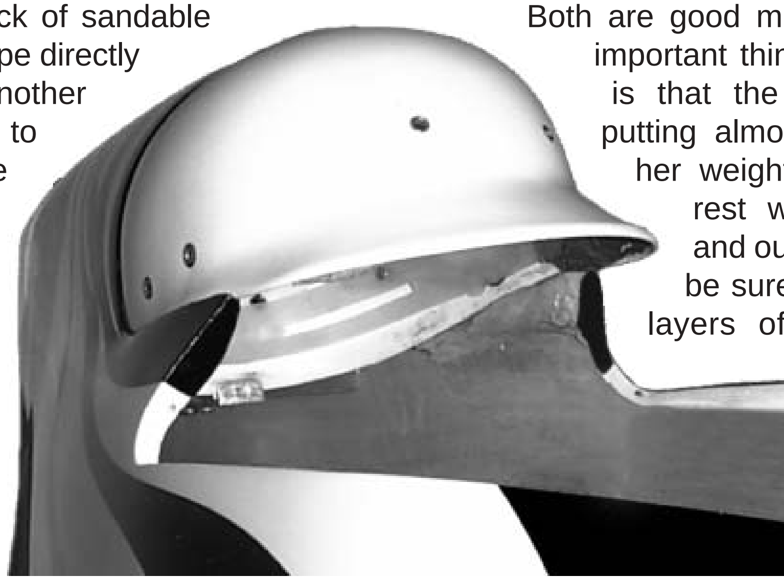


Figure 19.1
Helmet Support

Laydown car builders will need to form a headrest to streamline the back of the helmet. I usually form my headrests from a large block of sandable foam which I shape directly on the car. Another good method is to bend a flat piece of cured fiber-glass over the helmet and tail. To do this, you will need to cover a work surface with waxed paper and saturate a piece of fiber-glass with resin. Once it's cured, you can peel it up and it will be flexible enough to bend into a headrest shape. Both are good methods, but the important thing to remember is that the driver will be putting almost all of his or her weight on the head-rest when getting in and out of the car. So, be sure use to several layers of fiberglass so that it's strong. Also remember that no part of the head-rest should



be larger than the helmet. Your racer will have more exposed edges, frontal area and drag if any part of the headrest is higher or wider than the helmet. You should also try to fit the headrest as tightly as possible to the helmet, while maintaining the rules of helmet width and height above the top of the car.

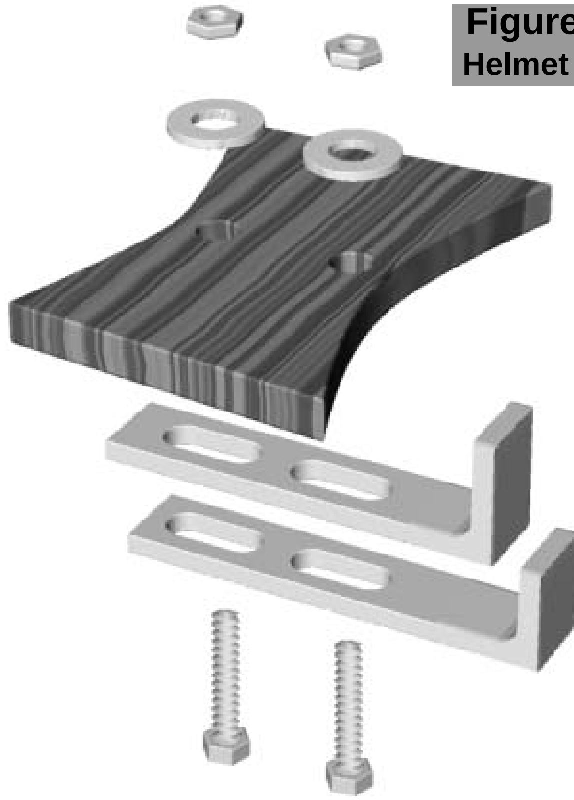


Figure 19.2
Helmet Catch

The helmet will need to be held securely in the car so that it doesn't shake or move while the car is racing. The sides of the helmet should be supported by the body of the car. It's important to keep this in mind when cutting the hatch. You will also need a catch for the back of the helmet (Figures 19.1 and 19.2). The catch is made from two thin metal angles that extend from a wooden support which is attached to the sides of the car. The holes in the metal can be slotted so that the catch can be slid into proper position and then bolted and epoxied into place. Also see Figure 20.1.

