

# MYP Personal Project

By: **MJ Mayo**



Mulgrave School (2424)

Supervisor: Greg Cusbert

2011

Word Count: 3,533

# Table of Contents:

Criterion B - Identify the goal:	3
Criterion C - Selection of Sources:	4
Criterion D - Application of Information:	6
Criterion E - Achieving the Goal:	7
Criterion F - Reflect on learning:	8
Works Cited - My Sources:	11
Appendix A - Process Journal Extracts:	13
Appendix B - Mk4 Roadster Vehicle Specifications:	19
Appendix C - Mk4 Roadster Performance Specifications:	21
Appendix D - Fortins Engine Assembly Pictures:	22
Appendix E - Build School Pictures & Summary Extracts:	25
Appendix F – My Mk4 Roadster Build Pictures:	42

-

## Criterion B: Identify the Goal

A dream made into reality, as my goal will result in the building of an all-out muscle car that delivers unbelievable torque and gut wrenching power. All my life I have had many passions but the two that I will never let go are ice hockey and cars. As I am already pursuing my passion for hockey, this is the place in my life where my passion for cars shifts into sixth gear. With the help of my step father, Dean, my goal is: *To learn the basic mechanics and functions of the systems within a vehicle.*

The Factory Five Mk4 Roadster kit car, a replica of the 1965 Shelby Cobra is an ideal choice for learning basic mechanics. As it is a very simplistic build and, when stripped down to its basics, includes five main systems: the body, frame, drive-train (engine, transmission & rear differential), suspension and electrical system. These are the systems which I dedicated countless hours of learning, analysing and working on, in order to achieve my goal.

The most intriguing thing about my goal is that I can never fully accomplish it, because I can keep broadening the simple concepts until the day where I am designing my own cars, and even then it never stops because there are unlimited possibilities to where engines and cars themselves will take us.

There are two Areas of Interaction (AOIs) which most encompass my goals. My goal of learning about the complex systems that come together to form a motor vehicle, represented in this project through the building of the Roadster, is the undeniably "Human Ingenuity". The IB states that, "Human ingenuity provides opportunities for students to appreciate and develop in themselves the human capacity to create, transform, enjoy and improve the quality of life."<sup>1</sup> In achieving my goal, I have been intimately involved in examining and appreciating how human creativity developed the mechanical systems that make up the modern motor vehicle. There is no doubt that the motor vehicle improved the quality of life and changed the course of history. Although only by small degrees in my first project, I will have some opportunity to create a new product which can never be exactly the same as someone else's.

The "Approaches to Learning" aspect of my project applies to learning how the car works by learning about the many systems that have been developed over the past century, which is really my overall goal. The heart of this AOI is "fostering the knowledge of lifelong learning"<sup>1</sup> and "learning how to learn", which is exactly what I have done with this project. This

---

<sup>1</sup> Sealey, O.B.. "Appendix C - The Areas of Interaction." Student Guide to the Personal Project. West Vancouver:Mulgrave School, 2011. 25 - 27. Print.

Personal Project was the first step in what I hope will be a lifelong project for me. As I have learned the basic mechanics of a car, I will never forget the most important parts and how they work so I can use that knowledge and expand on it throughout my life. I can guarantee myself that I will need and use the information I have learned more than once with the kind of lifestyle that I hope to lead.

The biggest way I will know if I have accomplished my goal is if the car runs. When you break it down means that by assembling each system, all systems will work efficiently together. (E.g. No leaks, clutch and gears function, there is power to the battery, etc.)

### Criterion C: *Selecting and analyzing sources*

From my initial research right through to my final product, I used several sources. These include key individuals, a build school, various websites, forums, and product suppliers. All of my sources have a successful history of work in the motor vehicle industry, are certified by regulatory bodies and come with sound references; they are therefore very trustworthy sources for my purposes. Each resource was very important at various stages as each allowed me to complete what I needed to get done to make it that much closer to the final product.

The largest part of my research came from the instructors<sup>2</sup> at the build school held at Mott Community College in Howell, Michigan which I attended for 3 days at the end of April 2011. There, I learned in a very hands-on way how to build the Cobra and how to use the detailed manual that would guide me through the process of learning. As well, I learned some tips and tricks along with some very useful information that I would not have known if I had not gone to this course. The photographs I took, the notes I made and the skills I learned at this school formed the basis of my research and learning.

I would be remiss if I did not mention the one source which made this all possible: my step dad, Dean<sup>3</sup>. Without him, I would not have been able to do this project as he provided the funding and, in my mind, a limitless amount of information which I took pride in learning. He was my key source to all of my information and learning before, during and after this project, as well as in future projects that I want to pursue.

---

<sup>2</sup> Markman, Charles. (Instructor) Personal Interview. 29 Apr. 2011. - 1 May. 2011.  
Shumaker, Scott. (Instructor) Personal Interview. 29 Apr. 2011. - 1 May. 2011.

<sup>3</sup> Fleming, Dean. Personal Interview. 1 Mar. 2011. - 12 Nov. 2011.

My other sources include: Factory Five Cars forums<sup>4</sup> and Factory Five forums<sup>5</sup> The forums were a big help because anybody who is building, has built or wants to build a Cobra is constantly on these forums discussing what the better engine choices are, why they only give you one brake reservoir and the many other things for which you may be looking for.

A website that I found very helpful just for reference tips was a Mk3 Factory Five Cobra Build site manual<sup>6</sup>, written by someone else who had made this build. It is very much like my process journal for this project, although it has less detail than mine but follows the same pattern of explaining what is going on in each stage as well as the author's troubles along the way. This became helpful when I was in the middle of the build and I did not know if I could put a certain part on the car without restricting access to the part when it needed to be connected and other things like that. It also helped me to make sure I was on the right track with the build and not skipping important steps.

Another vital resource was Al Beix from Western Canada Cobras<sup>7</sup> as he is the Canadian Customs broker for shipments coming from Factory Five to clients like us in Canada. He was a very important resource as he dealt with all of the paperwork needed to bring the kit car over the border, as well as helping us with some choices on the engine and transmission which we had to buy in Canada due to our laws. He also gave us some useful links to companies and stores that supply extra parts or upgraded parts for the build.<sup>8</sup>

Although, at times he did persuade us into getting a cheaper brand and we ended up paying for it in the end! As an example, he said the first electrical kit we bought would be much simpler and have easy-to-follow instructions. We bought it and it took us almost five hours to

---

<sup>4</sup> "Factory Five Forums - The Front Page." Factory Five Forums - The Front Page. N.p., n.d. Web. 2 Oct. 2011. <<http://www.thefactoryfiveforum.com/>>.

<sup>5</sup> "FFCars.com : Factory Five Racing Discussion Forum ." *FFCars.com : Factory Five Racing Discussion Forum* . N.p., n.d. Web. 15 Aug. 2011. <<http://www.ffcars.com/>>.

