PVC Vehicle

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Ravage

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1st - 2nd Hour

Research and Development

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Reference Page

- www.gokartgalaxy.com
- www.northerntool.com
- www.wilkinsonsteel.com
- www.wikipedia.org
- 8 HP Honda Engine Manual
- Comet Torque Converter Manual
- www.diygokarts.com
- www.kartbuilding.net
- Bill and Nick Walker from Parts Store
- Mark Ott and Chuck Frogge from Lakeside Collision
- Bob Adamek from Bodies by Bob Incorporated
- Mr. Mike Skoglund from Carry-On Trailer Corporation

The Idea

The idea of this project has an automotive base. This is also a hybrid with a go-kart theme. This oversized go-kart frame will be constructed entirely of PVC pipe and fittings. This project will test the student's ability to design, fabricate, and work with a team to reach a common goal. Once the "Poly Concept Vehicle" is fully assembled, it will be tested. The four vehicles will face off head to head in a series of vigorous challenges. Things like acceleration, agility, speed, braking and driver ability are the focus of the Testing. In the end, one vehicle will stand out as the best engineered piece of machinery.

Defining the Problem

We all encounter problems on a daily basis. Most of us would try to ignore the problem or go around it. Engineers, however, would try to solve it. The engineering process starts with identifying a problem, then conducting research, finding and analyzing possible solutions, and finishes with creating a product or solution. In the Research and Development class at Dakota High School, our first problem was selecting projects for the year. We came up with the concept of designing vehicles out of PVC that we could race and test out key elements such as steering, braking, acceleration and mileage.

The group needs to work as a team to research all of the various parts. We also need to find out how the parts work and how to integrate them into the vehicle. The vehicles would be based on go-karts, but expanded to make the go-karts look like real vehicles. We will be accommodating an 8 hp engine and need full steering and braking systems. The body should be made with aerodynamics in mind, which will lower wind resistance. This will result in greater speeds and better gas mileage.

Our vehicle will have a torque converter bolted to the crankshaft, that way a clutch pedal won't be used and the cart can still idle when at low RPM's. When the driver applies the gas, the higher RPM's will expand the clutch weights; subsequently the weights will grip making the cart move. The go kart will need to stop at some point, so a disc brake assembly will be mounted to the rear axle. From research, we have concluded that disc brakes are superior to drum brakes for stopping. The faster the kart can stop, the more agile it will be.

Other problems within our main challenge come from the constraints. Our vehicles cannot exceed a length of 9 feet, height of 5 feet, or a width of 4 ½ feet. As a class we had to research a uniform set of wheels, axle, and engine. Aside from those select parts, it was up to each group to find the majority of parts that would work best for them. A challenge would be not only finding top of the line parts, but also staying within our budget.

To make sure our vehicles are up to par, we will have an assessment involving tests of racing, turning radius, visual appearance, frame strength, gas mileage, endurance race, and off-road racing. It is up to each group to design and plan out two tests. We need in-depth descriptions and accurate illustrations. Moreover, these tests will prove how hard we worked to make this project a reality. This project will test what we have learned over the past 4 years with designing, researching, and applying everything we know about the designing and building process.

The Research

Aluminum Alloy 3003

Available Shapes	Typical Chemistry	Characteristcs	Typical Applications	Mechanical Properties	Fabrication Guide

Available Shapes

3003 is available in Coil, Plate and Sheet.

- Top -

Typical Chemistry (% Maximum unless shown as a range)

Cu	Si	Fe	Mn	Zn	Al
0.20	0.60	0.7	1.0 / 1.5	0.10	Balance

- Top -

Characteristics

The 3003 alloy is non-heat-treatable, its corrosion resistance and formability are excellent, but its anodzing characteristics are rated as fair.

- Top -

Typical Applications

3003 is often used in general sheet metal work, stamped, spun and drawn parts, cabinets, mail boxes, food and chemical storage and handling. If part is to be anodized consider 5005, if higher strength is desired consider 5052.

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Mechanical Properties

	Tensile Strength		Yield Strength		Elongation	Brinell Hardness
	ksi	MPa	ksi	MPa	% in 2" (50mm)	
3003-0	16.0	110	6.0	40	30	28

3003-H12	19.0	135	18.0	125	10	35
3003-H14	22.0	155	21.0	155	8	40
3003-H16	26.0	180	25.0	175	5	47
3003-H18	29.0	205	27.0	190	4	-

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Fabrication Guide

				Weldability		
	Corrosion Resistance	Formability	Machinability	Mpa	TIG	Resist.
3003-0	A	A	E	A	A	A
3003-H14	A	B	D	A	A	A
3003-H18	A	C	D	A	A	A

Aluminum Alloy 5052

Available Shapes | Typical Chemistry | Characteristcs | Typical Applications | Mechanical Properties | Fabrication Guide

Available Shapes

5052 is available in Coil, Plate and Sheet.

- Top -

Typical Chemistry (% Maximum unless shown as a range)

Cu	Si + Fe	Mn	Mg	Zn	Cr	Al
0.10	0.45	0.10	2.2 / 2.8	0.10	0.15 / 0.35	Balance

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Characteristics

5052 is one of the higher strength non-heat-treatable alloys. It has a high fatigue strength and is a good choice for structures subjected to excessive vibration. The alloy has excellent corrosion resistance, particularly in marine atmospheres. The formability of the grade is excellent and in the annealed condition it offers higher strengths than 1100 or 3003 grades.

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Typical Applications

5052 is often used in high strength sheet metal work, marine components, appliances, fuel and oil tubing.

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Mechanical Properties

	Tensile Strength		Yield Strength		Elongation	Brinell Hardness
	ksi	MPa	ksi	MPa	% in 2" (50mm)	
5052-0	28.0	196	13.0	91	25	47
5052-H32	33.0	231	28.0	196	12	60
5052-H34	38.0	266	31.0	217	10	68

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Fabrication Guide

				Weldability		
	Corrosion Resistance	Formability	Machinability	Mpa	TIG	Resist.
5052-0	A	A	D	A	A	B
5052-H14	A	B	C	A	A	A
5052-H18	A	B	C	A	A	A

Aluminum Alloy 6061

Available Shapes	Typical Chemistry	Characteristcs	Typical Applications	Mechanical Properties	Fabrication Guide

Available Shapes

Alloy 6061 is available as sheet, plate, extruded shapes, rod & bar, pipe & tube.

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Typical Chemistry (% Maximum unless shown as a range)

Cu	Si	Fe	Mn	Mg	Zn	Cr	Ti	Al
0.15 / 0.40	0.4 / 0.8	0.70	0.15	0.80 / 1.2	0.25	0.04 / 0.35	0.15	Balance

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Characteristics

6061 is a heat-treatable grade widely used in light to medium strength structural applications. The alloy has good corrosion resistance and weldability and possesses good formability in the 0 to T4 tempers. 6061 does lose appreciable strength when welded and it is replaced by the 5000 series alloys where afterweld strength is a prime consideration.

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Typical Applications

6061 is used in structural areas where both strength and corrosion resistance is required, truck bodies and frames, and towers.

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Mechanical Properties

	Tensile Strength		Yield Strength		Elongation	Brinell Hardness
	ksi	MPa	ksi	MPa	% in 2" (50mm)	
6061-0	18.0	126	8.0	56	25	30

6061-T4	34.0	238	22.0	154	21	65
6061-T6 (T651)	44.0	308	41.0	287	17	95

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Fabrication Guide

				Weldability		
	Corrosion Resistance	Formability	Machinability	Mpa	TIG	Resist.
6061-0	B	A	D	A	A	B
6061-T4	B	B	C	A	A	A
6061-T6 (T651)	B	C	C	A	A	A

Aluminium alloy

From Wikipedia, the free encyclopedia

Aluminium alloys are alloys of aluminium, often with copper, zinc, manganese, silicon, or magnesium. They are much lighter and more corrosion resistant than plain carbon steel, but not quite as corrosion resistant as pure aluminium. Bare aluminium alloy surfaces will keep their apparent shine in a dry environment due to the formation of a clear, protective oxide layer. Galvanic corrosion can be rapid when aluminium alloy is placed in electrical contact with stainless steel, or other metals with a more negative corrosion potential than the aluminium alloy, in a wet environment. Aluminium alloy and stainless steel parts should only be used together in water-containing systems or outdoor installations if provision is made for either electrical or electrolytic isolation between the two metals.

Aluminium alloy compositions are registered with the Aluminium Association. Many organizations publish more specific standards for the manufacture of aluminium alloy, including the Society of Automotive Engineers standards organization, specifically its aerospace standards subgroups,[1] and the ASTM.

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Engineering use

Overview

Aluminium alloys with a wide range of properties are used in engineering structures. Alloy systems are classified by a number system (ANSI) or by names indicating their main alloying constituents (DIN and ISO). Selecting the right alloy for a given application entails considerations of strength, ductility, formability, weldability and corrosion resistance to name a few. A brief historical overview of alloys and manufacturing technologies is given in Ref.[2] Aluminium is used extensively in modern aircraft due to its high strength to weight ratio.

Flexibility considerations

Improper use of aluminium may result in problems, particularly in contrast to iron or steel, which appear "better behaved" to the intuitive designer, mechanic, or technician. The reduction by two thirds of the weight of an aluminium part compared with a similarly sized iron or steel part seems enormously attractive, but it must be noted that this replacement is accompanied by a reduction by two thirds in the stiffness of the part. Therefore, although direct replacement of an iron or steel part with a duplicate made from aluminium may still give acceptable strength to withstand peak loads, the increased flexibility will cause three times more deflection in the part.

Where failure is not an issue but excessive flex is undesirable due to requirements for precision of location, or efficiency of transmission of power, simple replacement of steel tubing with similarly sized aluminium tubing will result in a degree of flex which is undesirable; for instance, the increased flex under operating loads caused by replacing steel bicycle frame tubing with aluminium tubing of identical dimensions will cause misalignment of the power-train as well as absorbing the operating force. To increase the rigidity by increasing the thickness of the walls of the tubing increases the weight proportionately, so that the advantages of lighter weight are lost as the rigidity is restored.

In such cases, aluminium may best be used by redesigning the dimension of the part to suit its characteristics; for instance making a bicycle frame of aluminium tubing that has an oversize diameter rather than thicker walls. In this way, rigidity can be restored or even enhanced without increasing weight.[3] The limit to this process is the increase in susceptibility to buckling failure.

The latest models of the Corvette automobile, among others, are a good example of redesigning parts to make best use of aluminium's advantages. The aluminium chassis members and suspension parts of these cars have large overall dimensions for stiffness but are lightened by reducing cross-sectional area and removing unneeded metal. As a result, they are not only equally or more durable and stiff than the steel parts they replace, but they possess an airy gracefulness that most people find attractive. Similarly, aluminium bicycle frames can be optimally designed so as to provide rigidity where required, yet exhibit some extra flexibility, which functions as a natural shock absorber for the rider.

The strength and durability of aluminium varies widely, not only as a result of the components of the specific alloy, but also as a result of the manufacturing process. This variability, plus a learning curve in employing it, has from time to time gained aluminium a bad reputation. For instance, a high frequency of failure in many poorly designed early aluminium bicycle frames in the 1970s hurt aluminium's reputation for this use. However, the widespread use of aluminium components in the aerospace and high-performance automotive industries, where huge stresses are withstood with vanishingly small failure rates, illustrates that properly built aluminium bicycle components need not be intrinsically unreliable. Time and experience has subsequently proven this to be the case.

Similarly, use of aluminium in automotive applications, particularly in engine parts that must survive in difficult conditions, has benefited from development over time. An Audi engineer, in commenting about the V12 engine--producing over 500 horsepower (370 kW)--of an Auto Union race car of the 1930s that was recently restored by the Audi factory, noted that the engine's original aluminium alloy would today be used only for lawn furniture and the like. As recently as the 1960s, the aluminium cylinder heads and crankcase of the Corvair earned a reputation for failure and stripping of threads in holes, even as large as spark plug holes, which is not seen in current aluminium cylinder heads.

One important structural limitation of an aluminium alloy is its fatigue properties. While steel has a high fatigue limit (the structure can theoretically withstand an infinite number of cyclical loadings at this stress), aluminium's fatigue limit is near zero, meaning that it will eventually fail under even very small cyclic loadings, but for small stresses this can take an exceedingly long time.

Heat sensitivity considerations

Often, the metal's sensitivity to heat must also be considered. Even a relatively routine workshop procedure involving heating is complicated by the fact that aluminium, unlike steel, will melt without first glowing red. Forming operations where a blow torch is used therefore requires some expertise, since no visual signs reveal how close the material is to melting.

Aluminium also is subject to internal stresses and strains when it is overheated; the tendency of the metal to creep under these stresses tends to result in delayed distortions. For instance, the warping or cracking of overheated aluminium automobile cylinder heads is commonly observed, sometimes years later, as is the tendency of welded aluminium bicycle frames to gradually twist out of alignment from the stresses of the welding process. Thus, the aerospace industry avoids heat altogether by joining parts with adhesives or mechanical fasteners. Adhesive bonding was used in some bicycle frames in the 1970s, with unfortunate results when the aluminium tubing corroded slightly, loosening the adhesive and collapsing the frame.

Stresses in overheated aluminium can be relieved by heat-treating the parts in an oven and gradually cooling it — in effect annealing the stresses. Yet these parts may still become distorted, so that heat-treating of welded bicycle frames, for instance, can result in a significant fraction becoming misaligned. If the misalignment is not too severe, the cooled parts may be bent into alignment. Of course, if the frame is properly designed for rigidity (see above), that bending will require enormous force.

Aluminium's intolerance to high temperatures has not precluded its use in rocketry; even for use in constructing combustion chambers where gases can reach 3500 K. The Agena upper stage engine used a regeneratively cooled aluminium design for some parts of the nozzle, including the thermally critical throat region; in fact the extremely high thermal conductivity of aluminium prevented the throat from reaching the melting point even under massive heat flux, resulting in a reliable lightweight component.

Household wiring

Because of its high conductivity and relatively low price compared with copper in the 1960s, aluminium was introduced at that time for household electrical wiring in the United States, even though many fixtures had not been designed to accept aluminium wire. But the new use brought some problems:

- The greater coefficient of thermal expansion of aluminium causes the wire to expand and contract relative to the dissimilar metal screw connection, eventually loosening the connection.
- Pure aluminium has a tendency to "creep" under steady sustained pressure (to a greater degree as the temperature rises), again loosening the connection.
- Galvanic corrosion from the dissimilar metals increases the electrical resistance of the connection.

All of this resulted in overheated and loose connections, and this in turn resulted in some fires. Builders then became wary of using the wire, and many jurisdictions outlawed its use in very small sizes, in new construction. Yet newer fixtures eventually were introduced with connections designed to avoid loosening and overheating. At first they were marked "Al/Cu", but they now bear a "CO/ALR" coding.

Another way to forestall the heating problem is to crimp the aluminium wire to a short "pigtail" of copper wire. A properly done high-pressure crimp by the proper tool is tight enough to reduce any thermal expansion of the aluminium. Today, new alloys, designs, and methods are used for aluminium wiring in combination with aluminium terminations.

See also: Aluminium wire

[edit] Alloy designations

Wrought and cast aluminium alloys use different identification systems. Wrought aluminium is identified with a four digit number which identifies the alloying elements, followed by a dash, a letter identifying the type of heat treatment and a 1 to 4 digit number identifying the specific temper, e.g. 6061-T6, the most common free-machining aluminium alloy. Cast aluminium alloys use a four to five digit number with a decimal point. The digit in the hundred's place indicates the alloying elements, while the digit after the decimal point indicates the form (cast shape or ingot)

Wrought alloys

The International Alloy Designation System is the most widely accepted naming scheme for wrought alloys. Each alloy is given a four digit number, where the first digit indicates the major alloying elements.