Hatch And Hinge

Figure 20.1
Helmet and Hatch

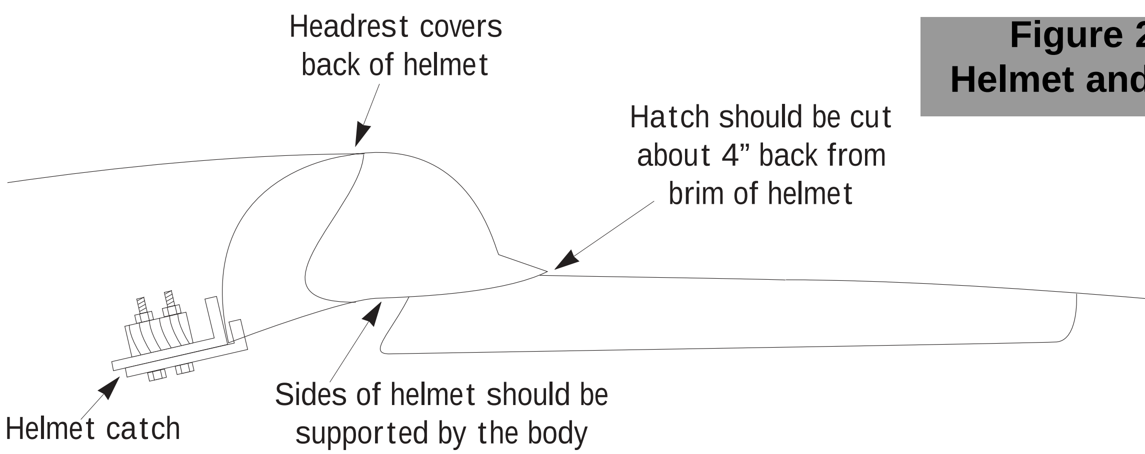
