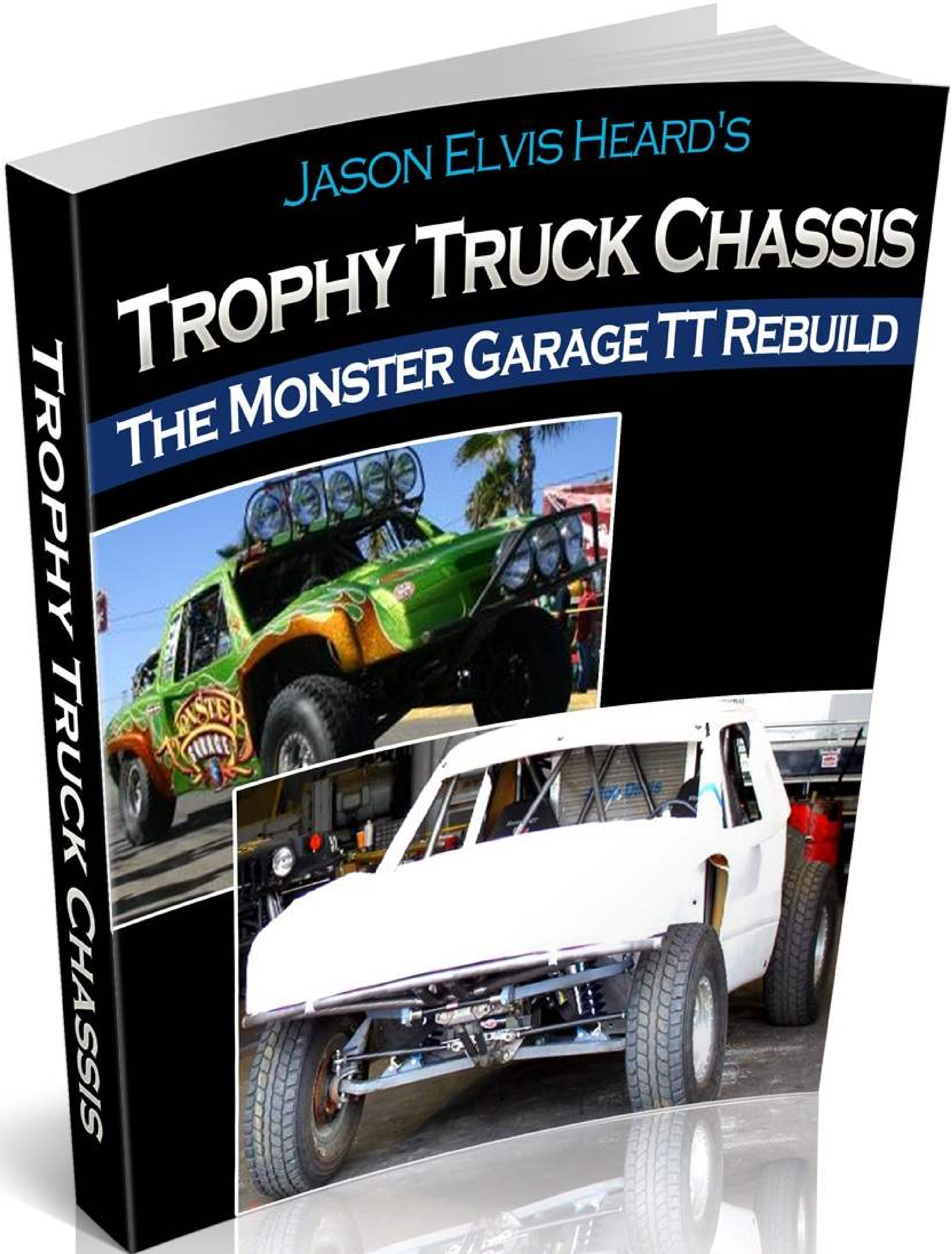
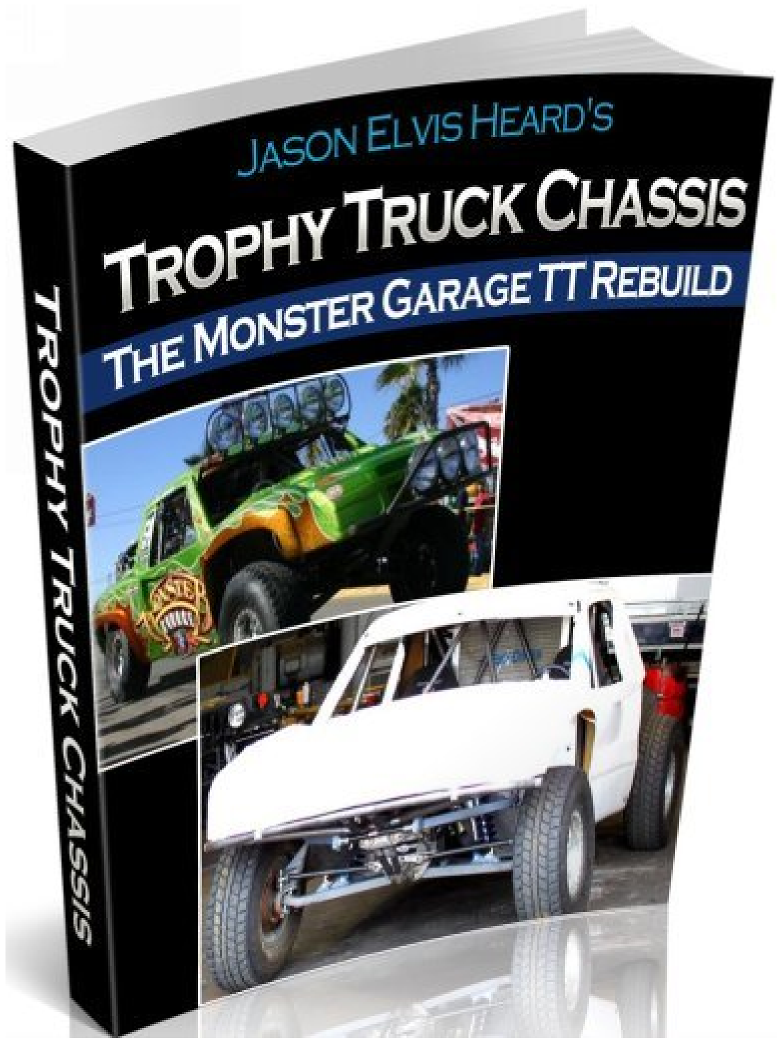

Jason Elvis Heard's
Trophy Truck Chassis
The Monster Garage TT Rebuild
Trophy Truck Chassis



Welcome to the second installment of the "Cut The Crap" book series from Jason Elvis Heard. This book details and explains the path / build of the Jesse James Monster Garage Trophy Truck rebuild that was done by ME at the GMR in long beach / signal hill.

Cut The Crap is engineered to be as simple and straightforward as possible. *Cut The Crap* explains things so that everyone can understand and avoids confusion by not using unnecessary engineering terminology or clogging things up with overly complex discussion topics.

With that said, I will NOT cover everything -- only the most important and key topics for the rebuild of this chassis. This industry like many others is plagued with guys who like to talk so that they seem way smarter than other fabricators

I "Cut The Crap" and stick to the core basics, so that you can learn faster and easier.

Preface…

I need to begin with a confession… I just turned 27 years young, while at the same time entering my 9th year in business! And I own multiple growing businesses, one of which is a dedicated top-tier rear-end manufacturer with a brick-and-mortar location that caters to a specific market.

My age does NOT disqualify me as an off-road fabrication specialist. I'm not an egotistical engineer wanna-be, fuzzy headed fabricator, a number-crunching machinist, or a glorified accessories installer.

I'm a very battle -tested and scarred veteran of the fabrication industry. Over the last 7 years, I've built well over 200 rear ends and many vehicles (truthfully I have lost count). My rear ends are in everything from Trophy Trucks to daily driven 300K+ Pro-Tour Muscle Cars. My clients have over 100,000 miles on my custom-built rear ends and even more in vehicles I have built in several states and even a few foreign countries.

> I am REAL. I have been on the beginner side looking for the answers with not much success and with a dozen know-it-alls saying different things, each claiming that everyone else is an idiot. Funny thing is – they're right. They're idiots. I have learned the hard way through blood-stained experience (not ivory tower theory) so that you don't have to.

Jason Elvis Heard

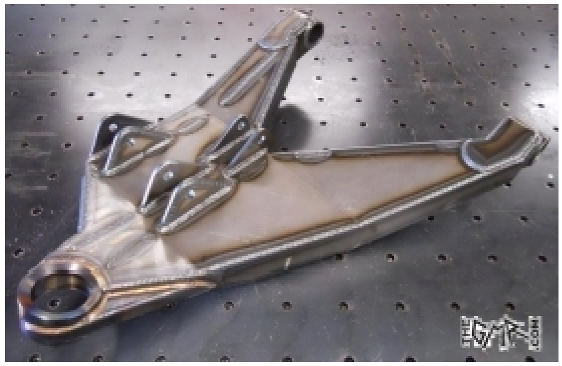
This Book was put together to specifically showcase the equipment, methods, and techniques that are used in the Off-Road fabrication industry.

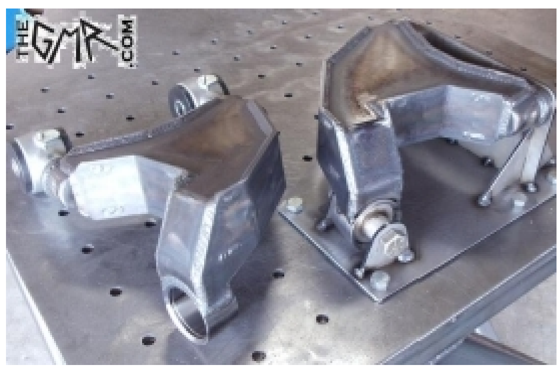
Although some of the material will and does cross over into other forms of fabrication, I have compiled this book exclusively for the Off-Road market.

I personally built and welded the cage / chassis of this truck, all 1.75" Chromo TIG welded. After the rollover, it was re-skinned and then sold. The cage work did not move. The occupants literally walked away with NO injuries, and everything held up perfectly. All that with a crew cab diesel weighing in over 7K lbs, definitely one of the heaviest trucks in the dirt (for reference: trophy trucks are between 4,800-,5500 lbs). This was built many years ago, well before I became a master of Off-Road welding. A picture is worth a thousand words. This one clearly verifies that I know what I'm talking about and will not steer you in the wrong direction.

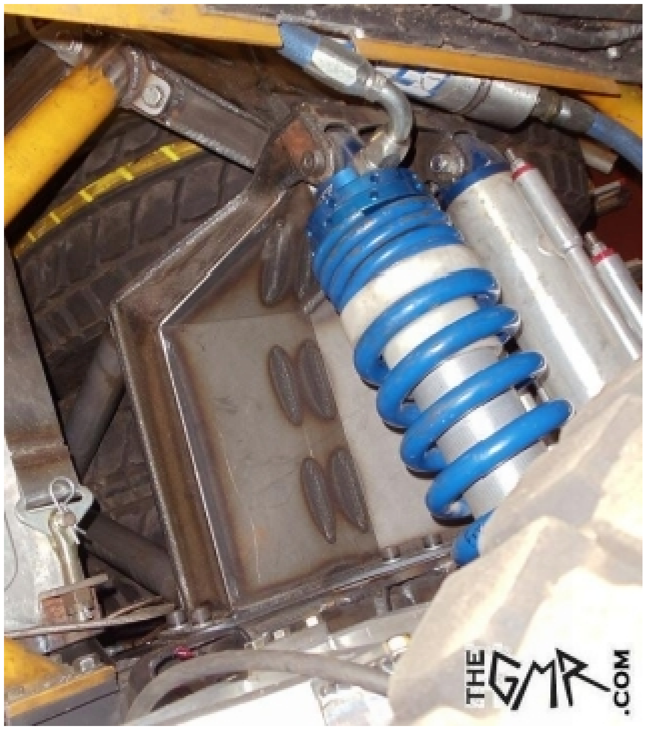
<u>What started the whole thing – The Go ARMY Hummer H1</u>

Years back The GMR was commissioned to build some components for the above Go Army Hummer H1 driven by Rob Everhart. After the initial build of the Hummer as a Stock Full class vehicle Rob wanted to go faster so he then decided to rebuild the truck and compete in the grueling Class 8. This is a very tough class with many high level competitors that compete at speeds just below the infamous Trophy Truck class. The GMR rebuilt all the suspension control arms along with some of the chassis and shock towers that support the truck.





Above are some of the control arms for the Hummer, 100% GMR Cad designed and fabricated in house at GMR back in 2008. The arms are 100% Chromoly steel and welded with ER80s-D2 MIG welding wire and some section were TIG welded for strength. They were designed for the stock chassis mounting points along with the dual shock setup the Hummer was currently running.



The rear shock towers were also designed in house at GMR and bolt into the chassis allowing for the spare tires to be mounted appropriately along with the Diesel fuel cell. We changed up the mounting of the spare tires for better weight distribution along with the fuel cell placement.

After being very satisfied with the work that GMR produced on the Hummer, Rob then decided to award GMR with the rebuild of the Monster Garage Trophy truck and the rest is history….

<u>What is a Trophy Truck?</u>

A trophy truck is an unlimited class vehicle that is raced through the unforgiving terrain of the deserts in Mexico and the American South West. Trophy truck is an unlimited class vehicle in that you can build the chassis, suspension, and power train to anything you want. The only limits are the safety factors that are involved in racing. After you meet the required safety specifications, then you are free to do as you please with the design of the vehicle. These trucks are the top class in off-road racing and are typically built with the most advanced technology offered in the industry. A new trophy truck will cost you well over 500K from any of the top builders, and in some cases more then 700K.

Just to be clear, we do not have that budget for this build. In fact, we are well under that for this build. So just being able to build something like this with a budget is a challenge all on its own. Another item to mention is that trophy trucks will have a build time well into 2 years on average. We only had 6 months to get her 80% done. Not much time but as you read, you will see how we did it.

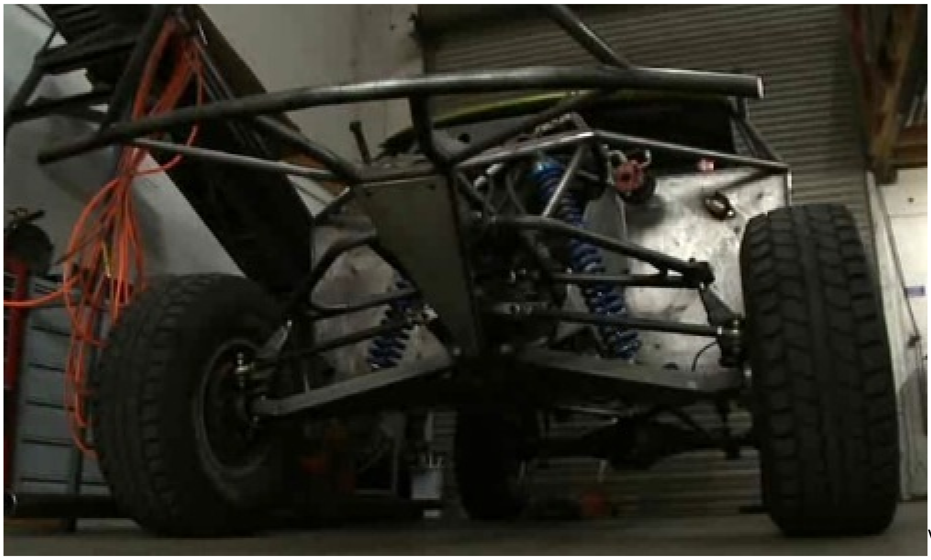
<u>The original Monster Garage Chassis</u> – To my knowledge, the original chassis was built by the guys at Donahoe Racing and had a S-10 body on it. It appeared to be constructed from 1.5” chromo. I did see some sections / repairs that looked to be DOM or possibly mild steel HREW tubing. Long story short, this truck was old even when it was being built on Monster Garage. The best way to describe it would be to say that the guys on Monster Garage “revamped” this old chassis, not built it. I don’t want to discredit the talent that group of guys had, but building a TT in that short time period is dam near impossible. Those guys got it done…. And on the show it was running / driving before the time ended.

Being that I was a young fabricator at the time the show aired, I looked up to the guys that were part of the original build. Many of the guys on the build were literally the industries “dream team” when it comes to building these impressive machines.

The truck was painted with a “Monster Garage” theme like shown above, a color scheme that is going to be kept with the new truck.

Above is a good shot of the original chassis during the tear down stage in my shop. I tore all the components off the truck then organized them to figure out what we could and couldn’t use. Of course our goal was to use everything we could. This was done carefully so we didn’t damage any useful components.

Original Front Suspension – The original front suspension was also built by the guys at Donahoe Racing years before the show; and then possibly rebuilt on the show, but I’m not sure. I know that after the show (I think) the guys at Porter Race Cars rebuilt the front end and machined the steering rack adapter (it has the PRC logo in it).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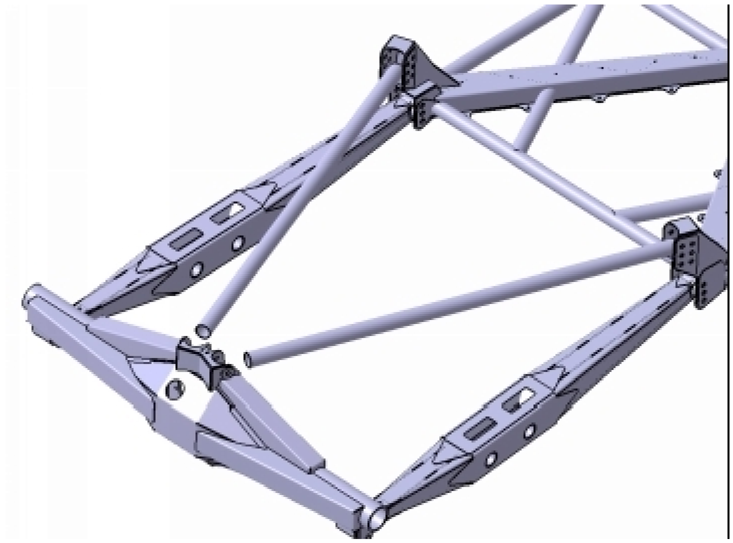
The front suspension style is considered a “J-Arm” setup because the upper arm is mounted entirely forward from the lower, then sweeps back to the top of the upright, creating a “J” shape with the upper arm. You can see this in the picture below; the upper and lowers are setup and pivot on the chassis in different locations. The upper arm pivots off a section that is above the steering rack, while the lower pivots below the motor and is located back in the chassis behind the steering rack. For reference, the steering rack is roughly located by the centerline of the front suspension and uprights. This is a very common Trophy Truck front suspension style, and it still used today by many of the industry’s top builders. The reason for the “J-Arm” setup is commonly mistaken for more wheel travel but that’s not the case. The real reason for this style was to be able to fit the motor in the front of the chassis while keeping the front arms mounted relatively close to the center of the chassis. The closer the arms are mounted to the center of the chassis, the longer they are, hence more travel. Some trucks are still the “A-Arm” style, like Robby Gordon’s rear engine truck. That platform can run a traditional “A-Arm” setup because he does not have the motor in the front of the truck.

Below is a great shot of the lower arms. They were originally fabricated from square 4130 Chromo steel and plate work. They looked to be hand-built, not CNC-built like the majority of arms built today. These were in good condition, with some small dings and in need of a little repair, but overall in good shape so we are going to reuse them. Notice the shock mounts; they are inline with each other. This is when the bypass shock is mounted on the exterior (to the outside of the chassis) of the coil over shock. This style is very common on older trucks and buggies; the more common shock mounting these days is called “side by side,” which we end up with on the new chassis.

Original Rear Suspension-

The original rear suspension was designed around the chassis that was dropped off to the Monster Garage Guys on the set and has since been reworked by a shop or two after the show initially aired. This style of rear suspension is considered a “Mezzanine” setup. It is something that has been seen throughout race truck design from the late 80’s to the early 2000’s with some builders. Today it is rarely seen and typically never used on new truck construction. It has been proven to be far from optimal for desert racing.



The suspension is setup like a traditional 4 link with straight bars for the link arms that connect the rear end to the chassis.

What you are seeing above is the actual Mezzanine arm, the structure that controls the suspension travel of the rear end and holds the up the weight of the vehicle. This arm is where the shocks are mounted; this truck used smaller 2.5” diameter KING shocks, very small for a trophy truck. They were also very short in length, about 12” and provided about 20” of wheel travel, estimated. Below you can see how the mezzanine arms are mounted to the rear end housing of the old truck.

The rear end for the old chassis was a Desert Specialties Ford 9” style Fabricated housing with 2.5” bearing hubs. This used to be considered top shelf components many years ago; these days it’s technically outdated for trophy trucks. The brake package for the rear was a Wilwood Forged Superlite 4 piston with 1.25” thick rotors that were 13” in diameter. This was something considered smaller for a TT but still good brakes.

Fuel Cell placement – On the original show, the guys in the Monster Garage shop built their own fuel cell for the chassis and located it right behind the cab below the radiator. This cell was about 50 gallons, small for a TT these days. It mounted from underneath the chassis forcing you to remove some of the suspension to get the cell out, not preferred for TT applications. Another odd issue with the fuel cell mount in the original chassis was that when the truck arrived at our shop, the mount was welded in, so there was actually no way to remove it without actually cutting it out. Clearly NOT ideal for any application, let alone off-road racing.

The truck also had some items there were placed there either during the show or post the show by Jesse and his guys, two of them that stood out were the shifter knob. Pretty sure that this will be going back into the new truck.

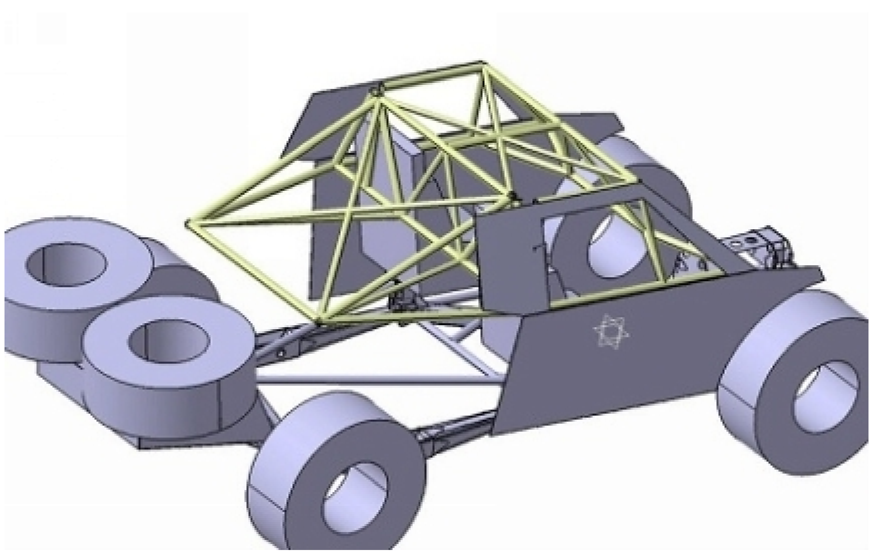
The second was the sticker seen below… it would go into the new truck, but we would have to remove it carefully and place it back… not worth all the work for it to just tear and not look as rad as it does here.

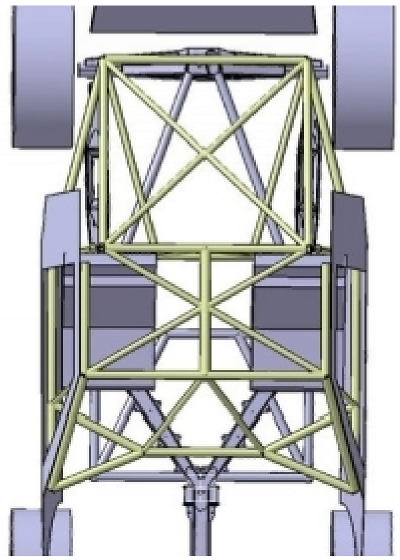
If you ever saw the original show, then you remember that they finished the truck within the time limit and were driving it around the streets of Long Beach afterwards. Below is a shot from the show when Jesse was driving it over a small hill and managed to get the truck airborne for a slight minute.

<u>New Chassis Layout and Design-</u>

The old chassis was just that… Old. The style, layout, and construction was that of well over 10-year-ago technology and completely outdated for the new path this truck is going to take. The bottom line is that the owner wanted to race the truck in SCORE and BITD. He wanted to have an updated platform that is more common with today's trophy trucks, along with simplicity so that parts are easy to prep and obtain.

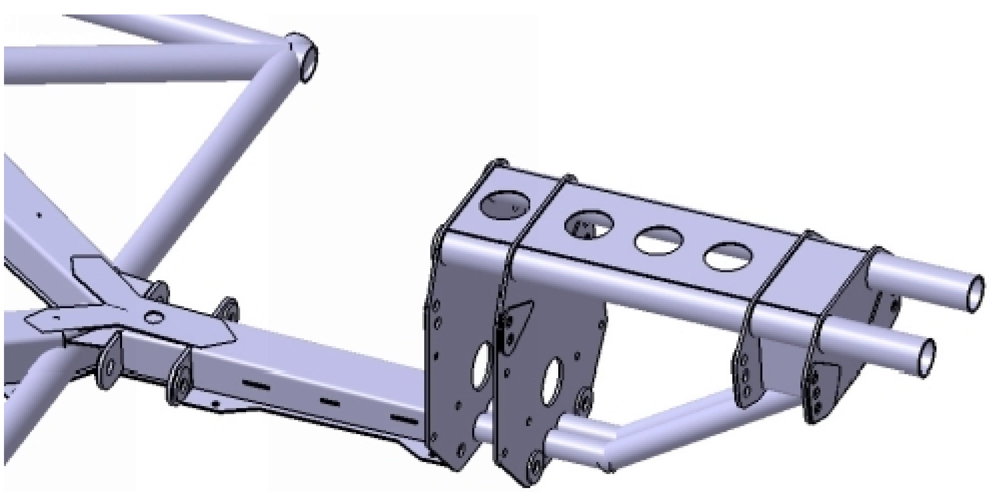
Chassis – The original chassis was grandfathered into the SCORE series, because the main structure was built from 1.5" tubing, not allowed for vehicles over 4,000 lbs now. The rules specifically state you need to have 2" tubing for the main sections of the chassis (stated in the rule book), thus requiring us to at minimum replace some sections of the original chassis to meet the tech specifications. The size and layout of the cab section in the old chassis was a little small and odd; the space for the occupants was very minimal and cramped. I can't image Jesse being comfortable in this truck. As I type this, Jesse is currently racing his new truck (a Geiser-built truck) that has quite a bit more room then the old Monster Garage Chassis. The goal here was to build a new cab section in the new chassis that will fit the same body as the old chassis (Geiser TT gen 2 Body) and fit the occupants comfortably.





It's easy to see that the new chassis is quite a bit different from the Monster Garage Truck. The layout of the tube work was refined and designed for optimal passenger safety, along with the utilization of all the components from the previous truck. After all we have to still use the old parts and style to some extent, otherwise this will not be a "rebuild."

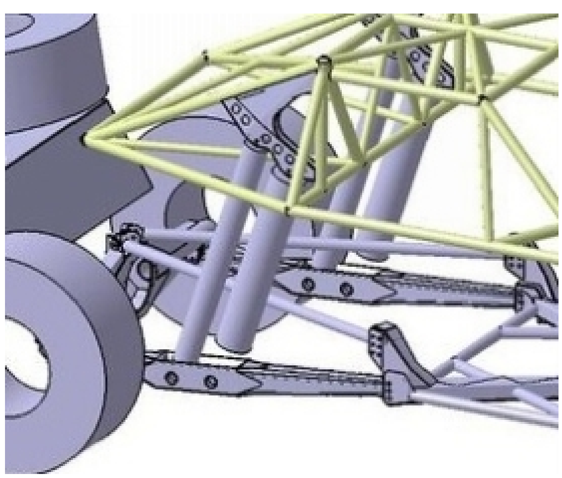
Front Suspension – The front suspension was one of the least changed sections for the new chassis. We were able to reuse the uprights, lower arms, steering arms, and steering rack. I just massaged the front-end geometry with the rebuild of upper arms and bulkhead.