- 1000 series are essenitally pure aluminium with a minimum 99% aluminium content by weight and can be work hardened
- 2000 series are alloyed with copper, can be precipitation hardened to strengths comparable to steel. Formerly referred to as duralumin, they were once the most common aerospace alloys, but were susceptible to stress corrosion cracking and are increasingly replaced by 7000 series in new designs.
- 3000 series are alloyed with manganese, and can be work hardened
- 4000 series are alloyed with silicon. They are also known as silumin
- 5000 series are alloyed with magnesium, derive most of their strength from solution hardening, and

can also be work hardened to strengths comparable to steel

- 6000 series are alloyed with magnesium and silicon, are easy to machine, and can be precipitation hardened, but not to the high strengths that 2000, 5000 and 7000 can reach.
- 7000 series are alloyed with zinc, and can be precipitation hardened to the highest strengths of any aluminium alloy.
- 8000 series are a miscellaneous category

Wrought aluminum alloy composition limits (% weight)

Alloy	Si	Fe	Cu	Mn	Mg	Cr	Zn	V	Ti	Bi	Ga	Pb	Zr	Other		Al
														each	total	
1060	0.25	0.35	0.05	0.03	0.03	0.03	0.05	0.05	0.03	0.03	0.03	0.03	0.03	0.03		99.6 min
1100	0.95 Si+Fe		0.05 - 0.20	0.05			0.10							0.05	0.15	99.0 min
2014	0.50 -1.2	0.7	3.9-5.0	0.40 -1.2	0.20 -0.8	0.10	0.25		0.15					0.05	0.15	remainder
2024	0.50	0.50	3.8-4.9	0.30 -0.9	1.2-1.8	0.10	0.25		0.15					0.05	0.15	remainder
2219	0.2	0.30	5.8-6.8	0.20 - 0.40	0.02		0.10	0.05 - 0.15	0.02 - 0.10				0.10 - 0.25	0.05	0.15	remainder

3003	0.6	0.7	0.05-0.20	1.0-1.5			0.10							0.05	0.15	remainder
3004	0.30	0.7	0.25	1.0-1.5	0.8-1.3		0.25							0.05	0.15	remainder
3102	0.40	0.7	0.10	0.05-0.40			0.30		0.10					0.05	0.15	remainder
4043	4.5-6.0	0.80	0.30	0.05	0.05		0.10		0.20					0.05	0.15	remainder
5052	0.25	0.40	0.10	0.10	2.2-2.8	0.15-0.35	0.10							0.05	0.15	remainder
5083	0.40	0.40	0.10	0.40-1.0	4.0-4.9	0.05-0.25	0.25		0.15					0.05	0.15	remainder
5086	0.40	0.50	0.10	0.20-0.7	3.5-4.5	0.05-0.25	0.25		0.15					0.05	0.15	remainder
5154	0.25	0.40	0.10	0.10	3.10-3.90	0.15-0.35	0.20		0.20					0.05	0.15	remainder
5356	0.25	0.40	0.10	0.10	4.50-5.50	0.05-0.20	0.10		0.06-0.20					0.05	0.15	remainder
5454	0.25	0.40	0.10	0.50-1.0	2.4-3.0	0.05-0.20	0.25		0.20					0.05	0.15	remainder

5456	0.25	0.40	0.10	0.50-1.0	4.7-5.5	0.05-0.20	0.25		0.20					0.05	0.15	remainder
6005	0.6-0.9	0.35	0.10	0.10	0.40-0.6	0.10	0.10		0.10					0.05	0.15	remainder
6005A †	0.50-0.9	0.35	0.30	0.50	0.40-0.7	0.30	0.20		0.10					0.05	0.15	remainder
6060	0.30-0.6	0.10-0.30	0.10	0.10	0.35-0.6	0.5	0.15		0.10					0.05	0.15	remainder
6061	0.40-0.8	0.7	0.15-0.40	0.15	0.8-1.2	0.04-0.35	0.25		0.15					0.05	0.15	remainder
6063	0.20-0.6	0.35	0.10	0.10	0.45-0.9	0.10	0.10		0.10					0.05	0.15	remainder
6066	0.9-1.8	0.50	0.7-1.2	0.6-1.1	0.8-1.4	0.40	0.25		0.20					0.05	0.15	remainder
6070	1.0-1.7	0.50	0.15-0.40	0.40-1.0	0.50-1.2	0.10	0.25		0.15					0.05	0.15	remainder
6082	0.7-1.3	0.50	0.10	0.40-1.0	0.60-1.2	0.25	0.20		0.10					0.05	0.15	remainder
6105	0.6-1.0	0.35	0.10	0.10	0.45-0.8	0.10	0.10		0.10					0.05	0.15	remainder
6162	0.40-0.8	0.50	0.20	0.10	0.7-1.1	0.10	0.25		0.10					0.05	0.15	remainder

6262	0.40-0.8	0.7	0.15-0.40	0.15	0.8-1.2	0.04-0.14	0.25		0.15	0.40-0.7		0.40-0.7		0.05	0.15	remainder
6351	0.7-1.3	0.50	0.10	0.40-0.8	0.40-0.8		0.20		0.20					0.05	0.15	remainder
6463	0.20-0.6	0.15	0.20	0.05	0.45-0.9		0.05							0.05	0.15	remainder
7005	0.35	0.40	0.10	0.20-0.7	1.0-1.8	0.06-0.20	4.0-5.0		0.01-0.06				0.08-0.20	0.05	0.15	remainder
7072	0.7 Si+Fe		0.10	0.10	0.10		0.8-1.3							0.05	0.15	remainder
7075	0.40	0.50	1.2-2.0	0.30	2.1-2.9	0.18-0.28	5.1-6.1		0.20					0.05	0.15	remainder
7116	0.15	0.30	0.50-1.1	0.05	0.8-1.4		4.2-5.2	0.05	0.05		0.03			0.05	0.15	remainder
7129	0.15	0.30	0.50-0.9	0.10	1.3-2.0	0.10	4.2-5.2	0.05	0.05		0.03			0.05	0.15	remainder
7178	0.40	0.50	1.6-2.4	0.30	2.4-3.1	0.18-0.28	6.3-7.3		0.20					0.05	0.15	remainder
†Manganese plus chromium must be between 0.12-0.50%.																

The "other" limits apply to all elements, whether a table column exists for them or not, for which no other limit is specified.

Cast alloys

The Aluminium Association (AA) has adopted a nomenclature similar to that of wrought alloys. British Standard and DIN have different designations. In the AA system, the second two digits reveal the minimum percentage of aluminium, e.g. 150.x correspond to a minimum of 99.50% aluminium. The digit after the decimal point takes a value of 0 or 1, denoting casting and ingot respectively.[4] The main alloying elements in the AA system are as follows:

- 1xx.x series are minimum 99% aluminium
- 2xx.x series copper
- 3xx.x series silicon, copper and/or magnesium
- 4xx.x series silicon
- 5xx.x series magnesium
- 7xx.x series zinc
- 8xx.x series tin
- 9xx.x series miscellaneous

Named alloys

- Duralumin (copper, aluminium)
- Magnox (magnesium, aluminium)
- Silumin (aluminium, silicon)

Overview of use

Common aerospace alloys

These are aluminium alloys which have a long history of being used in aircraft and other aerospace structures.[5]

- 7075 aluminium
- 6061 aluminium

- 6063 aluminium
- 2024 aluminium
- 5052 aluminium

Other aerospace alloys

These are currently produced, but less widely used, aluminium alloys for aerospace applications.

- 2090 aluminium
- 2124 aluminium
- 2195 aluminium - Al-Li alloy, used in Space Shuttle Super Lightweight external tank
- 2219 aluminium
- 2324 aluminium
- 6013 aluminium
- 7050 aluminium
- 7055 aluminium
- 7150 aluminium
- 7475 aluminium

Marine alloys

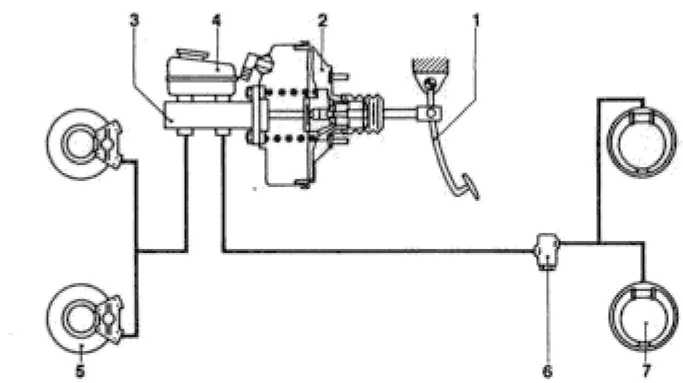
These alloys are used for boat building and shipbuilding, and other marine and salt-water sensitive shore applications.[6]

- 5052 aluminium
- 5083 aluminium
- 5086 aluminium
- 6061 aluminium
- 6063 aluminium

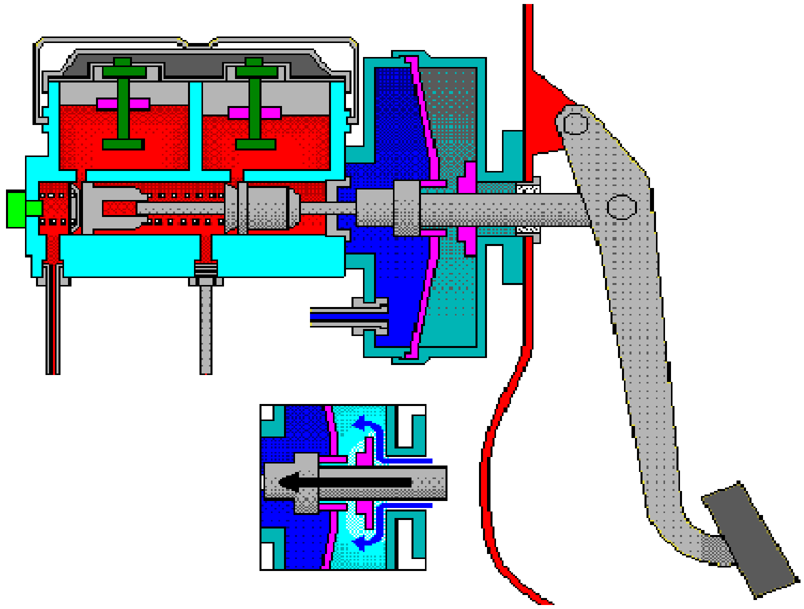
BRAKING SYSTEM COMPONENTS

When you push on the brake pedal, hydraulic pressure is generated in the master cylinder that is transmitted to the actuators -the wheel cylinders and caliper pistons- through the brake lines, thus applying the brakes.

Hydraulic braking system (passenger car).
1 Brake pedal, 2 Vacuum booster, 3 Tandem master cylinder, 4 Brake-fluid reservoir, 5 Disk brake (front), 6 Braking-force regulator, 7 Drum brake (rear).



The Master Cylinder – holds hydraulic fluid, displaces hydraulic pressure to the brake system.



Torque Converters

How does a Comet torque converter work? The drive clutch is activated by centrifugal force from the engine crankshaft. The moveable sheave of the clutch is forced in as the RPM of the engine is increased. This contacts the drive belt. The drive belt will then be forced to a larger diamter within the clutch sheaves, thus pulling it to a smaller diameter within the driven unit sheaves. The moveable sheave of the driven unit is forced out, allowing the belt to seek its smaller, high speed ratio diameter. As this happens, the speed from the engine transferred to the final drive is increased.

Model 20 Series (Symmetrical)

The model 20 uses a 3/4" top width belt. The belt mass lends substantially to the driving ability of the system especially in cases where added torque ability is required without danger of slipping the belt. The belt mass of 3/4" top width is especially helpful in applications of low speed, added power requirements such as tractor mowers, off road dune buggies, mini bikes, ATV's, and go-karts. This is a conventional type system featuring 13° angle sheave faces for a 26° collective angle. Driven units available with either 6" or 7" diameter sheaves.

Model 340 Series

Comet Torque Converters for All Engines thru 8 HP. The model 340 automatic torque converter system was designed specifically for light horsepower applications such as mini bikes and lightweight sports vehicles and industrial equipment. Generally, engine driven, this converter is torque sensitive, which the vehicle or driven load has influence on establishing the ratio between the driver and driven. In normal operation, the driver "shifts into high" in response to the engine's increase in speed; the driven follows this speed change as in any variable pitch belt drive. In the torque sensitive design, a cam actuator in the driven reacts to increased torque demands by downshifting without loss of engine RPM. In this way, the engine continues to operate at peak power range for all but the most sever loads when it will shift into peak torque range.

Model 30 Series (Asymmetrical)

The model 30 uses a 3/4" top width belt. The belt mass in No. 30 is desirable in applications requiring extra rugged driving ability, such as dune buggies, go-karts, mini bikes, ATV's, grounds maintenance equipment, materials handling devices and industrial equipment. The

Model 30 series is mounted with both stationary sheaves inboard. Mounting can be on a flat, fixed plane, requiring only minimum displacement.

TAV2 Torq-A-Verter

This is an asymmetrical type torque converter system which means the sheave faces are non-symmetrical. They have different angles. In this case, the moveable sheave face is 18" while the stationary sheave face is 2-1/2" for a collective angle of 20-1/2". Here are some reasons for selecting the asymmetrical concept. The Torque-A-Verter can attain an .90:1 or 10% overdrive.

Comet Industries manufactures a Speed Limiter. Easy to install, the speed limiter is the answer to control when inexperienced drivers get behind the wheel. Learn more.

Model 40 Series

The model 40 is sometimes referred to as the "Mid-Range" torque converter systems since it falls into the middle range between the Comet series. The model 40 is a rugged piece of machinery. The drive clutch is composed of heavy walled stamped steel to withstand the extreme rigors of rough applications. Whenever there is a need, want and use for a torque sensitive drive system device that is infinitely variable form engagement to the highest speeds attainable (within the pitch diameter range), the 40 model system should be considered.

Model 44 CV "Magnum" Series (Symmetrical)

The Magnum 44 continuously variable transmission torque converter system for up to 18 HP applications is a rugged piece of machinery. The drive clutch is designed to withstand the extreme rigors of rough applications. The driven unit is of the same quality construction as the drive clutch. Application possibilities cover a wide range. By changing pucks and spring, you can convert the Magnum from the standard 4 cycle setup to be used on 2 cycle engines.

Model 500 Series

The model 500 drive and driven variable pulleys are installed in a power train drive system to better match output requirements with an engine output. If the engine is allowed to run at its peak output power, the most power available from the engine will be directed to the driven shaft. The model 500 responds to load requirements and changes the ratio between the drive and driven pulleys so that the engine can maintain its peak power output.

Model 700 (Odyssey)

Model 94C Duster Clutch Series

This is the one to use for all V-twins and high torque applications! With a beefy 1-3/16" belt, the 94C has the rugged reliability needed when you want to spend your time riding, not making repairs. A 3.49-1 low and a .78-1 high provides a wide gear range for great low end pulling power without sacrificing top speed! Custom calibration of drive unit is quick and easy allowing you to get maximum performance out of your engine. Contact Comet Industries for recommendations.

Model 103 Series

Our new 130 HPQ performance clutch for Polaris and Kawasaki ATV's. Extensive testing showed that the 103 HPQ provides up to a 25% enhancement due to a larger diameter pulley and a greater sheave angle than the OEM clutch provides.

Model 102C Series

Designed for snowmobiles and other applications that require a full range of exceptional ability from engagement through the highest speeds available from the power source, the 102C clutch is one of the best for snowmobiles and other machines using belt driven torque converters. The 102C clutch has unsurpassed tuning ability, outperforms clutches of similar design, has an open face design for economical servicing. Contact Comet Industries for recommendations.

Model 108EXP Series

Designed for snowmobiles and other applications that require a full range of exceptional ability from engagement through the highest speeds available from the power source, the 108EXP clutch is one of the best for snowmobiles and other machines using belt driven torque converters. The 108EXP clutch has unsurpassed tuning ability, outperforms clutches of similar design, has an open face design for economical servicing.Contact Comet Industries for recommendations.

4 Pro Series

The super clutch! The 108 4-Pro utilizes four clutch weights rather than three, greatly enhancing tuneability. Arms can be used in sets of two, allowing you to zero in on the amount of weight desired, and a captivated tower allows the shouldered cover bolts to virtually eliminate tower spreading. A fourth load bearing member increases the roller and button life. New moveable sheave busing, higher heat and wear resistance also extends the clutch performance.

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Comet 20 Series Torque Converter

Specifications	Features	Applications
Diameter: 4-19/32"	Simple Design	Material Handling

Comet 20 Series Torque Converter

Actuation: 2 shoes w/garter springs	Easy user installation	Go-Kart & Mini Bike
Calibration: Spring Tension	Reliable	Junior Dragster
Bore: 3/4" & 1"	20 Series Symmetrical	Lawn & Garden
HP: up to 8		Industrial Equipment
Engagement: 1200 - 3100 RPM		

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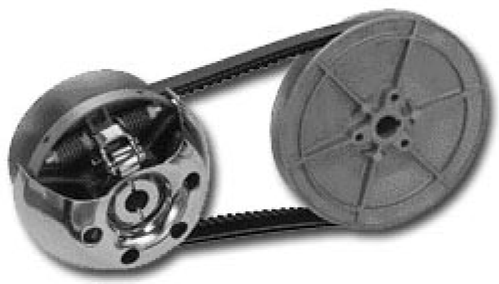
Comet 340 Series Torque Converter



Specifications	Features	Applications
Diameter: 4-1/2" & 4-3/4"	Easy User Installation	Junior Dragsters
Actuation: 3-roller Clamps	Adjustable	Go-Karts
Calibration: Spring Ramp, Weights	Reliable	Mini Bikes
Bore: 5/8" & 3/4"		Material Handling Equipment
HP: up to 8		Industrial Equipment
Engagement: 1700 - 5600 RPM		Lawn & Garden

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Comet 30 Series Torque Converter

Comet 30 Series Torque Converter

Specifications	Features	Applications
Diameter: 4-19/32"	Simple Design	Material Handling
Actuation: 2 shoes w/garter springs	Easy User Installation	Go-Kart & Mini Bike
Calibration: Spring Tension	Reliable	Junior Dragster
Bore: 3/4" & 1"	30 Series - Asymmetrical	Lawn & Garden
HP: up to 8		Industrial Equipment
Engagement: 1200 - 3100 RPM		

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Comet TAV2 Torque-A-Verter Converter

Specifications	Features	Applications

Comet TAV2 Torque-A-Verter Converter

Diameter: 6"	Can attain .90:1 or 10% overdrive	Go-Kart
Drive Clutch Engagement: 2200 RPM	Asymmetrical	Mini Bikes
Drive Belt: 3/4" Top Width Asymmetrical		Junior Dragsters
Drive Clutch Bore: 3/4" (3/16 KEY), 1" (1/4 KEY)		Industrial Equipment
HP: 8 HP (2 Cycle / 4 Cycle)		Lawn & Garden

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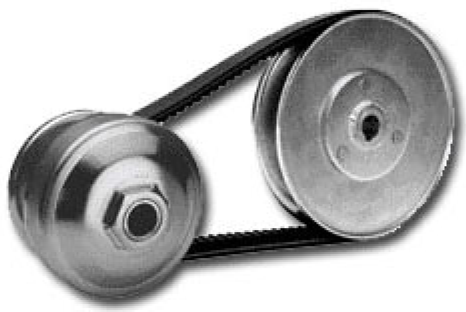
Comet 40 Series Torque Converter



Specifications	Features	Applications
Diameter: 5-17/32"	Simple Design	Go-Kart
Actuation: 3-roller	Quiet	Junior Dragster
Calibration: Spring	Durable	Light Utility Vehicle
Bore: 1"		
HP: up to 25		
Engagement: 1600 - 3100 RPM		

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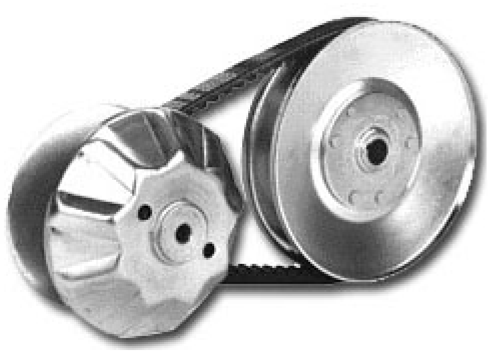
Comet 44C Series "Magnum" Torque Converter