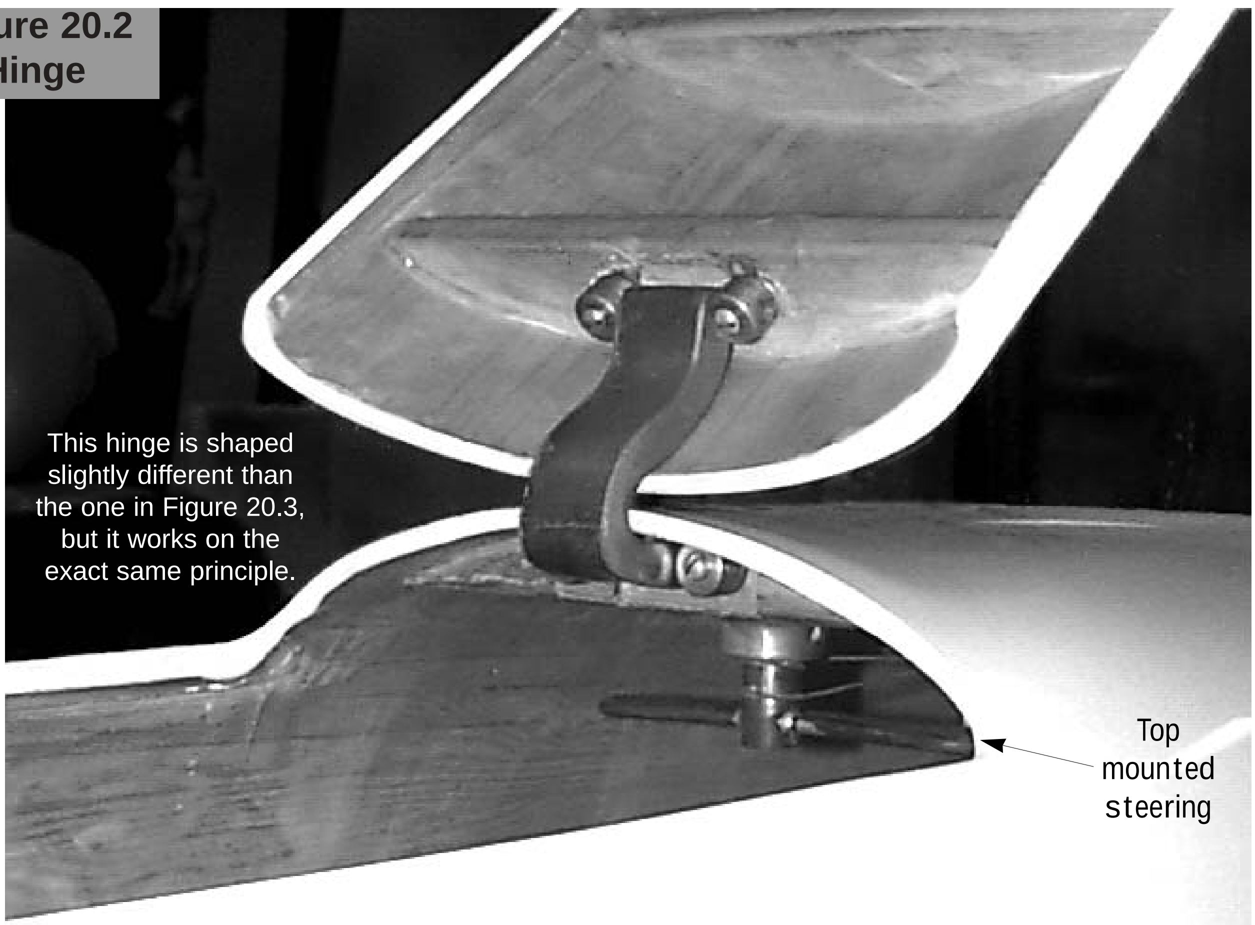
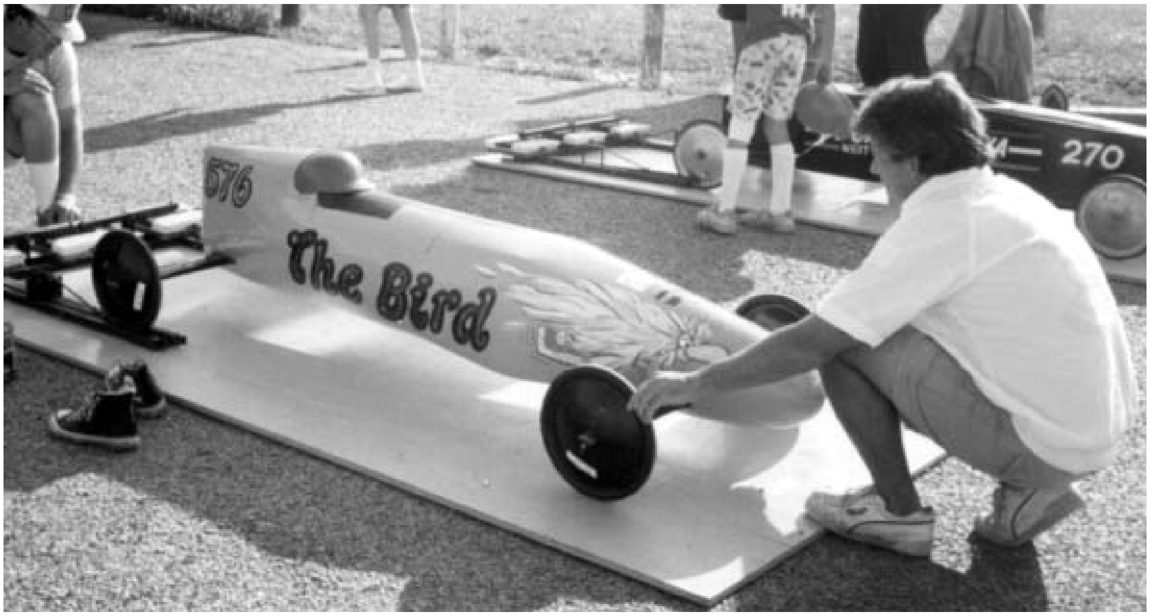
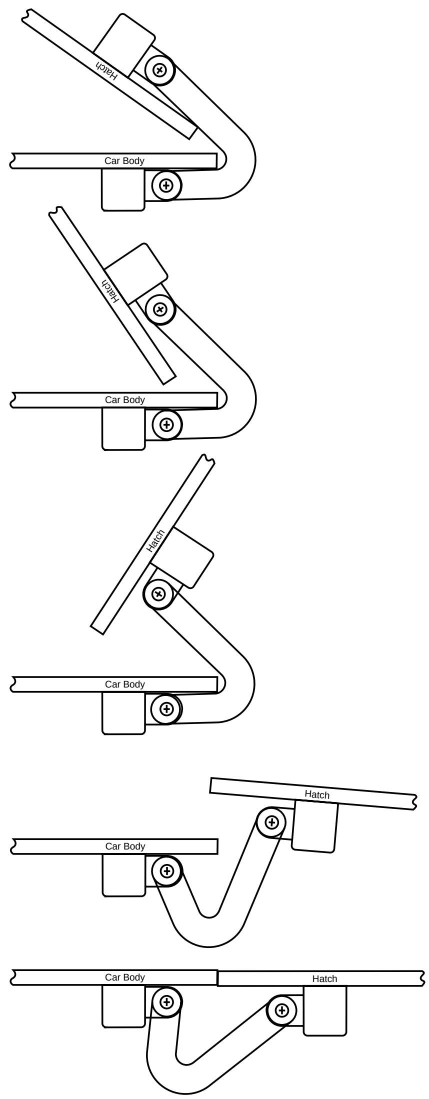