The bulkhead is the section of the chassis where the front suspension bolts to. What you see above is what is considered to be the bulkhead of the chassis. This section mounts the lower, upper, and steering arms for the *front suspension. It is the front part of the "Y-frame" as well. I will get to the Y-frame later on in the book.*

This was a serious task but I was able to accomplish it. I was restricted by the original components, but it was decided that if we were to rebuild everything, the project would go well over the budget and also take us further away from a "rebuild." We kept what we could, then moved forward. The front shocks and mounts were redone though. We changed them twice: once with the initial redesign, and then again later on through the build because of some component changes. The new bulkhead was designed to mimic the original chassis in style to add some relevance to the original Monster Garage truck.

Rear Suspension Style – After talking it over with the new owner, it was decided to change the entire rear suspension style to a traditional 4 link design, seen below. This new design does not feature the same Mezzanine rear facing arms like the original setup. With the new suspension, the shocks are now mounted on the lower link arms. The initial design with two lower links that are heading down to the bottom of the housing from the chassis, along with the two upper links meeting in the center of the housing top is relatively the same as the old truck. I did however utilize all new geometry that complements the reworked front suspension. I also increased the spread of the upper links on the chassis, reducing bind through travel and proving more lateral strength then the old chassis design.



There are a few benefits to the new rear suspension style that improves the performance / longevity of the new truck. I was able to improve the geometry of the rear suspension and add adjustment into the link arm positions on the chassis. Adding adjustment is always a good thing when you can. The moving of the shocks to a more traditional position on the link arm is beneficial for two main reasons: it's easier to tune / valve shocks relative to the chassis, because this is far more common and shock tuners typically have more experience with this style of suspension. The ratio of the shocks relative to the suspension travel (internal shock piston speed vs. suspension travel) was improved drastically, allowing the shocks to work better. The main benefit was the fact that we removed a very critical moving component of the chassis from the rear of the truck. The old Mezzanine setup was literally a target, and one simple tap / bump from a competitor and you are out of the race.

This was due to the rear pivot / mount for the mezzanine arm that was on the rear bumper. The shock mounts were not much better, being completely up and out over the back of the rear end. With the new setup, the critical components are tucked up into the truck and protected -- far more reliable for better race longevity. The weight was also moved to the center of the chassis, another element I prefer, also allowing for more room in the back to mount a fuel cell / tires with optimal positioning.

The Rear End housing and Link Arms Fabrication–

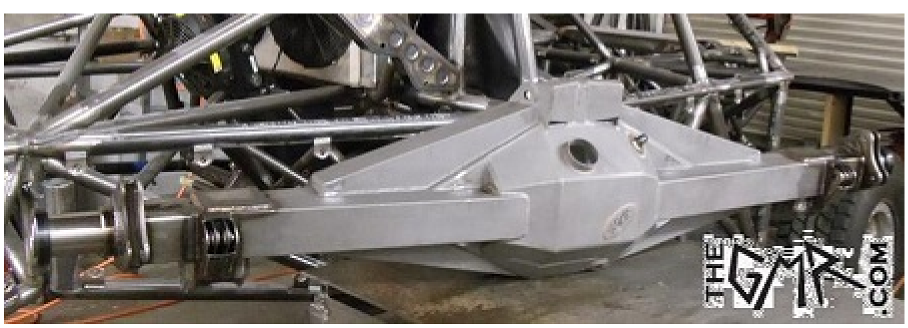
After going through the rear housing in the original truck, it was clear that we needed to build a replacement. We found a few issues with it caused by abuse from the Mexican desert. The housing itself was badly damaged and patched as if it were welded in the desert, not in a professional shop. It leaked badly and was NOT straight (out of alignment), thus requiring massive work to get it aligned. All the mounts for the limit straps and link arms were also different then the proposed plan above, thus requiring us to cut all the mounts off and weld new ones on. This process will warp the rear end even more and possibly so bad, it might not even work. So the decision was made…

The new owner decided to order up a completely new rear end for the new chassis layout and design. With the new 4 link design and new GMR9 TT style rear end, we are able to build a very strong and clean rear-end housing that will hold everything and provide protection accordingly.

The rear-end hubs off the old truck, along with the brakes were perfectly fine, so we saved them to reuse them. The third element was a new 40 spline spool, and that was also reused for the new rear end. Basically the only element we had to remake was the rear-end housing and axle. I changed the width of the rear end as well to complement the new chassis layout.

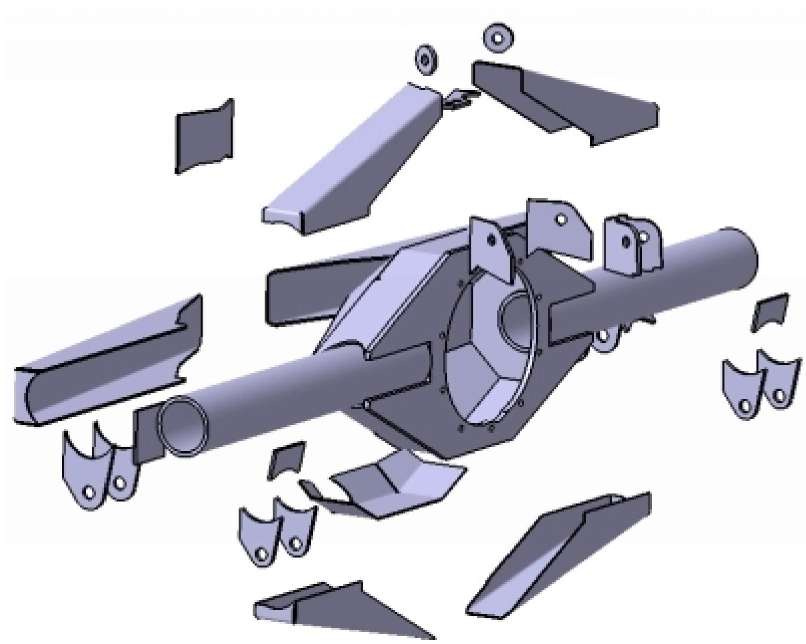
The rear-end housing and link arms were designed in the computer first, then CNC cut and bent to the specifications from the computer. Ensuring accuracy and fitment for the plate work.

The first component we fabricated for the new chassis was the GMR9 trophy-truck rear end. This 100% 4130 Chromo Steel fabricated rear end took about 3 days to complete, a mission all on its own. Then it took another 2 days to weld the full floater snouts in, caliper mounts, limit strap tabs, and bump stop mounts.

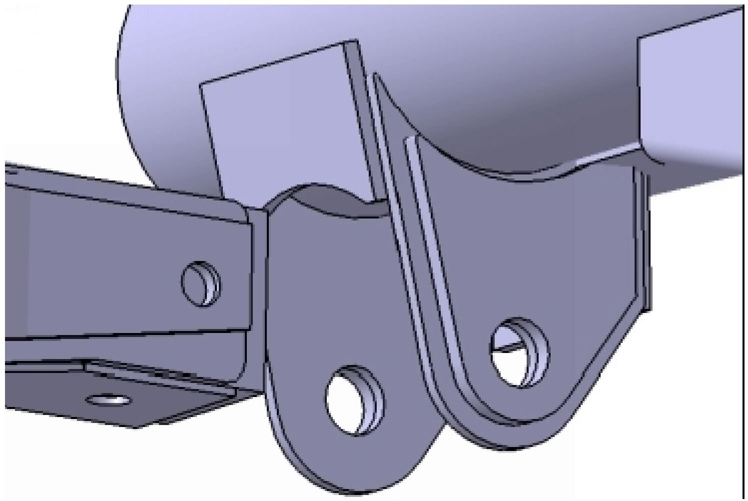


Above is the complete housing well into the build process. I will get to that later. First let's talk about the construction.

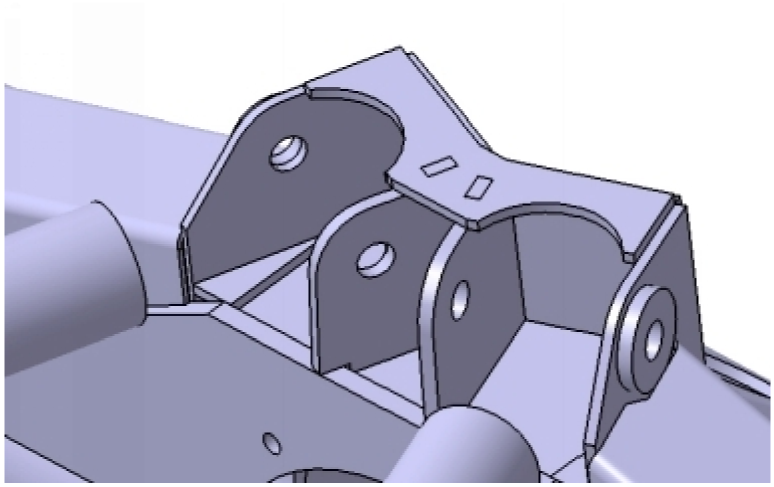
I can't show you everything on building the rear end housings, because some of the methods are propitiatory to GMR and how we do things. Although we do not sell off-road housings currently we are still building rear ends. The only difference is that now we build them for 200K plus pro-tour muscle cars.



The rear end I built for this rebuild was a GMR9-350-TT series fabricated Chromo rear end housing. It featured built-in link mounts, along with several truss sections on the rear, top, and bottom of the housing. The exploited view of the rear end above can give you an idea of all the pieces that it took to build this rear end (35 pieces in total).



I would like to take a second to highlight the link mounts on the rear-end housing. These have their own specific characteristics built into them. Above are the lower-link pockets for the 1.25” rod ends that are used in the lower-link arms. They utilize BMS high mis-alignment spacers with drop the bolt hole size down to ¾”. The spread on the tabs is considered to be the “tall” spacers, in that they are a full 3.06” spread, as opposed to the standard 2.76” spread. These link pockets are also double-plated with overlay plates. The main plate of the pocket is 3/16” material with an overlay of 3/16” to bring the thickness of the tab to 3/8” for strength. Arguably, these tabs will experience the most amount of force on the chassis, so they need to be very strong. The front and back of the tabs are plated in as well, just enough to provide added strength, along with having enough clearance for the rod end to flex during the suspension travel. These mounts are welded onto the housing tube before the rear truss covers it. This is for a specific reason; it ensures that your weld and connection to the housing tube is secure. You do NOT want to weld link tabs to the rear end truss. Instead, with the above method, the truss now acts as a gusset for the link mount.



The upper link mounts are also designed a very specific way for certain reasons. I utilize 1.25” rod ends for the upper pivots. They’re the same rod ends as the lower links but I do use different spacers. The spacers I use for the top are the standard-width 5/8” bolt hole spacers. I do this for one reason. When you are building link mounts on top of a housing like above (4 link) you want the mounts’ centerlines to be as close together as possible. The closer they are, the less “bind” will occur with suspension movement. Bind is the action of the suspension fighting itself to articulate through travel. With the use of the shorter spacers and smaller bolts, I can locate the centerline of the rod ends very close to each other. I literally designed this mount so that the interior tabs have just enough room to clear the bolt and lock nut of the 5/8” bolts. The center plates are ¼” material, while the exterior are 3/16” with a 1/8” overlay. I then located the top housing truss to come up against the tab to help gusset it to the rear end for lateral support.

After we clean and prep all the materials used for the rear end, we then locate everything in a rail fixture to ensure quality fitment throughout the welding process.

This fixture is built on one very large rotisserie and has the ability to rotate, making the welding process easier when building very complex rear ends like the one for this truck. If you look closely at the picture above, you will notice that I have special spacers bolted into the upper link pockets. These spacers are designed to mimic a uni-ball cup / rod end with spacers and provide about 0.020” wider space to allow for weld shrinkage of the tabs. That way the rod ends with the high-mis-align spacers will fit.

Below is an example of a uni-ball with the high mis-alignment spacers installed.

The welding process is slow and tedious. You have to take your time to ensure quality. NO rushing here -- these parts are built for quality and not quantity. This housing was welded up with two passes: the first was with Harris Super Missile rod, and the second was with a Stainless “cap” rod. That is why the welds have the color they do in the final product.

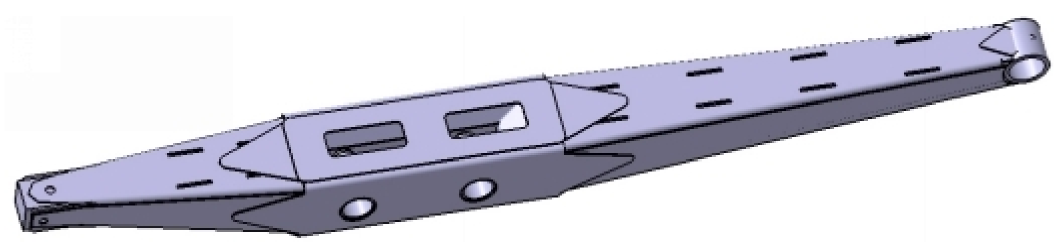
Just like the upper link mounts, I have custom-machined spacers for the lower link mounts to keep the tabs from moving on me, possibly creating a fitment problem with the rod ends down the road.

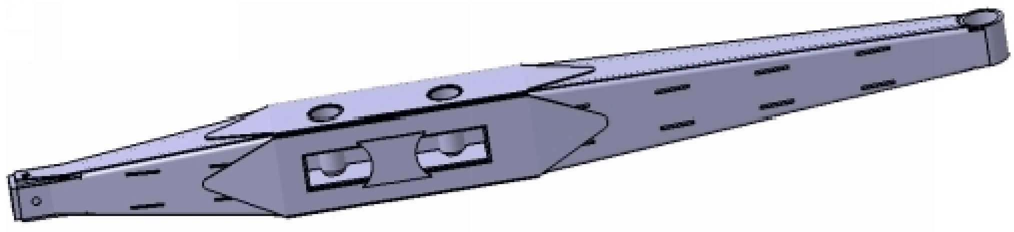
Above is a finished shot of the GMR9 trophy truck housing. The housing features a chromo bash plate welded to the bottom for added protection against off-road elements. The drain plug was located on the back side of the housing but not on the bottom. This is to prevent it from getting sheared off. If it were on the bottom, then I would run the risk of failure if we hit a rock hard enough. Further into the build, I will review the finishing of the rear end and the steps taken with it.

After I completed the rear end, I moved onto the rear lower link arms. I chose a 60” overall length for the rear trailing arms, along with very specific design elements. They are fully constructed from 4130 Chromo. Actually, everything on this new chassis was constructed from 4130 Chromo. So if you see platework / tubework, you can rest assured that it’s 4130.

There are many different rear lower-link arm styles and designs on the market.

Many of them work great, so there really is NO right or wrong way to build rear link arms. However, I can tell you how and why I built these the way I did.

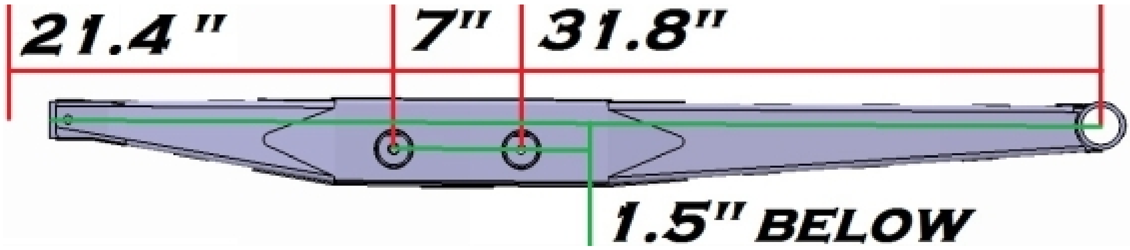




The shock mounts were selected to be in a very specific location for a reason. I wanted to provide a great internal shock piston-speed-to-wheel travel relationship. The rear shocks that we are using have an 18” stroke so I had to factor that in with the wheel travel I wanted. Given that the front end was being utilized from the original truck, we were seeing about 22-23” of travel from the front. So I decided to set the rear up to complement that, NOT simply to get the most travel we can. The suspension needs to be a compromise. And with rear trailing arms, you have to keep in mind the shock stroke length, desired wheel travel, and internal shock piston speed.

I personally prefer to have a lower piston speed to wheel travel, which means that the by-pass shock will be mounted closer to the rear end then some builders prefer. Below is a good shot of the final shock mounts and location.

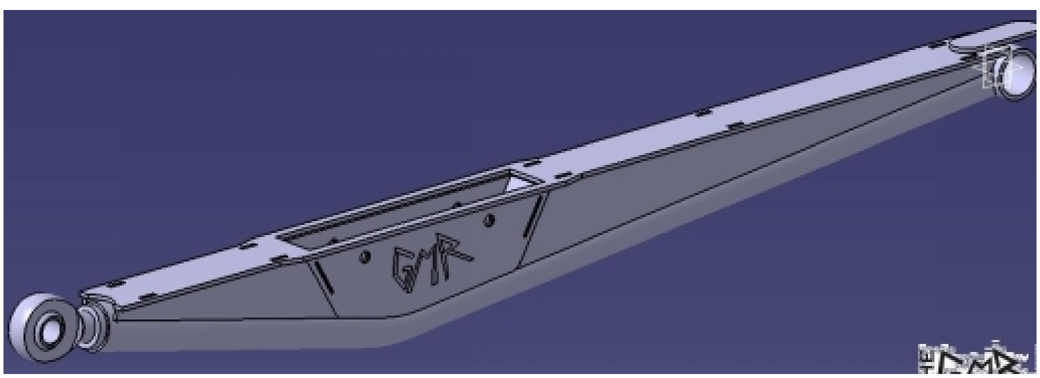
With the front at about 22-23” of travel, I was only shooting for 29” of travel in the rear. Here is my reasoning for that. The general rule of thumb is that you want more droop and bump travel in the rear of a truck then the front, so I went with 2 more” of droop and about 4-5” more bump travel. This will give the truck good balance when it comes to the wheel-travel relationship. The coil over was then placed in a location to clear the large by-pass shock through travel, and the ratio ended up being less than 50% up the arm, giving a great relationship on the spring rates and coil-over shock usage. The size ended up working perfect with a 16” stroke coil-over. In general you want to avoid placing the coil over past 50% up the arm toward the chassis. This is one big leverage arm. And when it gets closer to the chassis, you will find that spring rates are not favorable and tuning the truck can become difficult. It's all about setting up the shocks to work as effectively as possible.



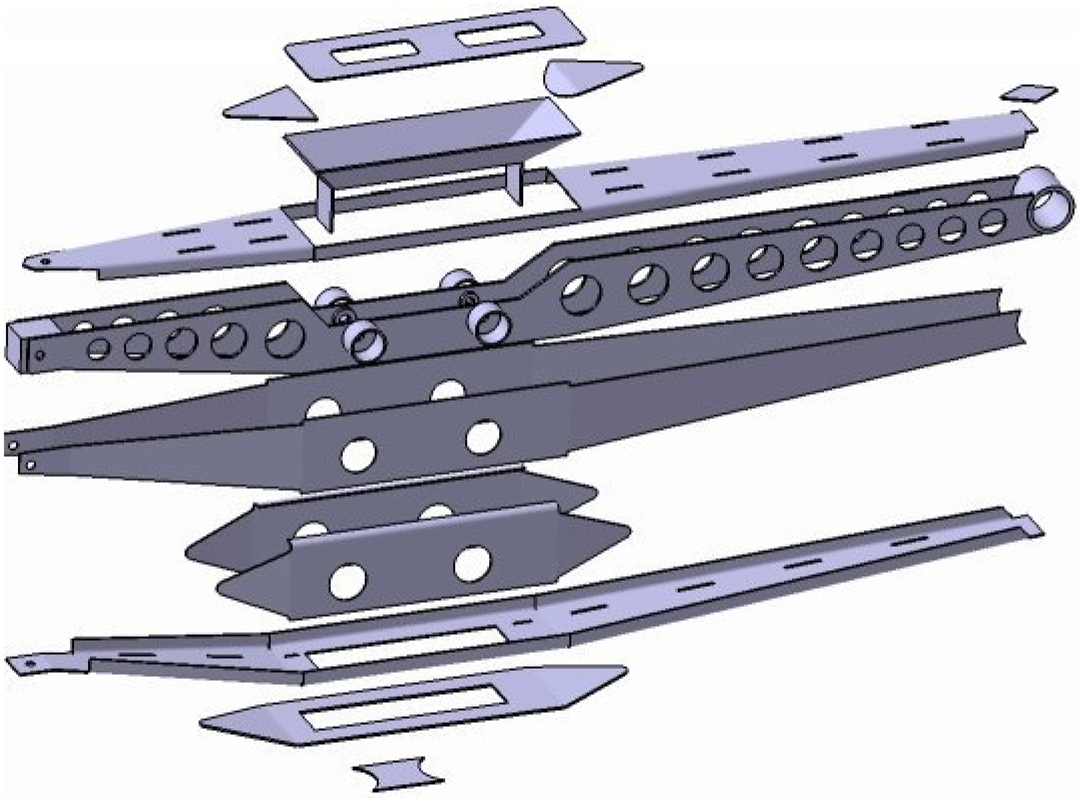
The last element to mention about the rear trailing arms is the shock placement relative to the centerline of the arm. Even though I'm using the wobble stoppers on the front of the link arms, it's still good to do anything you can to prevent the arms from twisting over. One very simple way to do this is to mount the shock below the centerline of the arm. I opted for about 1.5" below the centerline of the link arm, thus using the weight of the vehicle to literally force the link arm straight during wheel travel movement. If the shocks were mounted on center or above center, then it will have a tendency of forcing the arm to roll over in the truck, causing problems.

With the wheel travel in a good relationship to the front and our shock ratios placed, I was able to figure out the piston speed ratio, which was very good. It does slightly change as the shock moves because the angle of the shock changes through the travel. But keeping the piston speed as close to the wheel travel as possible will yield better tuning results and shock longevity. If the Shock stroke were to match the wheel travel, then it will be a perfect 1:1 ratio. If you have a 12" shock and 24" of travel, then you have a perfect 1:2 ratio. The higher the ratio, the harder the shock has to work to control the suspension. So by lowering the ratio, you effectively make the same shock work more efficiently and perform better. There is quite a bit more complex engineering behind that theory but those are the basics as to why I chose the locations for the shocks where they are.

Some link arms are built with a main tube construction. These are more traditional link arms, where a section of tube is used to construct the link arm, creating the base for the arm and plate work. Below is an example of a traditional tube lower link arm.



I opted to use a more non-traditional method; the link arms I designed did not utilize any tubes in the construction. Instead I used all CNC-cut plate work that was cut and CNC-formed to the CAD design I drew up.



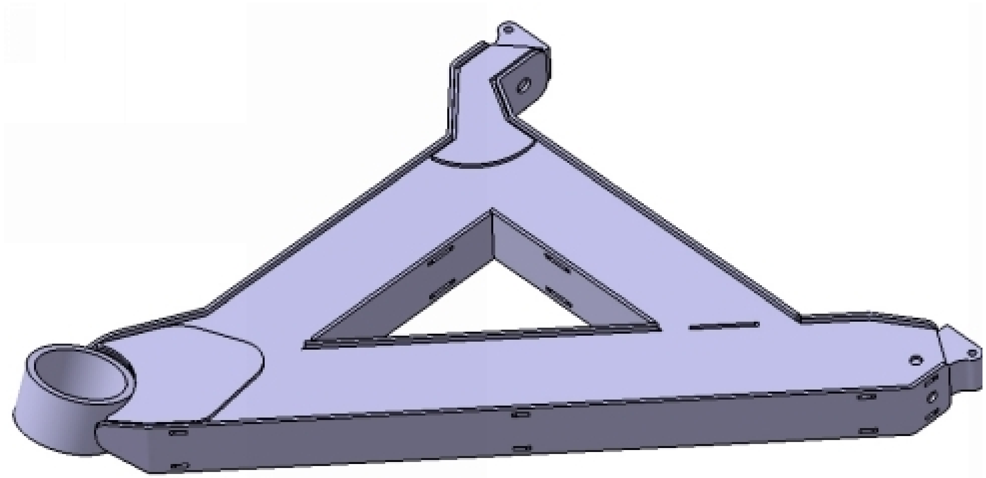
The design that I utilized features two long main ribs for the internals that were welded to each end, spanned the length of the arm, and also had the holes for the shock mounts. Then I plated in the arm around those, creating a complete box section for the arm. In the area of most stress, where the shocks are mounted, notice how I increased the size of the arm to provide the strength I required to support the forces this truck will see.

Just like the GMR9 rear end, I welded up the link arms in a complete fixture that rotated so I can weld everything accordingly. The arms were double-[pass welded with ER80s-D2 TIG rod, a personal favorite of mine. If you pick up my first book in this series, then you will notice that I prefer and recommend the ER80s-D2 welding rod. The fixture I utilized fully supported the ends of the link arms along with the shock mounts, making the construction of the arms very fast. It literally was 90% welding time to build the arms. Each Link arm took about 10 hours to weld up.

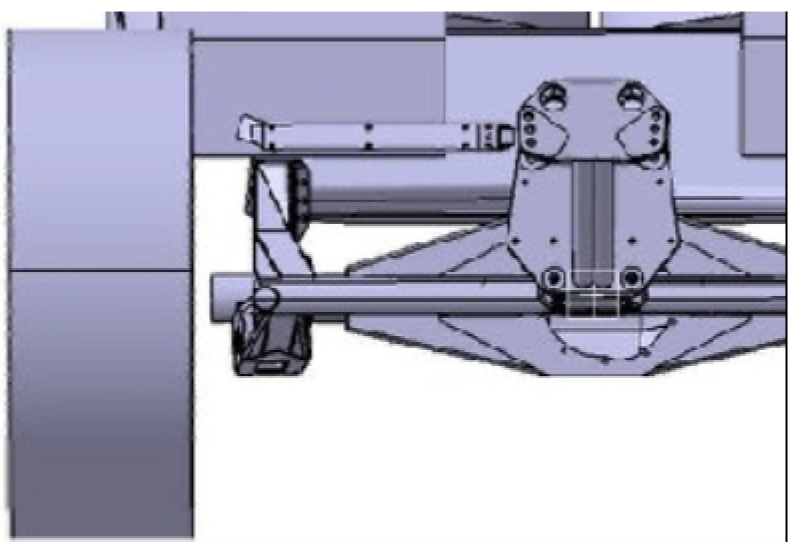
There is some debate on what is used to support the rear of the link arms and attach them to the rear end. Some prefer the use of a uni-ball while others like myself prefer to use a 1.25" rod end. Both sides have great points. The uni-ball is technically stronger, but you have to give up the adjustment of the rear suspension. Even though many builders use rear 1.25" rod ends on trailing arms without issues, opinions on this subject are mixed.

I opted for rod ends with adjustment for this truck, but in the future that could change. As for the front chassis mount on the lower arms, I went with something that is definitely considered to be a standard. It's a 1" uni-ball "wobble" stopper setup. These are machined by Blitzkrieg Motorsports and are designed to prevent the arm from twisting during movement. The worst thing you can have is a rear link arm that twists and rolls over through travel.