<sup>6</sup> "Build Manual [FFR Roadster]." BUILD MANUAL. N.p., n.d. Web. 1 Oct. 2011. <<http://mk3build.com/manual/doku.php>>.

<sup>7</sup> Beix, Al. "Western Canada Cobras." Western Canada Cobras. N.p., n.d. Web. 2 Oct. 2011. <<http://www.westerncanadacobras.com/>>.

<sup>8</sup> **Fortin's Engines (Chilliwack)** - "FORTINS." *Fortins*. N.p., n.d. Web. 2 Oct. 2011. <[http://www.fortins.com/fortins\\_engines.php](http://www.fortins.com/fortins_engines.php)>.

**Hooker Headers** - "Holley Performance Hooker Products." Holley Performance Carburetors, Fuel Injection, and Fuel Pumps. N.p., n.d. Web. 2 Oct. 2011. <<http://www.holley.com/division/Hooker.asp>>.

**Mopac (Langley)** - "Welcome to Mopac Auto Supply - Where Power is Everything.." *Mopac Auto Supply*. N.p., n.d. Web. 2 Oct. 2011. <<http://www.mopacautosupply.com/>>.

**TreMec** - "Transmission Technologies Corporation (TTC)." *TTC Transmission Technologies Corporation* . N.p., n.d. Web. 2 Oct. 2011. <<http://www.ttcautomotive.com/English/home/home.asp>>.

get organized and spread the wires to the selected sections of the car. In the end, we decide to rip out the electrical and spend the extra \$100 and get the pre-bound and pre-organized system which we installed in only about an hour. This taught me that you can only trust somebody so far before you have to start cross checking the information they are giving you.

The other sources in my bibliography are either part suppliers or external resources<sup>8</sup> which we used for ideas and decision making. Overall, for the magnitude of this project, I am surprised at how refined I have kept my sources when trying to achieve my goal. I believe I have defined my sources to a point of exactly what I got out of each of them and why I used each of them. As well I had no sources that I was questioning myself on, such as whether I knew if a person was telling the truth or not. There was very little doubt in my mind that these sources were reliable. They were full of the necessary information that I needed to take each leap and bound towards the completion of my project

## *Criterion D: Analysis of Information*

The core of my project was actually analysis because it was not just a huge learning project for me but also for my key advisor, Dean, as he had not done a project of this magnitude in a long time. The first source that put our skills to the test was the build school, as the instructors could not build it for us, they could only tell us what to do and explain the systems of the Cobra as we pushed on through the build. This made us think for ourselves and think back to if we maybe had done something similar to this before so we could apply that knowledge and skill in doing it. By taking this course I received a certificate of completion which displays the considerable amount of information and knowledge I have learned through my research.

Before we went to this course, Dean gave me a crash course in all the tools we would be or might be using while building the car. This was very helpful as when asked me to get them a certain tool I knew exactly what to bring him. Thus I was applying my recently learned knowledge of the tools and parts to decide what to provide to someone during the course or later when choosing what to use when, as we built our own Roadster.

The next vital source from which we had to syphon and analyse all of the information was the forum pages. Some people are experts and other people really don't know what they are talking about. Although, there was very useful information on which we relied when researching to figure out some of the problems we had along the way, we also had to decide which pieces of information to use. We analyzed the sources very well and cross-referenced

our information with other experts' information as well as just using common knowledge to fix the problems/challenges that arose along the way.

The final and most surprising source was information that I had already learned through the course of my life. Sometimes you do not have time to research an answer or the answer is simply not there so you have to problem-solve and think for yourself, trying different ideas until you find one that works. To do this requires flexibility in thinking. This taught me to come up with multiple solutions to a problem rather than trying to perfect one solution like the most of the situations that you have to figure out in life. This was probably the most valuable analysis of information that I could ask for. I had to define and analyze the answers that Dean or I were coming up with to see if they would work, which no teacher can teach you how to do.

## Criterion E: Achieve the Goal

While the achievement of my goal is to some degree reflected in the final product, the Cobra, my actual goal was to learn skills and develop knowledge that will enable me to pursue my passion for many years to come. You could give me hundreds of tests to test my knowledge to see if I know the information that I set out to understand. All that would tell you is if I studied for the past eight months, learning everything there is to know about basic mechanics, but as I said, in my mind that was never my goal.

I set out to construct a foundation on which I could expand my knowledge of mechanics in the future. In my mind, I have not only completed my goal but far surpassed it, as I have built the metaphorical frames for the hundreds of walls that I will continue to put up as I learn each new piece of information about basic mechanics. No book, website or encyclopaedia could teach me what I have learned on my own from building this car, as at each stage of the build I have learned so much information which hopefully will stick with me until I need it again.

As for building the Cobra, every step I took closer to completing the car brought me that much closer to completing my ultimate goal. Splitting the learning up into the five different sections helped greatly, as I am now able to identify these different systems and explain to someone what they do to contribute to the overall completion of a running car. Thus the first portion of my goal is complete, as I wanted to be able to explain what a certain part of the car does to someone who does not know much about mechanics.

The best thing about the learning that I have done is that from the countless pieces of information that I have researched, been told, discovered myself, or read in the 4-inch thick

manual or the many other sources that I have used to complete my goal, is that the pieces of information went to the back of my head and stayed there without me being able to tell you if I have learned it or not. You could ask me to give you step by step procedure on how to assemble the front suspension and I would take some time to articulate it, but if you gave me the pieces and tools I need to put it together, I could do it no problem. This makes me think about how many things have I learned that went straight to my long-term memory, to be saved for when I need to fix or build one of these types of parts again. This just goes to show how much information I have really learned and how far past my goal I really went. The proof of the quality of my learning is in the successful completion of the build school course and a running vehicle with no leaks, functioning brakes and clutch, power to the rear wheels from the engine, etc.

The physical project, which is the main reason for all of my newly gathered knowledge on mechanics, is about three-quarters of the way finished. The main systems of the car are fully operational. All that is left are the finishing touches such as the paint job which is being done as I write this. If we finish the car by the end of October, that is bonus points but even if we are not able to we could not have done anything else that would have made us complete the car any faster as back orders on parts are out of my control as to when they get here and if they are sending the right parts.

In conclusion, when reflecting on my overall goal, I am very proud of myself as I exceeded my expectations in the learning of basic mechanics and continue to pursue my goal even further as it never will be fully succeeded.

## Criterion F: Reflect on learning

Simplicity – the one word that made it possible to learn all of this information in a fairly short amount of time. This word does not define the difficulty level of this project but my approach in keeping everything organized and easier to learn. In spite of the fact that I had a four-inch thick manual that puts IKEA instructions to shame, this kit car could not have been simplified any further. We used a few optional parts which we chose to make the car have better performance, which means that those parts are just a bit more complicated, but in general this is a car that is stripped of complicated systems compared to the market cars that Ford, Dodge, Hyundai, etc. sell.



This car goes back to the basics of human ingenuity, as the car is almost all mechanical components and has only a few electrical components for the necessities. For example, the wires that go from the battery through the fuse box and then to the engine.