Figure 20.2
Hinge





The hatch on a laydown car can be tricky. A common mistake is that many people measure and mark the minimum legal hatch on the outside of the car, but forget that the 9 x 18" opening must clear the wall thickness of the body and the hinge. Therefore, your car's hatch has to be bigger than 9 x 18" to be legal. Be sure to check the most current rules on hatch dimensions.



Figures 20.2 and 20.3 show a hinge that is designed to snap shut and hold the hatch closed. It is based on a toggle-action much like a pair of vice-grips. This type of hinge is difficult to set up, so as a back-up you may want to install some cabinet door snaps to hold the hatch closed. I've even seen some hatches held closed with magnets. For the toggle-action to work, the hinge and hatch must be spaced so that just the right amount of pressure will be applied when point B is pushed lower than points A and C (Figure 20.3). This will be accomplished with the addition of very thin washers, and a bit of trial and error. When setting this hinge up, it is important to use the exact dimensions as shown in Figure 20.3.

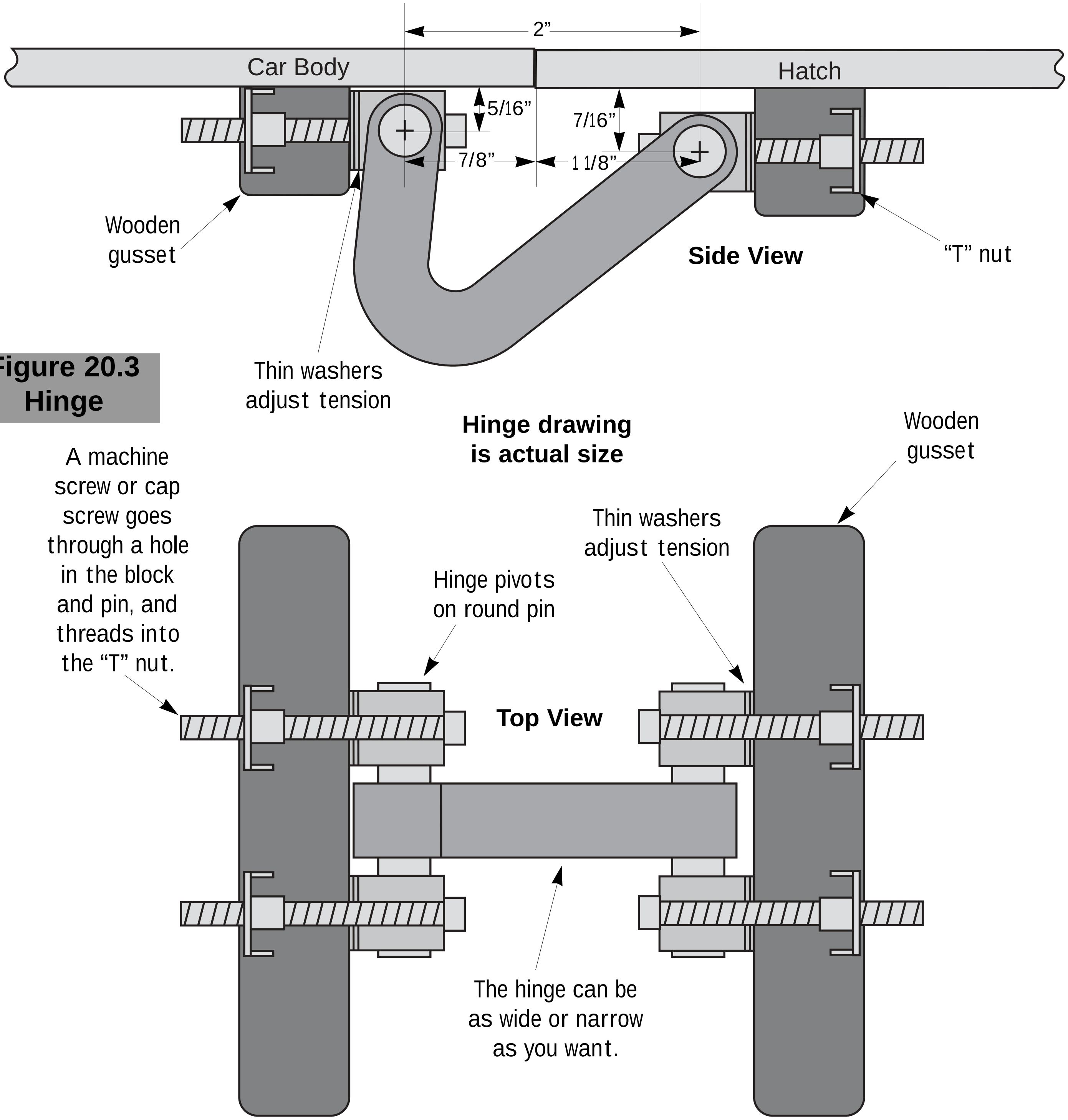
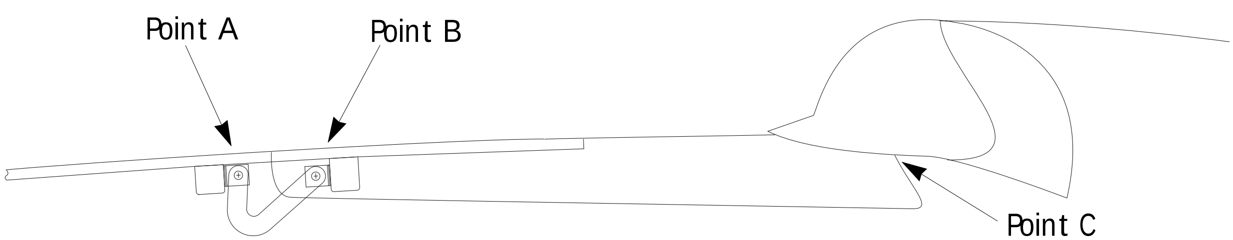