<u>New Front Upper Arms –</u>

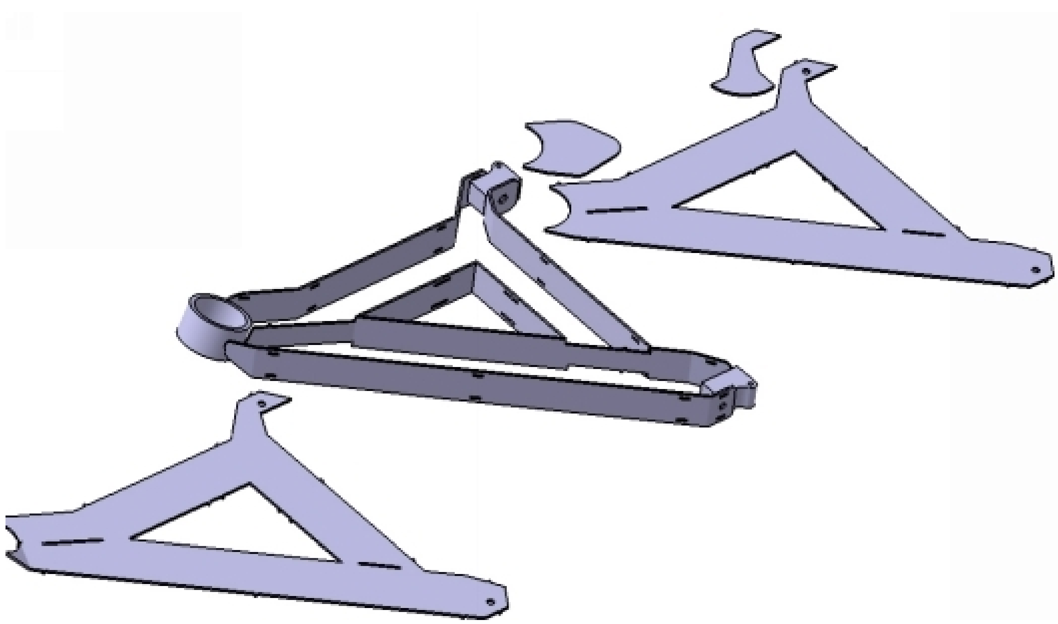


The old upper arms were a little off along with the camber curve of the front suspension geometry, so I set out to improve on them while using as much of the front suspension from the old chassis as I could. The solution was to rebuild the upper arms and change the upper arm chassis mounting points a little. I moved them in and added a few adjustment points. The arms that came off the truck were also slightly bent. They were not symmetrical to each other, which is not the ideal setup for a truck of this caliber. Not a big deal, I simply designed new upper arms with a new bulkhead to complement the original lowers and uprights.

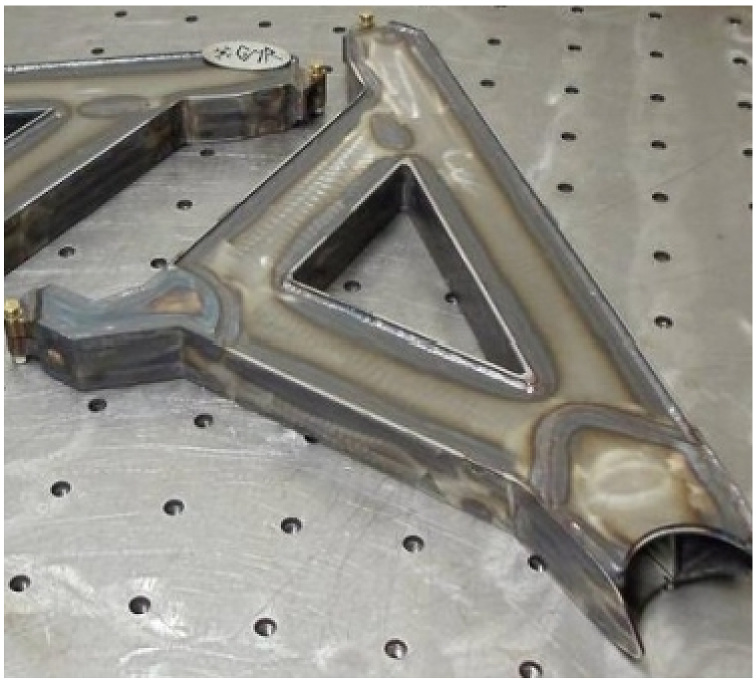


In the above picture you can see the new upper arm design, also note the angle of the bearing cup relative to the arm. This was done to complement the wheel travel, another item that would have had to be changed if we kept the old arms anyways.

I opted for a boxed construction as opposed to the original tube construction, these are stronger then the original design. Along with proving all the changes, I wanted to improve the geometry of the original front end. These are 100% 4130 Chromo and again welded with ER80S-D2 rod. For the chassis pivots I utilized square bungs from Light Racing and a 1.5” bearing cup from Blitzkrieg Motorsports.



The new upper arms were designed for a simple construction. I utilized a “snap” together design that provided me with easy assembly and welding. You will notice that I welded them up without the bearing cups in place. This was done for a reason. I wanted to double-check the angle I needed for the bearing cups, along with not wanting to warp the pickup points of the arm while I welded the center section.



The added plate that was welded to the upper arm right next to the uni-ball cup was there for a reason. It would act both as a support and the bump pad for the upper arm. On the chassis a final bump will be welded to strike this section of the arm to ensure that the suspension does not bottom out the shocks when the truck bottoms out. The rear gusset and plate added to the back chassis side of the arm was done so to provide support for the thin section of the arm. We needed the space to clear the large bypass during travel along with clearing the steering rack when at full droop and turned to one side.

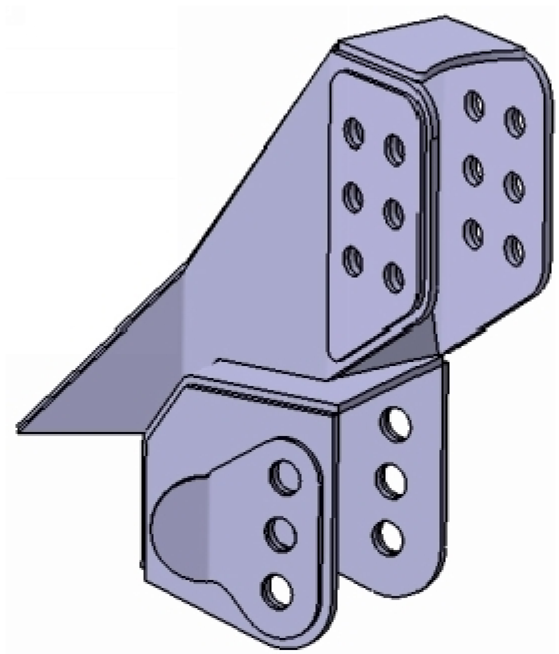
Bulkhead, Floor and Rear Pivot Boxes “Y Frame” – With the Rear lower link arms, housing, and new front upper arms done, it’s time to start the bulkhead and floor section of the chassis called the “Y frame.” The name comes from how the bulkhead section attaches to the bottom floor piece that form the shape of a “Y’ back down to the rear pivot boxes.

The beginning of the Bottom half of the chassis actually starts with the rear suspension location. Before I started with the bulkhead or floor, I welded up the rear pivot boxes in their own fixture. You will start to notice a theme with the construction of the chassis. Everything on this truck has been preplanned with a specific process that dictates when it’s built and how it’s built relative to other components. I subscribe to the school of “modular chassis construction” which is becoming the norm with trophy truck builders these days. The reduction of weld deflection (movement) is the key to maintaining a quality build process. Specific measures have to be taken to ensure the quality remains true through the build.

The basic concept of Modular Chassis construction is that each part or section of the chassis can and should be welded up off the chassis in its own fixture. You break the chassis up into sections of “sub-assemblies” that are built separate from the chassis, then added to the chassis at specific times. The least amount of welding as possible should be done to the core section of the chassis, to reduce the overall weld movement in the chassis. It is physically impossible to eliminate warping or post-weld movement. But through a process of “modular chassis construction,” you can reduce it.

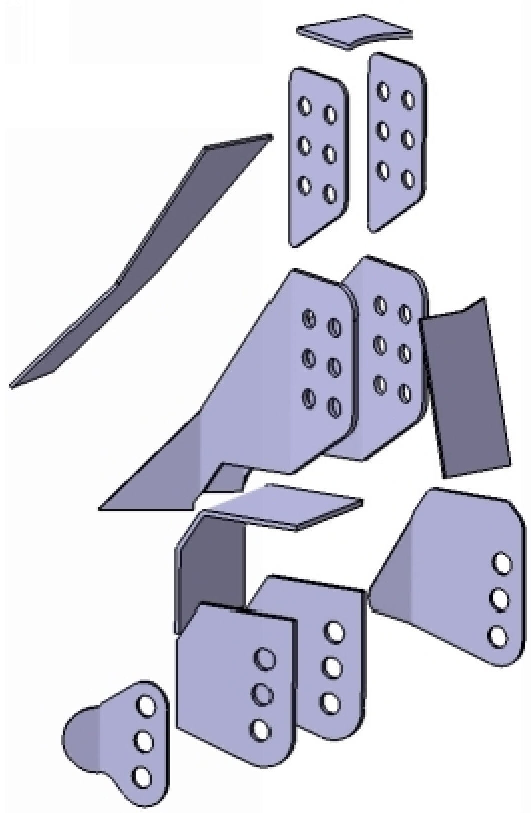
Below you can see the separate fixture used to weld up the rear pivot boxes. These are fully welded in their own fixture prior to joining the rest of the components on the large chassis table. These boxes were welded with ER80s-D2 rod and 100% 4130 chromo plate work.

Above are the rear pivot boxes of the chassis. These are the locations where the rear lower link arms will bolt up and locate the rear suspension. All the rear suspension geometry and adjustment are built into these.



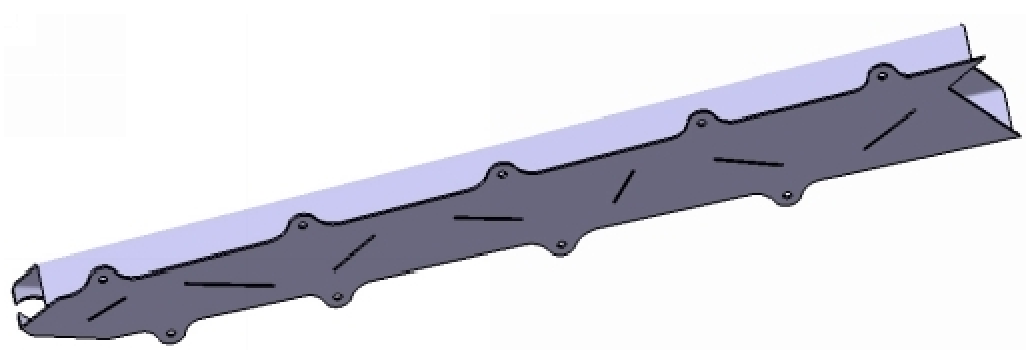
You will notice that I have multiple adjustment points for the rear suspension. This is set up that way for a reason. The front suspension was basically used from the original truck, so I do not know exactly how the rear will react accordingly with the front. I opted for plenty of adjustment so that I will have options when tuning the rear suspension. My initial designs optimal position for this truck was the middle location for the lower links and middle front hole for the upper links. From there I can move the lowers either down or up one bolt hole (1/25th" in each direction). With more room for the upper arm adjustment, I opted for movement forward and back as well. Being able to adjust the suspension will let us tune the truck exactly how we want. If I were to build a truck from the ground up then I could set all the suspension points relative to each other with my own design, hence not requiring this much adjustment, but when you working with a mix of suspension geometries, you need to take precautions to ensure a quality outcome.

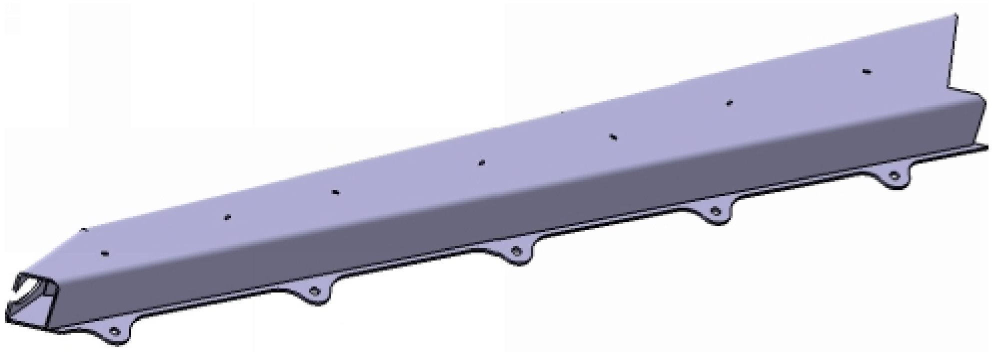
Another technique to notice being applied with these rear boxes is that of using overlay plates in high stress areas. If you read my off-road fabrication welding book then you will see me mention overlays and the style of welds they are.



The rear suspension points will see some very high stress loads, so I placed plate work over the initial tabs that were cut for the bolt holes. The bottom plates are 3/16” Chromo with 1/8” overlay plates. These pivot boxes were double “weave” welded as well for strength.

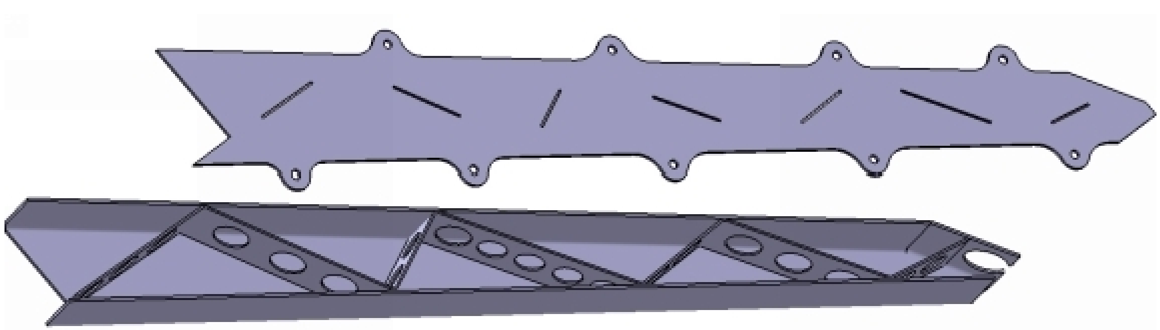
Once the pivot boxes were done, I finished welding the main sections of the Y-frame together. These boxed sections will create the floor of the truck and connect the bulkhead to the rear pivot boxes.



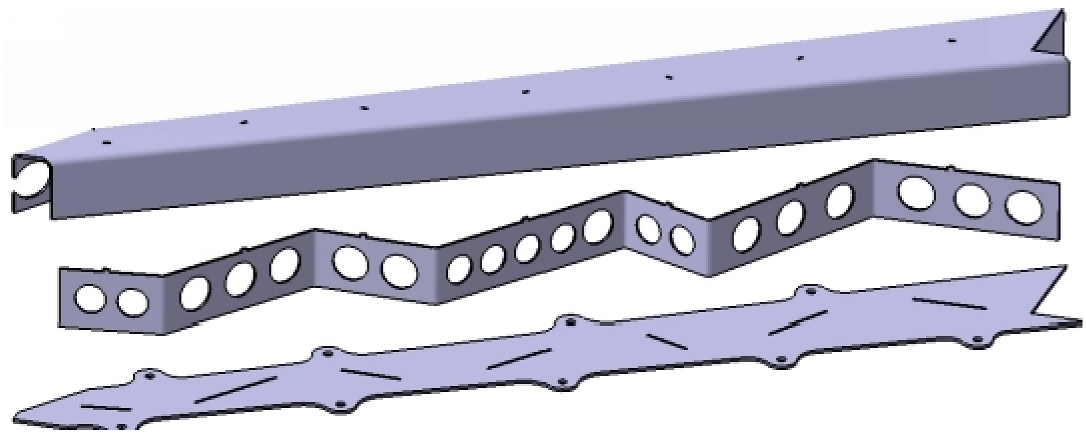


These sections were a special request from the new truck owner. You will often see trucks built with all tube construction floors, while others have the entire floors constructed from boxed plate work. I opted for a mix of plate work and tube work.

I designed these sections to be very easy to build and weld up. If you look closely, you will notice that the top is one big “C” channel of material. This allowed me to place internal ribbing into the channel and weld it up accordingly from the inside. That is why you see all the heat-affected areas on the top and sides of the material, indicating a welded gusset inside the floor section.



The internal ribs were lightened with holes and tabbed along the sides with cuts in the “U” structure to locate the internal ribs. This allows the pieces to literally “snap” together. It took about 10 minutes to tack weld these sections together. I MIG-welded the internals with ER80s-D2 wire and then TIG-welded the external sections.



The bottoms of these pieces were then located with snap-together locator tabs that were cut into the plate work. The bottom plates were also designed with little tabs and holes to locate a skid plate once the chassis was done. The plan is to bolt a large section of aluminum to the bottom as a skid plate for the center of the chassis. Having the tabs in place will make this very easy down the road.

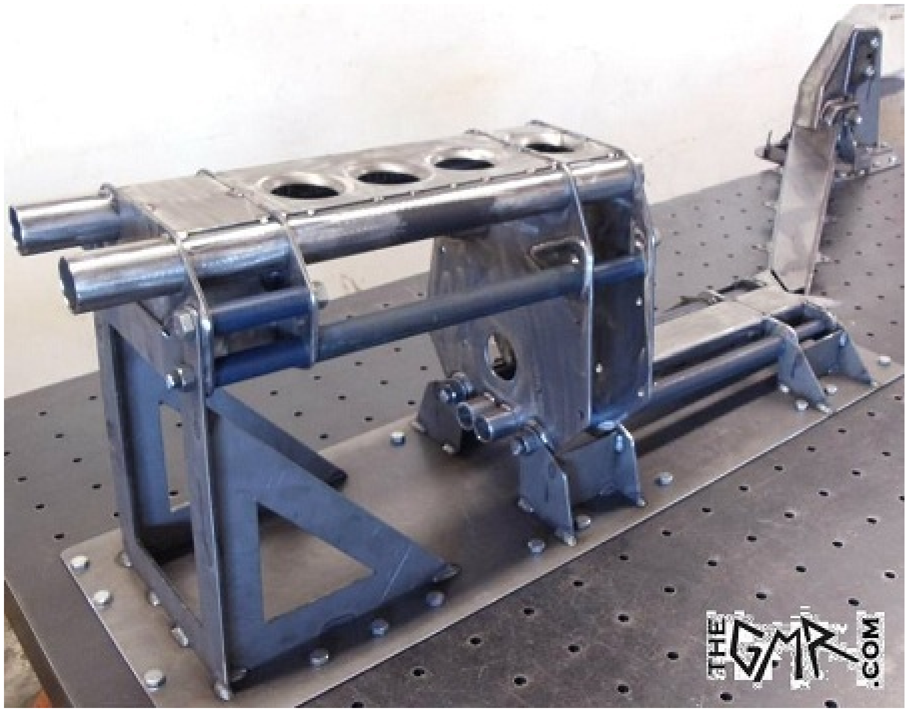
While I was reworking the suspension in the front, I also cut off the old shock mounts on the front lower arms and rebuilt them. The new mounts are designed around the same style as the original, but with the shocks in line with each other. Later on in the build I will be changing this up. We get larger shocks and change the mounting of the shocks on the front lower arms, so these new mounts are literally a waste… haha. That's just a part of building trucks -- not everything works out.

Some important items to notice on these mounts are the holes in the bottom mount plate. These are here for a very specific reason. The shock mounts are very high stress areas and will see significant force. The bottom of this mount is one big overlay plate. So instead of only relying on the circumference weld to hold everything in place, I decided to add several "plug-welds" to the bottom plate to better connect it to the lower arm. This will prevent any flex in the bracket and create a very sound bond between the new mounts and lower arm.

Above is another perfect example of my modular chassis-construction game plan.
These are the main plates for the bulkhead assembly. Each suspension mount has an overlay plate. Before I assembled the plate work in the fixture, I welded the overlays in place, thus preventing any warping once the plates were located in the fixture.

Just like in the rear suspension setup, I designed some adjustment into the front suspension along with bolt holes for future plans. I provided a few options to mount the upper arms so that we can dial in the camber /

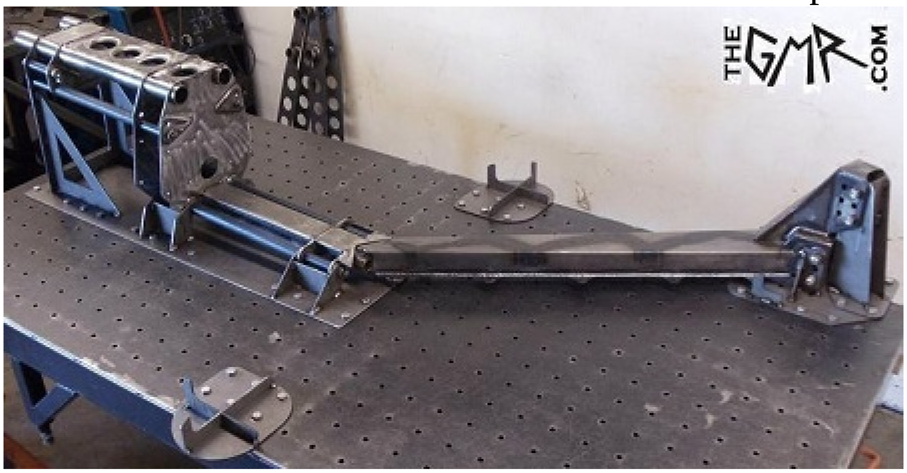
caster curves of the front end. Another advantage to the additional mounting holes is so that down the road when the truck is upgraded, we can build a new suspension and utilize the upper bolt holes. The uprights on this truck are very short so I prefer to build new taller uprights when the time comes… years down the road.



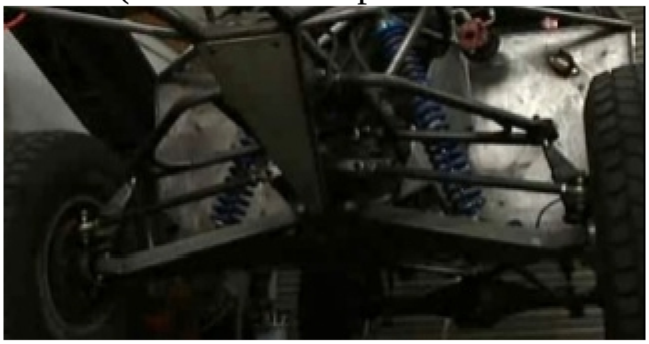
Looking closely at the above image, you will see that the entire bulkhead is set up on an angle (higher side toward the front). It's about 3 degrees. There are some different schools of thought about the angle of the bulkhead relative to the design of the suspension geometry, but that is a complete book all in itself. I will write a book on all the dynamics of a chassis and suspension development soon, look for it! Some builders will favor a large angle to the bulkhead, as much as 10 degrees, while others will favor about 1 degree. These arguments all have valid points so it's hard to say who is right and who is wrong. For now let's just move forward -- I set this truck to 3 degrees.

The pieces of blue tubing in the picture above are precision-machined steel spacers that were designed to properly locate the plate work and spread of the bulkhead. Thankfully, I have a buddy who machined these for me (thanks, Adam). I used very long bolts to locate the holes together (notice the length of the tube for the upper arm and lower arm sections -- those are long bolts). The bolts were expensive, but well worth the money. They held everything together perfectly.

With the rear pivot boxes and Y-frame rails welded, I was able to place them into the fixture and locate everything together. The fixture and plate work were designed to fit together and weld up nicely, creating a seamless Y-frame that will be the base for the chassis. The fixture is designed to properly locate the bulkhead in relation to the rear pivot boxes, ensuring correct fitment and end result that matches the computer design.



The style of how the plate work and tube sections are designed for the new front bulkhead complement the original chassis, hence the style of the front bulkhead. (see the below picture for reference)



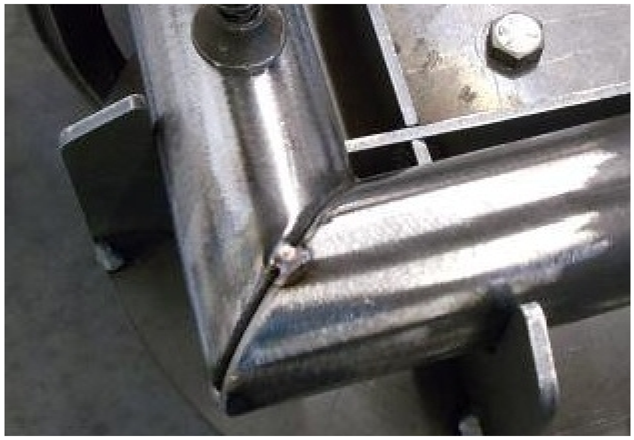
With both rear pivot boxes in place and the Y-frame complete, I then started on the tube section of the floor. The entire floor on this truck was built with 2” .120 wall 4130 Chromo tubing. Now it’s starting to look like something for a race truck. It’s not a complete chassis but something that looks like a race car. Until this point in the build, all I have are welded components. This is the first section of the chassis to be completed.

The tube construction of the floor was very simple. I utilized a fixture that located the tube pieces both laterally and vertically on the table, allowing me to easily cut and massage each tube into its desired location. If you look closely, you can see the fixture sections bolted to the table that locate all the tube work. This process was very simple and quick. It only took a day to get the entire floor for the truck built, even though I was doing all the work by hand.

Below is a great fabrication tip. This can be applied to any build you are working on where a mitered tube will be utilized in the chassis; the example below is the bottom-front passenger corner of the chassis floor.

First, fit the tubes together to get the joint perfect. Then take a piece of material similar to the tube (I used .125 Chromo plate on the 2” .120 wall Chromo tube) and make an internal gusset plate. I drill a hole in it because I’m TIG welding it. This lets the TIG gasses travel through and prevents internal gas buildup, causing the dreaded TIG welding “blowback.”

Second, single-pass weld the plate to the tube.

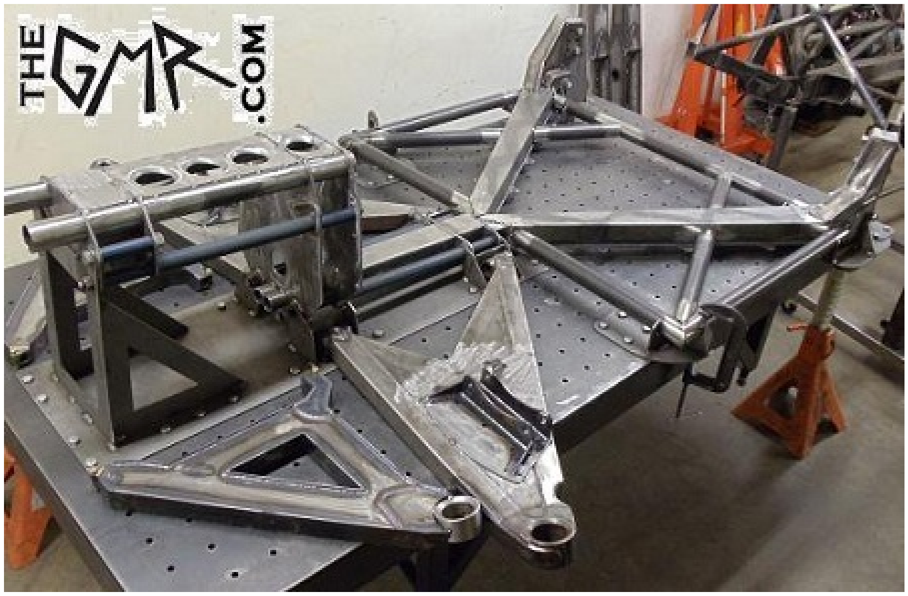


Third, place the junction back together with the newly welded internal gusset in place.

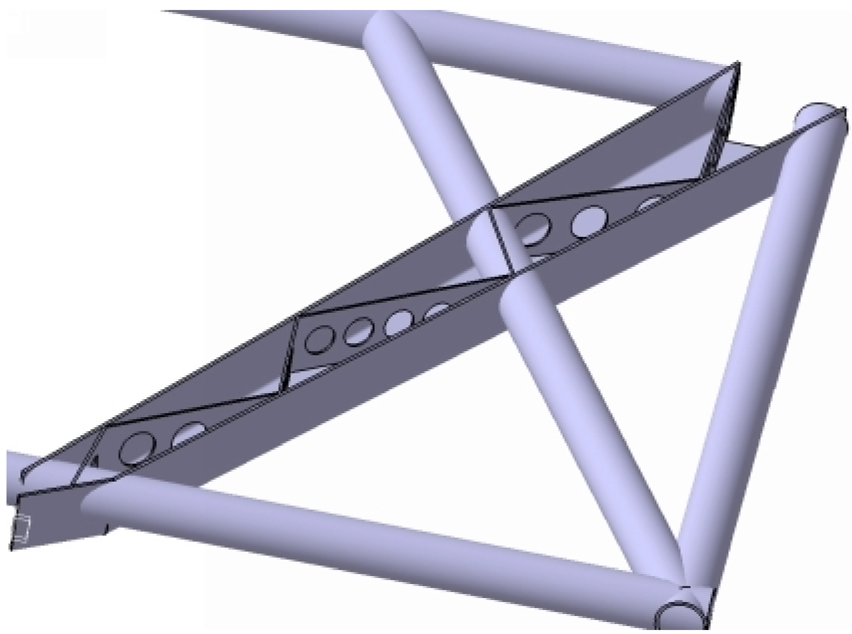
Fourth, single-pass weld the junction, and locate / add any of the connecting tube work. Be sure to weld the joint under the covered section. The photo above shows the interior of the junction being covered. Notice that the joint was welded prior to placing the third tube into the joint.