My step-father Dean, my most valuable source, explained everything to me, from the type of material the frame is made of, to how the engine and transmission work and I owe him an undefined amount of credit as he is the key aspect to my learning.

My former knowledge of mechanics was very little to what I know now. Before I started this project, I could list maybe three things that I knew for sure about mechanics; now I can list hundreds. Just some of the things that I now know, how they work, what they do and how they work together are: suspension, engine, transmission, riveting, fuel lines, brake calipers...the list goes on and on.

This project helped me develop as a learner, as now when I look at anything and I do not know how it works, I cannot resist asking myself or figuring out how it works so I can understand the many small things that are behind the items we see today. It has also taken my learning to the next level because every time I am learning something new, now I am going to strip it down to the basics: what do I need to know? Then, piece by piece, I will rebuild the new information until I can understand it inside out and backwards. A good example of this would be learning a new formula in math. You start with the simplest of questions and build more and more difficulty as you begin to understand it more. So you are up to the point where someone can give you any question and you can figure it out on a piece of paper. But if you really want to know it you will be able to do the formula in your head and generate the answer. Now you have mastered this formula and can continue to learn more math techniques.

This project has extended my knowledge on the topic of mechanics by more than I could have imagined myself learning. Dean has made an educated guess that my knowledge of mechanics is suitable to a grade 12 automotive course that can be taken in public schools. I am proud of what I learned as it will stick with me. Beyond what will be my lifelong passion for cars, examples where I would use my new knowledge would be in the many sports or activities I do. The first one is dirt biking because before I started the project if something happened to my bike on a trail, like I hit a rock and put a hole in my oil filter, I would know that something is wrong but I would not know what to do about it. I might ask myself if putting tape over it would cover it long enough for me to get out and take it to a shop. But now I know that if something like that happened I would be done for the day and would have to walk my bike out because the oil filter does exactly that, filters the oil and if it is not working properly dirt and grime would get into the engine which would ruin its insides and the whole bike would be toast.

A simpler example would be, I am on my mountain bike and my disc brakes stop working. Before I might check if something is stuck in them walk the bike down then take it to the shop, now I would look for things like are the brake pads tight to the disk when I pull the brake then I might tighten the wire up and they would work perfectly fine again. The simple things in my everyday life that this project has contributed to are absolutely extraordinary.

As for my AOI's, Human Ingenuity has been defined in my books by the fact that Dean and I have actually built a car and, secondly, the ingenuity does not stop there as I hope to design my own car in the future or build another; who knows, the possibilities are endless. On the Approaches to Learning side, again, I have out done my own expectations with the information that I have learned and will continue to expand and improve it in the future.

I was determined to have an extraordinary amount of self-discipline to continue to document and build the Cobra over the summer. As well, when I did not understand something or something wasn't working, I would have to take another approach or angle to figure out what the problem was so I could get that much closer to the end result The last thing I learned, which is an everlasting lesson, is that nothing is impossible if you put not only your mind to it but your heart as well. This final quote is true for everything that you truly believe on pursuing. "A journey of a thousand miles must begin with a single step" – Lao Tzu

-

# Works Cited

## Websites:

- "Build Manual [FFR Roadster]." BUILD MANUAL. N.p., n.d. Web. 1 Oct. 2011. <<http://mk3build.com/manual/doku.php>>.
- "Factory Five Racing." *Factory Five Racing*. Factory Five Racing Inc., n.d. Web. 15 Aug. 2011. <<http://www.factoryfive.com/>>.

## Books:

- Sealey, O.B.. "Appendix C - The Areas of Interaction." Student Guide to the Personal Project. West Vancouver: Mulgrave School, 2011. 25 - 27. Print.

## Forums:

- "Factory Five Forums - The Front Page." Factory Five Forums - The Front Page. N.p., n.d. Web. 2 Oct. 2011. <<http://www.thefactoryfiveforum.com/>>.
- "FFCars.com : Factory Five Racing Discussion Forum ." *FFCars.com : Factory Five Racing Discussion Forum* . N.p., n.d. Web. 15 Aug. 2011. <<http://www.ffcars.com/>>.

## People:

- Beix, Al. "Western Canada Cobras." Western Canada Cobras. N.p., n.d. Web. 2 Oct. 2011. <<http://www.westerncanadacobras.com/>>.
- Fleming, Dean. Personal Interview. 1 Mar. 2011. - 12 Nov. 2011.
- Fleming, Jay. Personal Interview. 1 Mar. 2011. - 12 Nov. 2011.
- Markman, Charles. Personal Interview. 29 Apr. 2011. - 1 May. 2011.
- Shumaker, Scott. Personal Interview. 29 Apr. 2011. - 1 May. 2011.

## Companies/Suppliers:

- **Factory Five** - <http://www.factoryfive.com/>
- **Ford** - "Ford." Ford. N.p., n.d. Web. 1 Oct. 2011. <<http://www.ford.ca/app/fo/index.do>>.
- **Fortin's Engines (Chilliwack)** - "FORTINS." *Fortins*. N.p., n.d. Web. 2 Oct. 2011. <[http://www.fortins.com/fortins\\_engines.php](http://www.fortins.com/fortins_engines.php)>.
- **Hooker Headers** - "Holley Performance Hooker Products." Holley Performance Carburetors, Fuel Injection, and Fuel Pumps. N.p., n.d. Web. 2 Oct. 2011. <<http://www.holley.com/division/Hooker.asp>>.
- **Mopac (Langley)** - "Welcome to Mopac Auto Supply - Where Power is Everything.." *Mopac Auto Supply*. N.p., n.d. Web. 2 Oct. 2011. <<http://www.mopacautosupply.com/>>.

- **TreMec** - "Transmission Technologies Corporation (TTC)." *TTC Transmission Technologies Corporation . N.p., n.d. Web. 2 Oct. 2011.*  
<<http://www.ttcautomotive.com/English/home/home.asp>>.
- **Western Canada Cobras (Alberta)** - <http://www.westerncanadacobras.com/>

## APPENDIX A: PROCESS JOURNAL EXTRACTS:

### My Goal

My goal is to learn the basic mechanics and functions of the parts within a vehicle. To do this, I, along with the help of my step dad (Dean Fleming) will build a Mk4 Roadster which is an exact replica of a 1965 Shelby Cobra. This car is simple light weight and right down to the core all out power. When stripped down to its basics it includes the Body, Frame, Drive train (engine, transmission & rear differential), Suspension & Electrical systems. During the process of building the car I will learn in basics what each system and part does to make the car run. So when someone asks a question about how something works within the car, I can give a fairly detailed answer to the question being asked. For example, "Explain to me what the carburetor does?" I will go on to tell them what I know about what a carburetor does within the vehicle.