Figure 20.3 Hinge



Access Hatch

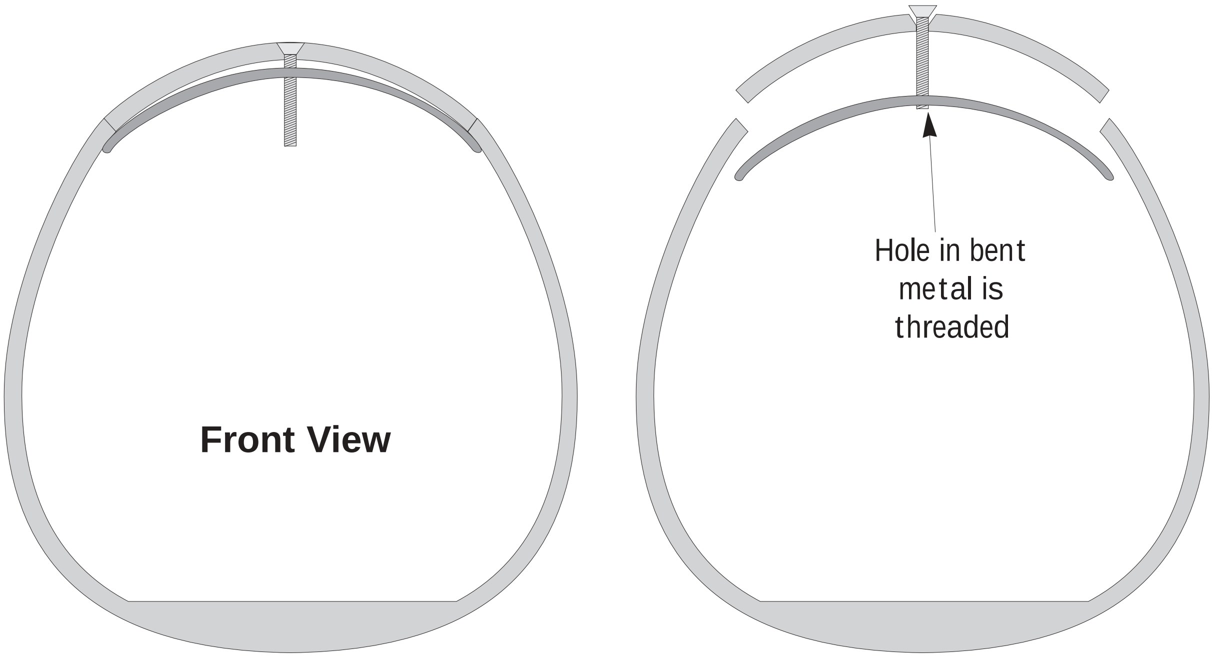
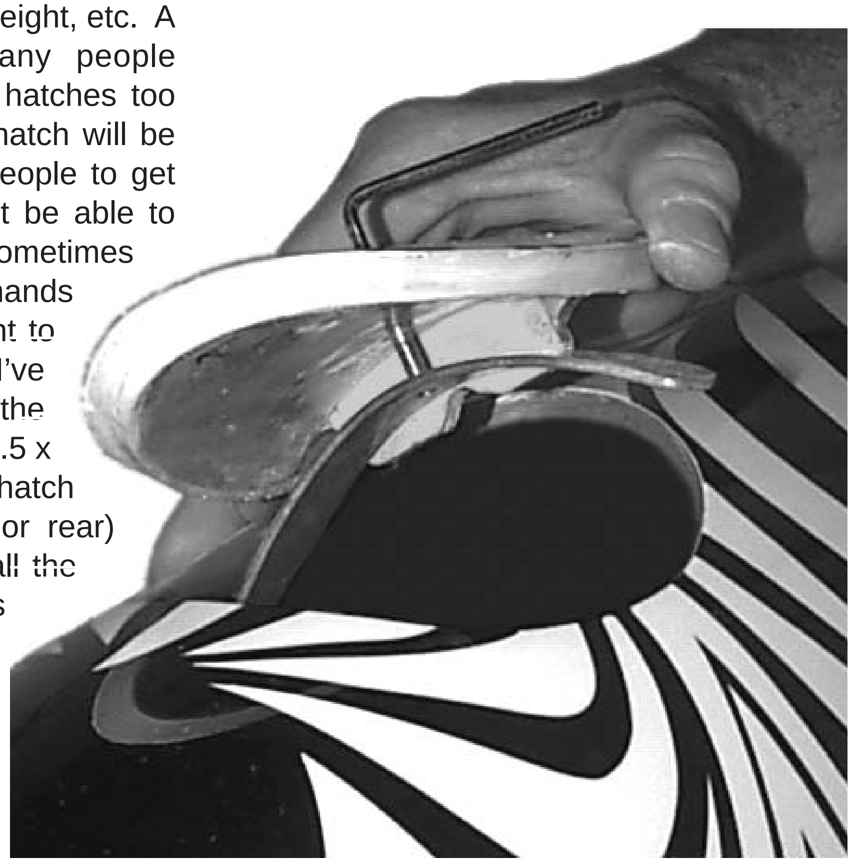
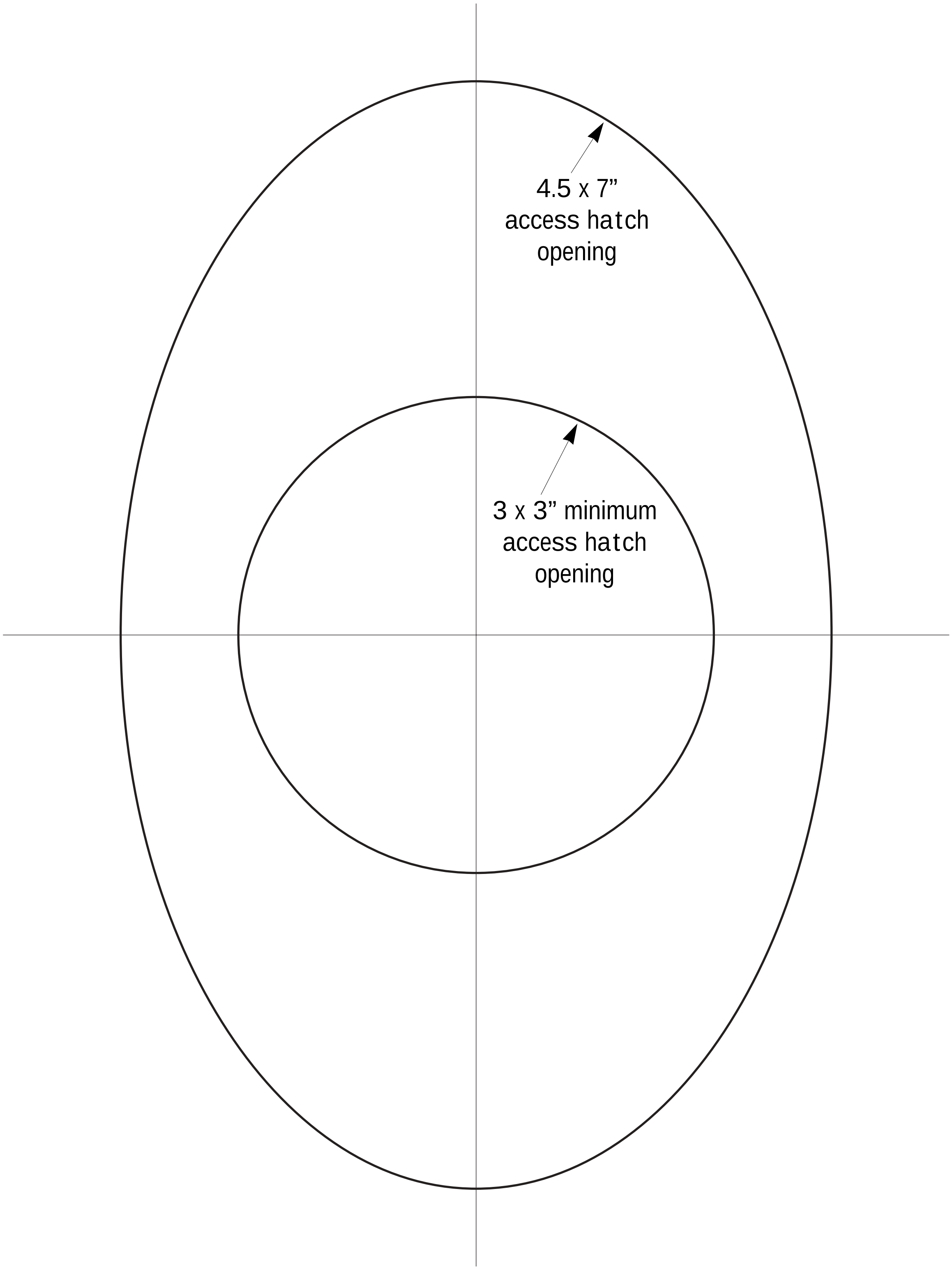