Fifth, finish weld the first root pass on the entire joint.

Lastly, second pass the joint, thus finishing the welding of the joint. This is the front corner of the floor of the chassis. There is a mixture of TIG- and MIG-welded sections in this truck.



Above is the completed floor and bulkhead ready for the welding process.



Notice the tube work and how it lines up with one of the internal ribs of the Y-frame floor sections. That was done on purpose. That way the force of the tube is not pushing on the empty section of the Y-frame channel.

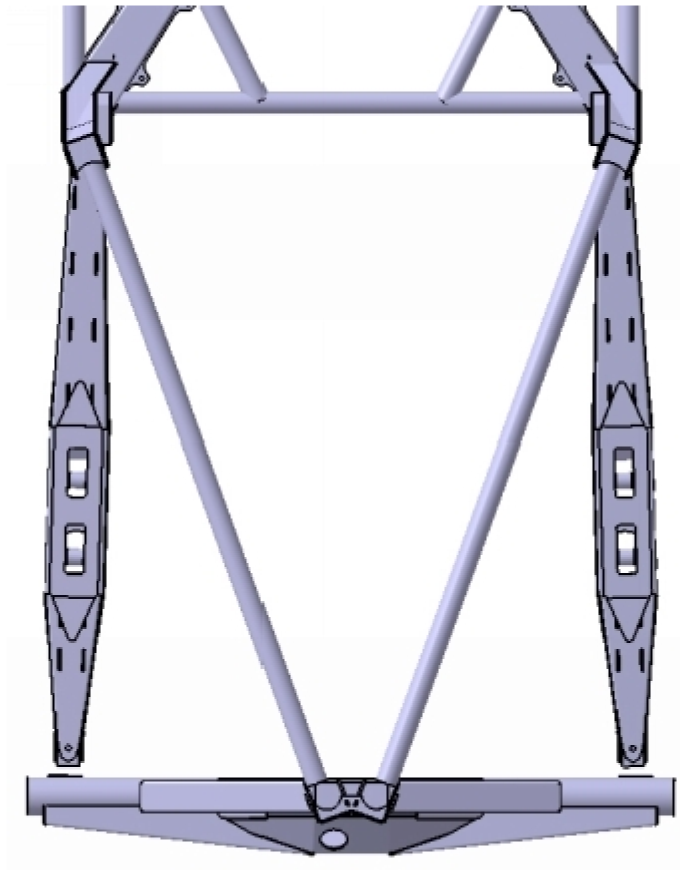
The Y frame was then welded up completely bolted to the table. Due to the Modular chassis construction, I was only welding up the connecting sections of the Y-frame, not the entire structure in the fixture. This drastically reduced the movement of the suspension points and the less welding the better.

When I design fixtures and have them laser cut, I always use 3/16” mild steel. It’s cheap and very strong for fixtures. This is my standard, so when you see pictures with fixture plates I’m using the 3/16” material.

With the Y-frame done and pulled off the table fixture, it was time to build the rear upper link arms. The rear upper link arms were fabricated from 2” .120 wall 4130 Chromo and threaded bungs machined from 4130 Chromo. They accept right-hand thread 1.25” rod ends. Note the Plug welds on the tubes. I prefer to place a minimum of 2 plug welds evenly spaced; 3 or 4 is not a bad idea either.

With the rear suspension setup on the table, this truck is staring to come to life. Now for the first time, you can see the suspension come together. One trick I like to employ with the upper link arms is that I use all right-hand thread rod ends. Many use right- and left-hand rod ends so that they can adjust the bars in the truck without unbolting a rod end. I’m not a fan of this, because they can come loose during a race and cause problems. With right- and left-hand ends, the assembly can come loose and literally unthread itself while in the truck during a race, causing a serious failure. I use right hand only to eliminate this. The only down side is that you have to adjust it by removing a rod end from one pickup point. I don’t see this as a problem because once the truck is setup, you should not be adjusting the links. With right-hand thread only, even if the ends come loose, they can only turn a half turn until it stops, preventing the assembly from ever coming apart during a race.

Now is a good time to go over the spread and angle of the rear link arms.

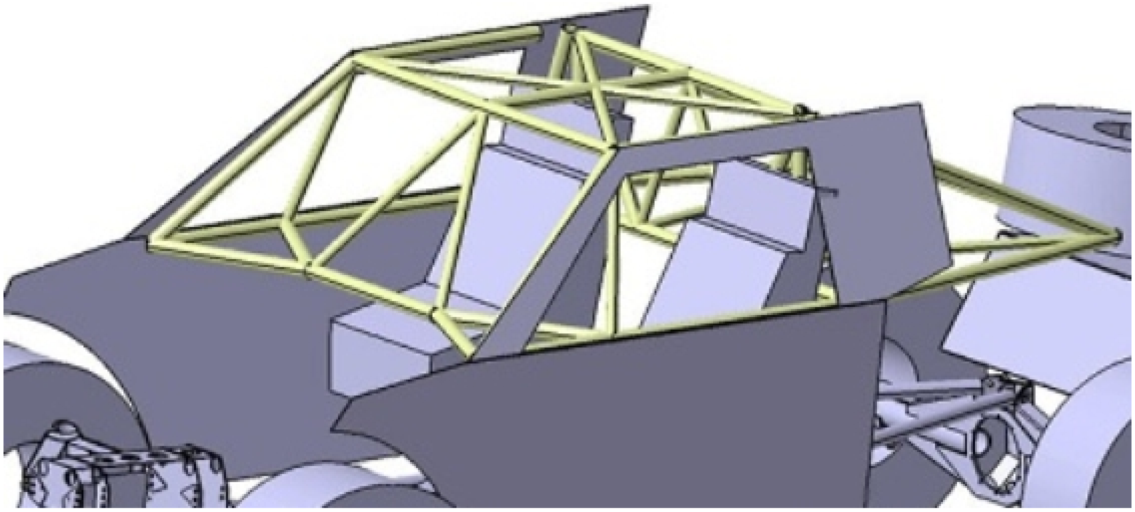


Looking at the above and below pictures it’s easy to see the angles that the rear suspension parts are located in. The upper links are spread at the chassis and centered on the top of the housing. These are the links that control the lateral movement of the rear end. It is optimal to get these as close to 40 degrees or more in spread, 20 per side. Looking closely you will also notice that I literally built the angle into the pivots for the links (rear pivot boxes) and top of the housing. This is so that the rod end and bearing can be in the optimal centered location. You don’t want a rod end or bearing to be moving on high mis-alignment spacers though the entire range of travel if it’s not necessary. The rod ends will last longer this way.

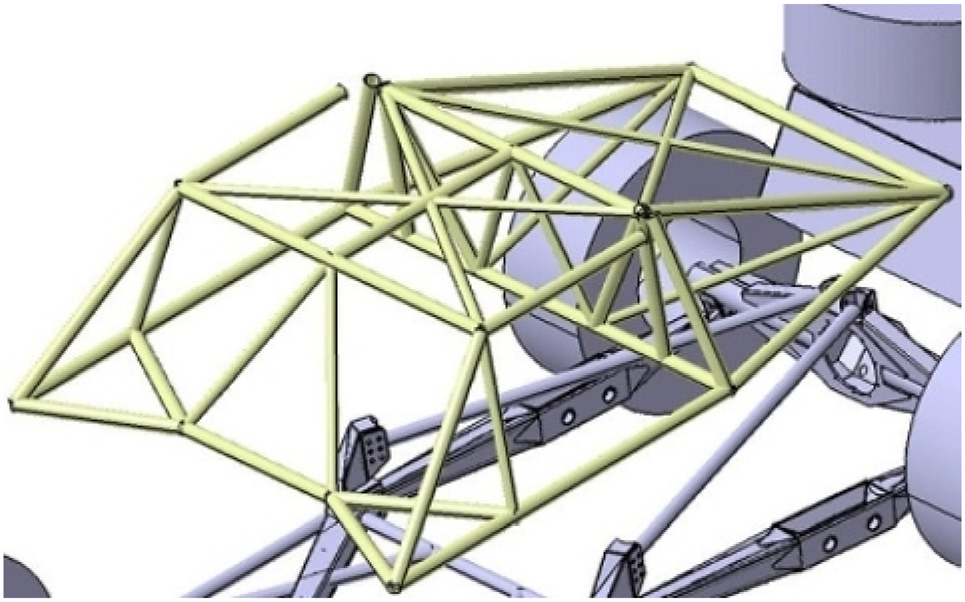
Looking closely at the lower links, you will also notice that they are slightly angled outward. This is a technique that I like to employ as opposed to keeping them straight with the chassis. When the suspension articulates, the links will roll and the link arm will move inward toward the chassis. When you angle the links slightly outward, it keeps the movement of the arm inward down, thus also keeping the movement of the shocks in the chassis down. Later on you will see that we have an internal sway bar mounted between the shocks in the chassis. This simple technique helped keep the shocks from swinging into the sway bar when the rear end articulates. I placed the rear links at 5 degrees facing outward as they lead back to the housing, so they are wider on the housing than on the chassis.

Above is a good shot of the front end on the new bulkhead with the new upper arms. Notice that I have still NOT welded in the bearing cups on the upper arms (waiting to check everything once the shocks are in place) . I have also designed the new setup to bolt up the original steering rack along with steering arms. The front end is now coming together and looking good. Time to start the tube work on the chassis.

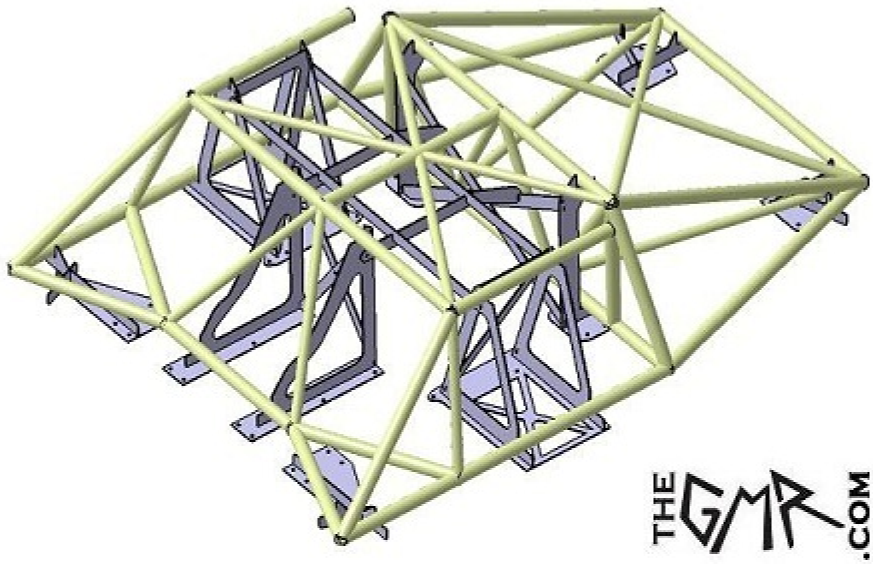
Building the TOP section of the Chassis



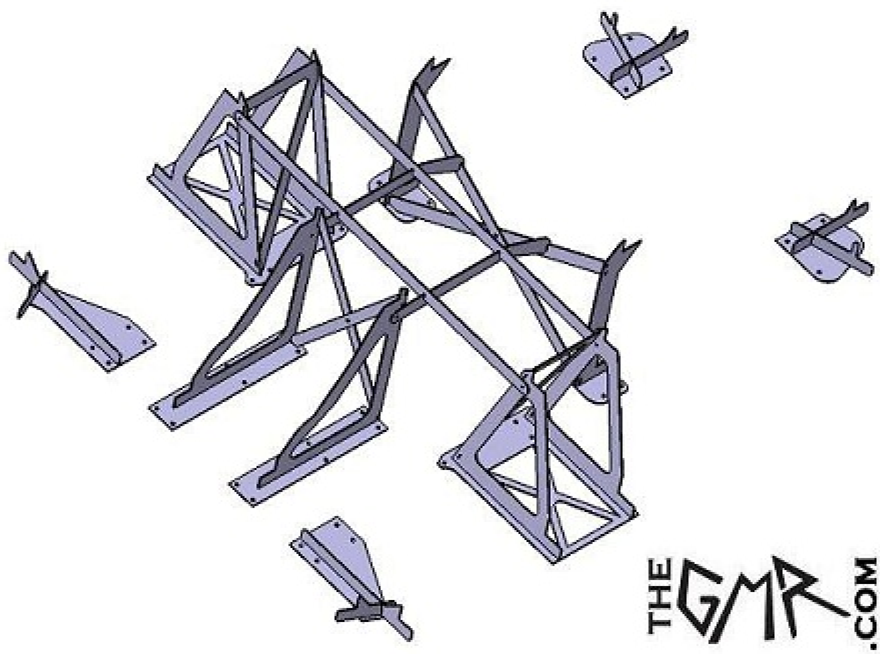
Keeping with the Monster Garage theme for this truck, the owner was able to get new Geiser Gen2 bodies for this build. Those are the same bodies that were used to build the original Monster Garage truck. I manually measured and designed a mock-up door in the computer so that I could draw up the general layout of the tube work for the chassis.



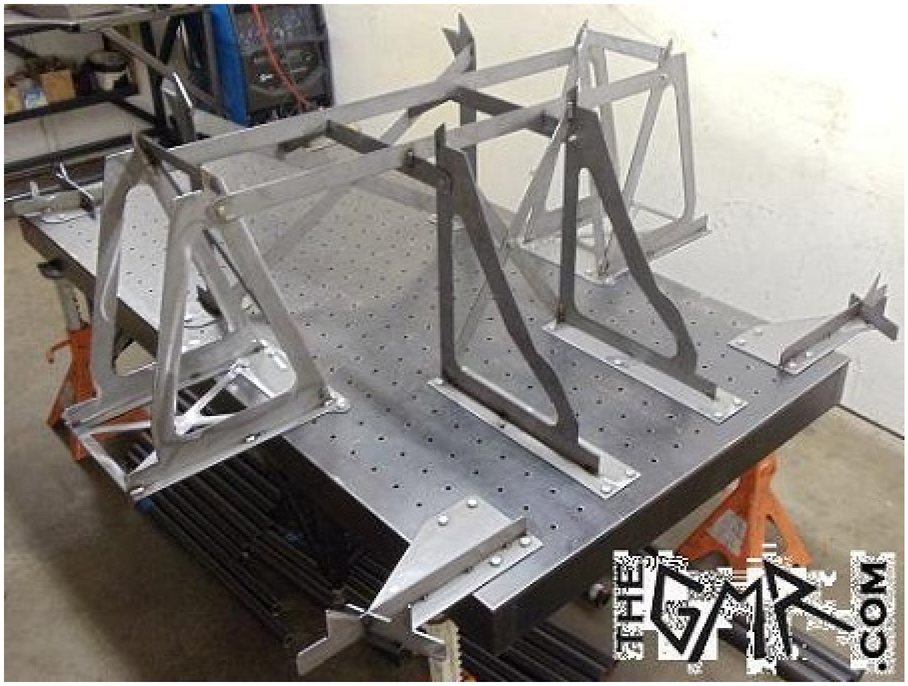
Above is the layout of the tube work for the top section of the chassis. Using a mixture of 2” tube and 1.5” tube, I was able to lay everything out to check fitment and ensure that the truck will meet the requirements for SCORE racing Trophy Truck Class.



With the tube layout dialed in, I was then able to design all the fixtures for the top half of the chassis. I only had a 4 x 8’ chassis table, so I had to be a little creative with the fixture for the top section of the chassis. Parts of the fixture overhang the tables, but the tables supported them properly, so in the long run it was not a problem.



Just like the other fixtures I have built, I choose to utilize all 3/6” material mild steel for the fixture construction. This process took a few days in the computer from measuring the Geiser body to getting all the fixture design files ready to be CNC laser cut.



A perfect matching fixture to the above CAD file of the design layout I did. One tip is that I never fully weld any of the fixtures, I only heavy tack-weld them or at most place small welds about ¾” long ever 6” on the fixtures. You do NOT want to fully weld ANY fixture. It will warp it, and you will loose all the accuracy you were trying to keep with the fixture in the first place. I also properly located the top of the fixture with bolted sections, so that everything would remain accurate to each other through the process.

It is very common to have trucks that get all the tube-work laser cut and bent from the cad files. I did not do that with this truck. I elected to make all the tube work by hand. I’m very skilled with tube work and VERY fast so this was not a problem for me. I knew that I would NOT be building multiple of these trucks so the added time and cost of going with 100% laser cut tubes was not an option. It was far easier and faster for me to simply hand-make the tube work.

Building all the tube work for the top half of the chassis only took me about 2 days. They were 14-hour days, but still only two days. The fixture was designed so that the tube would simply sit against locators for height and lateral placement (look closely at the above picture). This made the tube work process go very quickly, as opposed to securing the tube with circumference clamps. The accuracy result is the same but the building of the chassis is faster with my style of fixtures for the tube work. To keep tube work in place, I utilized simple trailer tie-downs -- strong!

I had a very specific order that I build the sections of the top half in. First, I bent up the rear B pillar hoop and then the A-pillars that bent back to the B-pillar. Once I had them bent and roughly placed, I then located all the bottom tubes, the sides and the front dash bar. I then notched the B and A pillars into place. After they were tacked in place, I completed the roof and added all the supports for the top half.

The A-pillar is the tube that travels up from the dash along the outside of the windshield and then back to the rear top corners of the cab. The B-pillar can vary in trucks but the general rule of thumb is that it's the vertical support hoop that is directly behind the driver and passenger.

The entire top section of the chassis from the rear bump stops up to the dash bar was built in a fixture on the chassis table. One item to notice is the rear “X” on the back of the chassis. The top sections do NOT properly meet up with the corners like they should. This is because we had to fit the original radiator into the chassis. Later on you will see what I mean. By the time the truck was done, this section was gusseted more then enough so that it will never be problem in a roll-over at speed.

In the above photo I have highlighted a gusset that supports the A-pillar junction to the B-pillar. This is a critical element to the strength of the cage portion of the chassis. Notice that the gusset was designed to properly brace the two tubes. The gusset attaches to the A-pillar and B-pillar after the bends, in the straight portions of the tube. This supports the bends in case of a failure.

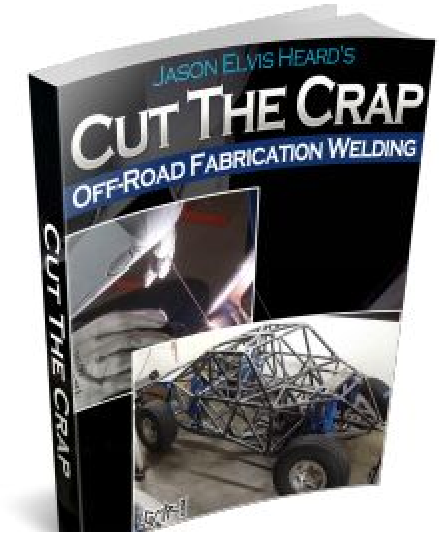
Another item to note is that I used the same diameter tube for the gusset as the tubes for the A-pillar and B-pillar. Using the same diameter material is highly recommended. It will not only look better, but it will be stronger. Having the gusset push on the overall diameter of the cage tubes allows for the maximum amount of force to be applied before failure. If you were to use a smaller tube, then it could act more like a spear and actually puncture the larger tube in the event of severe force being applied, like a high-speed rollover.

I MIG-welded this chassis with ER80s-D2 Wire. In fact the entire chassis was MIG-welded (most of it). The owner was on a budget and this was one area that saved money and time. Don't be concerned; MIG-welding a chassis is more then okay and sometimes preferred. Let me explain.

When you TIG-weld an entire chassis, you will end up with a very strong weld that is also less flexible then a MIG-weld. After you abuse the chassis and often after a race, the TIG-welded trucks will get quite a few stress cracks that need to be re-welded. Despite the misconception that TIG welding is stronger for these applications, some builders who are uneducated on the complexities of welding still state that MIG-welding a chassis is wrong… I laugh.

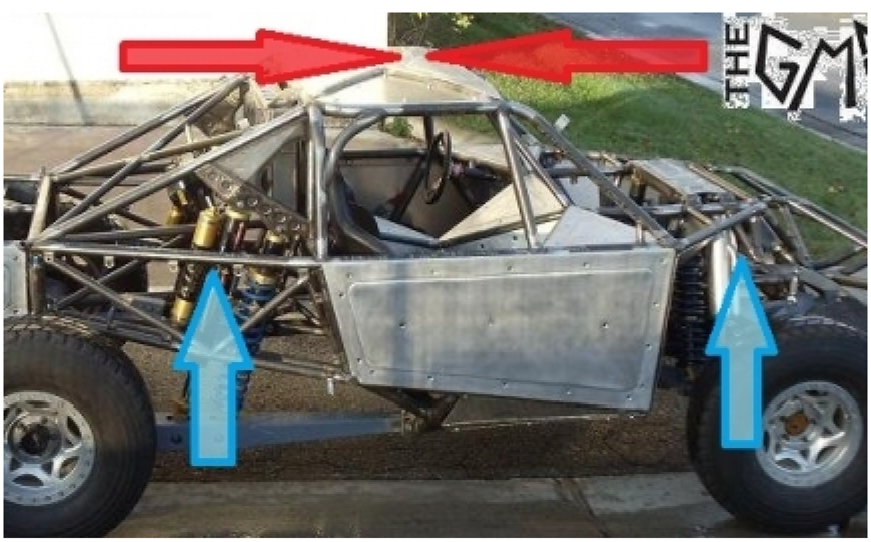
The failure with 4130 Chromo will be in the edge portion of the HAZ (heat affected zone) of the weld and NOT the actual weld (unless the entire chassis is heat-treated to stress relieve the Chromo tubing). This is common, so in short my properly laid down MIG welds will hold up just as good as ANY TIG welds on a TT chassis. Often the MIG-welded trucks will hold up better with less stress fractures over time. The debate goes on. If you can afford it then go ahead and TIG-weld the truck up, but the reality is that

MIG-welding the chassis is plenty strong enough. Even the top trophy Truck Builder (Geiser) has MIG-welded a chassis before.



For more information on chassis welding with off-road fabrication, you should get my other book in this series about Off-Road Fabrication Welding.

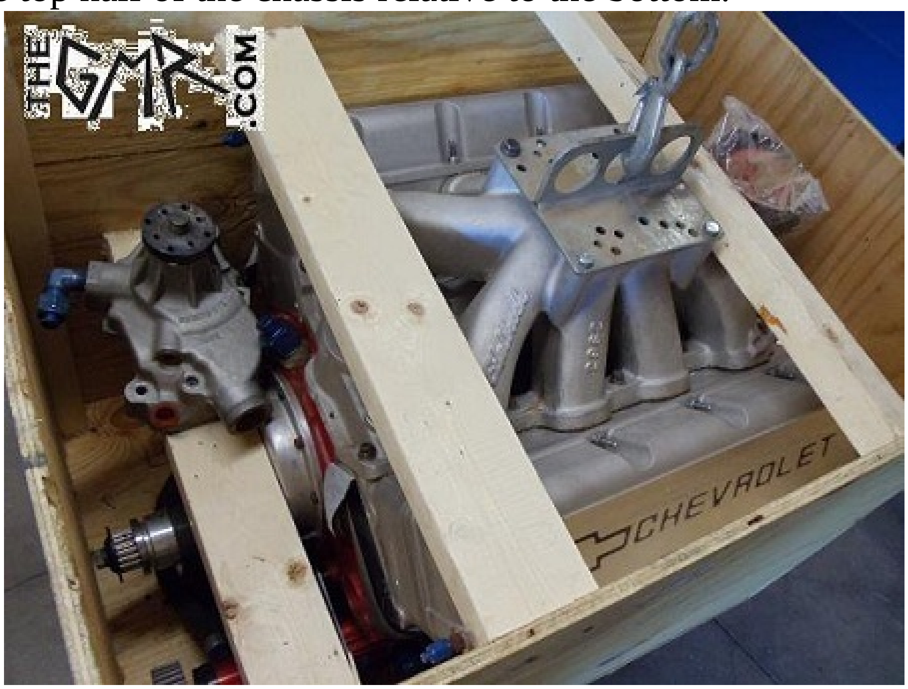
The reason for building this entire top section separate from the rest of the chassis and then welding it up completely first is to prevent / reduce any warping of the chassis during the final welding process. This is a key element to maintaining the accuracy in the pivot points of the Y-frame once the chassis is done.



When you weld up the top section, you will create a large amount of weld shrinkage in the structure. This shrinkage can lead to pulling of the Y-frame. So all the work put into the fixture to keep it straight to the design is lost. This pulling over the length of a chassis can be large, sometimes up to 3/4”. The image above shows the path of the weld shrinkage in RED and the pulling effect on the lower section of the chassis in BLUE.

Stage Two of Building the Chassis

After the Y-frame and top section of the chassis was complete, it was time to start locating the major components for the truck, along with setting the top half of the chassis relative to the bottom.



The power plant giving this new truck “gravitas” was the new Earnhardt Racing Cup Car Motor. Unfortunately, the original motor in the truck was blown, so we were forced to get something new. Fortunately, the new owner got a hold of this motor, over 700 HP and ready to rock with a dry sump setup.

The Race Transmission that came out of the Monster Garage Truck was still in new condition so we reused that. We were lucky -- the race trans turned out to be a freshly prepped Culthane T400 trophy truck transmission with a brand new output shaft. Perfect for this new truck and the races that it will soon see. The race transmission bolted right up to the motor with a Blitzkrieg Motorsports Trophy truck Motor plate to mount the setup in the chassis. I designed a fixture that located the top of the chassis relative to the bottom Y-frame. It was adjustable so that I could dial it in with the body and Motor in real life. I did not want to rely on the computer for this part of the build.

The motor plate is the component that locates and holds the motor / trans in the chassis. Looking at the above photo, you can see the holes that are shared with the trans / motor. This motor plate is 3/8” thick and machined from 6061 aluminum plate. When you utilize a motor plate like this, be sure to space the trans / torque converter properly to account for the additional 3/8” between the motor and trans. The outer bolt holes on each side are what mounts the motor plate. These ½” bolt holes are what hold the motor plate to the chassis. To support the front of the motor, we also mounted the block to the chassis on each side with the traditional motor mounting points. To be clear, all the motor / trans mounts are hard-mounted. None of them are on bushings. If you hard-mount the motor with a motor plate, then you have to hard mount the front of the motor and the rear of the trans or you will have issues.

With a series of Plumb Bobs and hours of measuring, I set the top of the chassis relative to the Y-frame to fit the body and components perfectly.

I cycled the front and rear suspension to get realistic measurements on the height of the cab section relative to the desired suspension movement. This process took a few days. I wanted to be sure that I accounted for everything that was going to be in the chassis. I test-fitted the seats and checked for head clearance along with dry-fitting the steering wheel.

Above you can see the chassis off the table for the first time. All the main sections of the chassis are located, and now it's time to "connect the dots" of the chassis. It's easy to see how the top section of the chassis is now attached to the Y-frame of the truck. The suspension is mounted to double-check all the parameters of the truck while the tube work is finished.