### 07/03/2011 - Engine Decisions

Journal #2

Over the past week or so Dean and I have been deciding on the different options we have been given to customize our car. For example instead of the standard black metal roll bars we have upgraded to the chrome coated roll bars behind the driver's seat. We have to decide on the specifications now because The Factory Five Company has to make the cut-outs for our choices. On a more important note we have to decide upon our engine size. Our two choices are a 302 and a 351. These numbers mean how many cubic inches of all cylinders of the engine combined. Generally the higher cubic inches more horse power. (Below are the two engine choices, 302 on the left and the 351 on the right.) The 302 engine delivers 350 HP (Horse Power) and the 351 engine delivers 435 HP (Horse Power), the 302 is more an everyday driving style engine but still has a lot of "Kick". The 351 engine is usually a "street performance" engine with a bit more "get up and go power." Going forward I will continue to find the answers to my questions. As well I look forward to the course and researching some more about the different systems within a car.

302



351



## **28/05/2011 - Body off (1h)**

Journal #10

Today we removed the body from the frame but before doing this we had to remove the vintage jacks which are mounted on the body in the front and back just below the lights. Originally they were used to lift the car up quickly to switch the tires when in a race but are now just for show. They are a bit tricky to put back on because they are each cut at a different angle to compensate for the body so that it sits straight. Next I got to use our new dolly to unscrew the two screws which hold the bottom of the body to the frame. Next by using the measurements of the body Dean cut a 2x4 to fit from the dash board to the back of the seating area to prevent the body from collapsing on it-self when we lifted it off of the frame. Next I asked my mom (Jay Lynne Fleming) to help us take the body off and place it on the body buck. This is because the body has to be pulled out from the sides and with one person at the front and one at the back we had no one to pull the sides out and up but now we did and so we got the body off swiftly and smoothly and placed it on the buck with no problem. There are pictures of us doing this below. This part didn't take us very long but we did read through the manual to see what was next so it only took us about an hour of work today.

## **11/06/2011 - Sheet Metal (2h)**

Journal #12

Today was pretty much the same stuff as the last time. We spent about 2 hours drilling and marking the panels so they can be installed swiftly. It is somewhat irritating because you are doing the same thing over and over again. In short you line the panel up on the frame where it is going to be riveted to take a sharpie and trace the frame lines to the panel. Then you take a pre-made ruler that we got from Factory Five which gives us perfectly spread hole markings for the size of the panel so we don't have to measure the distance of each hole from one to the next. We then take the panel to the drill press where we drill out each hole and if the panel is too hard to fit under the drill press we have to hand drill the holes. Then once all of the holes are drilled we have to go back with a smaller drill and a large shaving drill bit which takes all of the leftover burrs off of the holes so they are smooth and flush for when we rivet the panels to the car. This the point where it is very important to mark each of the panels so when you are stacking them up after drilling the holes you don't have to install them like you are doing a jigsaw puzzle. Thankfully we marked them with precision so we know exactly where they go when we put them back on the frame. It was just another one of those days where you just have to get the hard stuff done so everything will continue to move swiftly. Dean had a great idea to hook up the action camera that we had just got from the guy that is handling the paperwork for us to create a time-laps video then in the end it will almost look like we built it in 1 day. Instead of it being a constant video we set the camera to take a picture every 30 seconds when we are working on the car. I think it will look great when we finish.

## **27/06/2011 - Front Suspension (3h)**

Journal #13

Today we started the front suspension we spent approximately 3 hours doing this. We started by unpacking the boxes and laying everything out on the table. We started by mounting the upper and lower control arms to the frame on the left and right sides. We then assembled the coil over shock which is instead of having the shock absorber and the spring separate the spring rests over the shock absorber. It wasn't too easy to mount the coil over shock because multiple spacers must be implanted in between the frame and the ball joint on the top and bottom of the coil over shock so the bolt will fit snug in the frame. We had a bit of trouble trying to get the snap rings off of the shock absorber to fit the adjustment casing to loosen or tighten the spring. It was quite frustrating but eventually we got it, and it is working smoothly. We then installed the "disk" portion of the disk brakes to each set of control arms a quick rub of acetone to get the grime off, tighten a couple bolts and we were done for the day. The car is ready for the front brakes tomorrow.

## **28/06/2011 - Front Brakes (2h)**

Journal #14

Today we spent about 2 hours working on the front brakes. This was fairly easy because during kind of the research portion of the project before we left to go to the build school we replaced the rear brake pads on Dean's Jeep. We started by unpacking the Brake pads, hardware and calipers themselves. The front brakes are much larger than the rear brakes as they have 2 pistons instead of just one because when a car stops all of the motion going forward would tear smaller brakes. We placed the pads inside the slots. The tricky part was folding over the rubber seal cap from the mounting rods to the point where the fluid enters because it kept popping off the lip when we moved it. Eventually I got it and we greased the mounting rods and mounted the brakes over the disks and to the frame which was fairly straightforward. That was our main objective for the day and we completed it.

## **04/07/2011 - Rear Differential, Brakes & 3 link Suspension (4h)**

Journal #15

Since it has been a couple days since we last did work on the car we decided to make a dent and get the rear differential, brakes and 3 link suspension done. We finished in about 4 hours or so. Firstly you had to take a part the rear differential to replace a "C" clip within the gears and so because it was more so a one man job and was slightly complicated dean took over. Once that was finished and the backing plate was bolted back on we started by filling the rear differential with grease so the gears will turn smoothly. We then mounted the rear differential to the frame with some serious sized bolts. We used the jack to help us raise it to the brackets where it bolts to because it was fairly heavy to lift even with 2 people. Then we moved on to the 3 link suspension, they call it that because it is

connected to the frame in 3 different places. This includes the panhard bar which stops the side to side movement of the car when cornering. Without it the rear end of the car would crush itself. Then there is the main up and down shock absorbers which attach to the frame like the front suspension. Installing the 3 link suspension was fairly easy because all it took was 3 very large bolts to go through the frame. The only tricky part was getting the spacers to fit properly because it was a very tight fit. All of the suspension components must be set to the right length for it the function to its full capacity. Lastly we moved on to the rear brakes and like the front brakes, installed the disks on both sides. Then placed the brake pads within the calipers and inserted the mounting rods which the sealers had to be attached to like the front brakes but i had an easier time with these ones. We mounted the calipers to the frame and around the disks, and that pretty much summed up the days' work.

## **07/07/2011 - Fire wall/Driver Foot-box & Gas Tank (3h)**

Journal # 16

Today we spent about 3 hours drilling and riveting the driver side foot-box/firewall which was slightly difficult because there was a lot of holes to be drilled from underneath the frame which is sore on the arms after a while but eventually we got it done and the first few panels mounted on which I already explained how we put them on. On the floor panel we coated the bottom with a rough black tar like finish to protect it from rocks, dirt and other things on the road. Although drilling and riveting panels is easy it is very time consuming. Once that was done we moved on to trying to mount the gas tank. We fussed with it for a while because after we mounted the steel strapping harness for the gas tank we realized that the straps didn't align with the groves that we in the bottom of the gas tank. So after about 15 minutes of not coming up with anything, I went up and started to write more of this process journal and dean stayed and tried to figure out what was wrong. Finally Dean got it to fit and we just had to call it a day because it was quite frustrating trying to figure out what was going on. I definitively learned that sometimes you need to adjust parts or hardware yourself to make them work when you are building a car.