Specifications	Features	Applications
Diameter: 5-17/32"	Durable	Go-Kart
Actuation:	Tunable	Junior Dragster
Calibration:	Adjustable	Lawn and Garden
Bore: 3/4", 1", 1-1/8" & Special	Reliable	Light Duty Utility Vehicles
HP: up to 25		Industrial Equipment
Engagement: 1900 - 3900 RPM		All Terrain Vehicles

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Comet 500 Series Torque Converter

Specifications	Features	Applications
Diameter: 5-3/8"	Adjustable	Go-Karts
Actuation: 3-roller Cams	Tunable	Junior Dragsters

Comet 500 Series Torque Converter

Calibration: Spring Ramp, WeightsReliable Utility Vehicles

Bore: 3/4" & 1"

HP: 2 cycle - 25 4 cycle - 16

Engagement: 800 - 4000 RPM

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Comet 700 Series Torque Converter

Specifications	Features	Applications
Diameter: 7-1/4"	Adjustable	Go-Karts
Actuation: 3-roller Cams	Tunable	Industrial Equipment
Calibration: Spring Ramp	Reliable	Light Utility Vehicle
Bore: 1"	Wide Ratio	
HP: 2 cycle - 25 4 cycle - 16		
Engagement: 800 - 4000 RPM		

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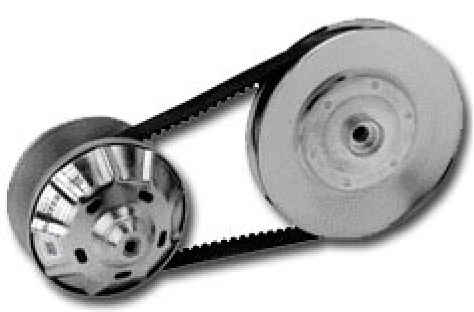
Comet 94C Series Torque Converter



Specifications	Features	Applications

Comet 94C Series Torque Converter

Diameter: 7-1/4"	Simplicity	Snowmobile
2 Cycle & 4 Cycle	Fewer Moving Parts	Golf Carts
Housing: Stamped / Cast	Easy Calibration	ATV
Bore: 30mm 1:10 Tapered 1" & 1-1/8"	Performance	Light Utility
HP: up to 40	Limited Maintenance	Industrial Equipment
Engagement: 1600 - 4600 RPM		Odyssey

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Comet 103 HPQ Series Torque Converter

Specifications	Features	Applications
Diameter: 7-9/16"	Highly Tunable	Polaris ATVs
Calibration: Swing Arm	Reliable	Kawaskai ATVs
Housing: Cast Aluminum	Quiet and Smooth	
Bore: 1:10 taper, 30mm	Heavy Duty	
HP: up to 120	Fan Cooled	
Engagement: 2500 - 5000 RPM		

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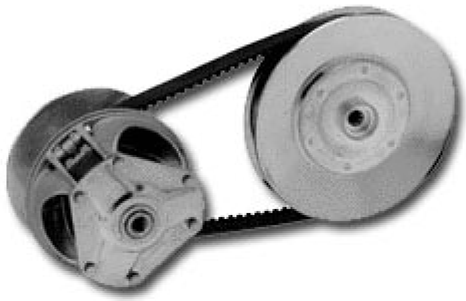
Comet 102C Series Torque Converter



Specifications	Features	Applications
Diameter: 7-9/19"	Open Face	Snowmobile
Calibration: Swing Arm	Easy Maintenance	Golf Carts
Housing: Cast Aluminum	Tuneability	Utility Vehicles
Bore: 30 mm 1:10 Tapered	Retro Fits	Industrial Equipment
HP: up to 120	Performance	Special Vehicles
Engagement: 2500 - 5000 RPM		

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108EXP Torque Converter

Specifications	Features	Applications
Diameter: 8"	Built to Handle High Horsepower Engines	Snowmobiles
Calibration: Swing Arm	Tunable	

108EXP Torque Converter

Housing: Cast Aluminum	Belt Adjustable
Bore: 30mm, 33mm 1:10 & 1:7.5 Tapered; 1-3/8" & 1-1/4" belt	Heavy Duty
HP: up to 150	Locate which 108EXP torque converter you should choose.
Engagement: 2500 to 5000 RPM	

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4-PRO Torque Converter

Specifications	Features	Applications
Diameter: 8"	Tunability	Snowmobiles
Calibration: Uncalibrated	High Heat and Wear Resistance	
Housing: Cast Aluminum	Roller & Button Life Increased	
Bore: 30mm, 33mm 1:10 Tapered; 1-3/8" belt		
HP: up to 200		
Engagement: 2500 to 5000 RPM		

Complete Set of Free Racing Kart Plans.

These plans contain information on how to build and construct this racing kart. They contain all the necessary details, including nuts, bolts and washers. Plans can be viewed using Adobe Acrobat which is typically installed on most computers.
Feel free to download and print them off yourself, however please do not redistribute these racing kart plans, but instead feel free to refer and tell people about these plans here on www.kartbuilding.net
Lastly - if there are any details you feel are missing from the Complete Set of Racing Kart plans below, please email me and, and I will endeavour to add them to the set below.

Scope of the Racing Kart Plans

This set of Racing Kart Plans do not cover transmission, drive setup, nor engine or brake selection. These Racing Kart Plans, unlike the Free Off-Road Kart Plans do not cover alternative methods of making the Kart, and assume bearings, bushings, wheels and hubs are purchased from a local engineering Suppliers. Please refer to the other sections on this Kartbuilding website for these extra details on engines, brakes, bearings, drive & transmission, wheels, steering etc.

Breakdown of the Complete Set of Racing Kart Plans

There is a seperate 1 page PDF for each area of the Racing Kart. They are arranged from 1 to 20, in the order you would begin to make the kart, i.e.: No. 20 is the last stage of making the Racing Kart.
These step by step drawings shows the assemblies, sub assemblies and details of over 40 components. Details for each drawing and step will be outlined below, with information on changing parts and components to suit your budget.

1. - Complete Assembly of the Racing Kart

- This Drawing (click on link above) shows the Overview, Layout and Dimensions/Size of the Racing Kart. You will also be able to see the various pieces involved in making up the racing kart - from the seat, to the wheels, to the axles etc. The main dimensions of the Racing Kart are: **Length 1.6meters x Width 1.2meters**, and will cater for the average-sized driver. The placement of the seat, the engine, the steering wheel and the pedals can be seen. Note that the placement of the engine and seat is up to yourself and does not matter much. The main **reason the engine is on the right of the driver is because on motorbike engines, the gear-change is generally on the left of the engine**. Thus with the engine on the right, only a short gear lever is required which provides positive gear change. The steering column & wheel and Pedals can easily be angled to one side so that they are within easy reach of the driver. There are several other features such as roll-bars/cage, emergency kill switch, chain guards, suspension etc. which can easily be implemented into this design.

2. - Labelled Overview of the Racing Kart

- The Labelled Overview of the Racing Kart **helps beginners identify key parts of a kart**, the names of which can sound complicated at first. Key parts to identify are "King Pins", "Steering

Column", "Track Rods", "Front Stub Axle", "Support Bushings", "Brakes" etc. Each of the individual parts and components within this drawing #2 will be discussed and detailed further in drawings #3 to #20 below.

3. - Chassis

The **chassis is the most important piece/section in the entire kart**. All other parts and components can be changed at a later date. As a result - a good deal of time must be spent planning, drawing out, cutting, and welding the chassis together. **The dimensions given are suitable for an average sized driver.** You can **test and confirm these sizes easily**, by placing the components (wheels, engine and seat) to the layout in this Drawing. Place yourself in the seat, and make sure there is enough room for the seat, pedals, steering wheel etc. **The front raised bumper and the "King Pin Mounting" should be left until last.** The chassis is made from 25mm outside diameter tubing with a wall thickness of 3mm for ease of welding via a MIG or MMA/Stick Welder.

It would be advisable to **draw out the chassis on the ground using chalk**, and cut the lengths of tubing based on this. The lengths of tubing can then easily be tacked in place with weld. **Measure the chassis to make sure it is square, true and not twisted**. Concrete blocks can be used while welding to secure the tubing flat to the ground. If you have access to a Pipe Bender - it would be advisable to bend the right and left front sides from one length of tubing. The reason the chassis is narrow in the front middle - is to allow the chassis to twist (a little bit) when going around corners. **The chassis must be able to twist**, otherwise the kart will not steer around corners correctly, and instead move in straight lines only. The Camber angle produces the small twist/flex in the chassis when cornering. You will notice the Camber angle on a Car when the steering wheel is fully locked to the right or left. The Front wheels of the car will be angled at 85degrees to the ground providing better traction, and better cornering. before been fully welded together. The Castor angle helps keep the front wheels pointing forwards, and as a result, if the steering wheel is let go - the kart should go in a straight line.

The "King Pin Mounting" piece is shown in its simplest form with NO bushing been used. It is simply a piece of 25mm diameter metal bar, 65mm long, with a diameter 13mm hole in the center (13mm is the diameter of the King Pin Bolt been used to attach the Front Stub Axles). A special brass insert can be fashioned and used also. **Make sure also that there are NO holes drilled or as a result of welding, in the main members of the chassis as this will weaken it greatly**. Grind all welds using a file or angle-grinder making sure they are sound.

It would be a good idea **at this stage to apply a primer and coat of Hammerite metal paint to the chassis**.

4. - Front Stub Axles and King Pins

The Front Stub Axle and King Pin is one complete piece, however **there is a Left and Right hand piece - so they are NOT identical**. Only the Left hand Front Stub Axle and King Pin is outlined in the above drawing. With some common sense, a Rigth hand part can easily be fashioned. The "n" piece of the King Pin is made up by welding 3 pieces of flat steel to form a "n" shape. **The steering arm is**

then welded to the King Pin (n shaped piece). Note this steering arm can be welded to the top of the King Pin to provide for greater room. In the plans above it was placed at the bottom, putting the track rods under the chassis and thus does not interfere with the Drivers feet etc. The angle of 110 degrees is a calculation from the Ackermann principle which is further discussed on this website here and here. The stub axle piece itself is welded onto the side of the King Pin. **If you dont have access to a Metalwork Lathe to produce the piece** as in the above Drawing, it can be made simpler by, obtaining a diameter 20mm metal bar, 125mm long. Obtain a 13mm Bolt, and cut the head off it. Then weld the 13mm bolt to the end of the 125mm long metal bar. Finally to prevent the front wheel from moving in on the Stub axle, obtain a piece of tubing, inside diameter 20mm and outside diameter approx. 30mm. Weld this small piece of tubing at the correct distance on the inside of the front wheel. The 78degrees angle is to counter-act the 12degrees Camber angle as was covered in the Chassis Drawing.
Attach the Front Stub Axles and King Pins to the Chassis using 13mm High Tension Bolts with Locknuts and washers in the appropriate places. Both Front Stub axles should now pivot and move from side to side. The "Track Rods" will tie together the Steering Arms which are welded to the King Pins. This will be outlined and covered later on in Drawing #12.

5. - Rear Axle Carrier

The Rear Axle Carrier **allows the Rear Bearings to be secured to the chassis while alloing the rear axle to rotate freely**. There are two plates which squeeze very tightly either side of a normal roller bearing. These roller bearings are cheaper than a purchased unit but are not the ideal method. When buying these bearings, and making the axle - **you must ensure that there is a VERY TIGHT FIT between the inside of the bearing and the outside of the axle**. Otherwise the axle may spin inside of the bearing - and the bearing would not serve its purpose at all! The Drawing above shows a very secure, however complicated method of attaching these bearings to the Chassis. Instead of making the rectangular enclosure, it would be possible to weld a single vertical steel plate (6mm) to the chassis, and then to use the Triangular pressure plate to squeeze the bearing, securing the outside rim of the bearing tightly while allowing the inside rim/center to rotate freely. Diameter 8mm High Tensile Steel bolts are then used to squeeze either side of the bearing as can be seen in the above drawing. Make sure to use Washers and Lock nuts so they will not loosen over time.
An **easier option to the above would be to purchase "Pillar Bearing" units** which simply bolt onto the chassis. These can be sourced from your local engineering suppliers.

6. - Rear Axle Complete

The Rear Axle can be fabricated using several methods, and depends on whether you have access to a Metalwork lathe and Milling machine. **The Axle itself is simply a 1100mm long solid metal bar of 30mm diameter.** Ideally there would be **"keyways" Milled/Ground into this metal bar**, which in conjunction with a metal "key" will **stop the rear wheels, sprocket and brake carrier from spinning freely on the axle**. The idea is that the Wheels, Sprocket Carrier and Brake Carrier all spin with the Axle. This is referred to as a "Live Axle" - i.e. the Axle itself spins (as opposed to a fixed axle). **It**

might be possible to use an Angle-Grinder to cut/grind out these keyways. It might also be possible to weld the Hubs of the wheels and the Sprocket Carrier directly to the rear axle - however it is not recommended. Although welding the wheels to the rear axle provides a quick fix, if the wheels want to be changed, or a sprocket changed etc. all the welds will have to be ground off (which is a tedious task).
You will also notice 2 shoulder pieces (diameter 40mm, 25mm long). These are pieces of tubing etc. which are either welded (via tack welding) or grub screwed to the axle. These **shoulders prevent the Axle itself from sliding/moving left and right in the middle of the Rear Axle Bearings**. Note: If you purchased and are using "Pillar Bearings" - you should not need these shoulders, as the Pillar Bearing units provide an inbuilt grub screw stopping the axle moving from side to side.

7. - Rear Hubs and Wheels

This Drawing #7 shows the **Details for making/buying suitable Wheel Hubs** which are used to attach the wheel to the Rear Axle.
Note: **Some wheels do not require a hub**. A large trolley/ wheelbarrow wheel has an incorporated hub, and does not need a seperate hub. In these cases the wheel can be placed directly onto the rear axle, and bolted/welded in place. Wide racing kart wheels however do require a Hub to secure itself to the rear axle. You can choose to buy the appropriate hub for the wheel you have, or attempt to make a proper hub yourself. **It would be possible to make a simpler hub**. The measurements and details for the Hub in this drawing are a little complicated for the average person to make, but it shows the key parts required in a typical hub, which are: A Matching Keyway to that on the Rear Axle, A Pinch Bolt to tighten the hub onto the Rear Axle to stop it moving from left to right.

8. - Brake and Sprocket Carriers

The **Brake and Sprocket Carriers are the Exact same as the Hubs used for the Rear wheels**. Extra holes may have to be drilled into the Brake Disc and the Sprocket in order to accept bolts. Use 8mm High Tensile Steel bolts with washers and Lock nuts.

9. - Rear Brakes

There are a few options which can be taken when installing Brakes onto a Kart. Typically it will involve placing a "Brake Disc" onto the rear axle, and then having "Brake Callipers/Shoes" fixed to the chassis. This Drawing shows just that - the placement of the Callipers and Brake Disc on the rear axle, and the support brackets required to secure the Callipers, preventing them from rotating.
Note: Depending on the speed of your Kart - you may require brakes on the Front wheels - however this requires more work and plans. For the moment - Brakes on the rear axle should suffice.
For sourcing the Brake Disc and Callipers, it would be best to take the whole complete front unit off a small Motorbike. Leave all the hydraulic brake pipes in place. Position the Brake lever onto the chassis - close to the Callipers on the rear axle. Operate the Brake Lever (off the motorbike) from the Brake Pedal via a manual cable. You can see it in action here and here.

Plumbing Techniques:

Gluing PVC Pipe and Fittings

In This Article:	**Related Articles:**
Purple primer is applied to PVC pipe fittings and pipe. When dry, PVC cement is applied and the pipe inserted into the fitting while rotating a quarter-turn.	• Index of Plumbing Articles • Index of Kitchen Articles • Index of Bath Articles • Cutting PVC Pipe
Skill Level: 2-3 (Basic to Intermediate)	**Time Taken:** A Few Minutes

By Bruce W. Maki, Editor

Start:

Joining PVC plastic pipe can be quick and simple when the proper procedures are followed. For best results the
the pipe should be cut reasonably straight. See Cutting PVC Pipe for more information.

	When I'm gluing PVC pipe together, the first thing I do is apply so **purple primer** to the hub of the **pipe fittings.**

Then I apply primer to the end of the pipe.

I let the primer dry for a minute before applying cement.

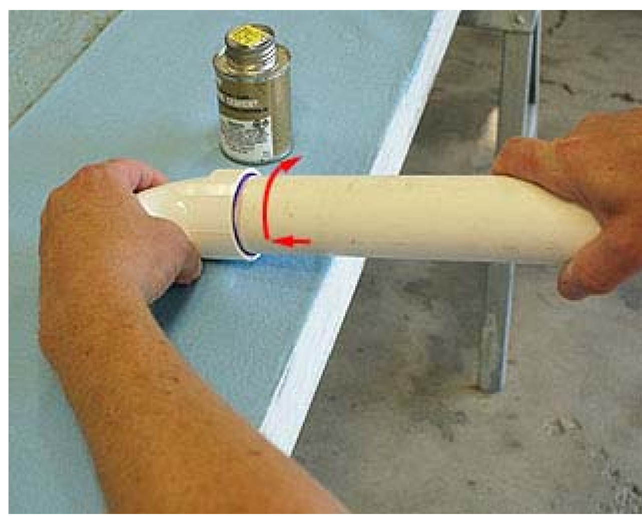
When the primer is dry, I apply some **clear PVC cement** to the hu
the pipe fitting.

Then I apply glue to the end of the pipe.

(By applying glue to the hub first, I can set the fitting down
need to worry about the glue touching the work surface.)

Then I push the pipe into the fitting **WHILE turning** the pipe about **one-quarter turn.**

BUT... I keep pushing the pipe into fitting. Often the pipe will "bounce" out of the fitting part way, so I keep the parts held together for a minute until the glue has a chance to harden.