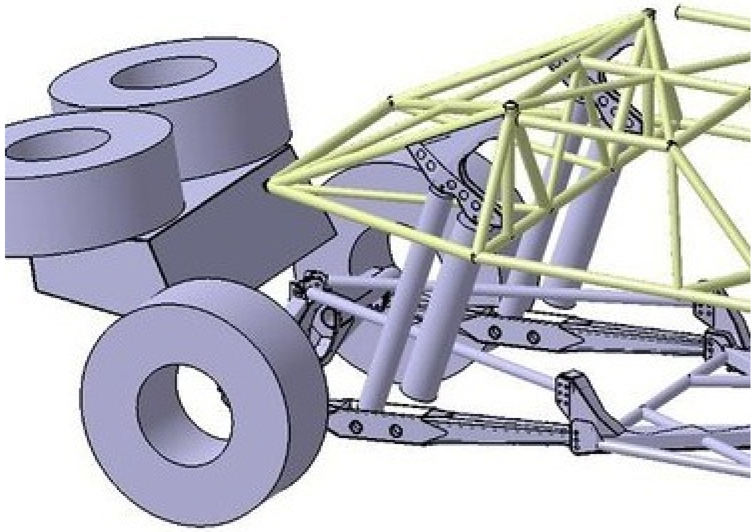
Looking at the center of the chassis, you can see one specific section that I built into this chassis for a reason. The center of the chassis, between the two seats and connecting the top to the Y-frame (basically the center console) is the "spine" of the truck. It's key to the rigidity of the chassis and thus adding to the stiffness / longevity of the chassis. This section creates a "star" in the center of the chassis, tying all the critical elements of the chassis together. As the rest of the chassis comes together, you will see the flow path of the tube work complement this structure. There are a few schools of thought on this section of the chassis, but I can tell you one thing: The builder who has the most championships under their belt builds the center of their chassis like this. It will also provide great occupant clearance, along with room for the headers/ exhaust the new owner has selected to run.

This stage of the build is where I construct the door panels and finish the shock mounts. Once the shocks are in place on the truck, I can then finish the tube work on the mid chassis. That way I can make sure the proper clearance is there for the shocks through suspension movement / travel.

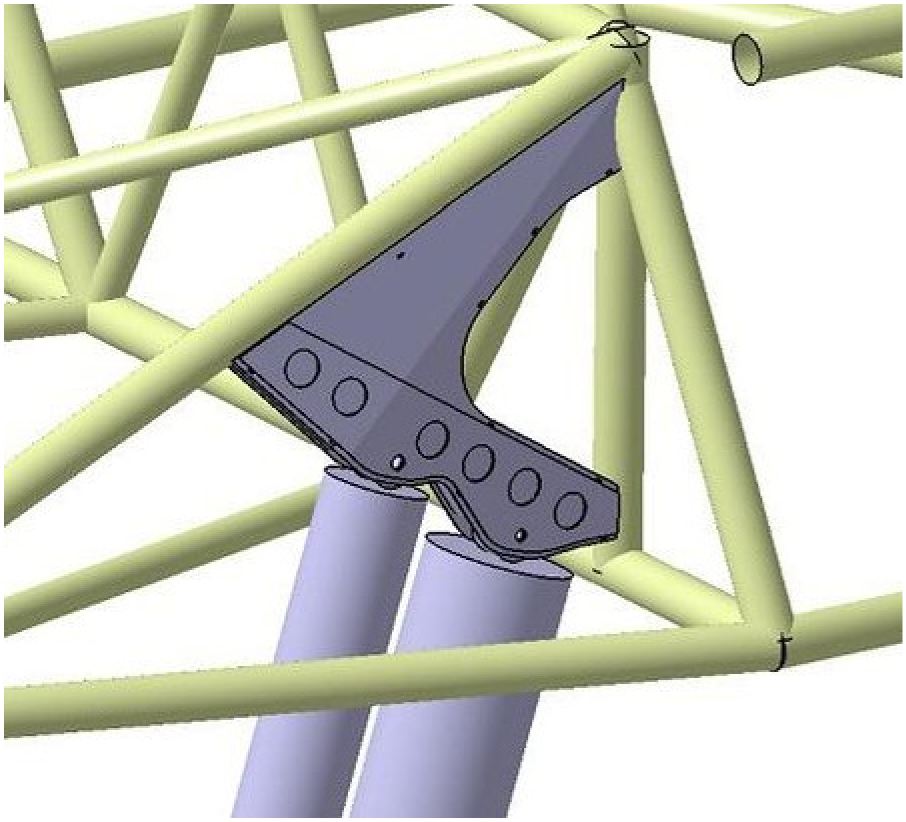
Like I mentioned above, the shocks that came off the original chassis were a little on the small side for a trophy truck. We actually thought they were drastically under-sized. Although KING (a premier shock manufacture) makes phenomenal quality shocks, we simply did not have enough shock for this application, along with the shock lengths we required being different.

During the beginning of the build stages, the new owner was able to come across the shock you see above. Rear 4.0 King Kong shocks with 18” stroke length. These specific units were slightly used, only for mock up by the guys over at Geiser Motorsports. During the build of Jesse James’s new Geiser Trophy Truck, they switched the bypass shocks out for larger 4.5” diameter units. The reason for this upgrade was to increase the performance of the truck and add some serious cool factor… See, this specific color pattern was made famous by Jesse James with his original Trophy Truck (the Porter-built TT). When guys see this color scheme on the shocks, it reminds them of Jesse James. So, since these were Jesse’s shocks and color scheme, the new owner of the Monster Garage TT decided to make this a “must have” for this new truck.

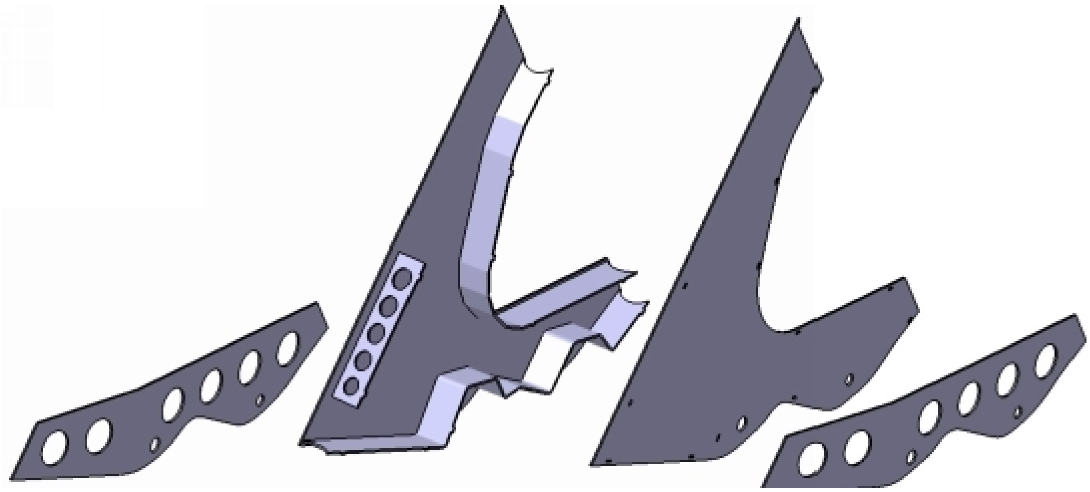
With the addition of the larger bypass shocks, the owner needed to get some new coil-over shocks. The shock of choice was Race series 3.0 diameter KING shocks to complement the new Jesse James bypass shocks. We ordered them with the same color scheme as the bypass so they would match. The only down side in the shock department was that we were unable to get the matching front bypass shocks, so we were forced to get some used 4” King Kongs that were the traditional King blue color. Eventually, once the truck is done being tested and out running,, the front shocks will be stripped and re-colored.



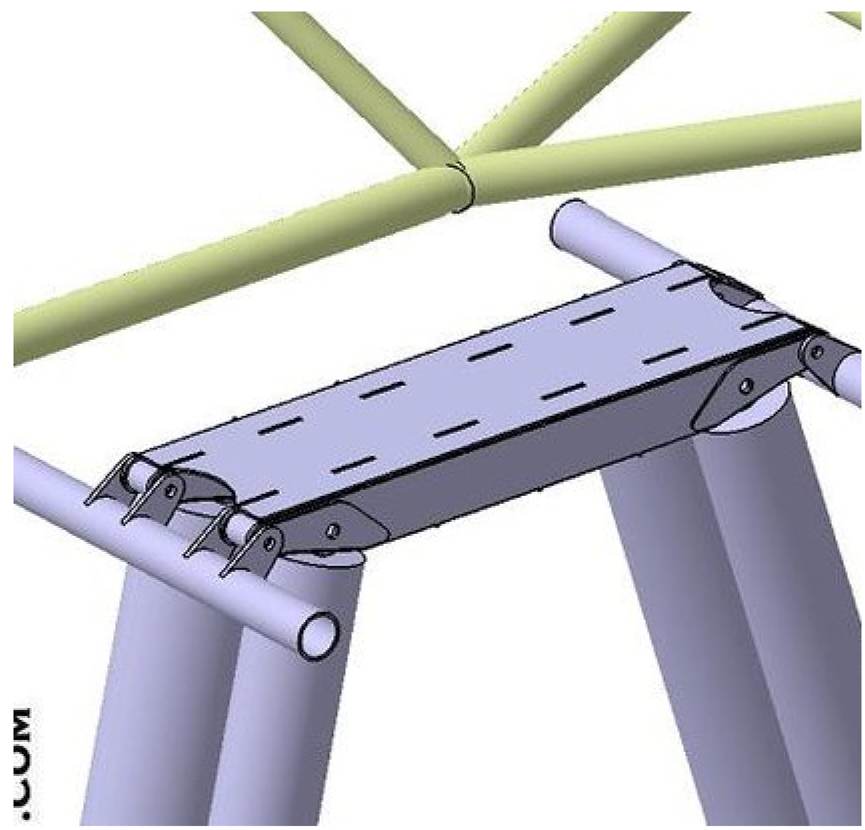
With the chassis off the table and the new shocks selected, it was time to design all the shock mounts for the truck. I did this with a combination of measuring and using the computer to draw up everything for laser cut / CNC bending. Above, you can see the computer mock-up of the shock locations for the rear of the truck.



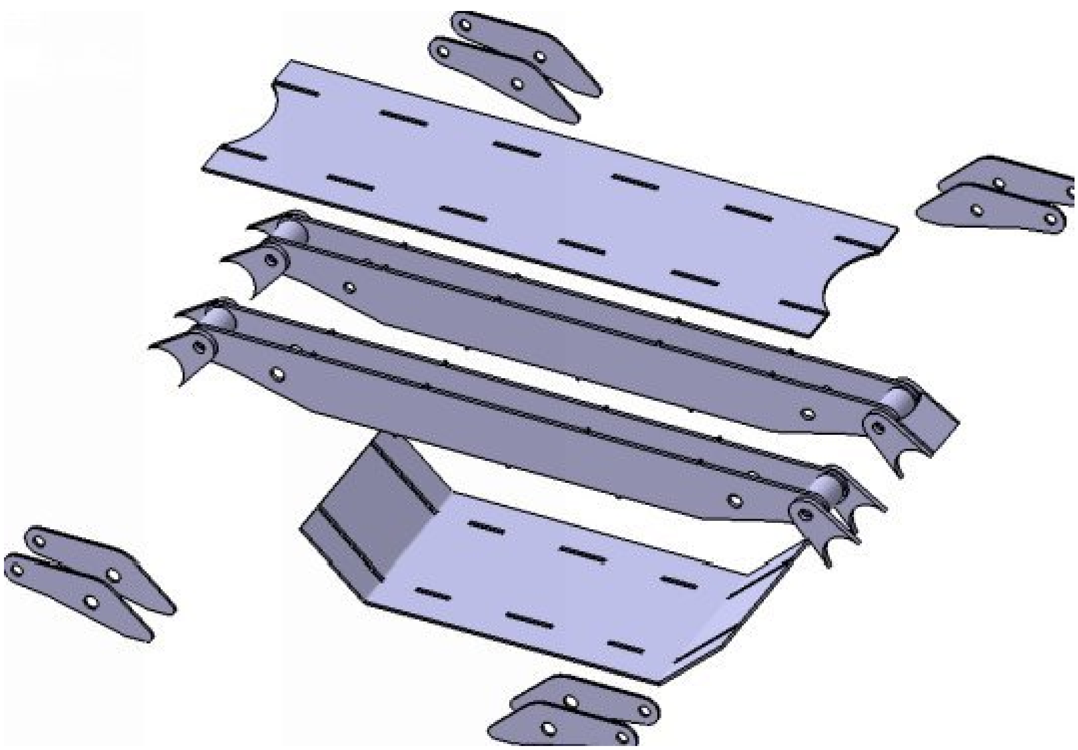
The rear shock mounts were spaced and designed around the 18” stroke bypass with the matching 16” stroke coil over shock. Given that we have slight modifications to the rear “X” of the chassis to fit the radiator, I opted to help gusset the entire junction with plate work. Typically shock plate work designed along the vertical tube is right behind the occupant’s heads but in this case it is somewhat the opposite. Proving that there is more than one way to “skin a cat” when it comes to building these trucks. I also mounted the shocks slightly more to the rear than in most trucks. This complemented the shock geometry of the lower link arms I mentioned above and was another reason for the unusual style of the plate work that I decided on.



The rear shock mounts were CNC cut and bent from 4130 Chromo steel and TIG-welded with ER80S-D2 rod. They are 1/8” plate for the base sections and internals. The overlays were cut from 0.095” material and then welded on for extra support and rigidity. As you can see in the picture above, the internal plates / gussets close off the entire bracket from the outside elements, preventing any moisture buildup in the future.



After we switched to the new shock setup, we had opted to change the style of mounting the front shocks from the original “inline” to the more traditional trophy truck style of “side by side.” This utilized two 12” shocks. Both the bypass and coil over are the same stroke length. They are mounted directly side by side on the lower arm and in the chassis. This way the shocks have the same internal-piston speed rate in relationship to the wheel travel, which creates a more efficient / better package setup for the front shocks. New, lower shock mounts were fabricated to check and design the front shock mounts for the chassis. The fit with the motor was close, so I had the motor and headers in the chassis during the mock up for the front shock design.

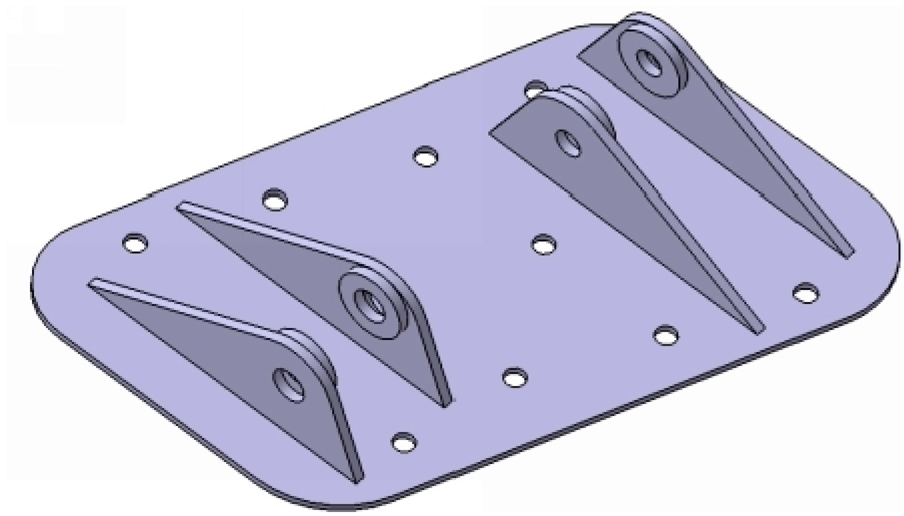


I opted for a removable shock section that bolts in place just above the front of the motor; this is to allow for the shock geometry I wanted along with the motor placement. When we need to pull the motor, we can simply remove the shock mounts and make the job very easy. The width of the tubes on this part of the chassis is designed to fit around the engine block without the headers on, making prep of the chassis easy.

This front shock mount was designed to properly hold the top of all four shocks in the chassis. I designed it with strength in mind. I wanted this component to be very strong. It will be holding quite a bit of force that is transferred though the chassis and front shocks. I designed the internal and main ribs of the shock mount to be 3/16” material with the top / bottom all cut from 1/8” material. The shock location overlays are 0.095”, while the tabs that bolt the mount to the chassis are 0.25” thick 4130 Chromo.

Keeping with the modular chassis construction method, I welded these parts off the chassis as much as I could. I utilized special machined spacers to keep the spread on the shock mount locations even and uniform to the shocks during the welding process. The front was even fully welded, before I final-welded the tabs in place that held the front upper shock mount to the chassis.

Above you can see the front bypass shocks getting tack-welded in place on the chassis. Note the new lower shock mount on the lower arms as well. The switch to the new style for the shock layout created some new problems for the truck. The bypass was now mounted in front of the coil over and was the main clearance issue with the new front upper arms. This had to be checked and cycled many time to ensure fitment before I placed them in the chassis.



The new lower shock mounts (above) were designed with the "side-by-side" style in mind, keeping the bypass and the coil over next to each other. One thing to notice is the holes in the bottom plate. These are plug welds for the mount. If you remember, earlier in the book I mention these with the original shock mounts. They are very important for the strength of this mount. You need to be sure the mount is properly connected with the lower arm; otherwise you run the risk of failure when the bottom plate wants to rip away from the lower arm.

You can also see that the final tube work for the front of the chassis is NOT complete. I waited to make sure I factored in all the components before I finished the lacing of the tube work in the chassis. The coil overs will be close to the motor, and I wanted to make sure I did not prevent any fitment problems with the front end. I did this while keeping the front wheel travel in mind (about 23", which made the 12" stroke shocks close to a 1:2 ratio on the front end). Not bad for the KING KONG shocks, these should provide great dampening so that we can tune them to perform great.

With the front sorted out and the new front shock location / mounts tack welded in place, it was time to verify and setup the rear of the truck. I assembled the entire rear suspension. I then located the rear end housing in the full bump position and then fit the previously welded-up rear shock mounts in place to check the fitment.

One item to note is the excessive use of the blue tape to cover the shocks. These are very expensive shocks and the coating on them is custom, so I did my best to protect them during the build processes. They were wrapped in plastic with padded paper, then I wrapped them in blue tape, this was tedious but well worth it, the shocks were never damaged.

Just like in the front, I cycled the rear suspension to ensure the shock mounts were going to work with the chassis. Above you can see full bump and droop of the rear suspension. I used the entire 18” of stroke to determine the location of the shock mounts so that once I finish off the suspension with bump stops and limit straps, we will never have a clearance issue with the rear shocks.

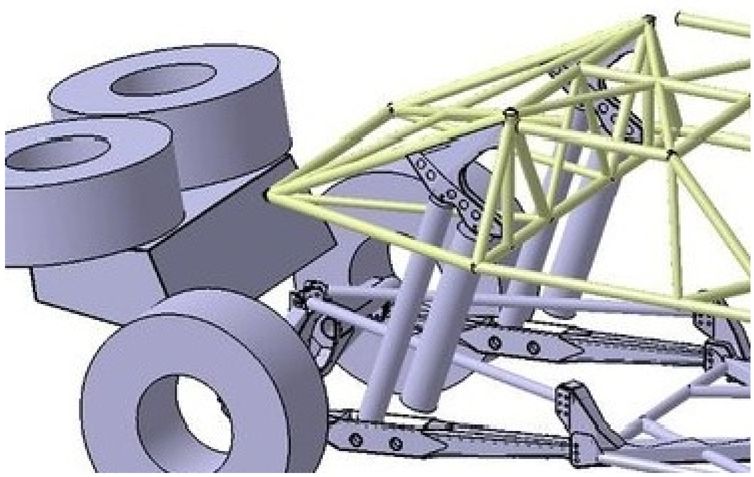
Also note that I did provide adjustment with the lower link arm pivot. So I did swap out the lower arm to make sure that the shock travel was accurate through the movement of the suspension with the different locations for the lower links.

All the Bypass shocks are mocked up in place and the mounts tack-welded into the chassis. Now I have to double-check all the measurements and locate the motor to complete the tube work for the chassis. I do this by starting the door bars, then move onto the front of the chassis.

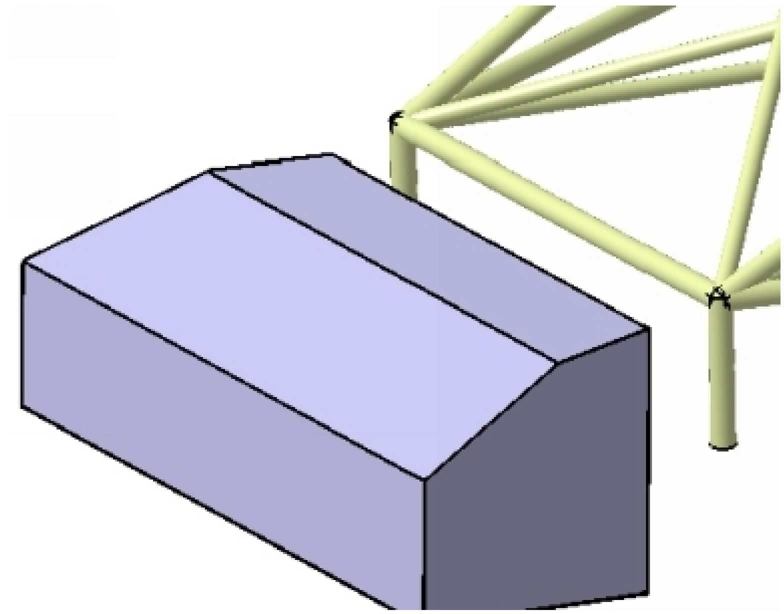
With the shock mounts tack-welded in place, I was able to place the motor back in with the new headers to finalize the tube work. The door bars were completed. Notice how they complement the chassis and flow nicely with the top half of the chassis. The load path of the critical junctions properly carries through the chassis to the main floor section. The headers that were selected for this motor are the actual Nascar Cup Car headers that the motor was tuned for; they hug the motor and run down the center of the chassis. This was a special request from the new owner; these headers were only another $800 from the guys we got the motors from. They are made from aerospace material, and each side only weighed 8lbs. Custom headers for trophy trucks can be very expensive, so building the chassis around these was a must. It presented a few challenges but nothing impossible. I was able to accomplish it, and the new owner was very pleased. This saved room in the budget for other items!

With the chassis coming together you can see the truck start to take form.

To ensure that everything will fit with the motor in place and the shocks / header selection, I had to design the front tube layout with all the variables in place. This was tricky but you can see in the picture above, the front tube work taking form around the motor. I have the suspension strapped to full bump with the motor in place to check the tubes around the motor that connect to the bulkhead. This truck is being built with a little overkill, but that is not always a bad thing.



Now it was time to start planning the rear of the truck and fuel cell location. With the original fuel cell drawn in the computer, I was able to play around with the fitment in the chassis. The original cell was designed to be placed behind the cab and tucked above the rear suspension, but this was not the game plan with the new truck. This created a few fitment problems. I tried everything. At the end of the day we would have a VERY awkward fitment, along with a small amount of fuel when compared to the volume that today's trophy trucks were built with.



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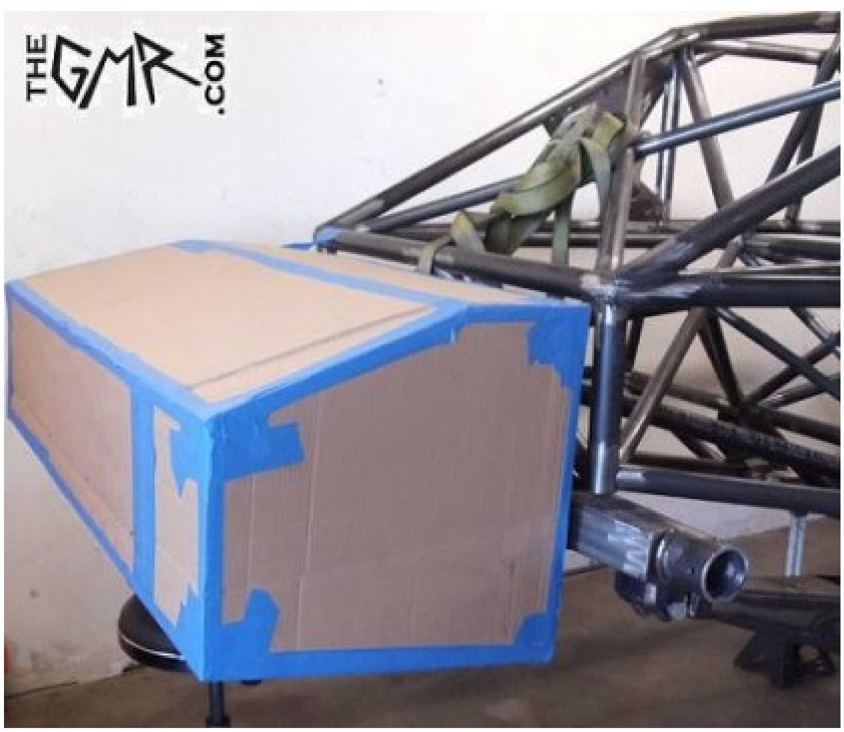
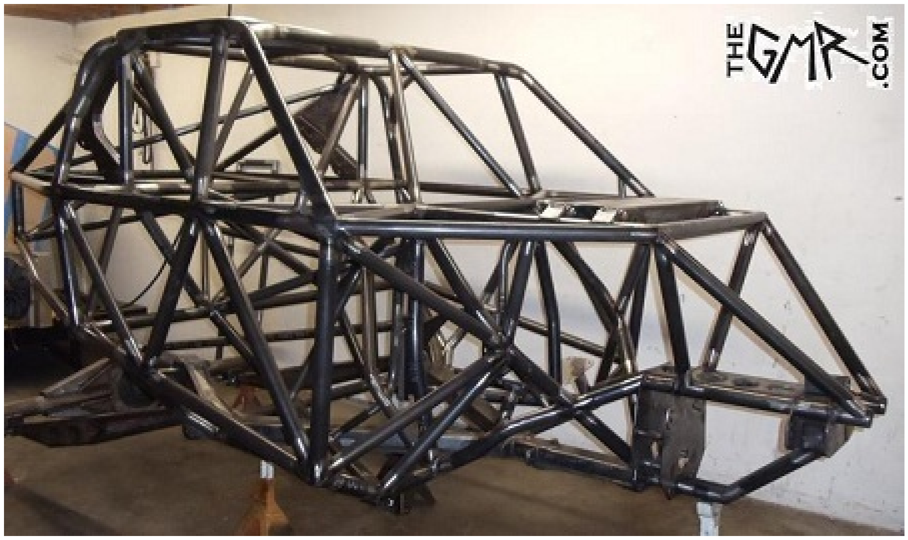
The decision was made to ditch the original fuel cell and custom-design something that would fit the new truck better and provide more fuel. I then set out to design a new cell that would be built by Harmon Racing Cells.



I wanted a min of 80 gallons along with proper fitment in the chassis. It can’t drag while at full bump, be too wide (or the tires will hit), and not too high in the chassis. In the picture above, you can also start to see the rear of the chassis tube work coming together. The bump stop down tube comes down from the rear of the cab and lands perfectly on top of the rear end housing, providing a great location for the rear bump stop mount. It was then connected to the cab below the seats and above the rear pivot boxes to clear the shocks and provide protection along with vital chassis support for the rear bump stops.

With the rear end at full bump and the body mocked up in place, I was able to determine the bottom of the cell location to ensure no issues with bottoming out the chassis in the rough stuff. Once that was factored in, I then determined the width. The front of the cell would fit between the rear bump stops and then taper outward to the rear of the truck. This taper was limited because you can’t build the cell too wide. If you do, when the rear suspension articulates, it can cause the tires to rub the sides of the cell. This truck has a wide chassis, with a narrow track width by about 4” compared to a more standard Trophy truck. I will discuss this more when I talk about the rear sway bar location. The other issue is that we still need to mount spare tires in the back, and we can’t have a fuel cell that caused the weight of the rear end to be very high in the chassis -- the lower the better for performance. Long story short, it was a challenge to get 80 gallons in the back of this truck.