## **16/07/2011 - Brake Lines (4h)**

Journal #21

As this part of the car it very important and can be very difficult and stressful to do Dean took over as I was away. It took about 4 hours to find the right length of rod and bend it along the frame from the brake calipers to the master cylinder which we haven't installed yet but it sits on the frame above the driver's side foot-box as it a part of the pedal box assembly. To bend the brake lines one of the easier ways is to use a vice mounted to a work bench and a socket, the size depending on how tight the bend is but the smaller socket you use the more likelihood of you kinking the line and then you have to start all over again with a new line. We used 5 separate lines to complete all four brakes, 2 in the front and 3 lines in the back. If you find the right length of line and bend it to the frame properly to start with you won't have to cut the line and flare the end of it to attach another line to which is another painstaking job if you don't get it right the first time. Fortunately Dean only had to do one flare at the rear to connect two brake lines which he did perfectly and there was no problem. For some people this job can be very overwhelming and very time consuming. Eventually without too much trouble Dean fit all of the lines along the frame and to the brakes calipers properly. Dean was done for the day after he mounted the brake lines to the frame, not looking forward to



bleeding the brakes where we make sure all of the connections don't leak. Next to finish we just have to mount the pedal box and reservoirs then bleed the brakes to make sure there is no air left in the lines.

## **25/07/2011 - Organizing Electrical (1h)**

Journal #22

Today we only spent about an hour unpacking and sorting out the electrical. We had to start somewhere on what we believe to be the most difficult job. We laid the very multi-colored wiring harness on the workbench and began to go through each wire reading what it was for and if we didn't need it we would mark it to be cut, for example electric widows which we don't have on the car. We organized which bunch of wires went to the front of the car, to the engine or to the dashboard for some examples. It wasn't much but it was something done, so we could feel good about that.

## **07/08/2011 - Pedal Box (2h)**

Journal #23

Today we left the electrical and mounted the pedal box which consists of the master cylinders the brake and the clutch pedals as well we ordered a single jointed aluminum gas pedal to match the brake and clutch pedal instead of staying with the standard black double jointed pedal. This looks much nicer. We had to assemble most of the pedal box which we did fairly swiftly; mounting the pedals and clutch cable to their proper positions, we then drilled six separate holes into the frame and bolted the pedal box to the frame on the driver's side foot box. This took us about 2 hours without any major problems.

## **10/08/2011 - Brake Lines Final Hook-ups & Line Lock Install (2h)**

Journal #24

Today we did the final hook ups for the brake lines, which took us about 2 hours. We also installed our specially ordered line lock kit. This mechanism when a switch is flipped on the dashboard locks the front brakes, which is good for doing burnouts or warming up the tires before and drag race, this is one of my favourite extras we have put on the car. We also bought a missile launch switch so it looks dangerous on the dashboard. We then hooked up the front and rear brake lines to the master cylinder which was very simple, we just made sure there was a snug fit and tightened the fastening strap. We also tightened all of the fastenings to the brake calipers on all four brakes. The Brake lines are ready to be bleed after we hook up the reservoirs which we didn't have time to do today.

## **12/08/2011 - Reservoir Installation (2h)**

Journal #25

Today was fairly simple as we only took 2 hours to mount the two reservoirs to the back side of the dash in the engine bay. They were mostly pre-assembled we just had to mount them to the sheet metal. The mounting was a bit tricky but a simple fix.. Everything looked good so far but we waited to hook up the hoses to the master cylinders until we are going to bleed the brakes which is the next thing we are going to do.

## **12/08/2011 – Engine Running (2h)**

Journal #42

Today was the second best day of this project in its entirety. This is because one special key made one big and very loud 351 engine start up. It must have shook, the building, blew my ear drums and gave our neighbours a heart attack. All we had to do before we turned the key was double check the distributor was hooked up properly to the spark plugs with the spark plug leads so it would fire properly. Then double check the wiring to the ignition switch was hooked up correctly which it was and so we tightened the screws. Dean came up with a make shift filler neck lid so fumes would spray back when we started it while I went to get the jerry can out of the Jeep. We filled the tank about half way and closed the cap off. Then we filled the radiator with half water and half antifreeze solution. Then we filled the engine with more oil and tightened the caps. Now was the moment of truth, was there going to be any leaks in the fuel lines, did we not hook something up properly, it all came down to this. We turned the key half way and the fuel pump came on which was good because that meant we had power from the battery, then turned it all the way and the beast started and then died. It was a glimmer of hope. But luckily we were expecting this as the build school instructor told us it would take 3 or 4 tries to get it running because none of the valves have been opened before and you needed to get the juices flowing. On the fourth try it rained happiness, we gave it some throttle and the beast roared, it was the best sound I have heard the whole time I have been doing this project. I couldn't get the massive grin off my face. It was finally something to justify all of our hard work.

## **APPENDIX B: MK4 ROADSTER VEHICLE SPECIFICATIONS:**

### **Suspension:**

Front Suspension type:	Independent double arm
Rear Suspension type:	3 link with panhard bar
Shock - Springs:	Koni coil over with ride height adjustability
Steering:	Manual
Brakes:	Vented 11/11.65 disc f/r
Wheels:	Vintage Halibrand-style 17" diameter
Tires:	Kumho Ecsta XS - 245cm Front / 315cm Rear

### **Vehicle:**

Weight:	2,300 lbs.
Weight Distribution F/R:	46.9/53.1 %
Wheelbase:	90 inches
Overall Length:	158 inches
Front Track:	58.5 inches
Rear Track:	58.5 inches
Overall Height:	48.0 inches
Overall Width:	70.5 inches
Ground Clearance:	4.0 inches
Fuel Capacity:	15 gallons/56.8 litres

## Construction:

Layout:	Front/Middle Engine RWD Roadster
Frame:	Twin tube space frame with integral backbone
Roll Cage:	3 point, structurally mounted 2 inch DOM tubing
Sub-Structure:	Aluminum paneling riveted and bonded to frame
Restraint System:	5 point Simpson Harness

"Factory Five Racing." *Factory Five Racing*. Factory Five Racing Inc., n.d. Web. 15 Aug. 2011.  
<<http://www.factoryfive.com/>>.