Figure 21.1
Access Hatch

An access hatch is very convenient (and required in some cases) for getting to the brake, axle mounts, weight, etc. A common mistake that many people make is that they cut their hatches too small. A three inch round hatch will be just big enough for some people to get one hand in, but they won't be able to see what they're doing. Sometimes you may need to get two hands inside, or you'll at least want to see what you're doing. I've found that for the front of the car, an oval hatch of about 4.5 x 7" is just right for me. The hatch (whether it is in the front or rear) should be cut at an angle all the way around, so that there is no chance that it can ever fall inside the car during a race. The hatch can then be locked in place with a single bolt and a bent piece of metal (Figure 21.1).



Full Size Access Hatch Templates



Airfoils And Fillets

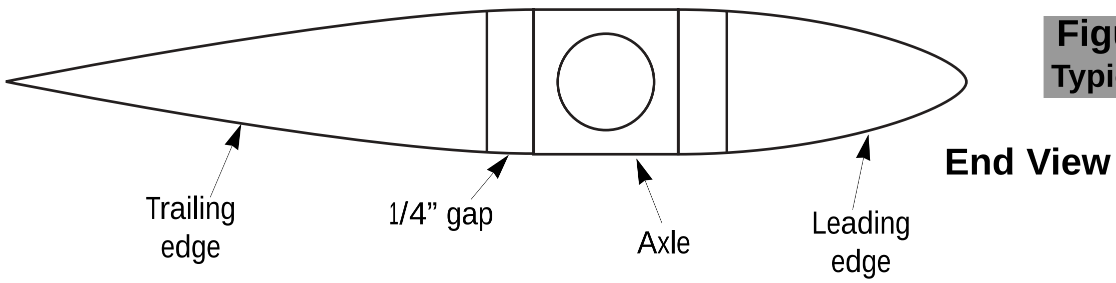
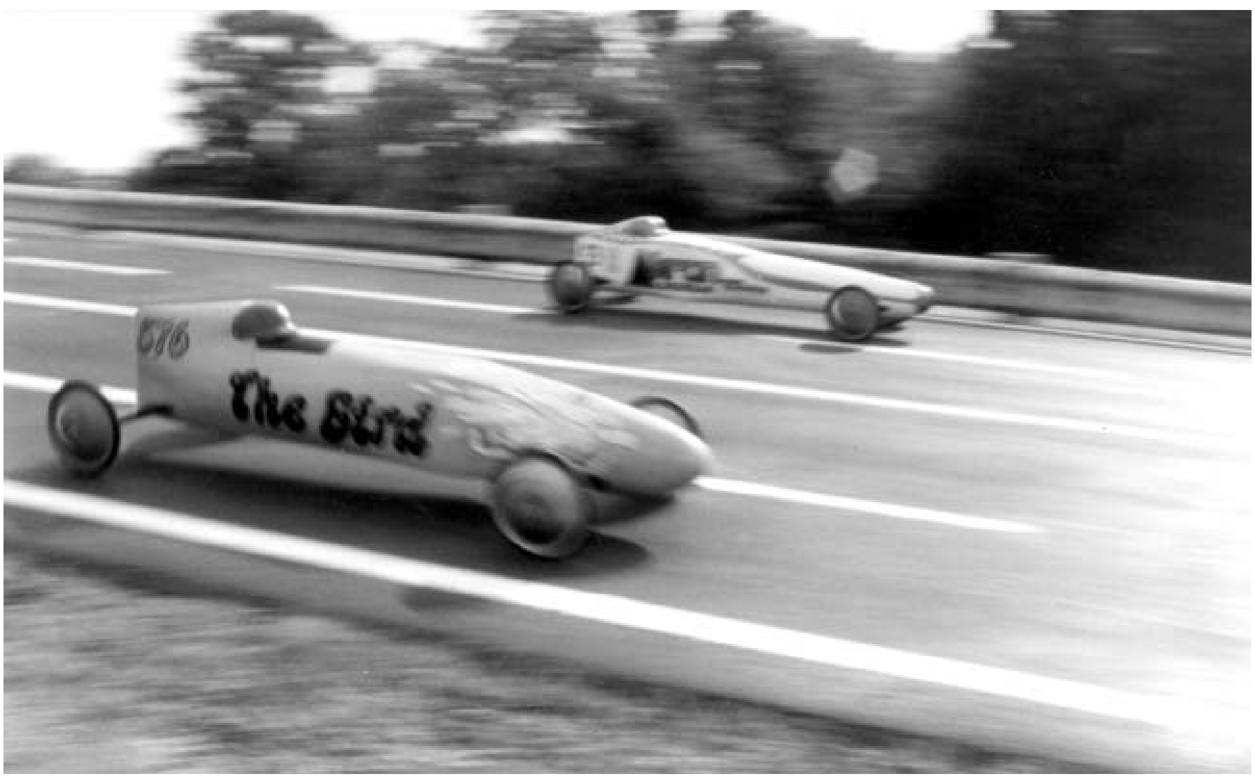


Figure 22.1
Typical Airfoil

No matter what type of car you’re building, to be at all competitive, you must have a set of airfoils, also known as axle fairings or axle trees. Their purpose is simple; to gently deflect the air over the square axle. Airfoils are usually made from wood, coated with resin, and bolted to the axles. Figure 22.1 shows the end view of a typical airfoil shape. Be sure to check the most current airfoil rules, as they may change from time to time.