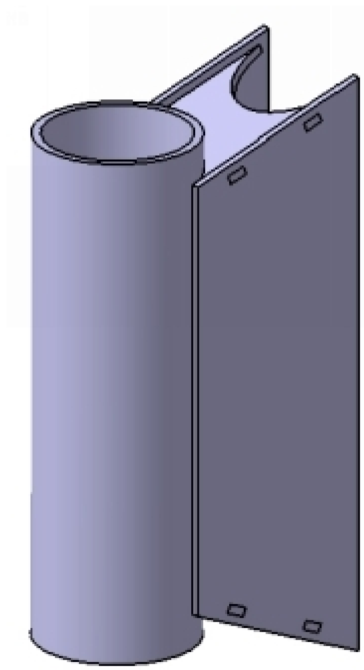
With the all the components removed, you can see the final tube work of the front chassis, supporting bulkhead, and shock mounts. Just like I mentioned how I built a center “star” in the cabin of the chassis I did the same on each side of the motor. The two sections are not perfectly symmetrical due to the components in the chassis, but they are very similar to each other. The two front “stars” properly tie the chassis into the bulkhead, while providing protection and clearance for the occupants of the chassis. It’s easy to see why I finished the door bars first, making for a well thought out and planned tube section around the motor of the chassis.

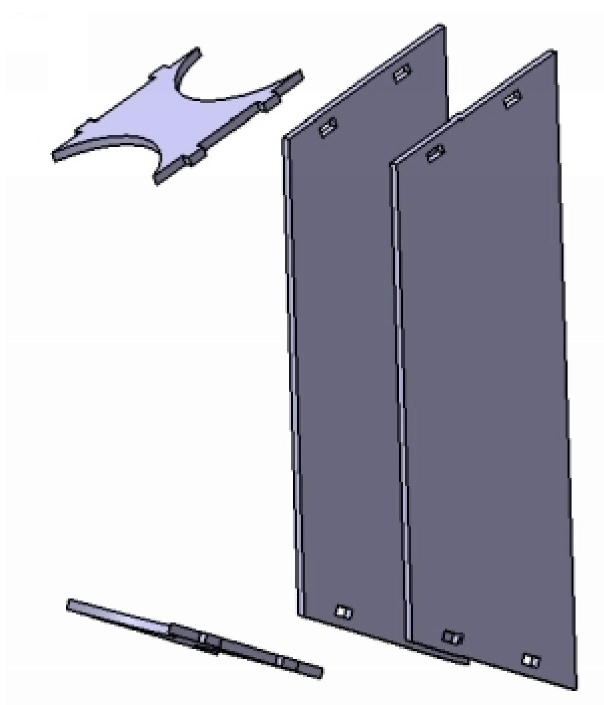
Getting closer to finishing all the tube work for the chassis, I took this opportunity to flip the structure over and finish all the welding.

Flipping this chassis over is needed. The ability to weld facing down as opposed to up will yield much better results and weld penetration. Again, the whole chassis was MIG-welded with ER80s-D2 wire for strength.

With the welding of the chassis taking place, I took this opportunity to get the suspension professionally heat-treated and stress relieved. I can’t go into detail on the process because it has many variables to it (not enough time in this book), but I can tell you that if you have any questions, please contact the guys at Certified Steel Treating In Los Angeles California. They are very professional and know everything there is to know about treating suspension components for trophy trucks. Each component was properly placed into a fixture that I built for the treating process and then sand-blasted prior to treating. That is why you see the gray color to the components. Prior to sending in the upper arms, I did weld up the uni-ball cups. All that after we set the shocks and made sure the bearing would cycle through the suspension travel enough.

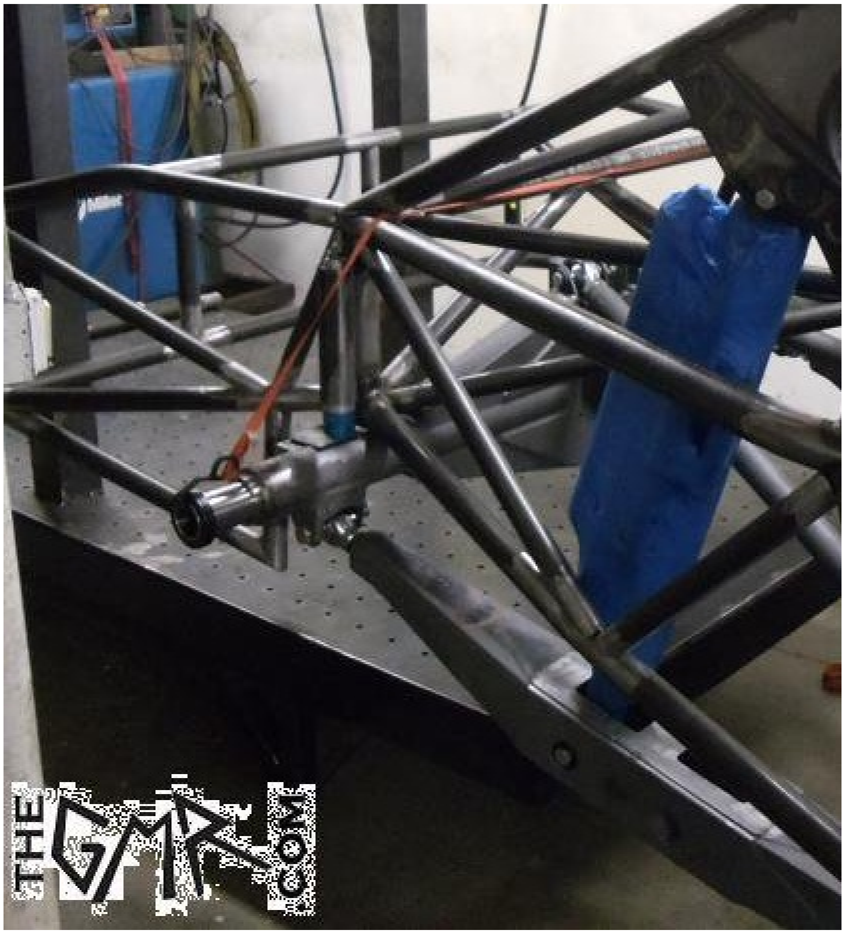
With the new fuel cell ordered to my specifications and design, Iit was now time to build the rear of the truck and fuel cell location. Once the chassis was cooled from the welding process mentioned above, I then placed it level to the chassis table and started to locate the fuel cell bay. I did all of this by hand, the time to put this in the computer was not worth it because this was all one-off fabrication. I used two 4x4” pieces of material to locate the rear of the truck and hold it in place while I connected the dots with tube work for the fuel cell. During the entire time I checked the fuel cell with the movement of the rear suspension to be sure everything was working out.



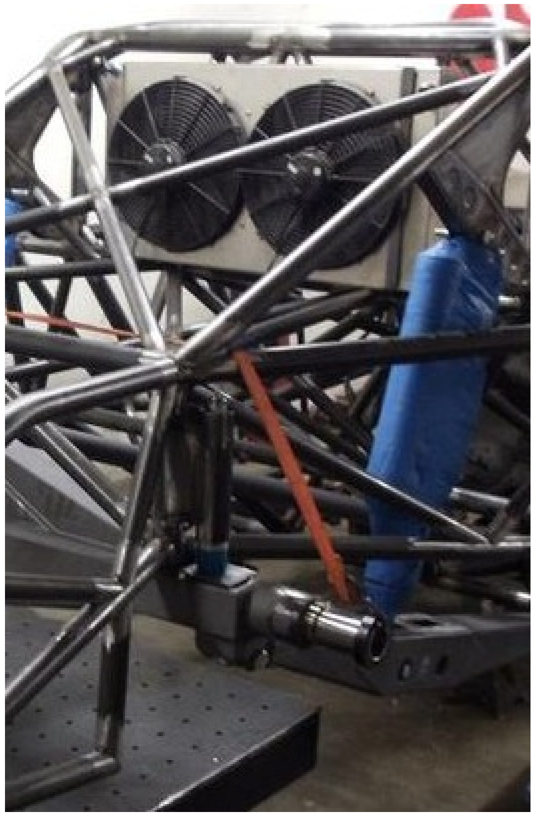


With the rear suspension mocked up and the bypass shocks at full bump, I started on the rear bump stop location. I reused the original bump stops that came off the truck; they are 4” stroke 2” diameter bump stops. They are a little small for a trophy truck but with the tuning of the rear suspension I do not see this being a problem. We still have massive KING

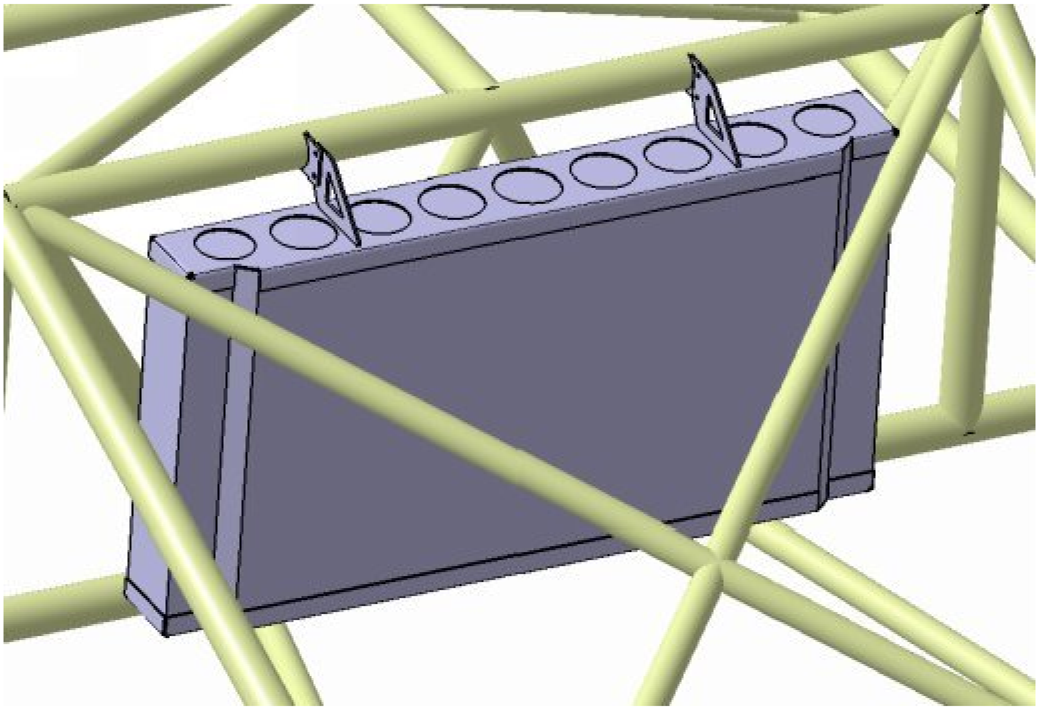
KONG shocks to control the movement of the rear suspension before the bump stops get hit, so they are literally a last resort. One key factor is that you need to be sure the rear end is centered in the truck.



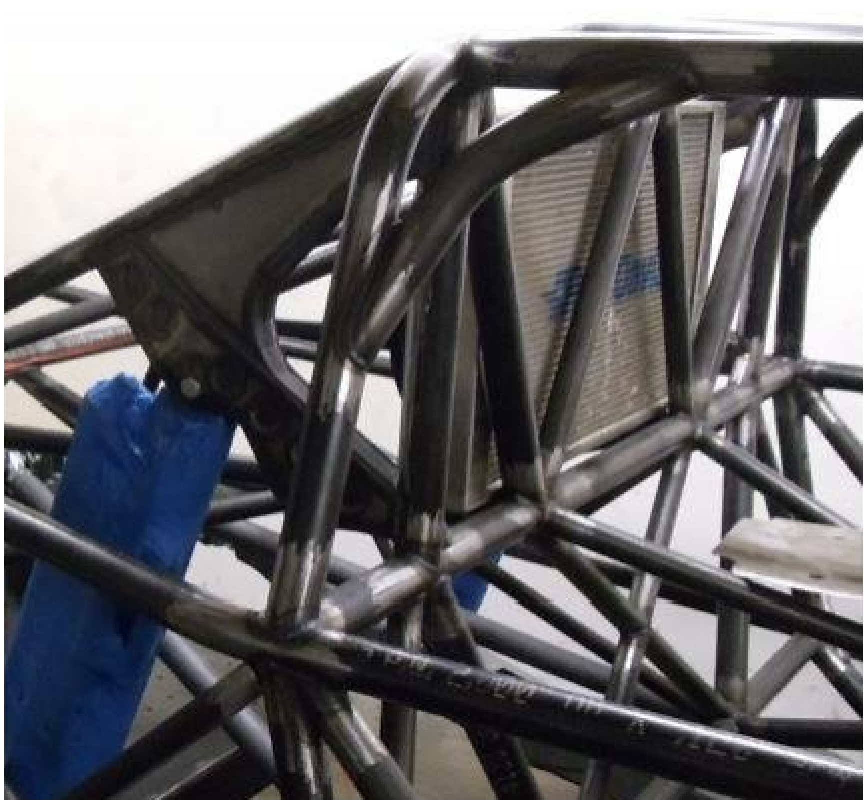
Before the treating process, I left the rear end snouts out of the housing along with the other mounts that will be welded to the rear end. I did this because the treating will move the components more than is optimal. So setting these components should be done once the treating is done. In the picture below you can see the rear end snouts placed into the rear end housing. I was able to reuse the rear end hubs but I did not use the old snouts. I got new BMS snouts for the 2.5” bearing hubs, and they were a direct replacement for the Desert Specialties rear floater hubs.



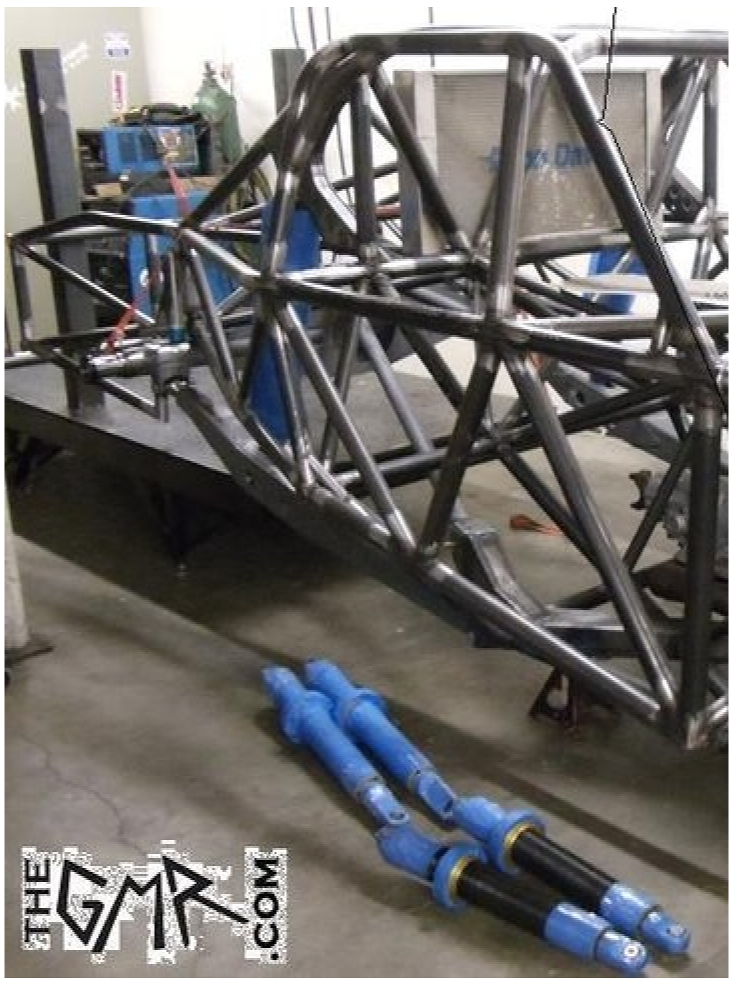
With the setup of a rear bump stop location, I like to utilize the offset plate on the housing, the bump stop landing pad. If you look closely at the picture above, you will notice that the plate is slightly favoring the outside of the rear end housing. The rear end will articulate. And if one side were to contact the bump pad first, it will do so toward the outside of the housing, hence why I have allowed extra room where the bump will hit the housing.



Still using as much as the components from the old chassis as I could, I managed to get the radiator to fit into the new chassis. Remember when I mentioned the tube work issue with the rear “X” of the chassis?



Well, that is all solved. Between the shock mounts and the added gusset tube, the radiator is easy to remove / prep and the chassis did not sacrifice in strength. With these trucks running absolutely NO front windshield, the radiator in this position will get direct air-flow so that it will be able to cool the motor properly. The added benefit of this placement is that we are able to fully protect the radiator as well. In the event of a roll over, the radiator will be protected by the tube work, just another item that is more likely to survive a roll over.



The chassis is starting to take full shape, and in this picture you can see the tube work and how it flows from the front of the chassis to the rear. The tube work is properly supporting all the critical junctions along with bump stops in the rear, making this once modular-constructed chassis into one strong unit. We got lucky that the radiator was such an easy fit into the chassis, a properly built trophy truck radiator is expensive and having to build another one could put this project over budget.

After I constructed the rear fuel cell portion of the chassis, I moved onto the rear bumper and spare tire mounts. With the idea in mind that this truck will be upgraded in the future to 39” tires, I allowed for space so that the 39” tires will not be an issue. This mounting is very similar to the traditional Geiser chassis and can be seen throughout the off-road industry.

Above you can see the space that was purposely created behind the fuel cell. This was done for two reasons: first, I wanted to use this space to mount a few items; and second, it acts as a buffer zone so that when we get “nurfed” from the rear, we avoid serious damage. The plan is to use this space to mount a jack, along with some tools that are vital to the recovery of the truck if we were to get stuck during a race.

The first TIME this truck in sitting on its wheels under its own weight, the tube work is almost done along with the shock / chassis components. I was able to bolt on all the suspension and use some springs from the Hummer H1 to get her rolling around..

This is a good shot of the fuel cell in the chassis along with the bumper section behind it.

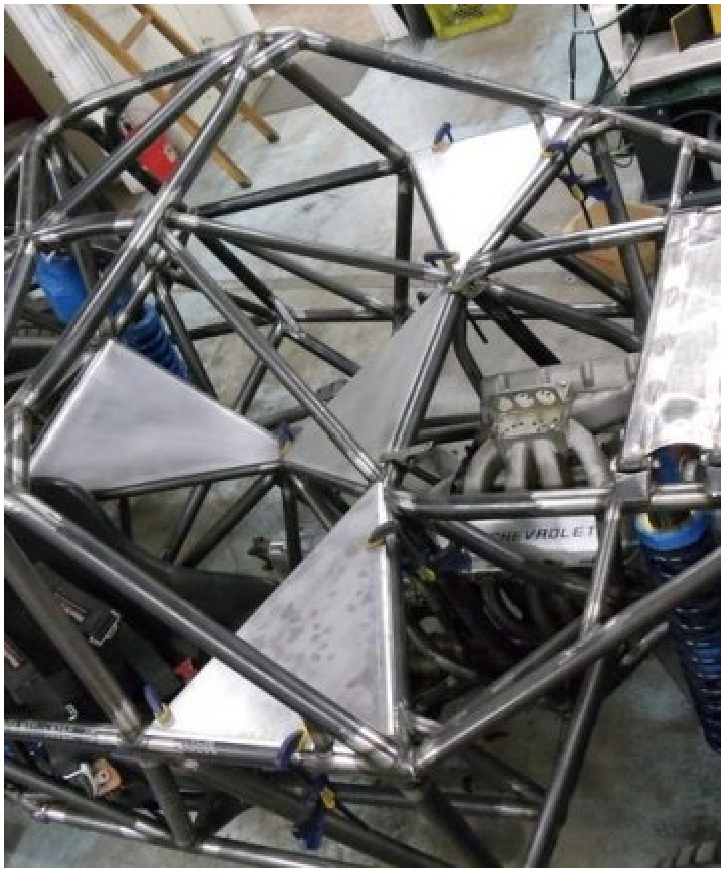
The front of the truck is starting to take shape and look more like a race truck. The shock mounts are in, and the motor is located in the chassis.

I rolled the chassis outside and got a few pictures for the new owner, along with prepping it for the sheet metal phase of the build.

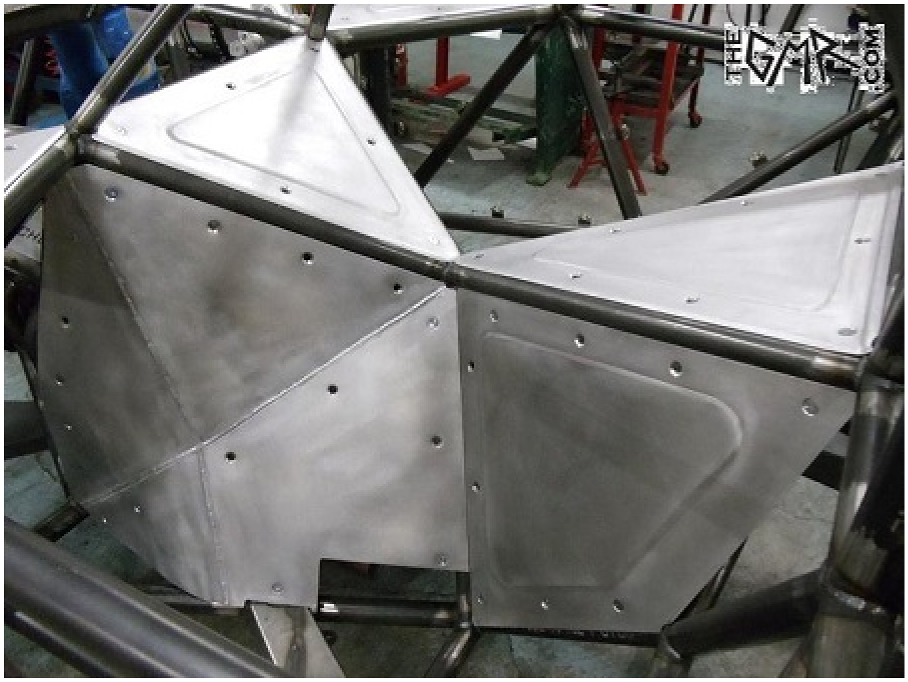
This Truck is officially a "ROLLER" chassis. The Monster Garage Trophy Truck rebuild is well underway and moving forward. The other thing to note is that it was only 3 months from the initial teardown of the original truck to this day as a rolling chassis. I was the only fabricator working on this project as well, with many long nights and 7-day weeks. I was able to get this far in three months along with running a full shop that had 3 other full builds going on!

The NEXT Phase of the Build (SHEET METAL) **–** Skinning a complete truck is a VERY large task and takes some time. I did not have time to do the sheet metal work on the truck. I was still in the process of getting the components mounted in the chassis when we sent the truck to get the sheet metal done. Fortunately, I was able to get the owner of G4 to step up and accomplish the sheet metal for the truck. His shop was not far from mine (about 10 minutes) so this was ideal. He was able to work on the sheet metal while I kept working on the components of the chassis.

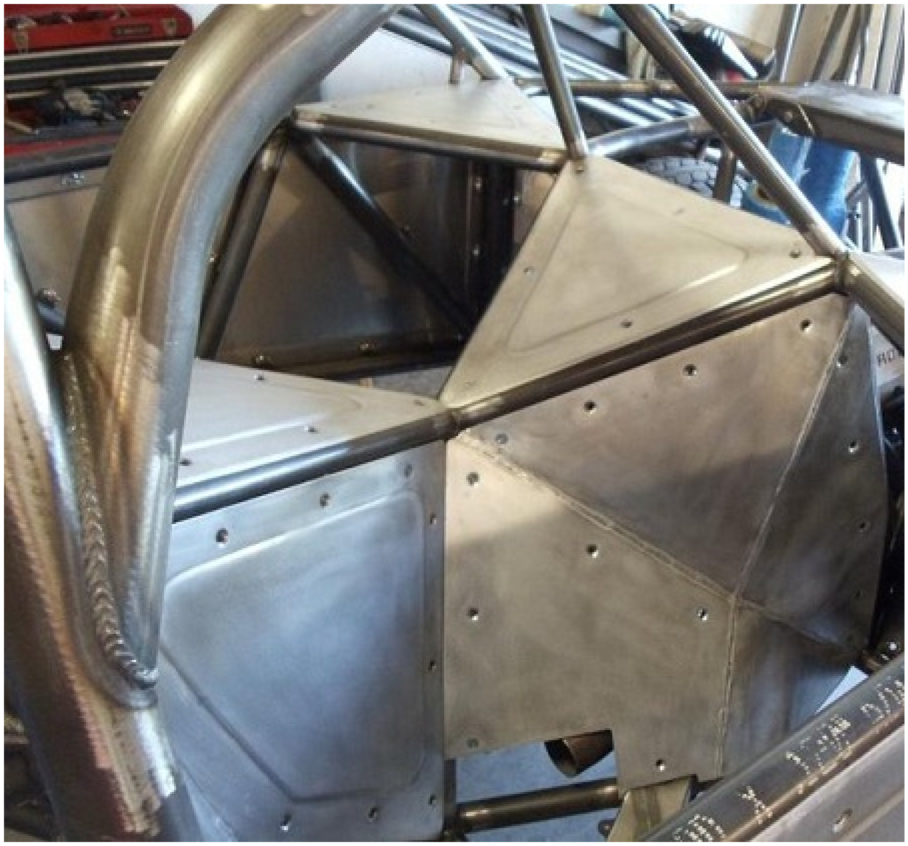
From the start of the sheet metal process, all the material sizes and specifications were done to the SCORE-regulated sizes for material thickness. We did not want to run into any problem with tech when the truck is finished and ready to race.



Above you can see how the sheet metal was started, with the 4 main panels that cover the tops of the tubing and center section. Each piece was hand-made, then rolled and placed onto the chassis with Dzus fasteners. The goal here was to skin as much as possible; then down the road we would mount all the necessary components, like shifter, gauges, switches, GPS, and other elements.

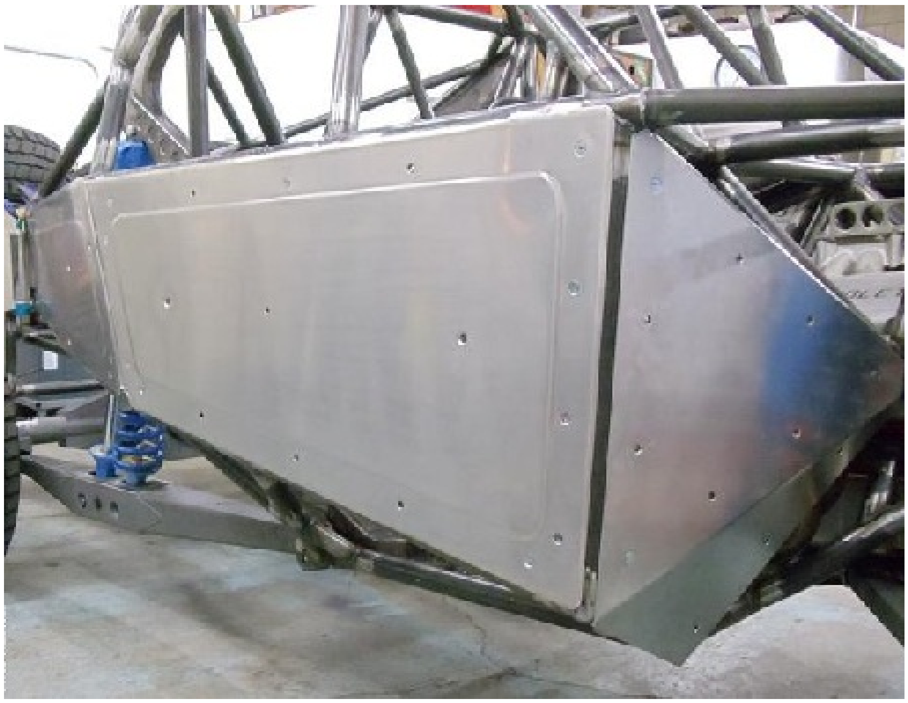


After the tops were located, it was time to skin the center section. This was a little tricky with all the different angles associated with it, but G4 was able to knock it out.