While holding the pipe and fitting together, I wipe off the excess
with a paper towel.

The glue joint seems to dry faster if the excess glue is wiped

Within a minute or two of applying the glue the joint is ready for use... unless the temperature is colder than 50 degrees F... in which case the glue dries much more slowly.

Warning - Cement and Plumbing Codes:

There are **different types of plastic plumbing cement** available, such as **multi-purpose cement** that can be used for PVC, CPVC, and ABS. Multi-purpose cement **may not** be code-approved for use on drain lines.

I **discovered this the hard way** many years ago when I built an addition to my house. The plumbing inspector r me replace ALL of my new drain plumbing because I used the multi-purpose cement instead of the clear PVC c

The inspector told me that the can of cement needed to be labele the **UPC symbol** (that's **Uniform Plumbing Code**) for use anywher except vent lines.

My solution is to avoid buying multi-purpose cement.

Kart Steering, Physical Forces and Setup - Theory and Practice

by James Hughes

Often when asking questions about chassis and steering settings, the usual answer is simply to say changing some setting or other causes an increase or decrease in grip. There is never an explanation of the physical principles involved in causing these changes. I hope in this article to explain the physical forces involved in driving a kart, along with how those forces are generated by the steering, and what the effect is on the track of changing the various parameters available as setup.

Although a kart may seem to be rather simple device, it is perhaps a more difficult subject to explain than an equivalent car. Both vehicles have many parts and principles in common but there two major differences, which account for a large divergence in design and in setting up. These differences are the karts lack of differential, and also its lack of any suspension components.

A good knowledge of the forces involved can help greatly when setting up a kart - giving the mechanic some knowledge as to what should happen when a parameter is changed. This should result in considerably less time spent on the track testing.

Steering Geometry

The steering geometry can be regarded at the movement and displacement of the front wheels as the steering wheel is turned. This movement is quite complex, and involves a number of different settings. There is one thing in common though, and that is the reason why we need a complicated geometry - We MUST lift the inside wheel while cornering.

The inside wheel lift is what enables a kart to go round a corner without using a differential.

Because of this lack of a differential, a karts natural direction of travel, forwards, is very difficult to change. This is down to the differing radii of turn experienced by the inner and outer rear wheels while turning a corner. The inside wheel is actually travelling a shorter distance than the outside, so therefor is needs to take fewer revolutions to go round the corner. However, the two rear wheels are attached by a solid axle, and must therefor move together, so in order to turn, one of the wheels need to skid over the track surface. In a car, the differential will allow the wheels to turn at different rates, without this skidding action.

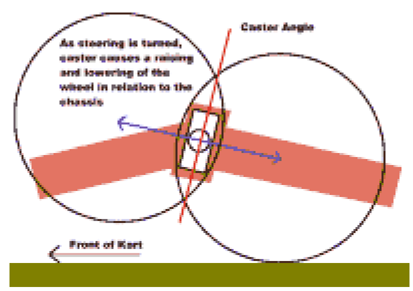
This skidding action, or indeed the lack of it, is what make a stationary kart so difficult to turn round - you have to overcome the grip of one of the tyres, and with the sticky tyres used in many kart classes this can expend a lot of energy.

This is the reason for lifting the inside wheel and it effectively turns the kart into a tricycle during the cornering process! The steering geometry causes the inner rear wheel to lift off the ground while cornering, which means the wheel can rotate faster than it is passing over the ground. The rear inner wheel is no longer touching the track, and we therefor no longer need to overcome the grip from that tyre in order to turn.

In fact, depending on the power of the engine, we may be able to allow some scrub. For example, while a Prokart may need to entirely lift the inner wheel, because it does not have enough power to overcome the scrub, a more powerful kart may have power to spare in the corner, meaning that the power loss to scrub can be overcome. However, any scrub will start to cause understeer when entering a corner, so even though the engine may be powerful, it may still be necessary to completely lift the inner rear to maintain decent handling.

However, we haven't yet explained how the front geometry can affect the rear wheel lift, and in order to do this, lets define a few terms used when describing front end geometry.

- **Camber**. This is the degree to which the front wheel lean in (or out) from each other. A camber setting of 0 means that both tyres sit flat on the track. Maximising the amount of rubber on the track is one of the aims of kart setup.
- **Caster**. This is the angle of the kingpin, which is the point around which the stub axles rotate. This is one of the most important settings for inducing wheel lift during cornering.



Click for a larger image...

Figure 1

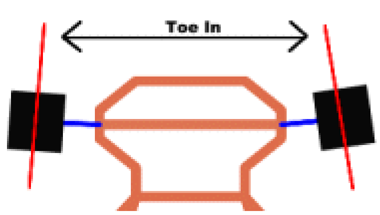


Figure 2

- **Toe In/Out**. This is the angle at which the front wheels either point in towards each other, or away from each other. Zero degrees toe in/out means that the wheels are parallel. Toe in/out is set by changing the length of the tie rods.
- **Scrub Radius**. This is distance from the centre of the tyre to the point where a line down the kingpin axis intersects the ground. Along with caster this affects wheel lift during cornering. Scrub radius is set using spacers

on the stub axle.

- **King Pin Inclination**. This is the inward lean of the kingpin, and it modifies the amount of camber change caused by the caster when steering. It is not usually possible (or necessary) to adjust the KPI although some camber adjust systems may let you do it.
- **Ackermann Steering**. Ackermann steering uses the angle of the stub axle arms (and often an offset on the steering column) to make the inner wheel on a corner turn more than the outside wheel. With cars this is used to reduce tyre scrub on corner, but of more importance to karts is the greater wheel lift effect caused by increasing the inner wheels turn when compared to the outer.

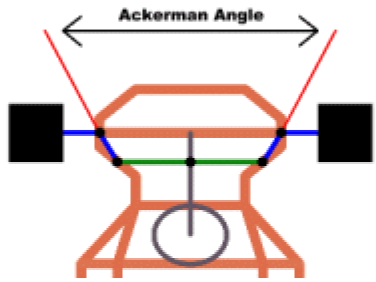


Figure 3

To help explain how the front geometries affect the rear inside wheel, lets assume that the chassis is completely rigid - it is so stiff that it cannot bend in any direction. This assumption makes things a little easier to understand. Kart chassis are not actually this stiff - they flex in a number of areas. However, the differing effects caused by differing stiffness' in various parts of the chassis are beyond the scope of this article.

When we turn a corner, the steering geometry (but mainly the caster setting and scrub radius) causes the inside wheel to move down in relationship to the chassis, and the outside wheel to move up. As this happen, because our chassis is rigid, it pivots around a line from the inside front and outside rear, causing the inside rear to lift!

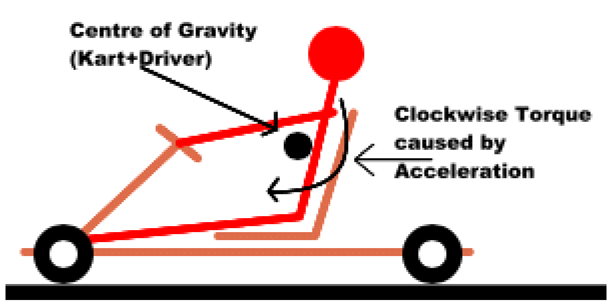
OK, so we have now explained how the front geometry is used to raise the inner rear wheel during cornering. There a quite a few other forces that come in to effect one a corner has been initiated, and that is what we will talk about next

Karting 'Forces'

During Acceleration/Deceleration

These are the most obvious forces, and are a caused by the tyres exerting a force on the track, either forwards or backwards, with the result being to brake or accelerate.

Its is important to remember that this force is in the same plane as the track, that is, it is below the karts centre of inertia. For this reason, the force exerts a



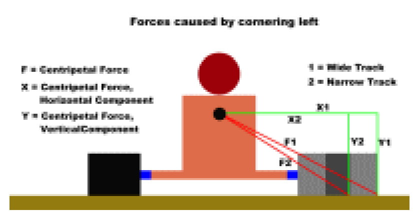
turning moment (or torque) on the entire kart. During acceleration this torque causes a weight transfer to the rear of the kart, and during braking it causes a weight transfer to the front of the kart. There is no actual movement of any mass, but the torque effectively forces the appropriate part of the kart 'harder' down on the track. It is possible to calculate the amount of weight transfer if we know the acceleration and the distance from the centre of inertia to the rear wheels, but that is beyond the scope of this article. Figure 4 shows the rotational torque while accelerating.

Figure 4

While Cornering

During cornering the driver feels like he is being pushed outwards from the kart. This is actually wrong, he is not being throw out but is simply trying to move in a straight line. The tyres of the kart are producing a grip which imparts an angular acceleration on the kart (and driver), forcing the kart to corner. It is this angular acceleration that the driver feels. The force which the ground imparts on the kart to make it corner is known as the Centripetal force, and it always acts at towards the centre of the imaginary circle we are cornering round. It important to remember that there is NO SUCH THING as centrifugal force.

In figure 5, we see that the centripetal force is split into two components, a vertical and a horizontal. The horizontal force we have just described, but the vertical can be regarded as the cornering equivalent of the forward acceleration case. Because the centripetal force is acting on the kart, it imparts acceleration to it, and again, this acceleration is acting at ground level. Therefor a torque effect is again produced, but this time it is acting across the kart, and we get a weight shift to the outside of the kart (vertical component Y in our diagram). This weight shift also helps the inside wheel lift, as the weight shift reduces the weight on the inside wheel by an equivalent amount. This force has not been show on the diagram to aid clarity, but is simply in the opposite direction over the inside rear. In fact once cornering is initiated, this weight shift is more important to raising the inside wheel than the steering geometry.

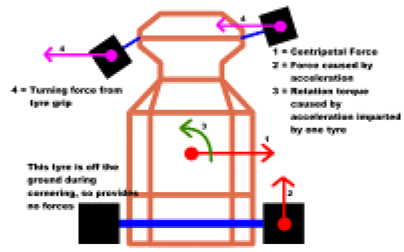


Click for larger image...

Figure 5

The distance between the rear wheels affects how the centripetal force is distributed over the horizontal and vertical components. In the diagram, F1 is the centripetal force spread over a wide track, F2 over a narrow track. In proportion to the Y components, X1 is higher than X2, meaning that as track is increased, more centripetal force is distributed as a sideways force in relation to the weight shift. This means a wider track produces less weight shift to the outside rear, and more sideways force. A narrow track increases the weight shift and decreases the sideways force. Therefor a narrow track is less likely to exceed the grip of the tyres when cornering than a wide track. Consequently, the grippier the tyres used, the wider the stance can be before the grip is exceeded.

On final force to consider is a torque around the vertical axis experienced when accelerating during a corner. It is common knowledge that braking while cornering on a kart causes massive understeer (the kart attempts to continue in a straight line) while accelerating can improve cornering. This at first seems counterintuitive, since normally when accelerating there is a weight transfer to the rear, which you would expect to try to push the inside rear back onto the track. However, this weight transfer is dwarfed by the torque around this vertical axis caused by the fact that only one wheel rear wheel in on the track, and this wheel is offset from the centre of inertia.



Click for larger image...

Figure 6

The further this wheel is from the centreline of the kart (and therefor the centre of inertia), the greater the turning moment, and the more likely the kart is the overcome the grip of the tyre on the track . This causes the back to break away - oversteer when accelerating and understeer when braking.

Handling Problems - Symptom and Cures.

Understeer at first, then a sudden grip of front which pulls you into the turn, and possibly going into oversteer.

This is usually explained by insufficient lifting on the inside wheel, causing the initial understeer. As the car starts to turn, weight transfer through centripetally caused torque on the chassis lifts the inside rear. Unfortunately, you now have so much steering lock on trying to initiate the turn, that once the inside rear lifts, the fronts are turned so far that massive oversteer usually results.

This can often be mistaken for a lack of rear end grip, since the final sensation is one of oversteer, but it in fact almost the opposite, since it's too much grip on the inside rear which is the main culprit.

We can use the steering geometry to cure this problem. As we showed above, increasing caster causes the inside front to move down further, thereby increasing inside rear lift. Also, moving the front wheels out on their stub axle (increasing the scrub radius) gives a greater effect, with the same result. Also, increasing the Ackerman effect can have an influence on this - making the inside wheel turn further and therefor move further down.

Oversteer

This is where on turning the wheel, the kart immediately and rapidly changes direction, the rear end breaks away, which results in a spin, or rear end slide.

This is down to insufficient rear end grip - as the turn is started, the inside wheel lifts, but the outside rear is unable to cope with the extra cornering forces involved, and breaks away. So we either have approached the corner too fast - and hence corner forces have overcome the grip of the tyre, or the tyre isn't producing the required grip level.

If the inside wheel is lifting a long way, this can causes grip problem since the tyre is at a larger angle to the track. Kart tyres do not react well to large angles of attack (unlike road or car race tyres which are able to distort to a greater extent because of a lower profile ratio), and this reduces grip. Reducing caster may reduce initial lift, but may also detrimentally affect initial turn in. Since the centripetal force acting on the kart overrides the caster settings while corning, there is probably a problem with the chassis more than the front geometry. It is flexing too far and allowing the rear too far off the track. Moving the rear hubs outwards can improve this situation, since a wider stance makes it harder for the centripetal forces to lift the inside rear, thereby decreasing the amount it will lift in any given corner.

If the back breaks away under braking or acceleration, then its possible that our rears are too far apart, which increases the rotational torque under changes of speed. Since this is most noticeable in wet weather, its is more fully described in the next section.

It could be that our tyre is running at the wrong pressure - and is therefor not at the right temperature to produce the required grip level. Tyre pressures are an arcane science that also won't be explored here, so the best option is to try different pressures during testing, once initial handling has been sorted out.

Wet Weather.

This is where things get (even more) complicated. The ultimate aim is the same, but because of various changed factors, there are some alterations to make…

In the wet, we are cornering much more slowly, and we cannot accelerate as fast, or brake as heavily because of the lower grip levels available.

Lower corner speed means we do not get the same level of centripetal force during cornering, so the inside rear may not lift correctly. Moving the front wheels outwards emphasises the twisting effect induced by caster, improving initial turn in. In effect the front geometry has more of an effect throughout the corner in wet weather than in dry, where it is overshadowed by the centripetal forces.

Because we still have the same amount of power available, in low grip conditions the rotational torque caused on power application can exceed the grip levels more easily, causing rapid spin out. Moving the rear wheels in reduces this torque, so more power can be applied without breaking rear end grip. Some people refer to moving the rears inwards as increasing grip. This is not strictly true - the grip level remains the same, but the power can be applied more efficiently along the chassis, giving forward acceleration, rather than as a rotation torque which can cause spin out.

Other problems

You are sure to encounter many other problems with handling, but there isn't the space to go into them all here. However, hopefully the information presented should now be enough to make an educated guess as to the causes of any problems.

Summary

You will have guessed by now that we have described an optimal set of parameters for the kart geometry and wheel setup. Of course this never happens - tyre grip level change according to the circuit, weather, and the whim of the manufacturer, some circuits are mostly large radius corners while other are very twisty. What we need is to get to a setup that sits in the mid range of acceptable parameters, and adjust along this range for a particular circuit. For example, on a low grip circuit (or in cold weather) we may want to increase the caster to improve initial turn in. In very cold weather we may want to increase toe in, forcing the tyres to scrub, and therefor warm up faster to the required grip level. However, this can cause other handling problems, which may need to be over come.

The most important thing is to ensure that the inner rear contributes little or no grip in order to improve handling and reduce scrub and hence power loss. This is so important to keeping up speed through the corner, and makes handling so much more manageable.

However, we can also see from the explanations above that changing some settings can affect more that one area. For example, changing the distance between the rear wheels affects both weight transfer across the kart, and the rotation torque caused by accelerating or braking while cornering. Setting the kart up, even with of good knowledge of why a particular change works, still requires a certain amount of track time, although hopefully with the additional knowledge presented here, this track time can be greatly reduced.

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Thanks to James Hughes for supplying the article!

Steering Geometry and Setup for Go-Karts

Published by

Stephen Burke

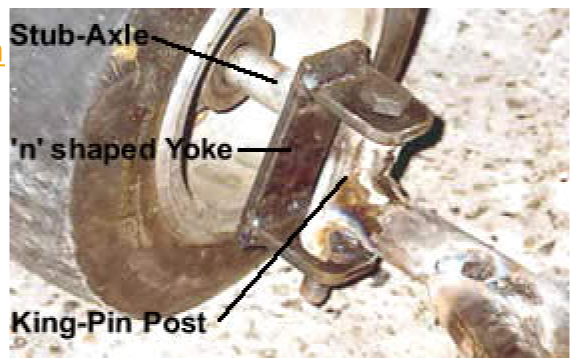
at July 12, 2007 in Steering Setups.

There are three different factors when deciding on the Steering Geometry for Go-Karts. Those are:

1. Castor Angle
2. Camber Angle
3. Ackermann Angle

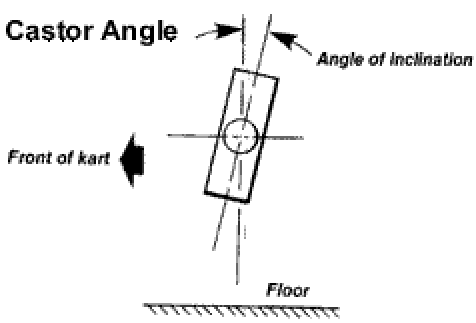
This article covers the above three factors in relation to Go-Karts with **no** suspension, and outlines typical angles and geometry which should be used. The information for this article is taken from "The NatSKA Guide to Karts and Karting" and is currently available on ebay! The off-road kart plans, and racing kart plans on this website, take into account these steering geometry angles and match the values in the above Guide.

Parts of the Steering Setup on a Kart



The (1) Stub-Axle, (2) **n** shaped Yoke, (3) King-Pin Post make up the essential parts of the steering.
The King-Pin Post is attached/welded to the chassis.
The n shaped Yoke pivots/hinges on the King-Pin Post.
The Stub-Axle is attached to the n shaped Yoke.