Airfoils must be securely fastened to the axles using bolts, wood screws or dowels. Figure 22.2 shows a popular method of burring “T” nuts in the trailing edge, and using small bolts (preferably cap screws) to hold the airfoils in place.

Some builders like to smooth the area where the car body meets the air-foils with a fillet. Fillets don’t have to be big. An expert once told me that the radius of a mans thumb was about the



right size. That seems to be consistent with the fillets on most top running cars. Fillets can be flexible or hard. Tape or thin rubber from a latex glove can be stretched to form a nice flexible fillet, while hard fillets are made from the actual airfoils. It takes a little more time to make hard fillets, but the end result is very clean. Start by bolting the airfoils to the axles and make sure that they are in their final position. Next, glue the airfoils directly to the body, making sure that the rear axle is squared to the body and the steering is perfectly straight. Once the glue is dry, blend the transition area of the body and airfoil with thick resin or body filler. Always check your current rules, but at the time when this construction manual was written, it was legal for a fillet to cover one inch of axle, measured from the body. Figure 22.3.

Figure 22.2
Airfoil Attachment

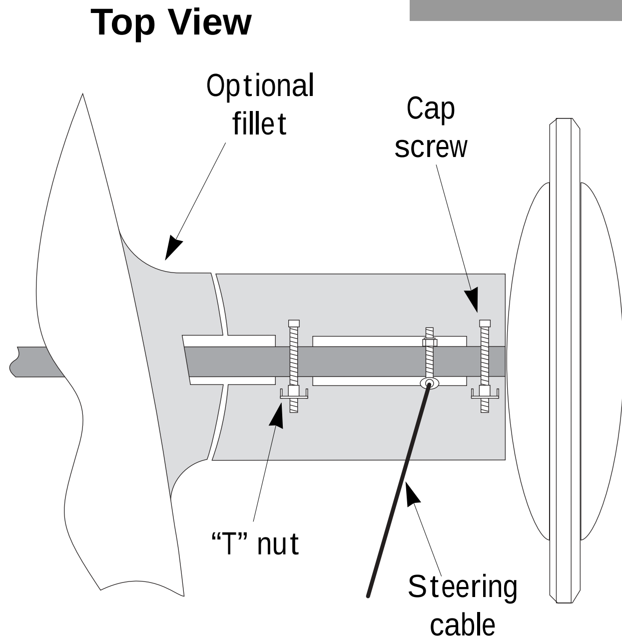
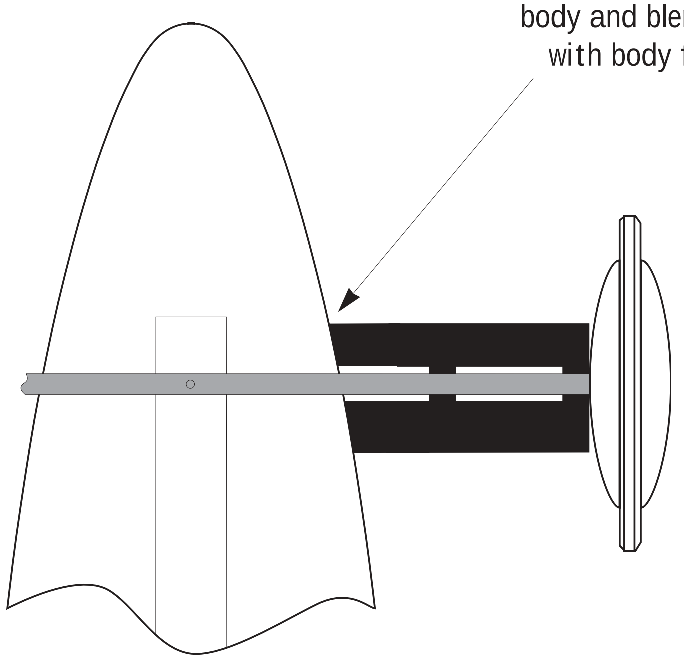
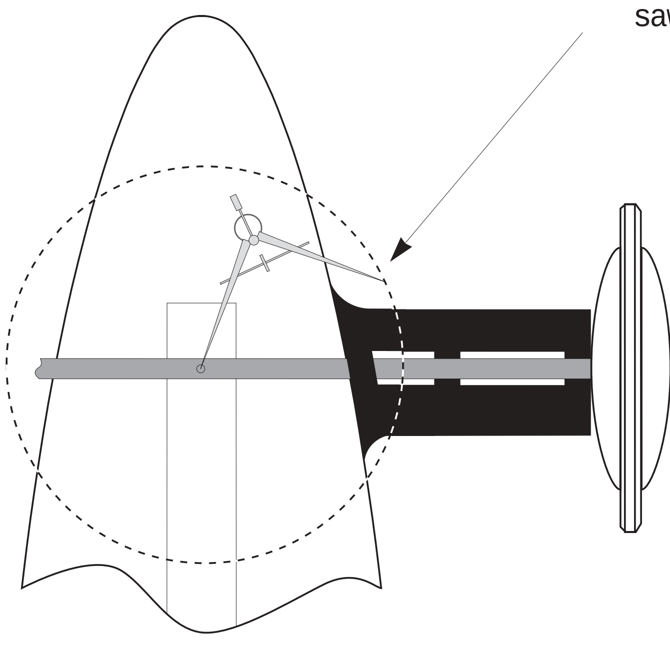