The center section was also setup with cut outs to allow for the exhaust to run through the chassis once the truck was further along. The plan was to run the exhaust along the floor below the seats (with enough room so it's not too hot).

Above is a good shot of the truck in process at G4, with everything in place and ready to move onto the exterior sheet metal work. With the sheet metal on the center, you can see how the shape of it really caters to the room in the cab of the truck along with components in the center.



With the center section done, G4 moved to the exterior of the truck. The owner of the truck had a few specific requests that I will get to in a moment. The main door panel and many other panels were designed to be one section so that we can easily remove them when necessary for prepping the truck and in case it needed to be remade after a race.

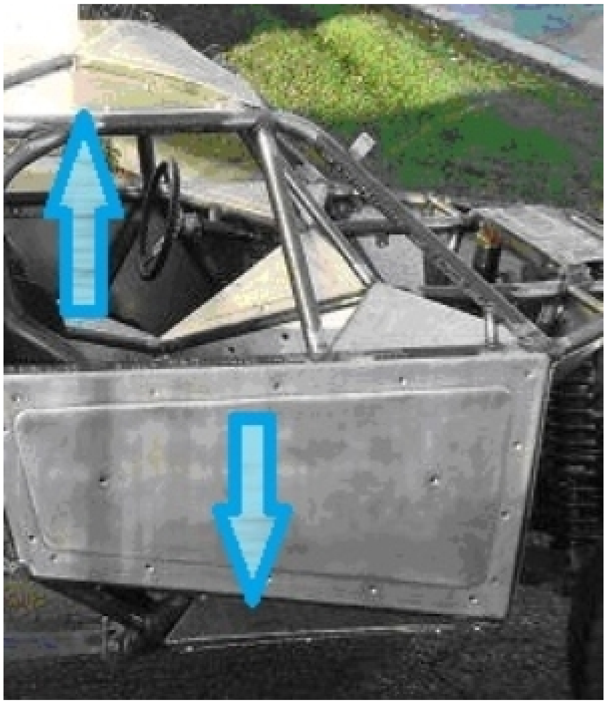
The flat sections of the chassis made for nice and simple panels that cover specific areas of the truck. Each section was designed and laid out with chassis prep in mind.

All the panels on the truck were made by hand with templates, not in the computer. This is another example of something that was easier and faster to do by hand rather then in the computer.

One of the special requests from the new owner was that we wrap the sheet metal completely around the truck, even in the back. This is more of a preference for looks; in reality, this rear section will be destroyed once we get tapped by another racer.

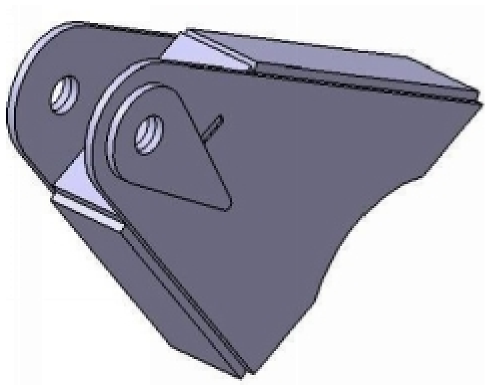
The roof was then skinned with the sheet metal. But we left the sections over the occupants and below the occupants empty for thicker material than the other sheet metal. Another item to note is the use of 2" diameter tubing for the roof; this was a very specific request by the owner.

He was not concerned with the extra weight the 2” may add, but felt more comfortable with the strength the 2” would offer as opposed to the industry norm of 1.5” tube.

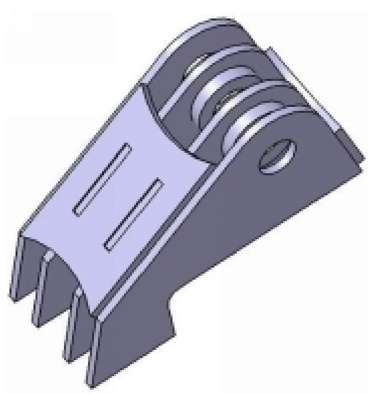


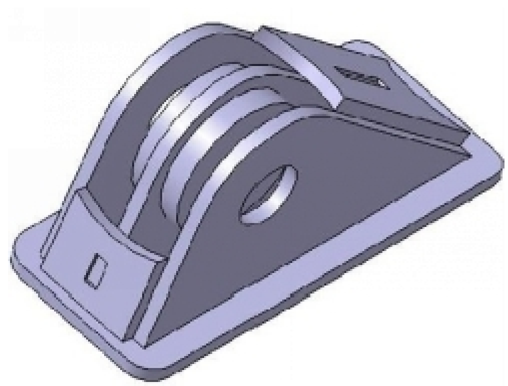
The reason for the thicker material in these two sections (above arrows) was for occupant safety. We wanted to prevent any debris from entering the cab or puncturing the thinner material, so we opted for 3/16” thick 6061 material. These will help to keep rocks, branches, and anything from protruding into the cab.

__Chassis Components__ – With the sheet metal underway and the truck coming together, it was time for me to finish some of the chassis components that were critical for the progress of this truck.



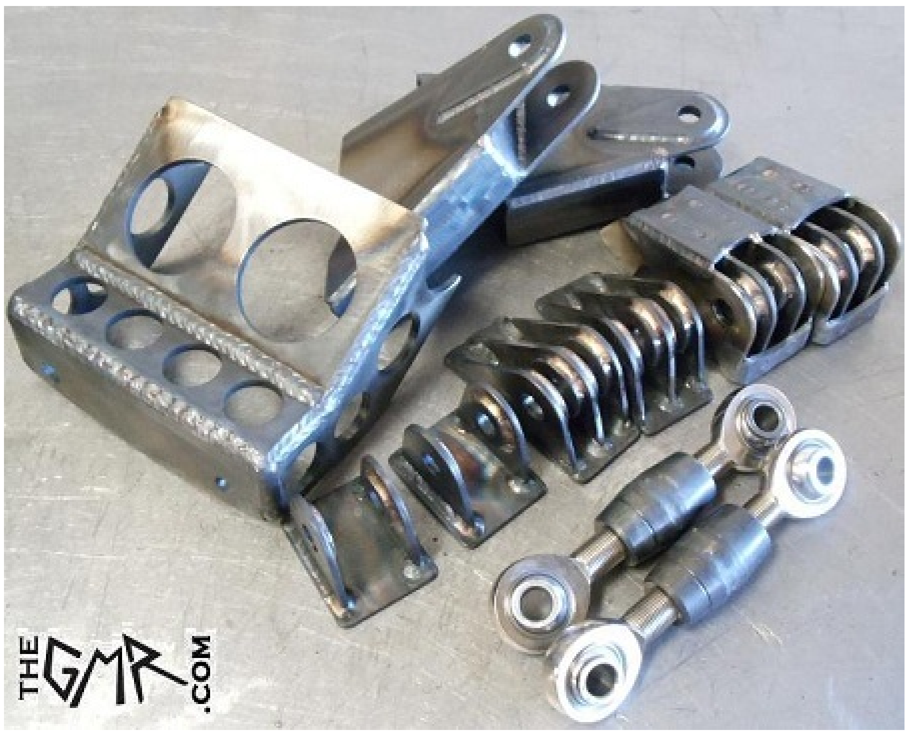
The next components to mount in the truck were the front and rear sway bars. Typically all trucks will run a rear sway bar, but not all of them run a front sway bar. I wanted to run a front sway bar so that we can tune it in and complement the rear setup. This is still not 100% proven, so it will take some tuning to get it dialed. (I will explain more in a few paragraphs.) Above are the CAD files for the front sway bar arm and the rear sway bar GMR9 housing mount.





To control the suspension from over-extending and causing damage to the shocks / components, you need to stop the down travel of the suspension with limit straps. Limit straps and the mounts for them can add up, so we were fortunate to be able to reuse the straps / mounts from the original chassis.

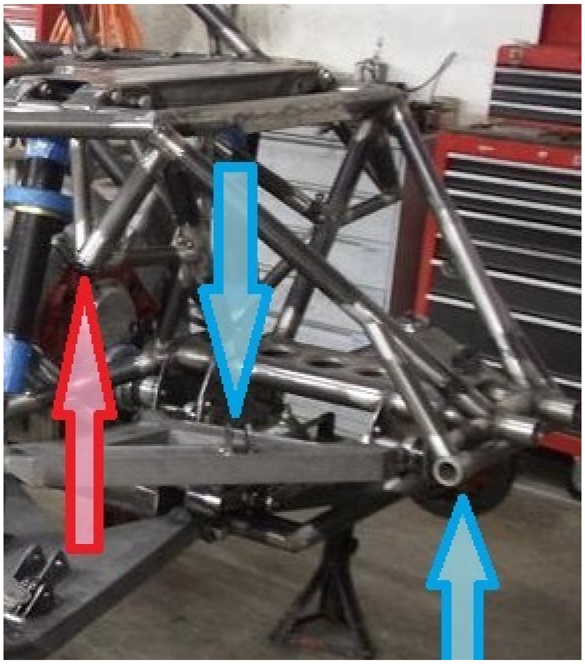
Above are example pictures of the straps and clevis mounts that I reused from the original truck. They are standard in off-road and can be found at many different parts locations. The rear of the truck will utilize a triple adjustable clevis, while we opted for the front to use a double clevis mount. The best part about these mounts is that you can set them in the truck, and as the straps stretch or wear, you can adjust the clevis up to tighten the straps up more. Some builders will hard-mount the limit straps, but I prefer to have the adjustment. So I decided to keep the clevises that came off the original truck. The only down side was that I had to make the lengths we had work on the new truck as I will explain later.



Once I got all the parts back from the laser cutter and CNC bender, I welded all of them up on the table, TIG-welded some and MIG-welded the trans mount.

Pictured above are the front sway bar arms welded up. These were custom-made with broached doughnuts that are machined by Blitzkrieg Motorsports and designed in the computer by me with laser-cut 4130 Chromo plate. Once welded, I then took some ¾” by .120 wall chromo tube and notched it into the back side of the doughnut. I fully welded up the arms and these large ½” pinch bolt retainers on the back of the arms.

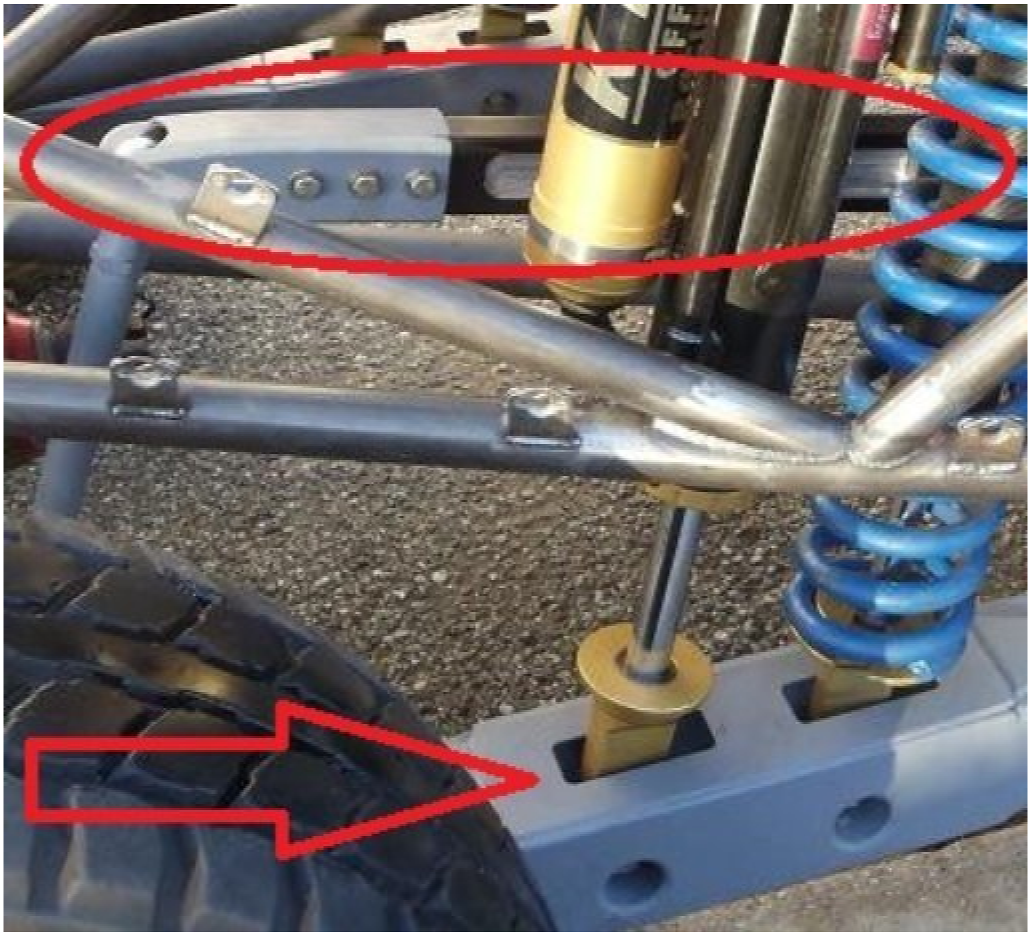
Given that the front sway bar setup is still more of an experiment, I opted to make the setup very economical and simple to adjust. The bar itself is what the variable will be, so I used a standard off-the-shelf-length 1.25" Speedway solid-sway bar. The reason I went with solid was that I can tune it down from there. If we need to get something in there that is not as stiff, we can simply swap in another bar (about $120 each) that is hollow with variables in wall thickness from 3/8 to 3/16" in thickness. That will be lighter than the solid bar if we need it -- always thinking ahead. For the adjustment of the arm, I utilized male / female Heims with built-in high misalignment spacers.



In the above photo I point out the mounts for the front sway bar in BLUE. In RED I point out the final bump stop for the front suspension. The mount that holds the actual bar (in front of the upper arms, blue arrow to the right) is constructed from 1.5" by .120 wall chromo tube. It holds the sway bar in the chassis with two Delrin bushings and lock in place with the large ½" pinch bolts located on the back side of each fabricated away bar arm. The sway bar is designed to tuck under the bumper and the arms bend up and over the upper suspension arms. The heims of the front sway bar mount to the top of the front arms, which is how they will control the movement of the suspension.

The awkward shape of the front sway bar was specifically designed to have the front sway bar tuck up to the side of the tube work that holds the front bulkhead in place. This is dead space in the truck so there is nothing in the way to cause a problem with the movement of the suspension and sway bar arms. I prefer this mounting because it keeps the sway bar up and out of the way from any debris that may come in contact with the front of the truck. Some builders mount them lower, but I prefer to keep things protected from the elements.

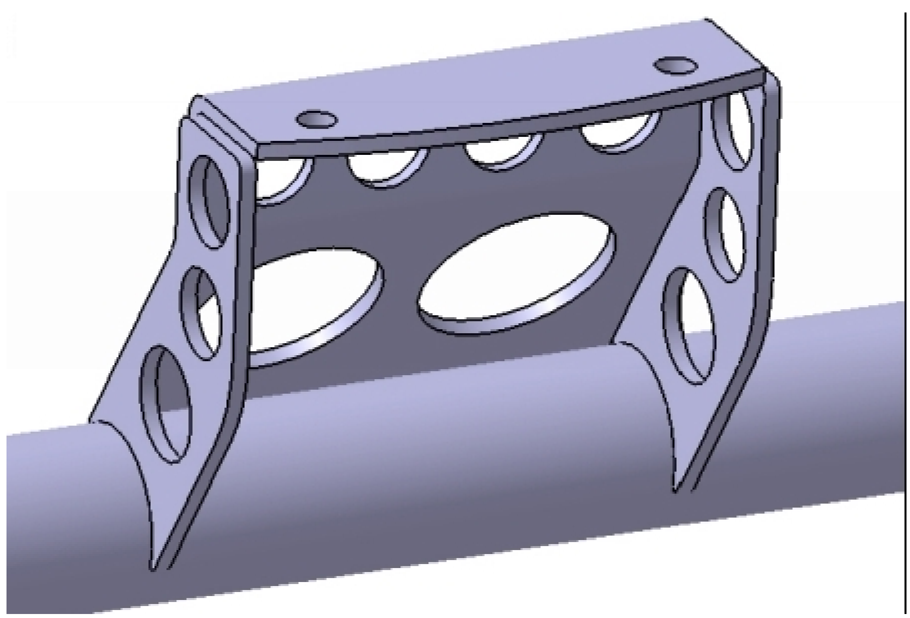
Above you can see the side profile of the front sway bar mounted in the truck at ride height. One thing to notice is that the mounting of the sway bar on the upper arms is not very wide. This means that the leverage of the suspension will work the bar more than the rear. That’s why I went with a solid bar first, so that we can step down if need be. The other issue with the length of the front sway bar is that you need to be sure it will clear the turning radius of the front suspension. The last thing you want is a flat tire because the sway bar contacts the tires at full turn lock.



The rear sway bar is hidden in the chassis like the front. The reason for this was because of the wide cab section of the chassis relative to the track width of the truck. We had the thought in mind that eventually when the truck is ready to upgrade to 39” tires from the 37”, we will widen the track width of the truck 4” to make it 94” overall, like many of the trophy trucks built these days. Basically we did not have the room necessary between the chassis and the rear tires to clear the sway bars. Well, they clear but at extreme articulation the tires would contact the sway bar, possibly causing a flat tire down the road. To prevent damage, I decided to mount the sway bar up in the chassis behind the cab, completely out of the way.

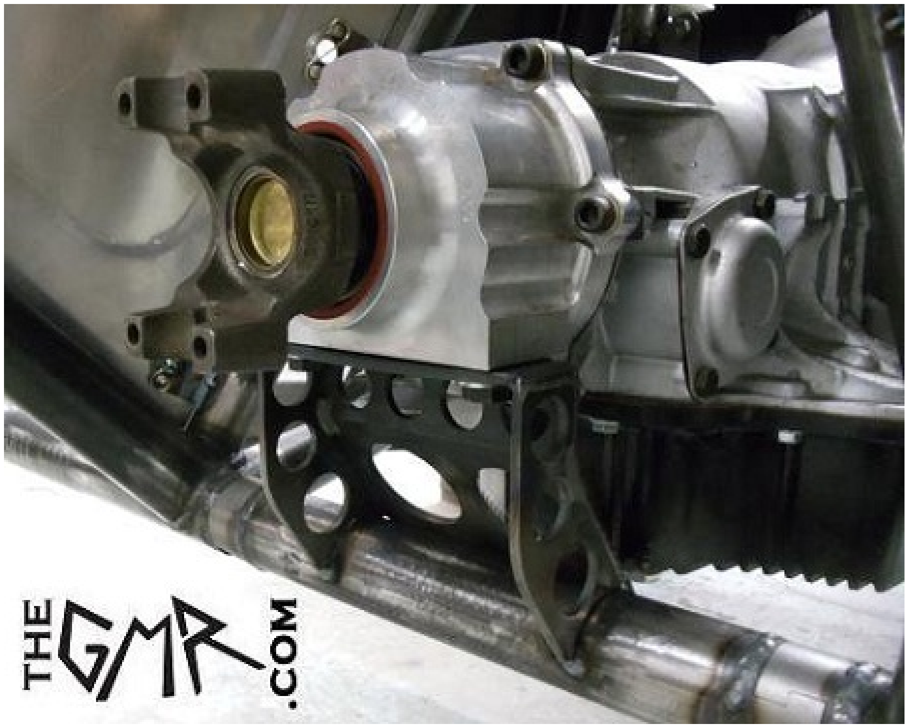
The guys at Blitzkrieg Motorsports machined the bar I used. It was the proper length to fit in the chassis and work for the suspension travel that the rear was capable of. The sway bar is a 1.5” diameter for the rear and is located off the front of the rear end housing. This will properly control the movement of the rear suspension and complement the front sway bar nicely.

The red arrow above is also noting something different on the lower link arms. Notice the cover plate that is welded to the top of the link arm. This cover was placed there to prevent large rocks and debris from entering the pocket in the link arm, possibly causing problems with the shock mounts during a race. This was part of the original link arm design, but I waited to place it on the arm so that I was sure the cutouts will clear the shocks through the travel of the suspension.



With the truck back from sheet metal, I was able to final-mount the rear of the transmission into the chassis. Looking at the above image and bottom photo you will notice that I have some removable clamps located in the tube. They were not welded into the tube until a specific point in the build. This tube is the rear floor tube that was welded between the rear pivot boxes when I originally built the new Y-frame section of the chassis.

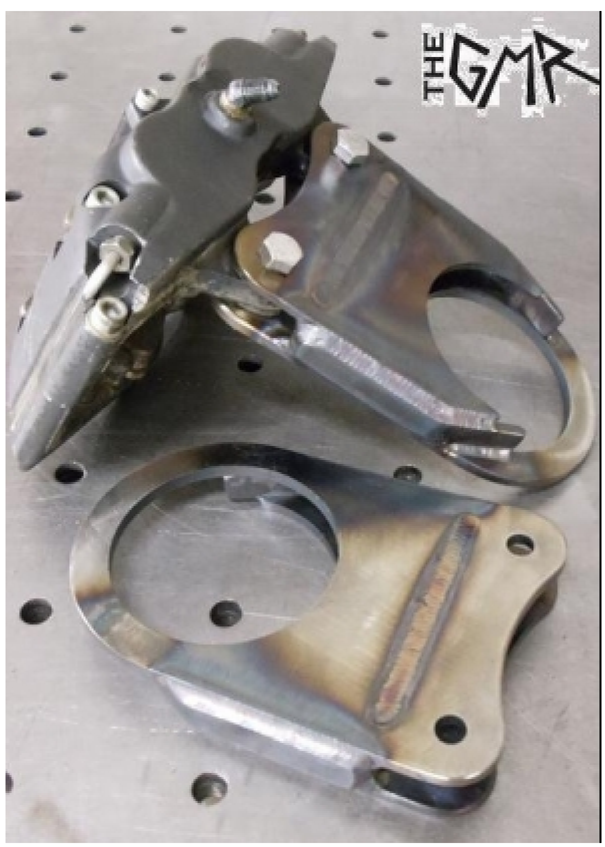
I waited until all the welding on the main structure of the chassis was done before I installed the removable tube clamps. These clamps have two bolts in each side and interlock into place, creating a very strong junction, perfect for this part of the chassis. The down side is that they are a real PITA when it comes to weld movement and the removable bar lining back up to bolt in easily. That is why it is critical to weld them in last. I cut the tube and then shortened the removed section to weld in the clamps. Once the clamps were fully welded in place, I then located the trans mount bracket on the tube (note that the trans mount bracket was also previously welded before being located on the tube).



After I checked the fitment, I then removed the section and welded up the bracket to the tube. I did have a little bit of weld shrinkage and movement, but the piece did go back in without a struggle. If I were to weld it all up at the same time or put the tube clamps in at the start of the Y-frame, then I would be in a “World of Hurt” right now. Although it may be hard to see in the picture, I did mount the tube clamps in the same direction and facing down. That way I only have to unbolt the two bolts that hold the trans, then drop the mount out through the bottom, making prep of the trans very easy.

Finishing up the Rear END Housing - Once the truck was back from sheet-metal fabrication, I was able to complete out the rear end housing and the brackets I designed earlier for the limit it straps / rear sway bar mount.

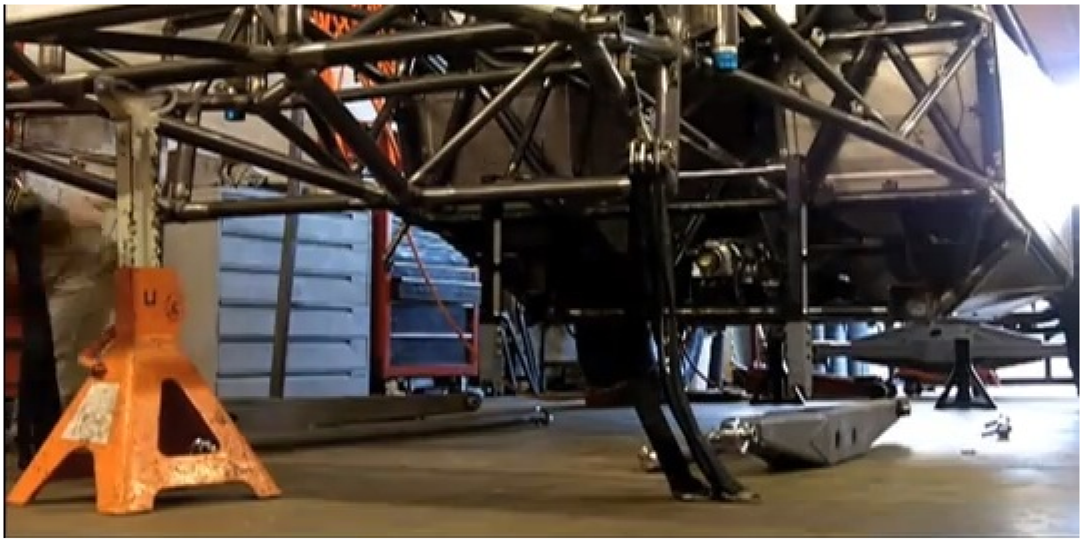
Always thinking of reusing all the components that we can from the old chassis, we decided to reuse the old calipers from Wilwood on the new rear end. The rear calipers, rotors, and brake pads were all in very good condition, basically new, so it was not a problem to reuse them.



The new mounts are double sheer, in that they have tabs on both sides of the caliper lugs. This is the ideal setup for high performance applications. These are 4130 Chromo, and the outward-facing side of the bracket wraps around the end of the housing for strength.

With the housing ends set and the rear calipers mocked up, I clocked them to the back of the housing and upward, to get them out of the way from any debris that may cause problems with the rear end. In the picture above you can also see the final bump stop mount located on the top of the housing.

On the back side of the housing, you can see the limit strap mounts for the triple rear strap setup that was based off the rear width chassis. If you look closely, I also extended the rear truss structure to the housing ends where the caliper tabs are welded. This creates one large, very strong structure for the rear end. Even with the housing treating process, it's more than strong enough, because we welded these parts with ER80S-D2 welding rod.



To complement the rear limit straps on the rear of a housing, the old limit straps from the original chassis were then mounted to the back of the chassis with the adjustable clevis mount. The length of the straps worked out. Once we got them wrapped up, there was a bungee cord placed between them so that when the truck is at bump or even ride height the straps will not get caught up with the tires (prevents the straps from rubbing).

Before the new owner took delivery of the chassis, we had time to mount a few items from the old truck, items like the gas pedals, brake pedals, steering column shaft, and several other items. We genuinely did our best to reuse as many components as possible from the old truck. In the photo above, you can see the original front hub and rotor that were in great shape from the original truck. The front hubs are old school Cone 2.5 Race series hubs, more than strong enough for this truck. They feature large 2.5" dual Timken roller bearings, along with bolt-on heat-treated 4130 Chromo snouts. The bolt-on pattern is very common as with the dimensions of the front hubs, so replacement is not a problem even if we need to switch to a manufacturer other then Cone in the future.

Some of the best items we were able to use from the old chassis were the original 3G seats and harness mounts. The seats fit perfectly in the new chassis. And overall I would have to say that we drastically improved the interior space and comfort of the new truck relative to the old cab. For mounting the seats we utilized part of the rear pivot boxes, along with some additional tube structure. For the front of the each seat mount, we welded in a 1.25” piece of .120 wall Chromo, then utilized some simple tabs off that bar to locate the front bolt holes of the seat. The rear was a little trickier. We had to use some plate work to mount them above the pivot boxes. The seat ended up almost touching the rear pivot boxes. They are very close, so this required us to build the mounts carefully to ensure that nothing would be an issue.

Being that I’m a stickler for safety, I also added a 3/16” thick piece of 4130 Chromo right above the back side of the pivot box, coming up to the chassis to protect the occupant in the event that the rear upper link broke at the front, keeping the tube from penetrating the cab. Better safe than sorry.