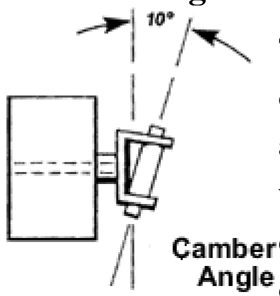
These three parts are welded/attached at various angles to make steering easier on a kart. The practical side/making of these parts are not discussed here, and instead just the theoretical setup.



Castor Angle

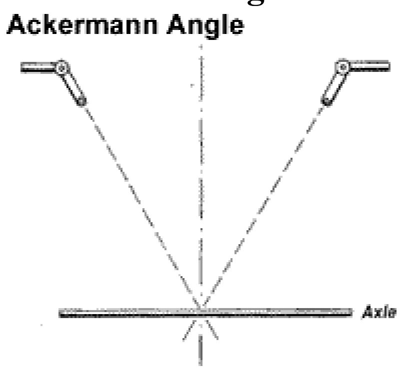
This is the inclination of the King Pin whose top leans in a backwards direction towards the rear of the kart. This is the most important factor governing how the kart will handle. This is however, interrelated with the other angles. In the case of the King Pin inclination, the greater the angle, the greater the "jacking effect" on the chassis, and the greater the oversteer the kart will develop. If there is too little, the kart will tend to understeer. The greater the angle, the heavier the steering and tendency to self-center. In practice, many people settle for angles between 20 and 25 degrees.

Camber Angle



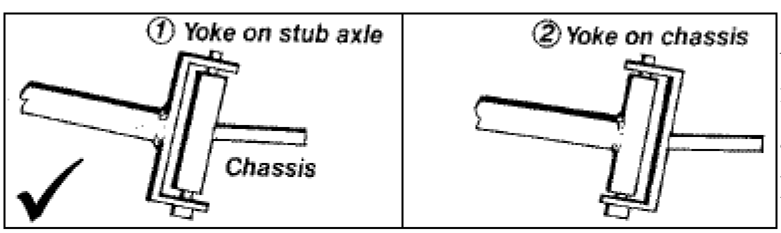
This is the inclination inwards at the top of the king pin towards the center of the kart, and it is aimed at counter-acting the jacking effect of the castor: at the same time it helps to produce a stronger joint, which will be able to withstand higher shearing forces. Generally this angle is between 10 degrees and 12 degrees, and to allow the wheels to stand flat on the floor, is offset by a similar angle on the stub axle.

Ackermann Angle



This refers to the placement of the steering arms (when viewed from above), in relation to the chassis, and the rear axle. Ideally, lines projected through the center of the King Pins, and through the bolts holding the track rods, should meet at the center point of the rear axle. The effect of this is that the inside wheel always describes a smaller radius arc than the other wheel, when the kart is being turned - this is most especially important at low speeds, and on tight corners. The length of the steering arm, in relation to the spade/drop arm, effects the "speed" of the steering reaction. A long steering arm causes slow but very light steering, whereas a short arm causes quick steering but requires greater effort.

Correct Placement/Arrangement of n shaped Yoke

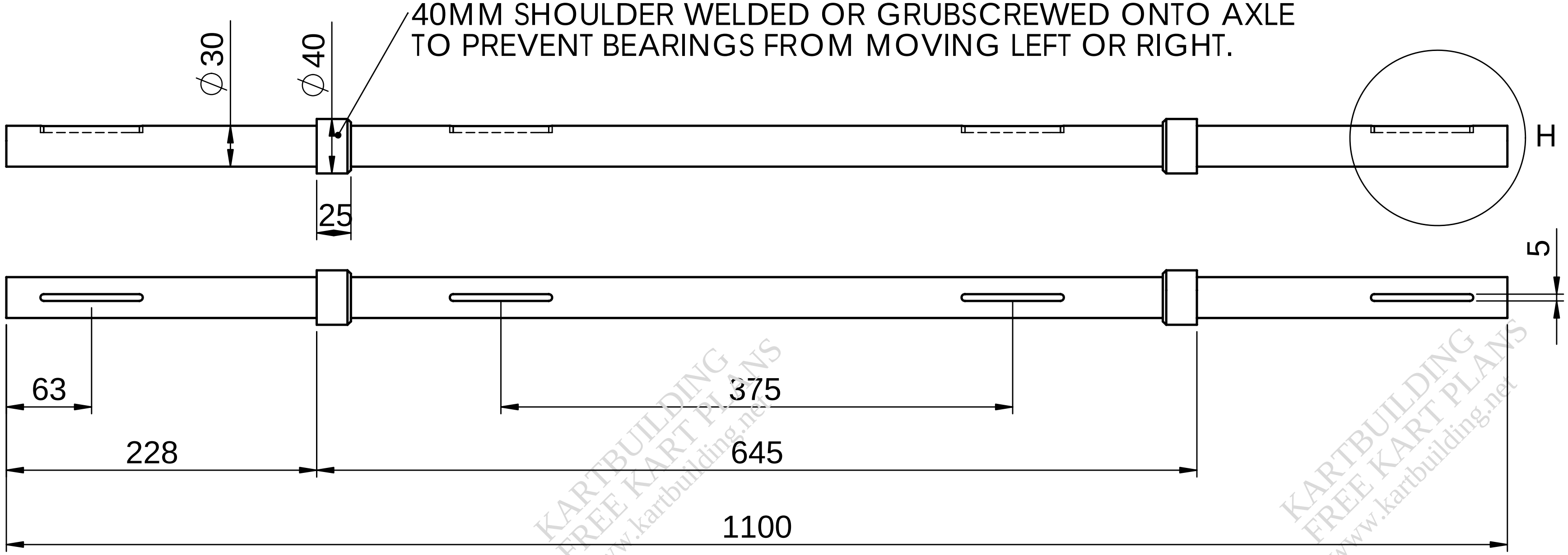


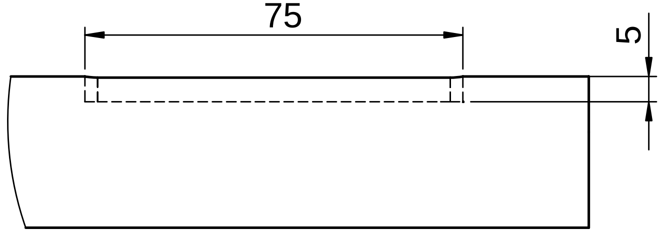
As can be seen from the following image, there are two possible arrangements of the **n** shaped Yoke. It can be attached to the chassis, or it can be attached to the stub axle (recommended). It is recommended that you attach the "King Pin Post" to the chassis, and that the n shaped yoke is attached to the front stub axle. This will make it easier if you are installing brakes on the front wheels. It also provides for greater clearance for the steering arm. The problem with installing the n shaped Yoke on the chassis, is that when attempting to achieve "full steering lock" the steering arm hits off the n shaped Yoke. This

was found on a previous kart and a notch had to be removed from the steering arm to allow for extra steering lock.

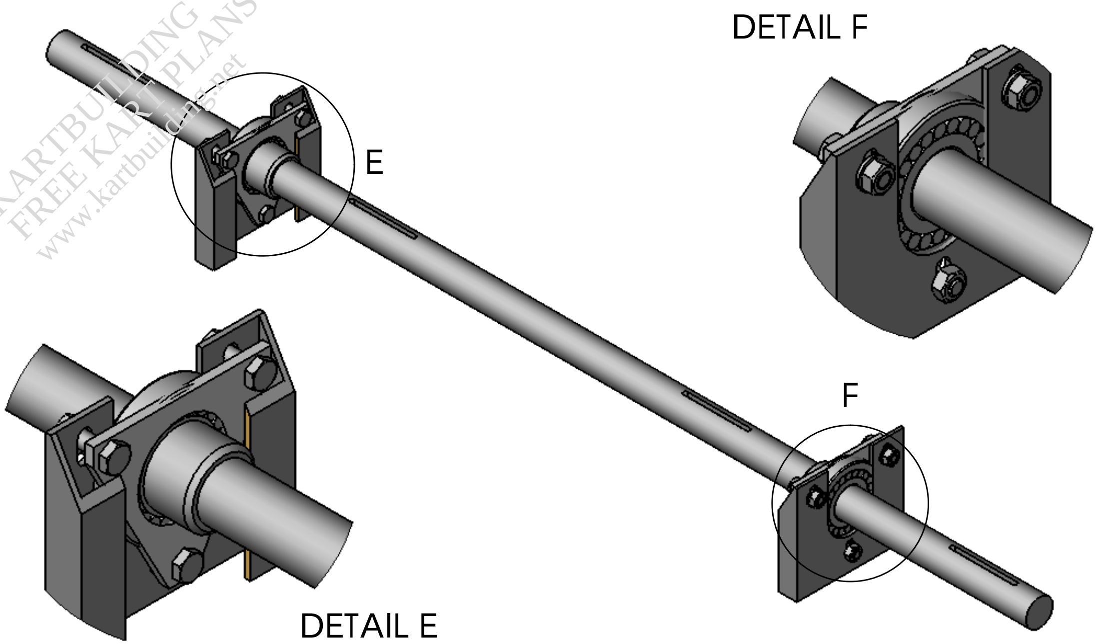
Conclusion

There does be a lot of debates regarding the ideal steering setup for karts, and especially when deciding on the actual angles to use for King Pin Inclination (KPI), Camber Angles and Castor Angles. All these angles are interrelated and allow for a Go-Kart with **no suspension** and a **solid live** **rear axle** to steer smoothly.





DETAIL H - KEYWAY



MATERIAL:

- DIAMETER 30 STEEL BAR
- KEYWAYS TO BE MILLED OR GROUND

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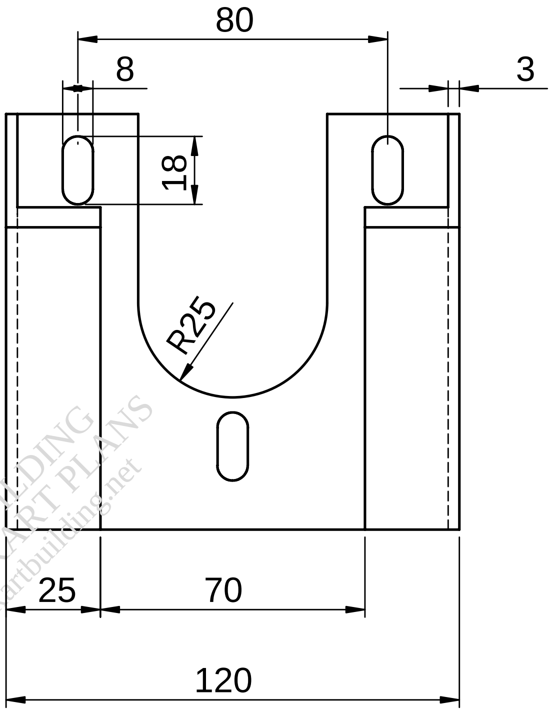
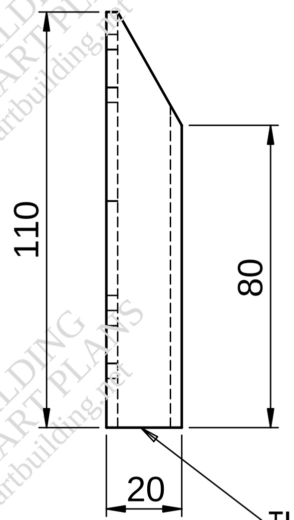
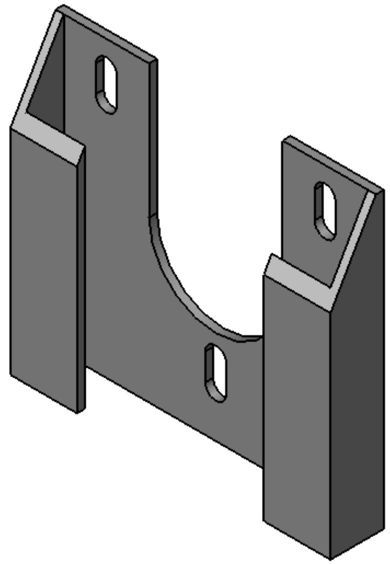
		FREE RACING KART PLANS
REAR AXLE		www.kartbuilding.net
DRG. NO.: 6	DATE: 24/07/03	© STEPHEN BURKE

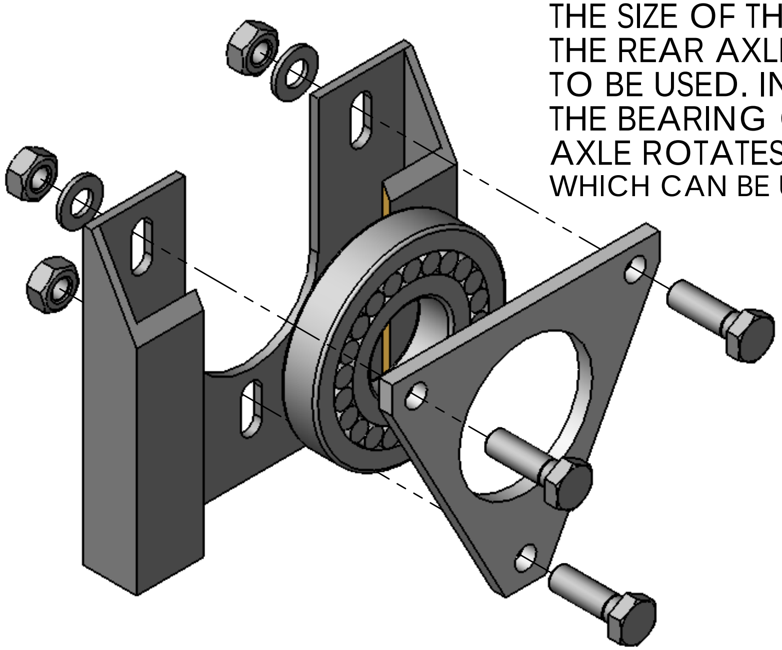




THE UNDERNEATH CAN BE FILED TO GIVE A CURVED MATING SURFACE WITH THE CHASSIS. (SEE SHEET 6)



THE SIZE OF THE ABOVE BRACKET DEPENDS SOLELY ON THE SIZE OF THE BEARING. THE REAR AXLE CARRIER ALLOWS A STANDARD ROLLER BEARING TO BE USED. IN COMBINATION WITH THE TRIANGULAR FACE PLATE, THE BEARING CAN BE SECURELY HELD IN POSITION WHILE THE REAR AXLE ROTATES. NOTE: THERE ARE OTHER SIMPLER SOLUTIONS AND BEARINGS WHICH CAN BE USED INSTEAD.



MATERIAL:
- 3MM FLAT STEEL
- BENT TO SHAPE

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	FREE RACING KART PLANS
REAR AXLE CARRIER	www.kartbuilding.net
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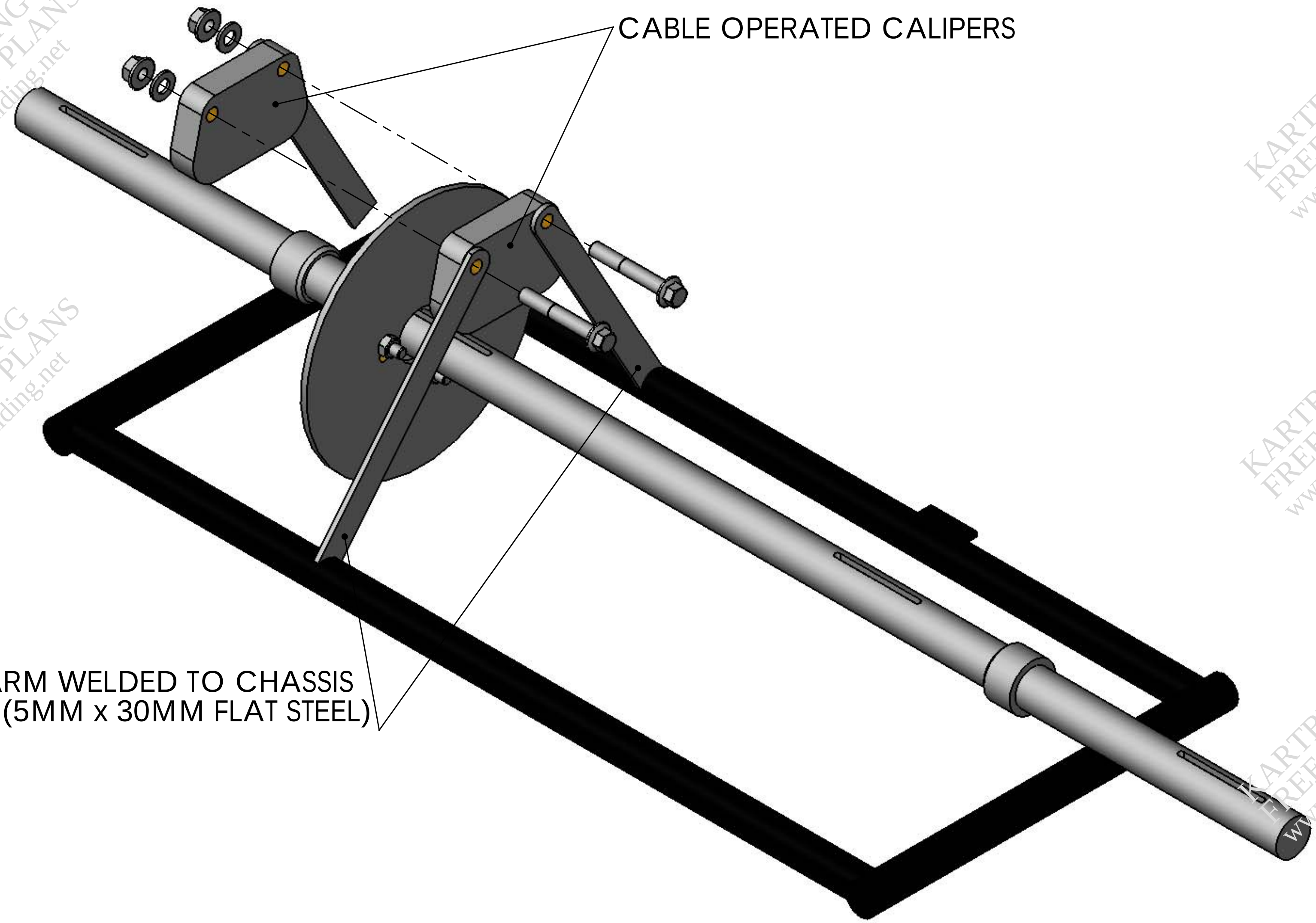

NOTE:
THERE ARE SEVERAL METHODS/ SOLUTIONS TO PROVIDE THE BRAKES ON A KART. THE ABOVE MANUALLY OPERATED DISC BRAKE AND CALLIERS WAS OBTAINED FROM AN OLD RACING KART.