-

## APPENDIX C: MK4 PERFORMANCE SPECIFICATIONS:

### Performance Comparison (Source Car and Driver Magazine)

Vehicle Type	0-60 MPH Sec.	0-100 MPH Sec.	¼ Mile Sec @ MPH	Braking 70-0 MPH Feet	Skid Pad Lateral G	Curb Weight lbs.	Price as Tested
<b>Factory Five Mk4 *</b>	3.6	9.0	12.3 @ 113	181	1.00	2,062	\$32,109
<b>Ferrari Enzo</b>	3.3	6.6	11.2 @ 136	151	1.05	3,262	\$659,430
<b>Ford Shelby GT500</b>	4.5	10.3	12.9 @ 112	172	0.90	3,896	\$45,000
<b>Ferrari F430</b>	4.1	9.4	12.5 @ 116	162	0.97	3,344	\$192,545
<b>Lamborghini Murcielago</b>	3.8	8.8	12.6 @ 116	155	0.98	4,058	\$283,600
<b>Dodge Viper SRT- 10</b>	3.9	9.2	12.1 @ 119	166	1.00	3,214	\$85,109

1<sup>st</sup>

2<sup>nd</sup>

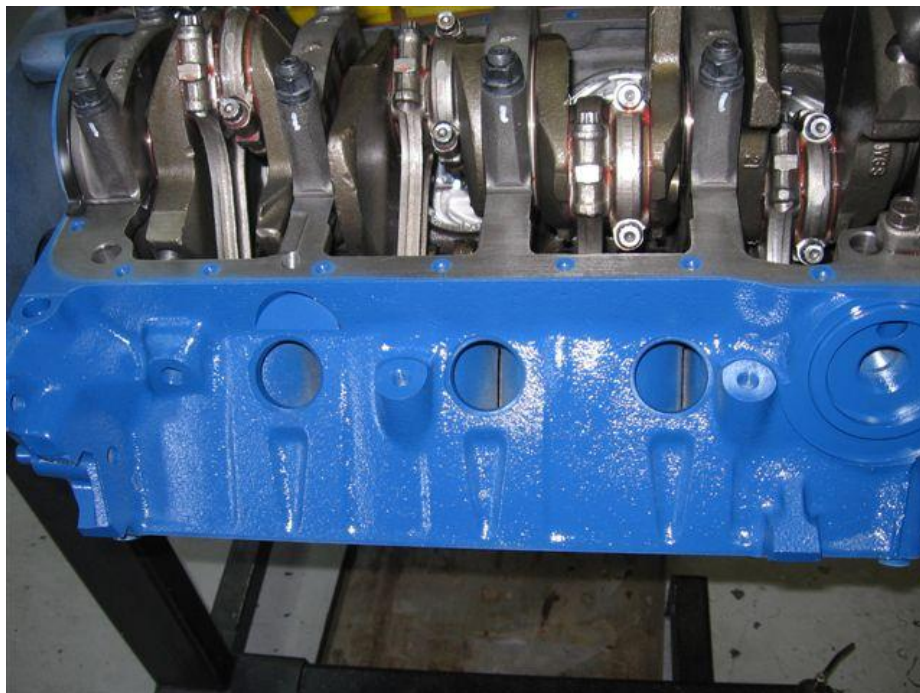
3<sup>rd</sup>

\* Not our Roadster – This Roadster was built by a FFR Engineer Dave Riha. This car delivers 298hp at the rear wheels powered by a 325hp small-block Ford engine.

"Factory Five Racing." *Factory Five Racing*. Factory Five Racing Inc., n.d. Web. 15 Aug. 2011. <<http://www.factoryfive.com/>>.

## APPENDIX D: FORTINS ENGINE ASSEMBLY PICTURES:

*Crank Case – Where  
pistons are attached  
(Bottom of engine)*



*Side View of  
Crank Case*



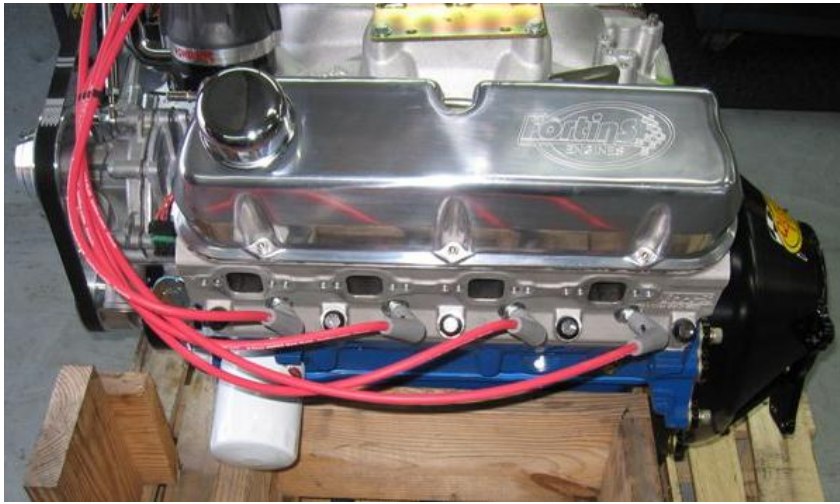


*Top of motor  
looking down at  
the pistons*

*Valves with valve  
covers off*



*The Finished  
Product  
Delivering over  
450hp*





## **APPENDIX E: BUILD SCHOOL PICTURES & SUMMARY EXTRACTS:**

### **Factory Five Build School Syllabus ~ The Itinerary**

#### **Friday Objectives:**

**8:00 AM: Introductions & Continental Breakfast**

**9:00 AM: Unpacking you kit**

**10:00 AM: Break**

**10:15 AM: Front Suspension**

**12:00 PM: Lunch is served**

**1:00 PM: Rear Suspension**

**3:00 PM: Break**

**3:15 PM: Pedal box**

**4:30 PM: Passenger side foot box**

**~ By the end of Friday's class it should be a rolling chassis ~**

#### **Saturday Objectives:**

**8:00 AM: Introductions & Continental Breakfast**

**8:15 AM: Bleeding brakes & Flaring**

**10:00 AM: Break**

**10:30 AM: Set the engine**

**12:00 PM: Lunch is served**

**1:00 PM: Wiring**

**3:00 PM: Break**

**3:15 PM: Final Hook-ups**

**4:30 PM: Engine Test**

**~ By the end of Saturday's class the engine should be in and running ~**

**Sunday Objectives:**

**8:00 AM: Introductions & Continental Breakfast**

**8:15 AM: Body Prep**

**10:00 AM: Break**

**10:30 AM: Seat Belts**

**11:00 AM: Body on**

**12:00 PM: Lunch is served**

**1:00 PM: Wind Shield**

**2:00 PM: Doors**

**3:00 PM: Break**

**3:15 PM: Final fit & trim**

**4:30 PM: Instructor Test Drive**

## Day 1 Pictures (Friday - 29/04/2011)



**This is the 302 engine sitting on its block until we get to the stage where we get to install it.**



**This is an inside view of the passenger seat in the car before we have taken the body off which is what it comes like in the crate and you have to take all of the paneling off and drill through the pre-done rivets.**



**This is me taking notes on the key points which the instructor is giving us on the body work, paint jobs, taking the body off and building a body buck which the body will sit on until it is time for it to be painted.**