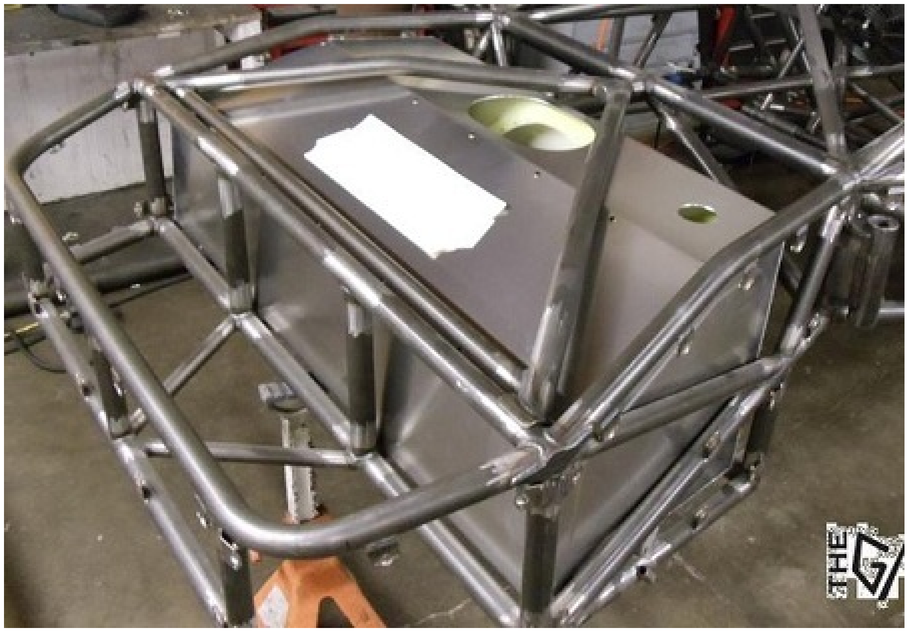
With the seats in place and the truck coming further along, it was time to mount the body.

As stated earlier in the book, we opted to keep the same body as the original monster garage trophy truck, a Gen2 Geiser body. Although the body we got was used for mock-up on another truck, it was in great shape with only a few minor cuts and modifications to it from a previous chassis mock-up.

Located directly behind the radiator, you can see in the picture above a smaller black cooler with an attached fan. This is one of two that are mounted in the back of the chassis behind the radiator and above the rear sway bar. These are the locations for the transmission coolers. We are running them in line to increase the cooling power, and they tuck nicely in the cage work and about a foot behind the radiator so that air flow will not be a problem.

The oil cooler was then moved to the front of the chassis. It was placed just above the bulkhead and in front of the shock mounts. This was a perfect location for the oil cooler, it allowed for ease-of-line placement with the dry sump system, along with great airflow for the cooler. I prefer this spot because it is also very protected from exterior elements that can penetrate the radiator, causing problems and possibly a DNF for the race.

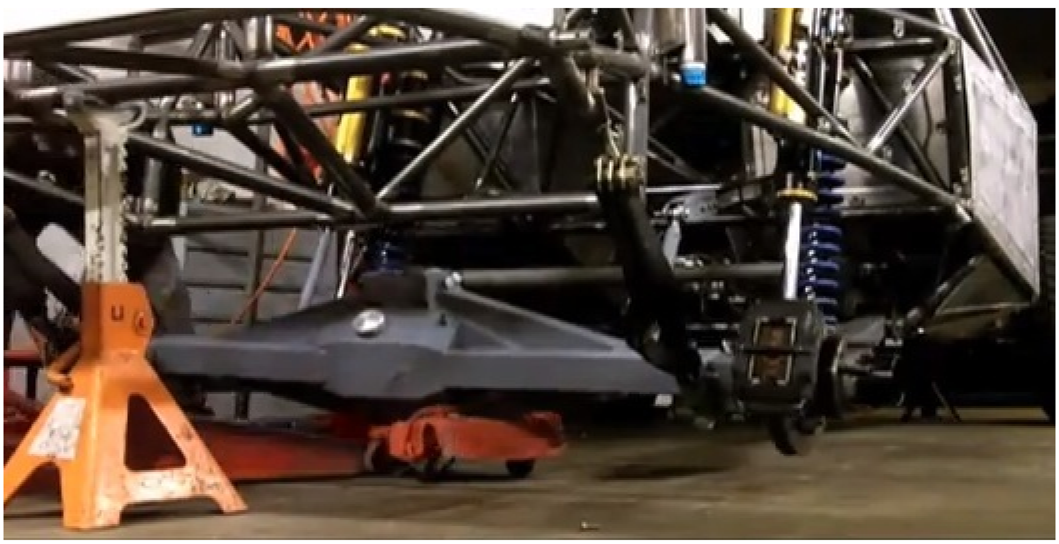
I also fabricated the front bumper to match the front clip of the truck; the front bumper is removable and is also adjustable with rod ends at the top. The idea here was to build it simple, so that it will be easy to rebuild because this piece will be thrashed, just like on all trophy trucks.



After the truck was back from sheet metal and we were final-assembling some of the other original components into the chassis, the custom-designed fuel cell arrived. Thankfully, the guys at Harmon followed the specifications perfectly and the cell dropped right into the chassis, fit snugly and required no modification… it was almost too good of a fit. I then fabricated a removable mount for the top of the cell that would also support the spare tires, so that the cell would not be crushed.

The removable mount uses the same tube clamp as the trans mount in the front and the rear bolts in place using overlay tubes as support on the rear main tube of the cell mount. The overlay tubes are 2” diameter by .120 wall tubes. The rear cross tube in the back of the cell box (top) is 1.75” in diameter. So the 2” sit over it perfectly. Then I drilled a bolt hole through both tubes so that the structure could be bolted in place.

Before the new owner took delivery, we bolted everything to the truck for final fitment and got everything ready for transport to the owner's new shop. Once it was there, his guys would finish the truck with wiring, plumbing, and mounting all the other items in the chassis.



Above is a good shot of the rear suspension. You can see the rear end hanging with the shocks in place, along with the bump stops and limit straps.

Once everything was on the truck and ready to go, we took some pictures of the truck sitting outside before we loaded it onto the trailer. This was Christmas Eve, six months after the initial teardown of the old chassis for the start of the build process.

The angle of the picture above really gives a perspective on the air flow through the cab of the truck and into the radiator. You can also see the spread of the occupants, along with the front components tucked into the chassis.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With a six-month job complete and the new truck resting at the owner’s shop for finishing up, it was time to take a rest. It was a long six months, but I got it done and the new owner was very pleased. Another happy GMR client!

BONUS SECTION:

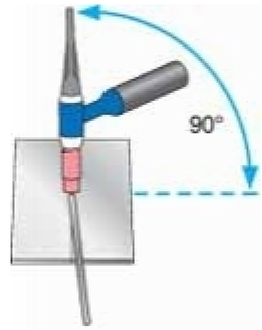
If you are looking for more information about the details of Off-road Fabricvation welding then please check out my other book on Amazon.com titled “Jason Elvis Heard’s Off-road Fabrication Welding”… Here is a little sneak peek from my welding book…

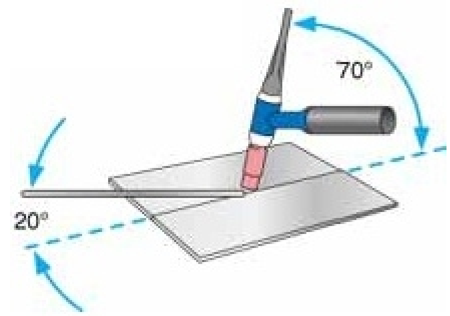
TIG Welding Joint setup with Rod / Torch position.

Before I dig into the actual techniques for TIG welding, it's important to review the proper torch and rod position to ensure proper starting technique. These are only recommendations. Once you start welding and gain experience, feel free to tweak these to suit your specific application. All the diagrams below are pictured for right-hand users. In other words, they are set up to show you the position if you were to have the torch in your right hand and the rod in your left. A general rule of thumb is that you want to all the rod to the bottom of each weld puddle. This will allow you to properly monitor the addition of filler and control its position.

The Butt Joint Position *– Given that both plates are perfectly flat, you are going to split the angle, which is 180 degrees, and you will end up with 90 degrees, the standing position for the torch (seen in the image below, center). This is only when you are looking down the direction of the weld, not from the side.*

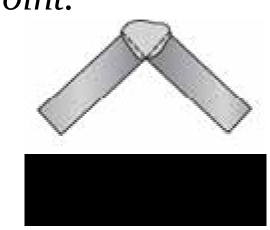
In the image to the right you will notice a different angle and lean; this is the weld direction lean, or the lean of the torch in the direction of the weld. If you are welding to the left, like in the picture on the right, you will notice that the torch is leaned back, exposing the tungsten toward the direction of the weld. The general "rule of thumb" for butt welds is about 70 degrees leaning back. To complement the torch and provide optimal welding rod placement, you want to keep the welding rod 90 degrees to the torch facing the direction of the weld bead. The rod should be close to following the direction of the weld (see the middle image) but it's not critical to be perfectly straight to it, slightly off up to 15 degrees is more than acceptable.

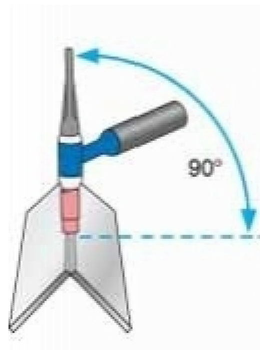


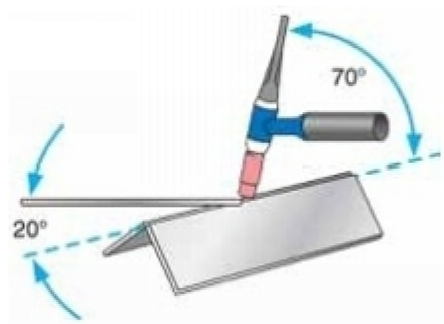


The Edge Joint Position *– This is a little tricky because not all the time will you have optimal position of the work piece with this joint. A perfect example of this is when welding A-arms, and you have them in a fixture or table where you are forced to weld them standing up. One side is 90 degrees to the table and the other (top) is flat, so the joint is facing 90 degrees differently than the picture on the left below.*

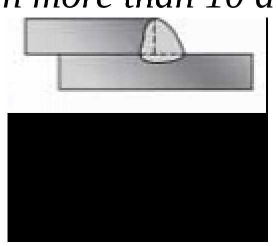
You will also start to see the strategy for TIG torch position -- you are looking to split the joint as best you can. If the plates were even and the joint is facing up, you will be looking to achieve a 90-degree angle on the torch, splitting the joint. If you are slightly off by 10 or so degrees it's not going to be a problem. The same rules and guidelines for the Rod apply to this joint as the above Butt joint.

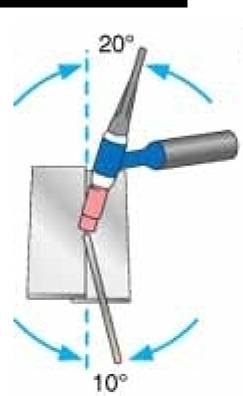


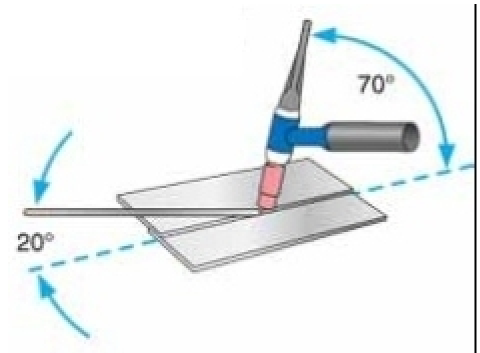




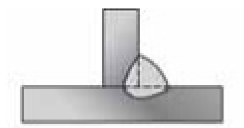
***The Lap Joint Position** – Breaking the pattern that you see in the above two welds, the Lap joint is different in regards to the torch position. This is because you have the full side of one plate above the top of another, thus forcing you to NOT split the joint so that you can direct more heat into the lower plate to ensure proper penetration. With the torch both 70 leaning back and 70 degrees up, you can provide the proper penetration for this weld. The welding Rod still follows the same general path as the Butt joint, but it's OK to cheat it even more than 10 degrees leaning in than depicted.*

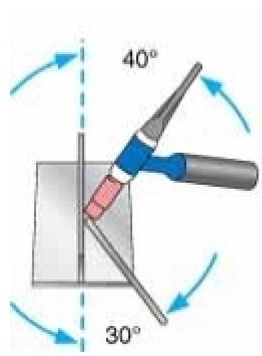


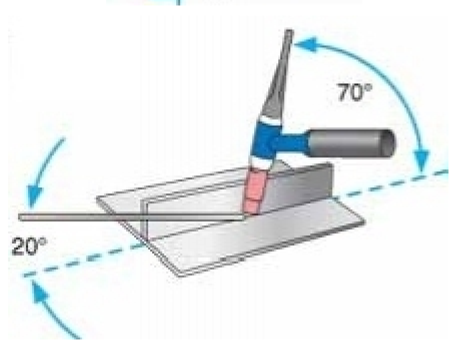




The Fillet Joint Position *– With the idea that the plates are perfectly 90 degrees to each other, you are going to favor a degree split with the torch, favoring the bottom side. This is why you see a 40-degree angle and not 45. You need to make sure penetration is complete with both top and bottom plates. The other difference you will notice is that the rod will be at a farther angle away from the weld-bead direction. Below it's showing 30 degrees, and that is pretty close to what I utilize.*



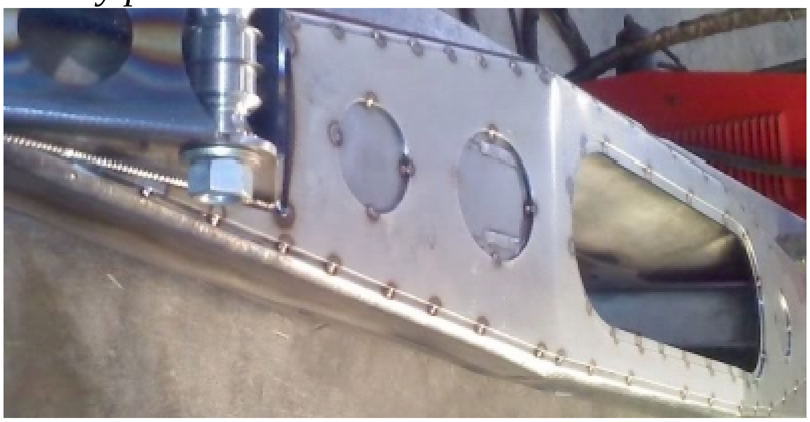




Keep in mind that all the above joint positions are simply suggestions. When you are welding in the off-road industry, rarely will you encounter perfect weld-joint position. Often you will have to adjust the angle of the torch to compensate for gravity, and watch your weld puddle *accordingly. The goal is that with some tweaking of these above positions, you will be able to weld anything around or off the chassis.*

Distance of TIG torch / Tungsten from welding Puddle *– One of the most challenging elements to TIG welding is controlling the distance of the tungsten to the welding puddle. As mentioned above, the tungsten can be of various different lengths when it sticks out past the TIG nozzle. This is not important. As long as you have proper gas flow and coverage, then you can literally have the tungsten sticking out 1" from the nozzle (typically with a gas lens). The important thing to note is the distance of the tungsten tip to the weld puddle. The general rule of thumb is that you want it to be about 1/16" away from the puddle, but never in the puddle. Once you touch the tungsten to the weld puddle, you need to clean the tungsten because it's now contaminated. The farther away you are from the puddle, the more difficult it is to control the puddle and weld. This takes practice. Do not get frustrated. It literally takes hundreds of hours to properly master the distance of the tungsten with all welding positions, especially in chassis welding.*

TIG - TACK Welding *– When working with plate work or extensive tube setup like chassis work, it is critical that you properly tack-weld your work piece so that you avoid any issue while welding. Below is what a properly tack-welded overlay plate looks like.*



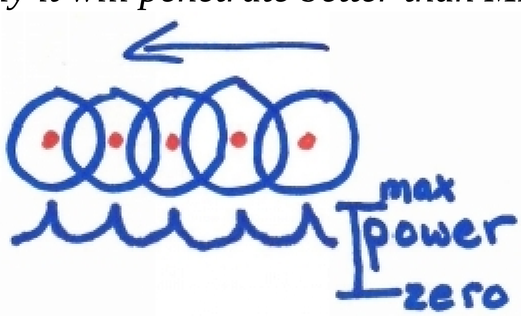
You will notice that each tack weld is about one each from each other. This is because all too often your work piece will move and warp as you weld one section up. If the plate work is not properly tack-welded down, it will start to pull itself away from the base material causing a problem and gap with the weld. Keeping things where you want them is key.

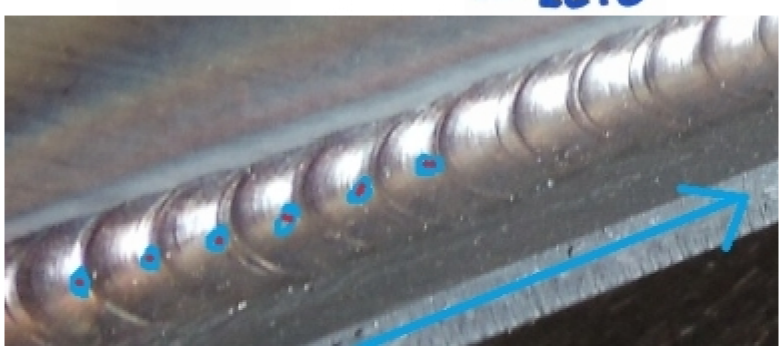
Be sure to tack weld your work piece properly before you start to weld them up.

TIG welding technique.

You can ask about 10 different professional TIG welders in the off-road industry about TIG welding, and you will certainly get more than 10 different answers. With that in mind, please know that what I explain below is simply MY way of doing things. There is more than one way to skin a cat so to speak, but I have had great strength results with the methods below, along with countless compliments on my TIG welding appearance. Proof…

TIG Pulse Welding – *When it comes to beginner TIG welding, this form is hands-down the easiest to learn, and I recommend you start with this. The concept is simple: you are going to make several tack welds on top of each other, while adding welding rod with each puddle. This will create the stacked look you see below. One interesting fact about TIG pulse welding is that typically it will penetrate better than MIG pulse welding.*





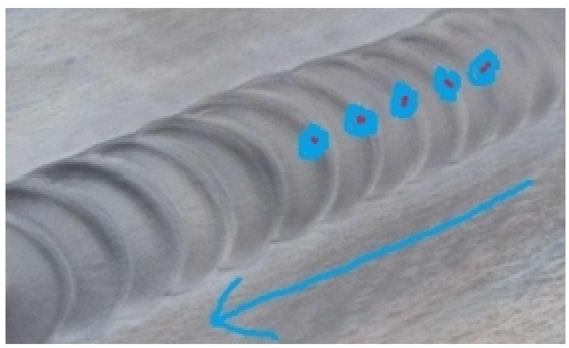
These days some TIG machines will come with a built in "pulse" feature -- I want you to turn that off immediately. It's NOT good for beginning TIG welders. It will become a crutch and only hurt you in the long run as these techniques become more difficult.

I want you to learn the hard way -- it will teach you pedal control. You need to master pedal control; once you do so then all things TIG welding will be easier.

With the "pulse" feature off, you need to set the machine to the max amperage for the selected material (see your machine's guide). Then strike *an arc and bring the amps up to melt some rod and form the first puddle.*

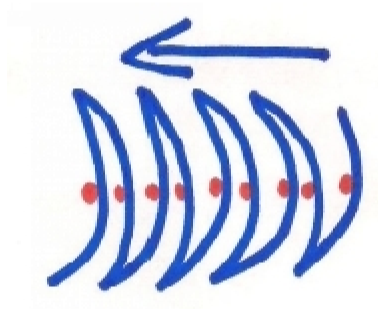
Once you have the puddle formed to size (about 3/16" to ¼" in diameter when welding 1/8" material), remove the rod and slowly lower the amperage. DO NOT let all the way off the amperage; only lower it enough to stop the melting of the rod. With the amperage at 50-60%, quickly move the torch / tungsten over to the forward edge of the formed puddle. Increase the amperage again, while adding rod to create another puddle the same size. The puddle should overlap about 50-60% of the previous one like pictured above. Repeat the "pulsing" of the amperage with your foot while adding rod each time you create a new puddle.

In the drawing above you see the red dots, which indicate the rod location for each puddle, directly in the center. The wave-like drawing below represents the amp level being increased and decreased. Notice it peaks when the red dots appear (when the rod is added to form the large blue circle puddles). Here is an example of Pulse TIG with a LAP joint and 1/8" material.



Stacking your welding beads closer together, like in the photo above, is not a problem either. This lap joint is a great example of the perfect amount of ROD and heat. Notice how the puddle perfectly lays in the joint, creating a flat, seamless appearance, even though the plate on the top left is sitting on top of the lower-right plate. There are no signs of undercut (described in the Troubleshooting Section), and each bead is very close to identical in size / spacing. I would trust this weld to a rollover.

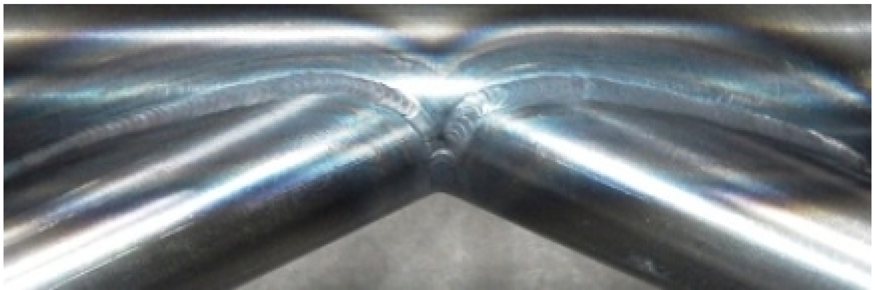
***Traditional Single Pass** – The next form of TIG welding for you to try out and master is the single pass, or what I call the traditional single pass. Not everyone calls it that. Some use different names, but the technique is the same. Many of the industry's top professionals still use this technique to this day. The new Terrible Herbst Motorsports Trucks were almost entirely welded with this technique, including the suspension.*



This method is simple and straightforward; it is also one of the easier techniques to learn. The key to this is consistent heat. Unlike the above pulsing technique, you will be working toward keeping the amperage consistent while welding.

The picture above is of a lap weld with two 1/8" pieces of material. I prefer to be in the 115 am range throughout the weld bead from start to finish. Different materials and positions will yield different amperages. The key is to go slow and take your time, but do not overheat the material.

As you start you form a puddle toward the base of the top material, then while adding rod work your way slightly forward and up. Once you move up and form the puddle at the top edge of the above material, you then move the puddle forward and downward, creating a "C" like shape. Notice the drawing above with the back-and-forth motion while moving forward. The red indicated where the rod should be added; when you are in the middle of the "C," you simply shove in slightly more rod than at the ends. While you move forward, you can keep the rod in the puddle the entire time and control the puddle size with the addition of rod in the middle of each "C" pass.



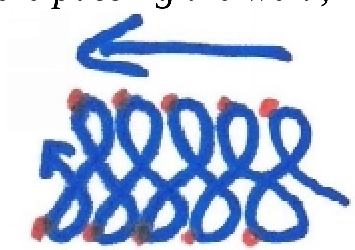
Above are perfect examples of traditional single-pass welds that are both very strong and aesthetically pleasing. Notice the symmetry of the beads and the sections where you can see the rod being added while the puddle is moving forward.

The Double Pass "Weave" *– One of the most famous and notorious TIG welding techniques is the Double Pass weld. This is very complicated to do correctly and will take some practice. The top builders and trophy truck teams typically will utilize this technique for everything from chassis to suspension construction.*

The main downside to the double-pass weld is the difficulty and time involved. If you were to double-pass a chassis (instead of doing a single pass or even MIG weld), you will be tripling the time it takes to weld the structure, maybe even more.

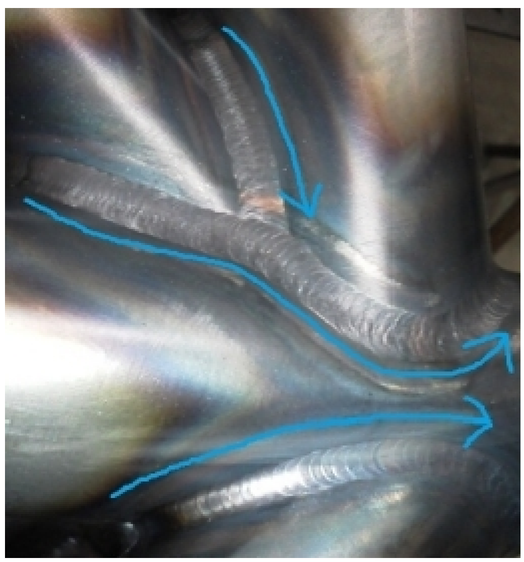
The first step to a proper double pass is a good foundation with a single pass weld. Notice the pictures above: the one to the left is a miter joint with a single pass and the accompanying tube tack welded in place. The middle photo is the three tubes appropriately single pass welded fully. Once cool, you can then run your double pass weld over the single pass weld. You are literally double passing the weld, hence the name.



The technique for the second pass is basically a backwards Figure 8 that moves forward. Note in the drawing above the direction of the arrow. In the picture you can see the second pass going over the first with the different pattern. The reason for this pattern is that it literally blends the two materials together, creating a very strong bond. While moving forward with the Figure 8 pattern, you want to strive to keep the amperage consistent and be sure to NOT overheat the material.

One sure way to be sure you do not overheat the material is to start to weld with the amps set to below the material thickness by about 10%. So if you are welding 1/8" material (roughly .120), you want to be at about 108 amps max. This is a good starting point, and you can adjust from there, given the joint and weld complexity. The red dots represent the addition of rod. At the upward outer swoop of each Figure 8 movement, you want to add rod. This is where you get the "dual stacking dimes" look that the double pass is known for. When you tighten up the Figure 8 pattern, you will start to see more of a "weave" going on, hence why this is also referred to as the "weave" weld.

The pattern and addition of rod should yield a result that expands the overall width of the second weld bead so that it completely covers the first. The tricky part of this weld is preventing undercut with the second pass. You will have to really watch your weld puddle and be sure you are not digging into the base material.

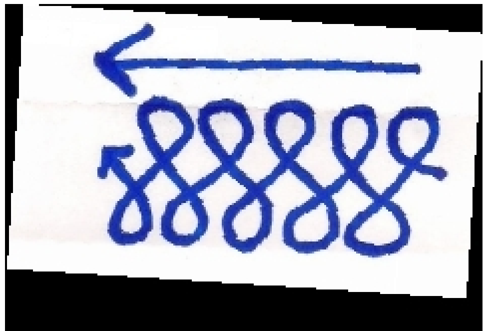


The picture above and on the left shows a dual pass weld joint in process. The top two welds and tube are completely double pass welded, while the bottom is still single passed, awaiting the second pass. Note the direction of the welds and how it runs over the previous welds from tube to tube, creating one continuous bead with three tubes. The picture to the right is a great example of a professional double pass weld on the critical junction of a trophy truck chassis.

It's all in the wrist. The "weave" technique will require you to practice the movement of the torch with your wrist. As you move the torch through the pattern, you will also angle it slightly inward (away from the edges) with each side of the Figure 8. This slight 10 degree or so angle will drastically help with decreasing the chances of undercut.

Walking the Cup – *Another very popular form of welding in the Off-Road industry is called "walking the cup," and some use it for just about everything. I am not one of those. It has its place, and that place is not on structural components. Items like chassis and critical suspension welds should not be done with this technique. When it comes to overlays and decorative items, this technique will provide the look you are going for.*

The concept is very simple. It's basically identical to the "weave" weld, but you do not add any welding rod while making your second pass. The pattern you utilize is the same; see the images below for reference.



Above you can see the initial single pass weld being covered by the second "cup walking" pass. One distinct difference you will notice between this and the above "weave" is the lack of size with the second pass. The lack of additional filler material will yield a smaller bead (usually, but not all the time). Below is a perfect example of when this technique is more than acceptable to use. This is a logo plate on the back of a GMR9 housing that is under a 90 Firebird Pro-Tour Car.

Thank you for purchasing this book. I hope that you found it informative and entertaining. If you have any questions, please feel free to email me Jason@thegmr.com

Thanks, Jason Elvis Heard.