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		FREE RACING KART PLANS
BRAKES		www.kartbuilding.net
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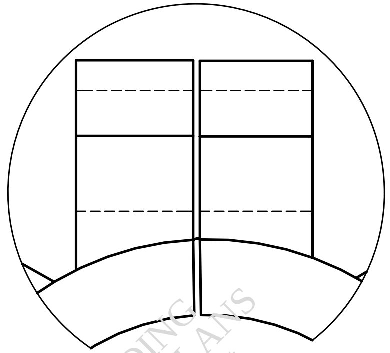
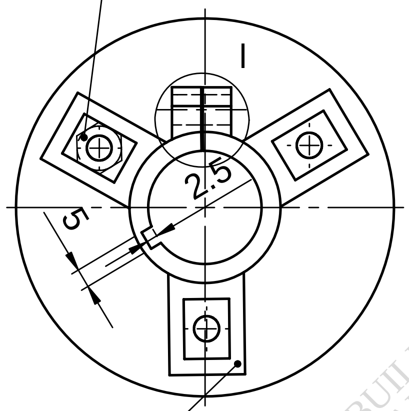
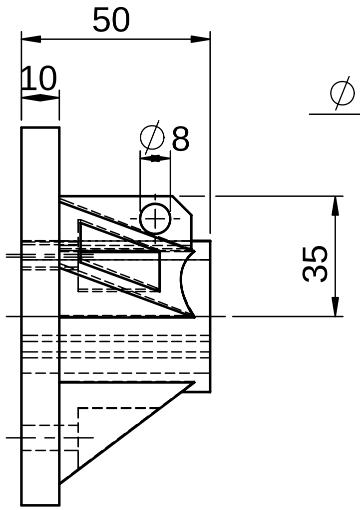
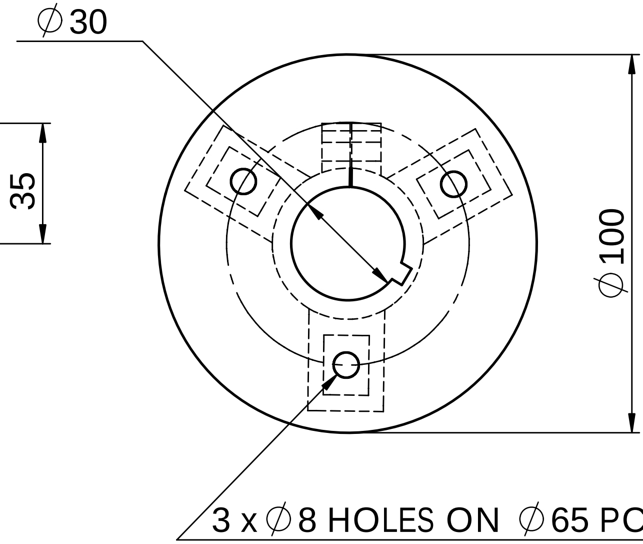
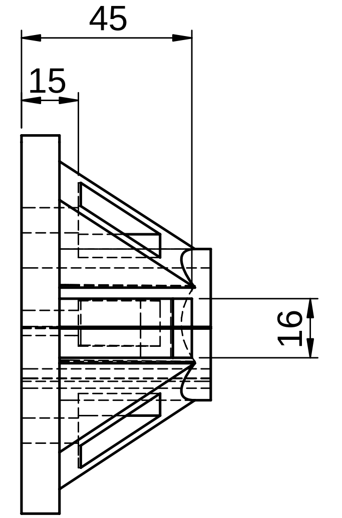


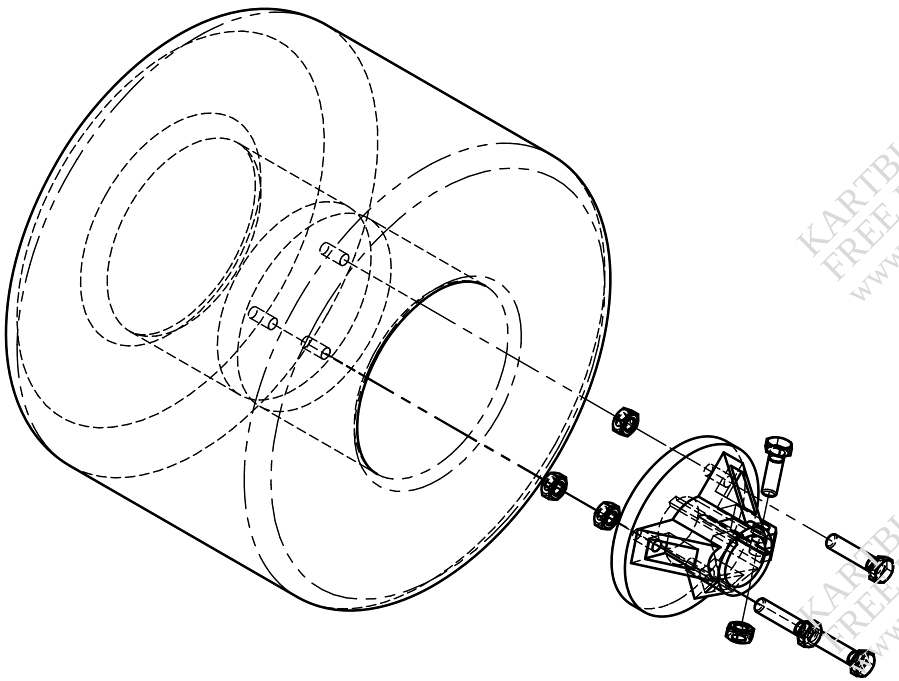
DETAIL I











NOTE:
IT MAY BE POSSIBLE TO
BUY THESE ALUMINIUM HUBS
FROM A KARTING CATALOGUE!
THE HUB MUST SUIT THE TYPE
OF WHEEL BEEN USED!

MATERIAL:
- ALUMINIUM
- TURNED/MANUFACTURED
- POSSIBLY WELD ON REINFORCING SHOULDERS.

KARTBUILDING

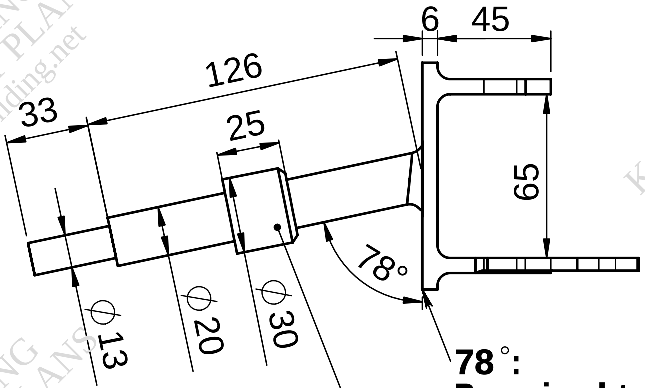
FREE RACING KART PLANS

REAR HUBS AND WHEELS

www.kartbuilding.net

DRG. NO.: 7

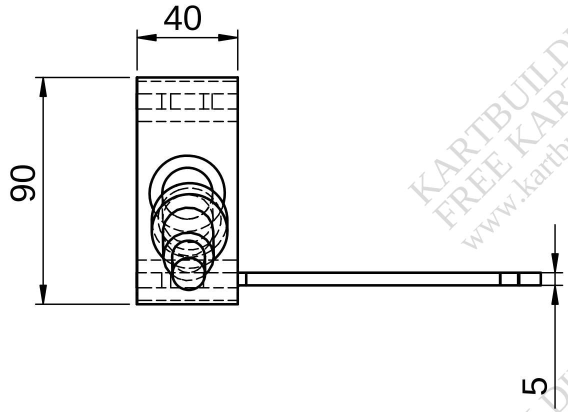
DATE: 24/07/03



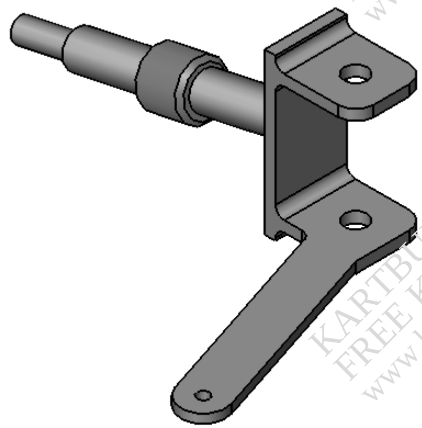
30MM SHOULDER WELDED
OR GRUBSCREWED ONTO AXLE.

78°:
Required to Balance
out the 12° Camber Angle

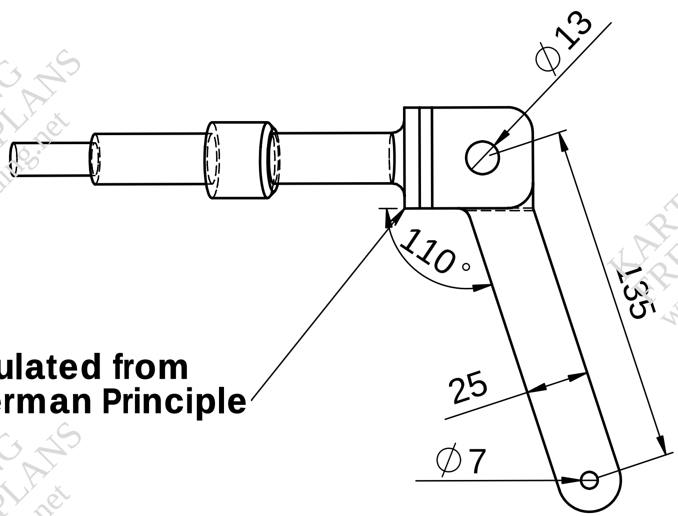
FRONT ELEVATION



LEFT ELEVATION



ISOMETRIC



110°:
Calculated from
Ackerman Principle

TOP PLAN

MATERIAL: 6mm FLAT STEEL FOR "n" shape
5mm FLAT STEEL for Steering Arm

LEFT STUB AXLE
& STEERING ARM

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STUB AXLES & KING PINS	www.kartbuilding.net
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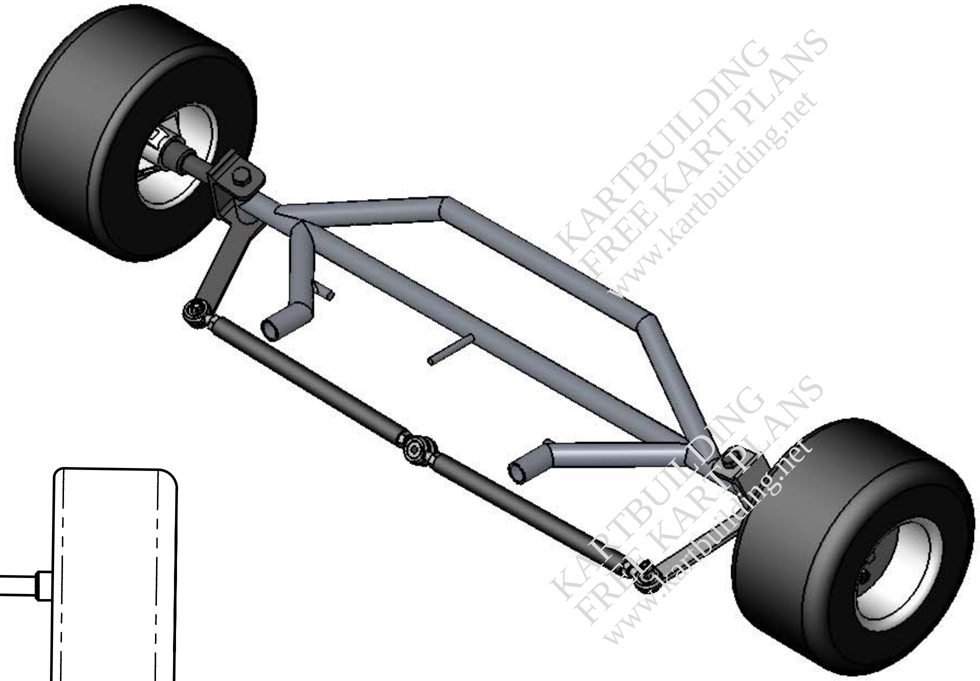

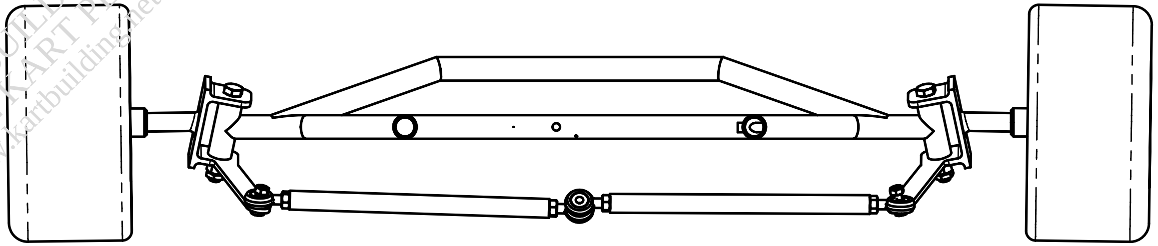

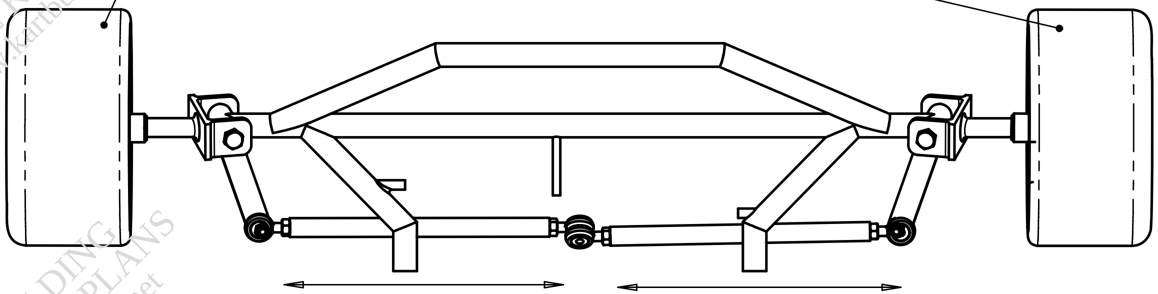

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		FREE RACING KART PLANS
FRONT STEERING		www.kartbuilding.net
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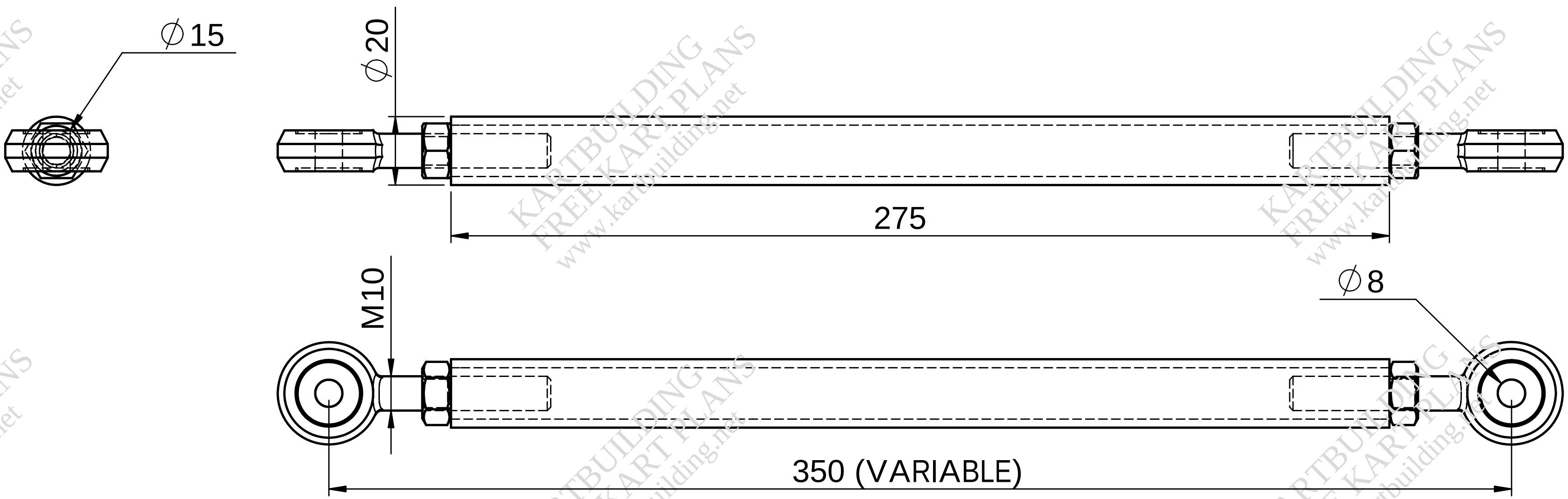
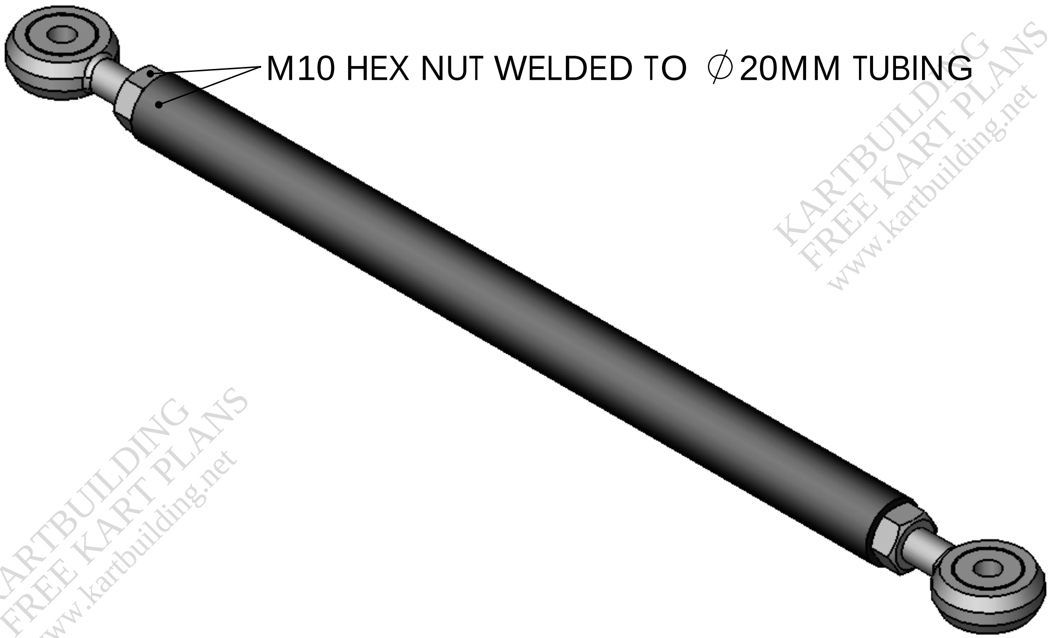
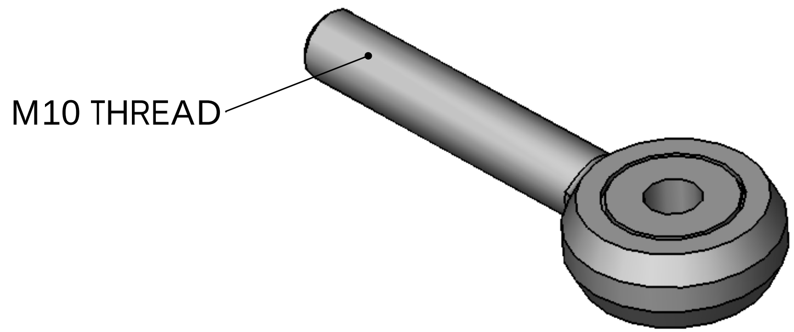




ROSE END (ROD END BEARINGS) CAN BE PURCHASED AT A LOCAL ENGINEERING SUPPLIERS.