**In this photo I along with the other participant are carefully removing the body from the frame and placing it onto the body buck because we won't need it for a while. The instructor is also telling us how to take the body off and the wood support like the one in the photograph, you need to keep the body from collapsing on it-self.**



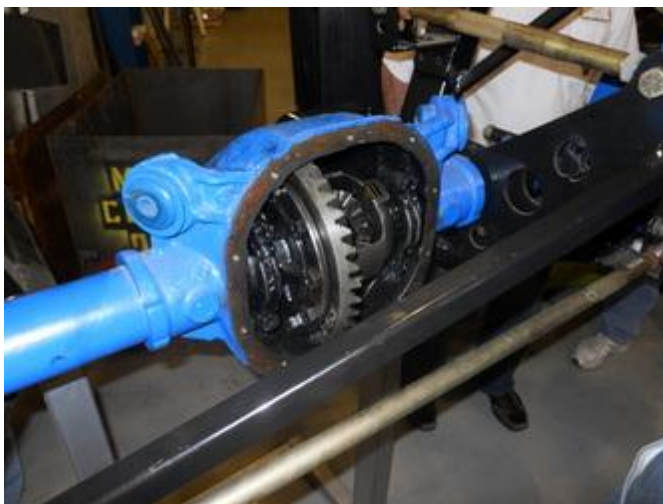
**This is the body sitting on the body buck where it will sit until all of the under body parts have been installed.**



**Here is the base frame which the car is built around.**



**A picture of the frame and paneling which laid under the body. The instructor is also explaining how to properly mark the panels and drill out the rivets that are holding them there.**



**This was a model of the rear axle which the back plate had been unbolted and so it was a model diagram for the instructors to show us what really goes on within the axle as well as how you can take the right and left sides of the axle out of the casing but only very carefully.**





**This is a photo of me installing the rear shock absorber, which was not an easy task. It took a lot of effort to get the pin through the top so we could bolt it down, but nothings impossible and we eventually got it.**



**This is the fame with the front and rear suspension as well as the front and rear axles mounted.**



**Here we are installing the basis of the gas tank and mounting it to the frame. There are no fuel lines attached at this stage.**



**The last thing we did on day one was installing the foot pedals along with the fuel reserves. As well the instructor is explaining to us how Factory Five tells you to only use one reserve it is always safer to use two in-case there is a leak in one you have the other for back up. We then bolted these on and were done for the day.**

### Day 1 Summary

After a lot of information being rushed into my head from the first moment I stepped into the college I began to comprehend what I was getting myself into. Although I was ever so thankful for the manual Factory Five provides each kit with. Even though the manual is like 4 inches thick most of it is pictures explaining and showing you how to put together each part of the car. After day 1 was complete Dean and I discussed how good of an idea this was. From the first hour in the class we realized how much time taking this course is going to save us when we start to build our Roadster. Just the little tips and tricks on minor things that the instructors taught us and the book didn't provided us with many useful insights into how we are going to put our Roadster together when the time comes. It doesn't look like we have completed much from the first day but we weren't necessarily supposed to, a lot of the class was spent on the instructor telling us what to do right and what the manual does not say to do. As well as more details specifically appointed toward each member of the class if they are using a donor car or not or just using some parts of a donor car it was all explained very nicely.

## Day 2 Pictures (Saturday - 30/04/2011)



**This is what the Roadster we are building looked like at the start of the second day, with the front and rear suspension, brakes, rear differential, pedal box assembly and the steering shaft in place.**



**Here is a side view of the car with the driver and passenger side foot boxes installed. As well as the 2 reservoirs mounted to the back side of the dash.**



**This was very exciting because this was the part everybody was waiting for, the engine has been hooked on the the engine crane and is being lowered onto the engine blocks on the frame.**





**Where the engine sits is vital if it is just off the mark you won't be able to get the bolt through the hole so you must be exact when you place the engine on its blocks .**



**This is the engine bolted in place with the electrical systems sitting on top waiting to be hooked up and wired through the rest of the car.**



**This is what the engine looks like and its model, a 5.0 fuel injected 302 Cobra engine.**



**This is an image of the mounted side exhaust pipes and the fully wired electrical system to and from the engine. As well as all of the paneling in place, ready for the body to be put on.**



**A photo of the electrical spark plug leads coming from the engine. As well as the headers which join up to the exhaust pipes.**



**The last thing we did on day two was the instructor fired up the engine which filled the room with echoing vibrations, and he taught us what to expect and what to do the first time you start up your engine, to make sure everything is running properly, as well as checking your gas and brake lines. Then we all got to sit in the drivers seat and see what it feels like, this is Dean testing out how crammed in he is.**

## Day 2 Summary

Day 2 was probably the most exciting day other than watching the instructor take the Roadster for a spin because we got so much done in a very short time. We probably learn the most useful information today because of the amount of hands on work we did on the car. From finishing off most of the paneling to installing the engine and hooking up all the wires. As well two different Roadster owners one of them being one of our instructors brought their Roadster in for us to see them. I especially liked how even though they are the same car there are so many differences in the layouts and options you can put into your car. Today I'm taking away that you have to keep everything very, very organized and planned out so you don't start asking yourself , wait a second where does this bolt go and pray that it's not for something important.

## Day 3 Pictures (Sunday - 1/05/2011)



**For the start of day 3 we began to put the dash board together. The instructor taught us how to properly fit the leather covering onto the panel.**



**Here we have finished installing the gauges to the dash board, you can get all different types of gauges which will tell you what you want to know that's going on within the car. This is just the basic set, speed, rpm, etc.**





**Here we are screwing the dashboard to the frame and looking for a snug fit against the frame.**



**To the body we go, we installed the tail lights and head lights which are not as easy as it may seem as getting inside the body of the car is not so easy when it is on the body buck, but we got it done and the lights were ready to be hooked up to the battery.**



**This is a picture of us lowering the gas tank on a jack stand so the body can fit over properly and the filler tube can be placed correctly.**



**This is most of the group helping to put the body on as you have to pull the sides out and down so it sits nicely on the frame.**



**With the body finally on we can hook up the lights and fasten the radiator.**



**One of the final parts to be placed on the car is the windshield which is very fragile if a screw is too loose or too tight it could crack, and so the instructor gave us an 8 min lecture on what to do when unpacking and installing the windshield. Luckily i videoed the lecture so we will know exactly what to do when the time comes.**



**Here we are installing the windshield into the frame mounts and tightening up the screws.**



**A last shot of the car before we mount the wheels on and take the jack-stands away.**



**The wheels have been mounted and the car is being lowered to the ground, but we had to do a final sweep of left over rivets so we don't get any flat tires.**





**The view of what the finished dashboard looks like with the steering wheel, gauges and sifter in place.**



**The final product without the hood as the instructor took it out for a spin and showed us what it can do as you can watch in the videos below.**



**Me in the finished product of the Mk4 Roadster.... We have a lot of work cut out for us when our Roadster arrives.**



### Day 3 Summary

Day 3 was an awesome day because we finished the Roadster but also because I think it's a relief that if we plan and stage the building of our Roadster well the job won't be overwhelming. One of my favourite quotes from one of the instructors which is very true is "If you are becoming frustrated, LEAVE and come back to it tomorrow before you break something." The instructors helped greatly today when we were installing the windshield and putting the body on because each of these parts to the car are not easy to fix if you damage them, and so the instructors told us exactly what to do if we have a fresh paint job done to the body and are ready to have the body mounted what the proper way of doing that would be and how to specifically tighten each screw on the windshield just enough but not to overdo it and break the glass. The last tip I took away from this course was patience as you need a lot of it if Dean and I are going to build this car. All in all I had a great time at the course and would recommend it to anybody thinking of building anyone of Factory Five's cars.