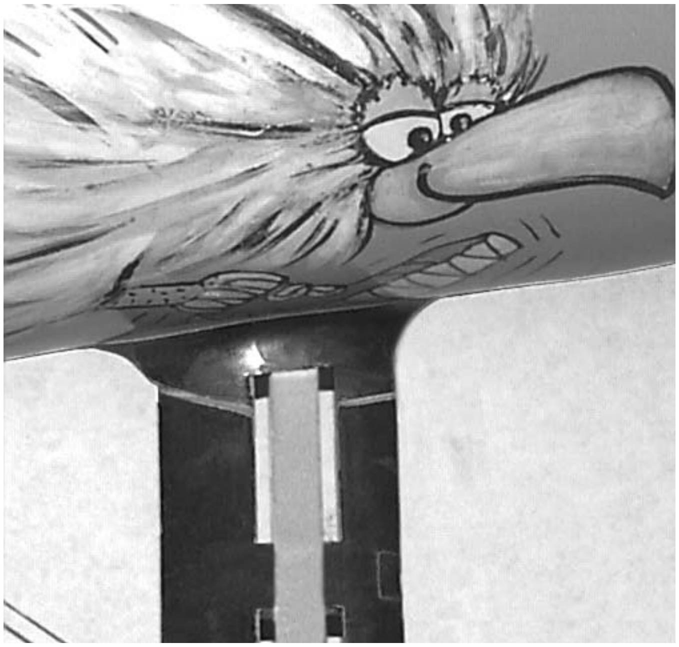
Figure 22.3
Making Hard Fillets



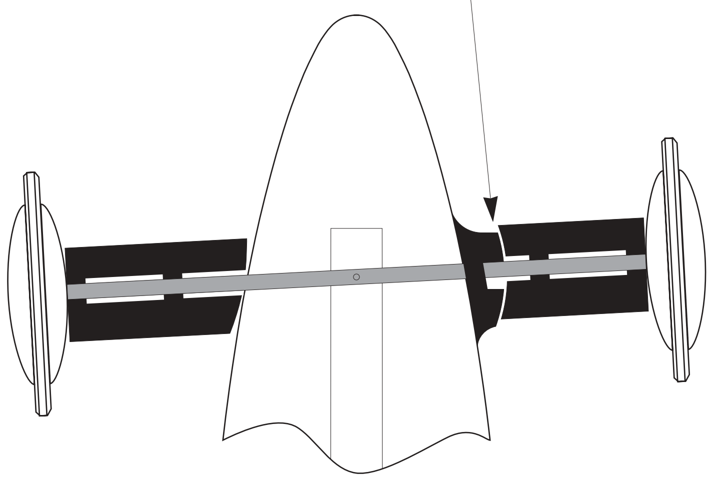
Using a thin saw blade, you will cut a straight line, freeing the rear airfoils from the fillets. The front axle has to steer, so the cut must be made on a circular arc. To do this, use a compass, and from the front kingpin, draw an arc on the airfoils. Cut along this line, and the axle will be free to steer.



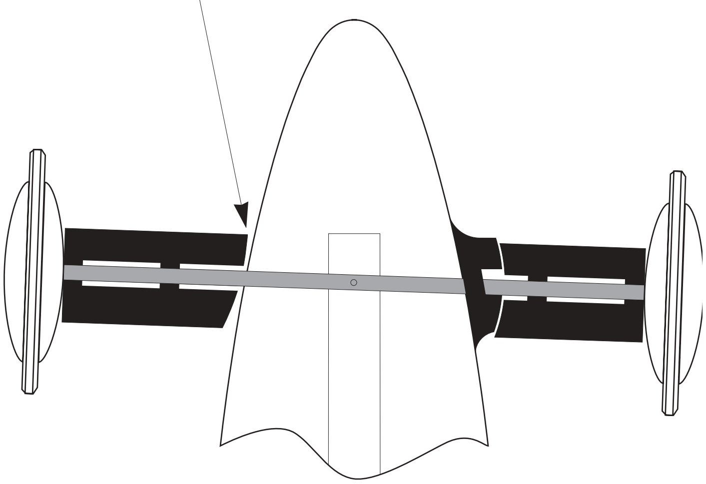
One final note. Making solid fillets should be one of the last things you do to your car before you paint it. It's very difficult to do any body work (sanding, filling, etc.) around finished fillets. Unlike airfoils, you don't need fillets to be competitive, so they should be low on your priority list.



Cutting hard fillets on
a circular arc allows
for steering



If fillets are not used, the
airfoils must be sanded to
allow for steering



And So...

I sincerely hope that my plans and this manual have been a help to you in the construction of your racer. I've done my best to cover everything that I thought was necessary, but this is a work in progress. I'm going to continue to expand and improve my plans and construction guide to try and make the building process easier. I welcome comments and constructive criticism on the contents and clarity of this manual. I'd like to know what (if anything) you would like to see added or expanded upon. Hopefully as you discover new construction methods and tricks you will drop me a line and describe them to me so that I may share these ideas, the next time I update this manual.

83 Godfrey Road
Lake City, PA 16423

As you finish your racer and anxiously get ready to race, please look for me out on the racing circuit. I don't hit as many races as I used to, but if you happen to see me at a rally or at the nationals, please say hello.

Left to Right: Bob Messersmith, Jaclyn Messersmith, David Seitzinger, and David Seitzinger

Dreams Really Do Come True.

SEITZINGER RACING INK!

83 Godfrey Road - Lake City, PA 16423