MATERIAL:
- 20MM STEEL TUBING (GUNBARREL) 2.5MM WALL.

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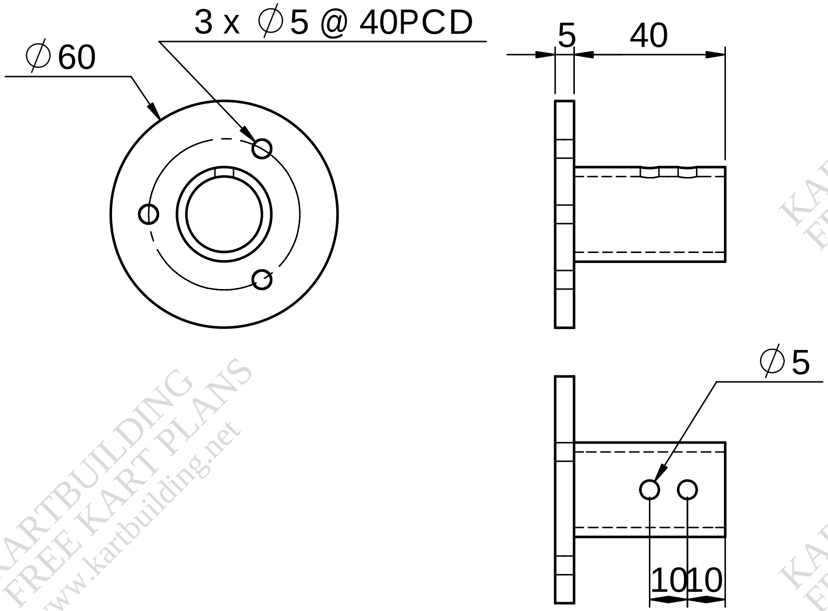
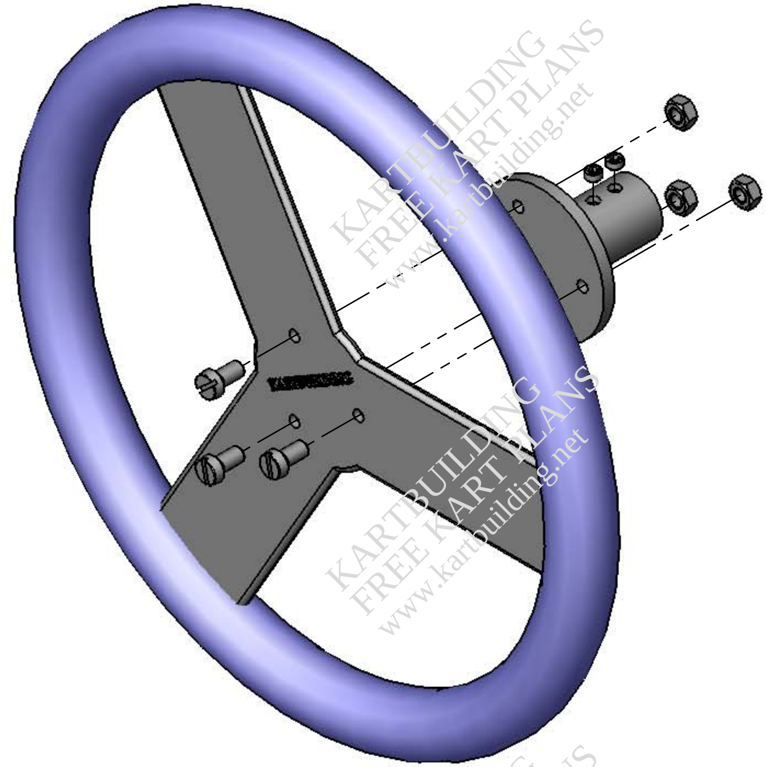
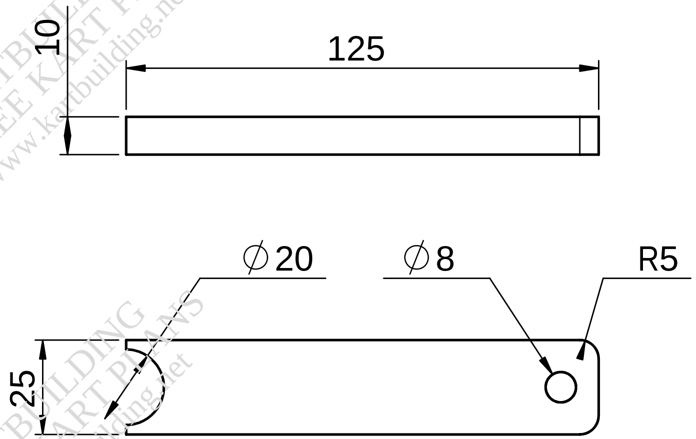
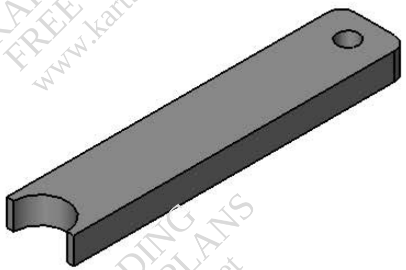
		FREE RACING KART PLANS
TRACK RODS		www.kartbuilding.net
DRG. NO.: 11	DATE: 24/07/03	© STEPHEN BURKE



STEERING COLUMN CAP







STEERING DROP ARM

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STEERING COLUMN PARTS		www.kartbuilding.net
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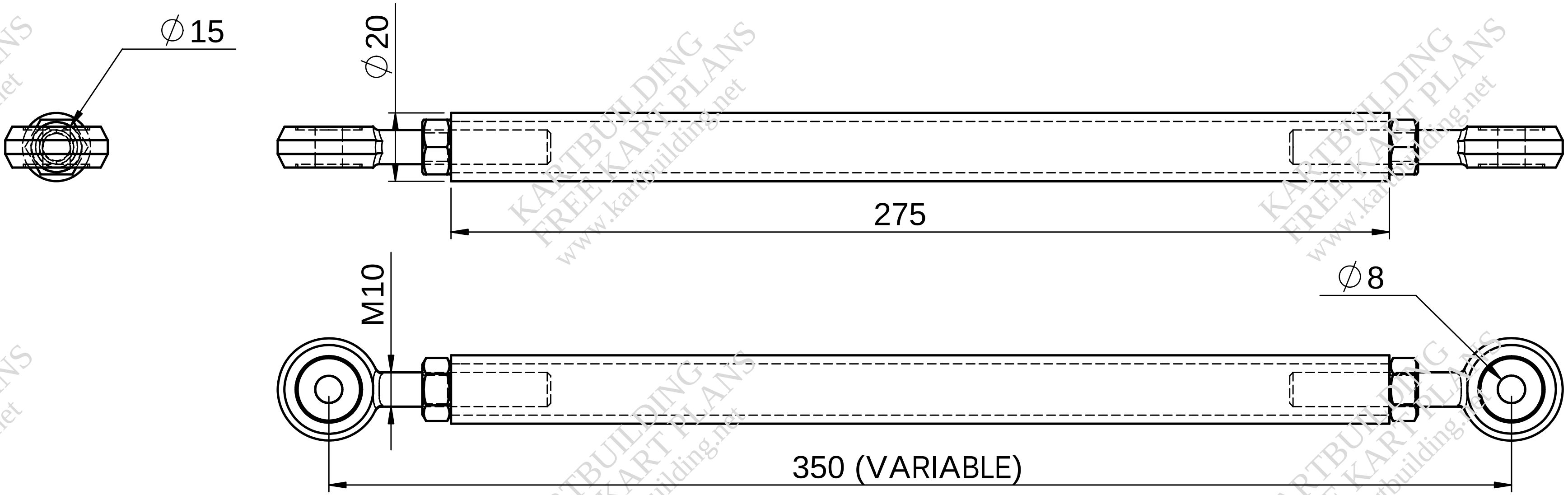

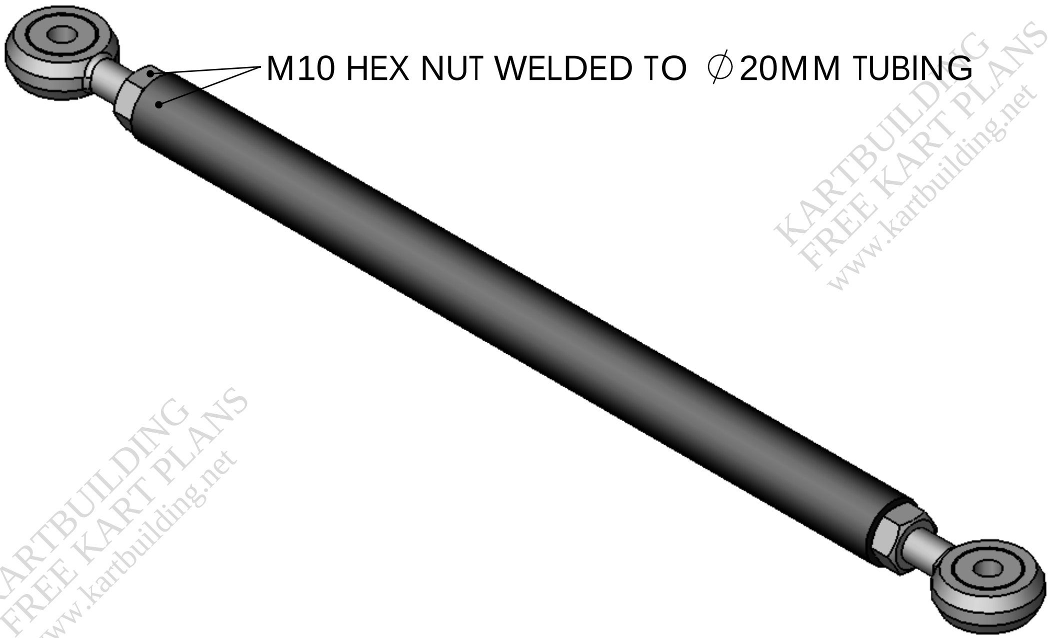

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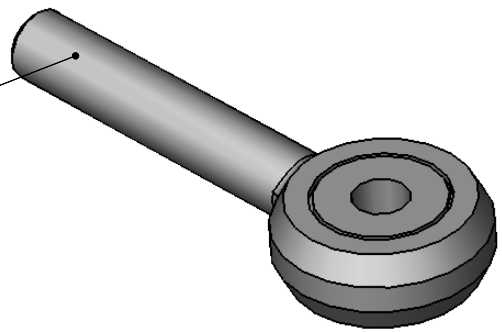

MATERIAL:
- 20MM STEEL TUBING (GUNBARREL) 2.5MM WALL.