## APPENDIX F: MY MK4 ROADSTER BUILD PICTURES

For a full detailed set of pictures, more journal entries plus video of the build process as we did it, please see my web site at:

<http://mjspersonalproject.weebly.com>





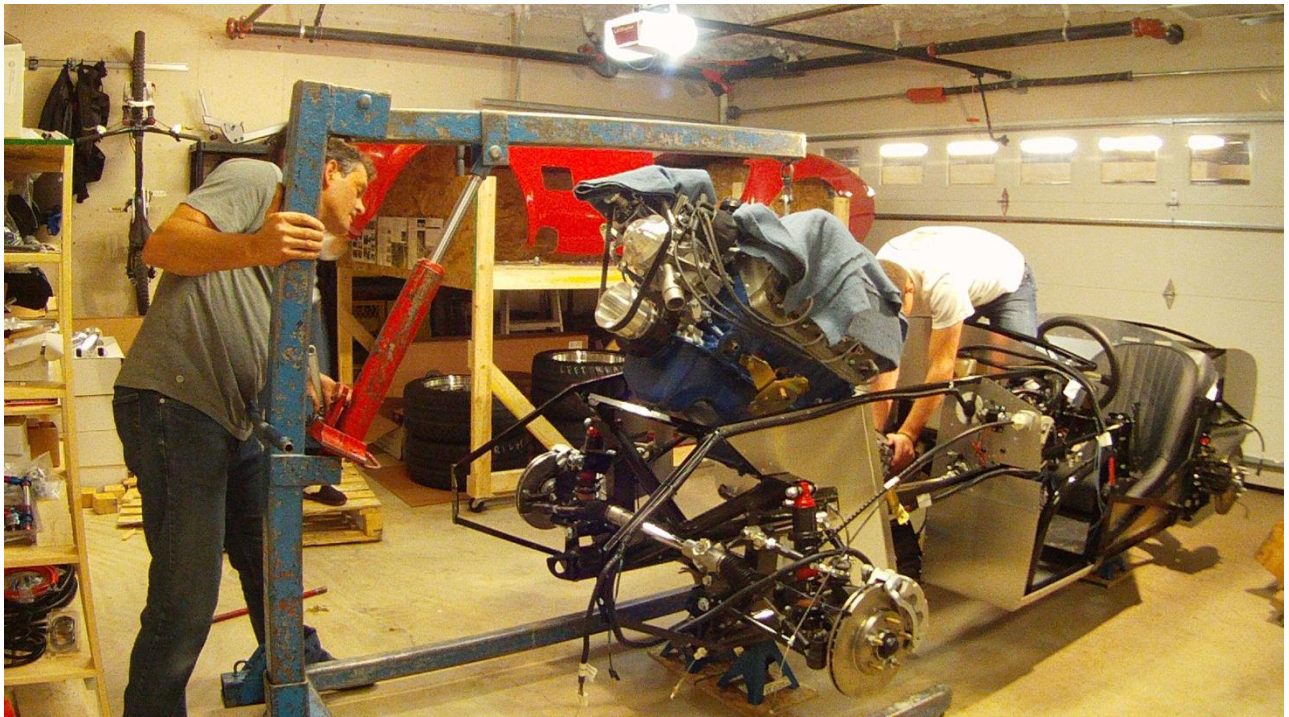








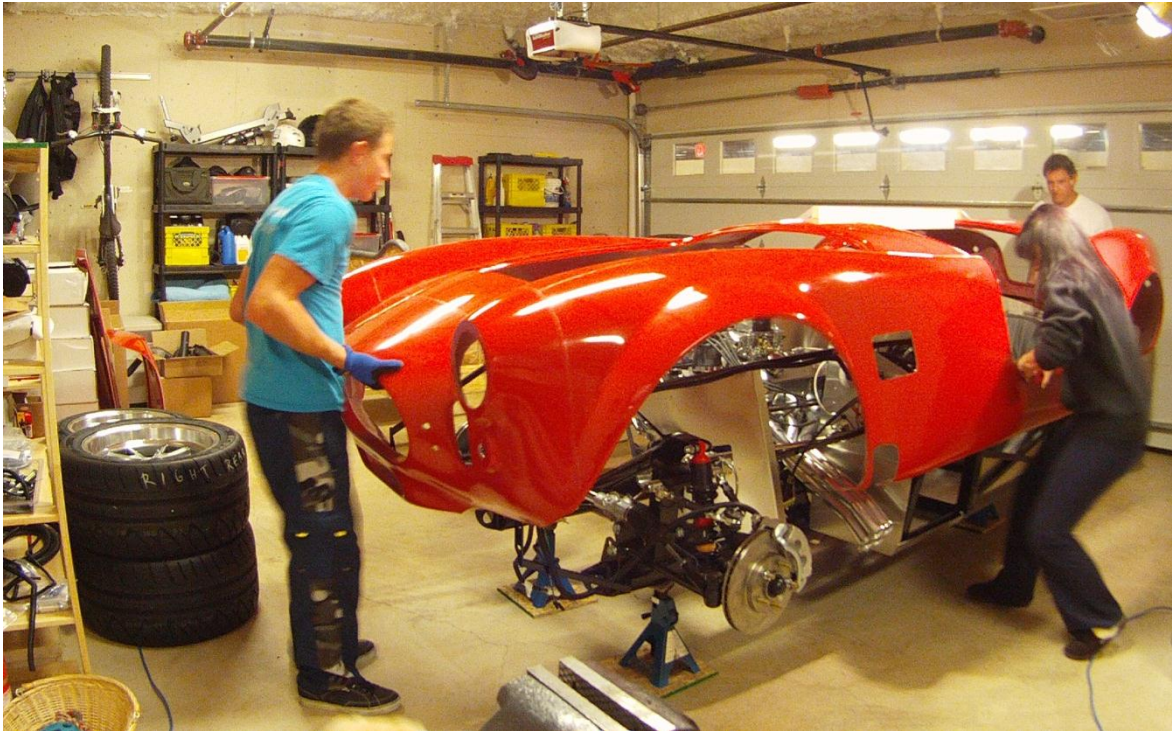
















**THIS IS NOT THE END...**

**...IT IS JUST THE BEGINNING**