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		FREE RACING KART PLANS
TRACK RODS		www.kartbuilding.net
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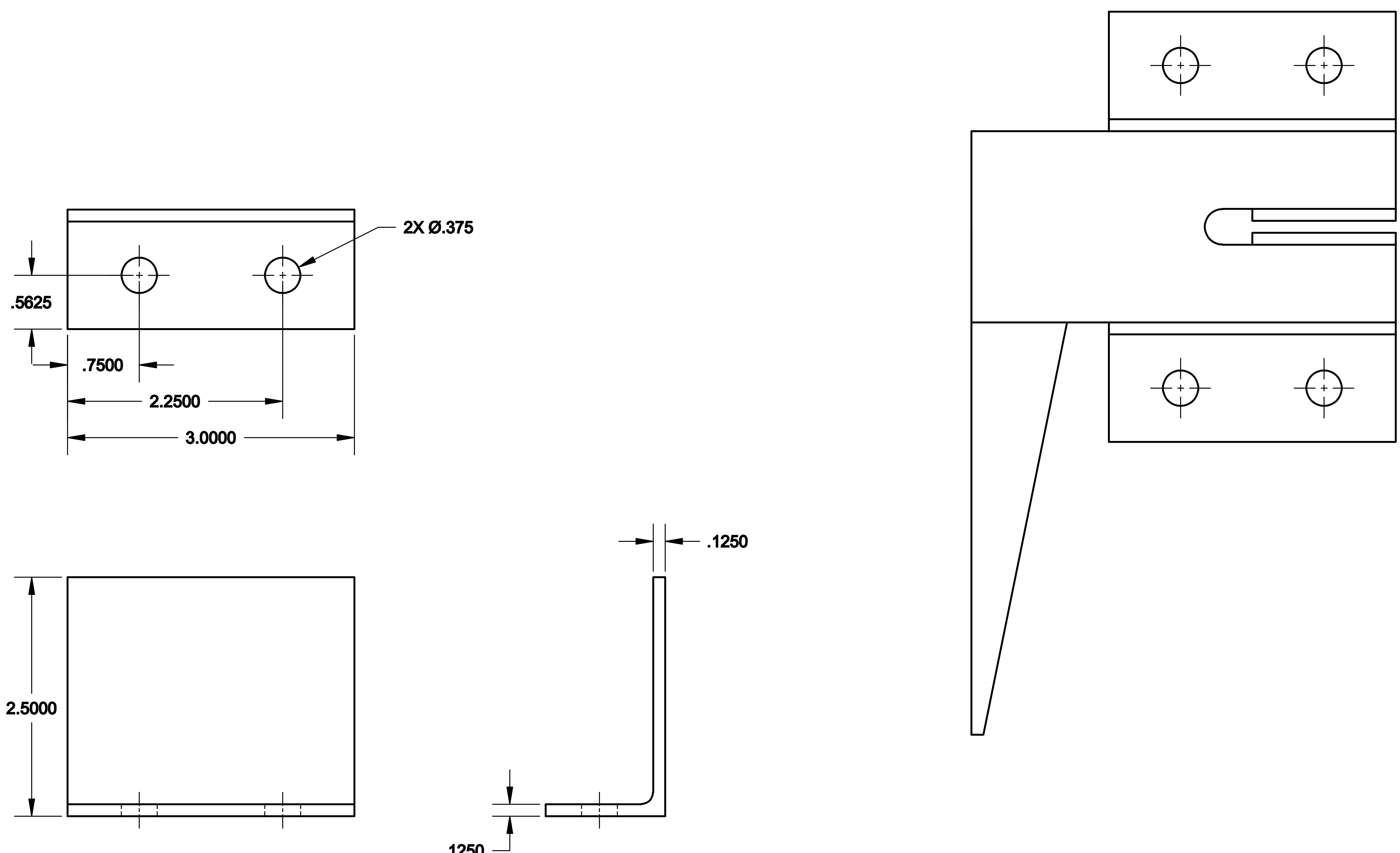
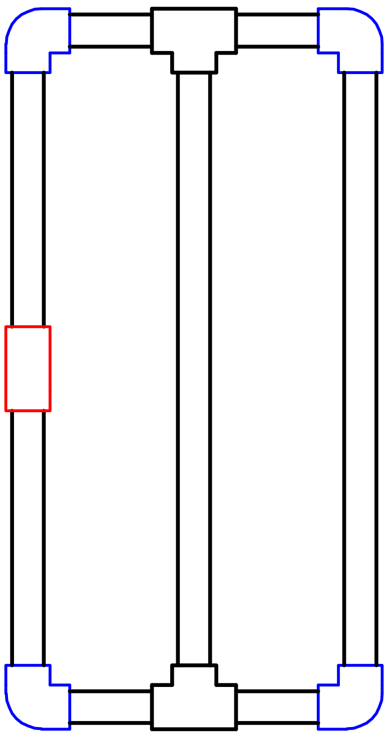
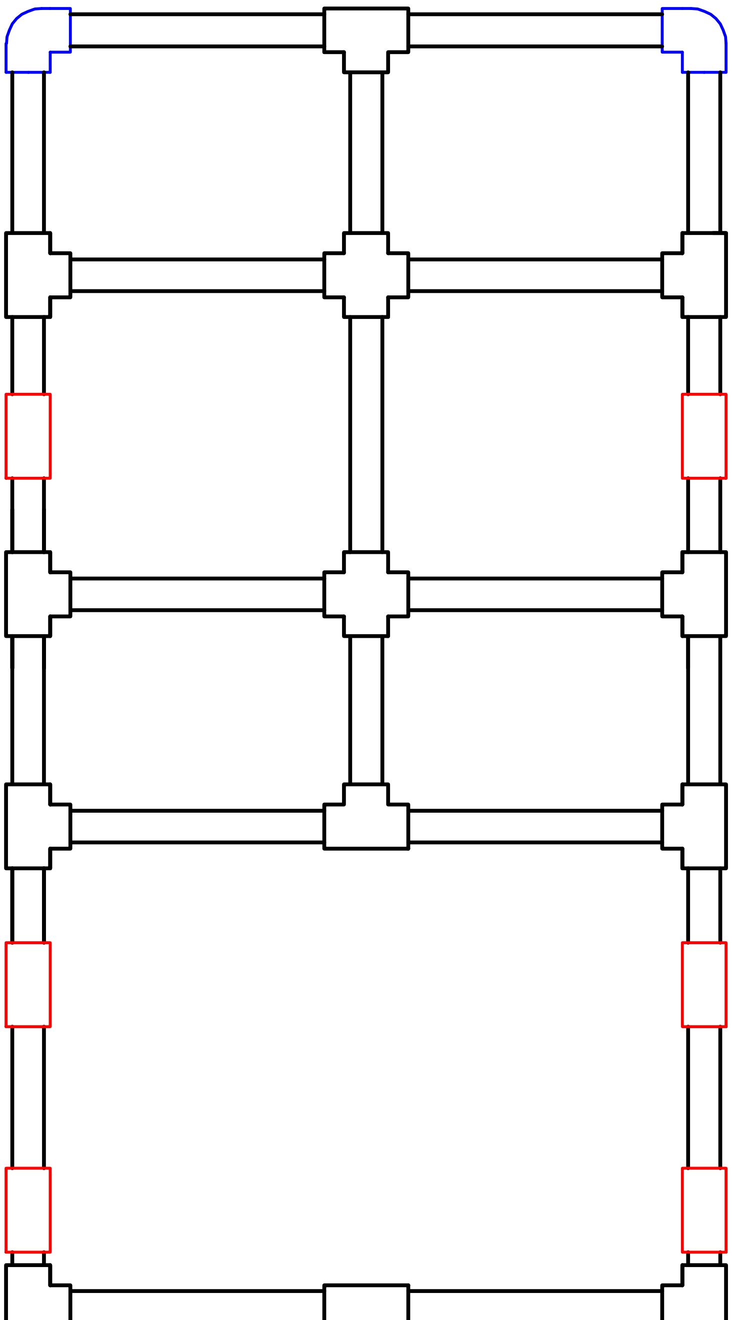
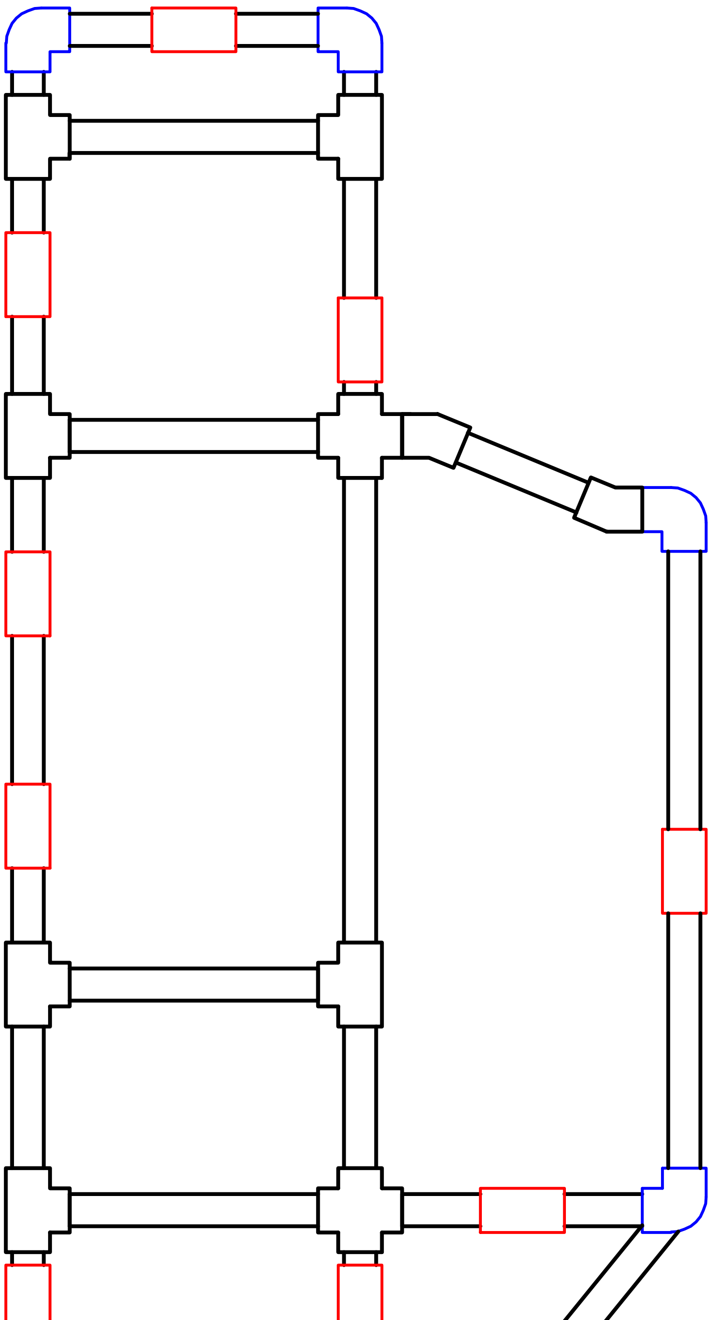
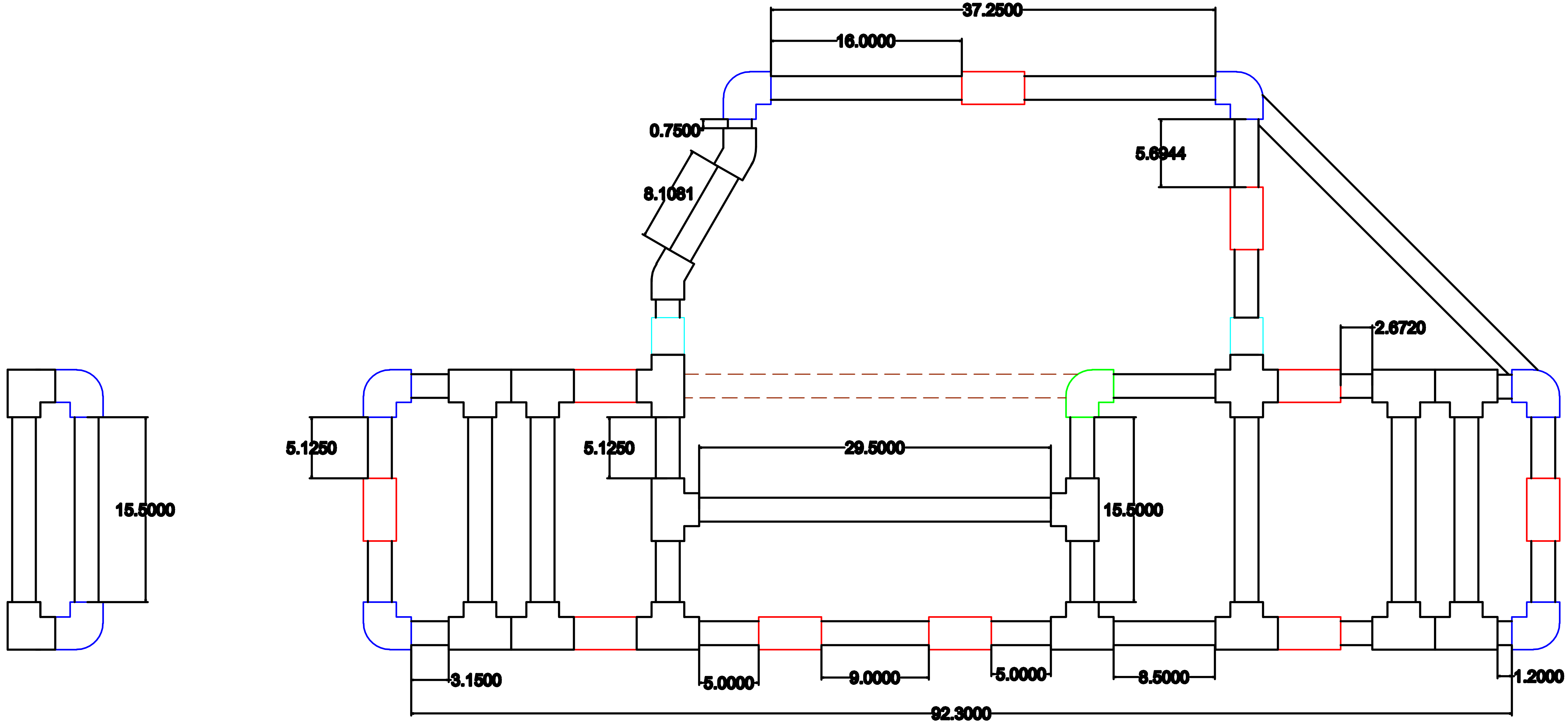
The Design Process



BRAKE PLATES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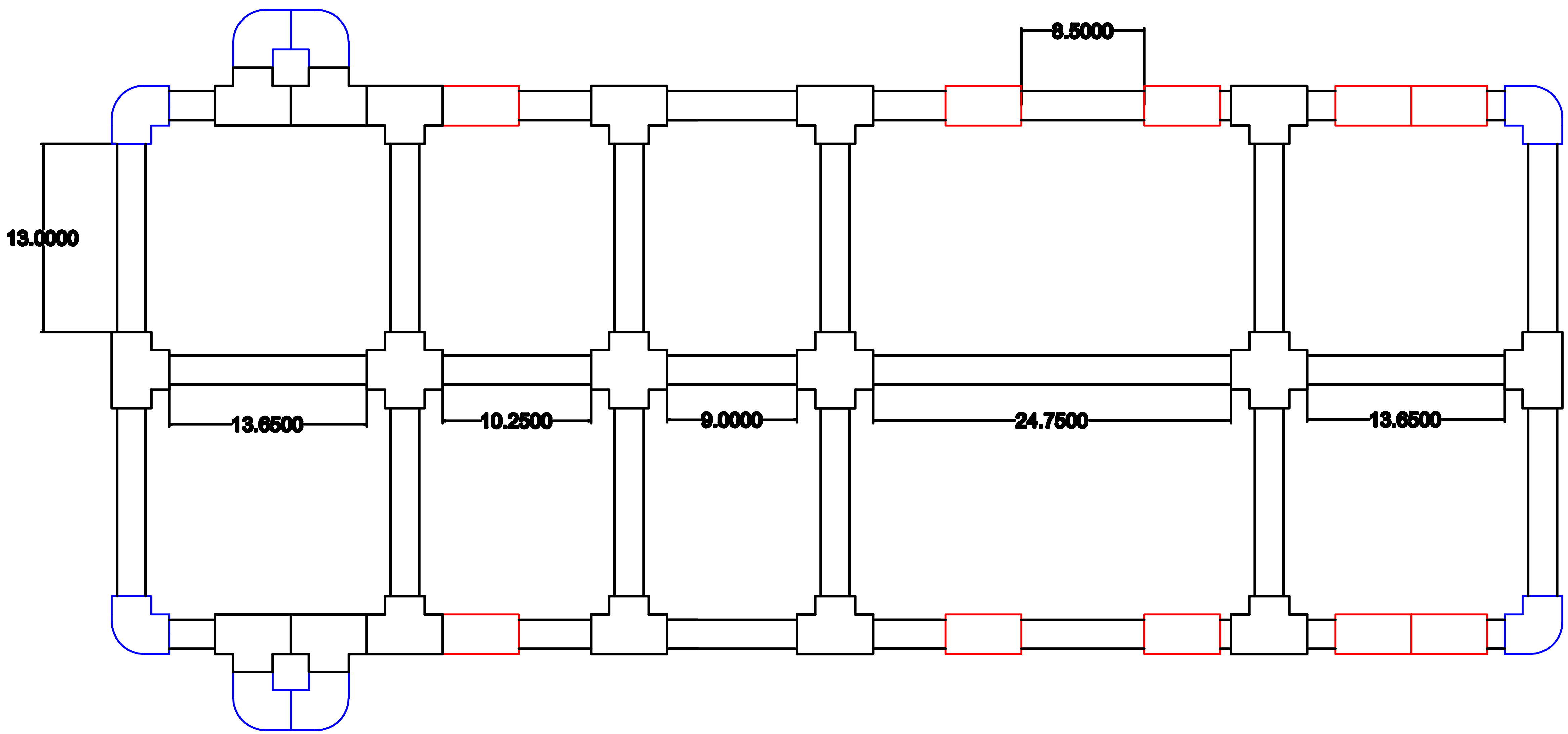
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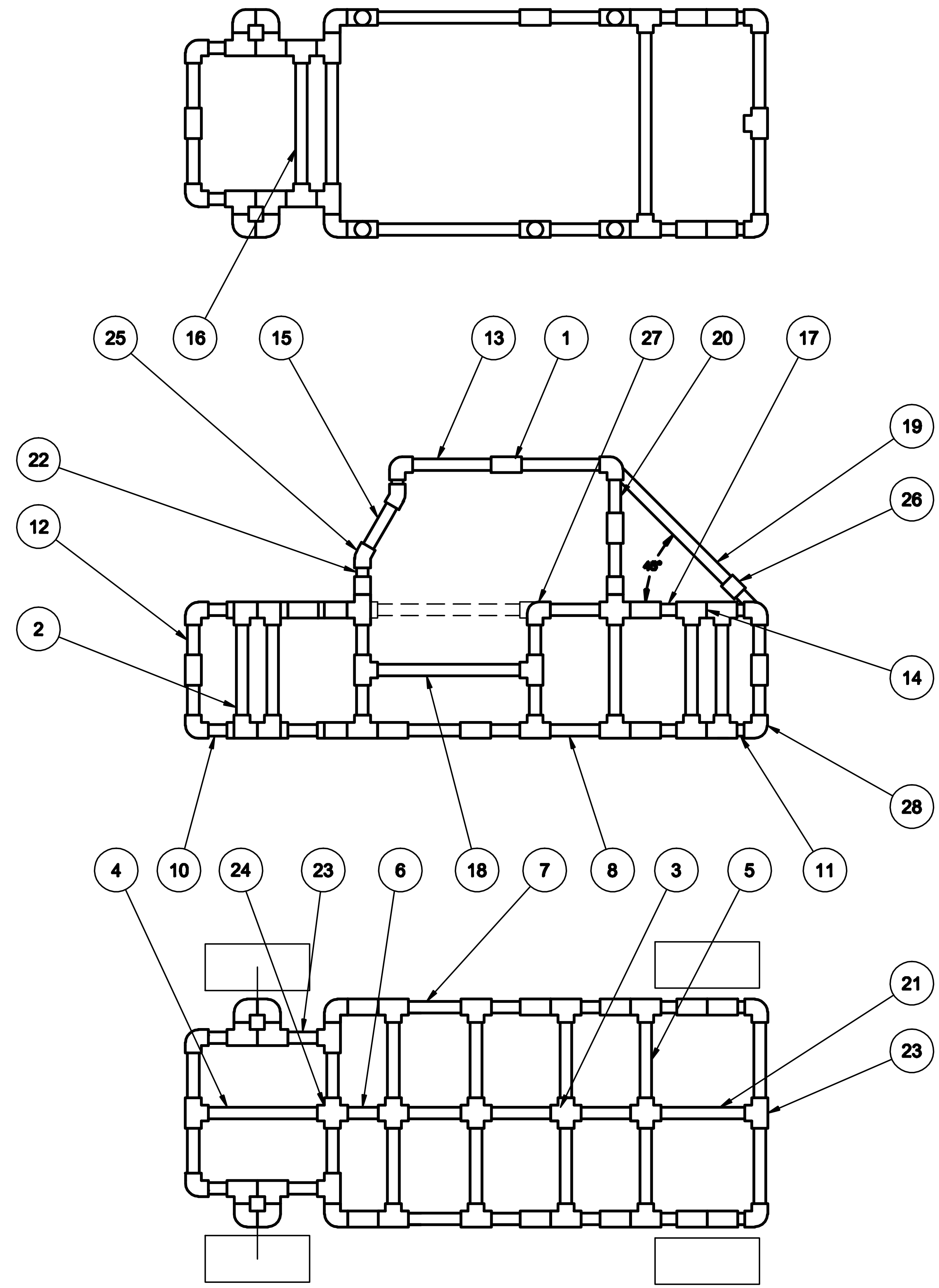
ZONE	REV	DESCRIPTION	DATE	APPROVED

REVISIONS



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NO.	QTY.	DESCRIPTION	MAT'L
28	20	3-WAY SOCKET UNION	PVC
27	1	90° SOCKET UNION	PVC
26	5	COUPLER UNION	PVC
25	4	22.5° SOCKET UNION	PVC
24	9	CROSS SOCKET UNION	PVC
23	50	T-SOCKET UNION	PVC

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21051 21 MILE ROAD, MACOMB, MICHIGAN 48044
PHONE: (586) 723-2000 FAX: (586) 723-2701
www.dakotahighschool.com

DESIGN TECHNOLOGY DEPARTMENT

PART NAME: POLY CONCEPT VEHICLE

CUSTOMER: DAKOTA HIGH SCHOOL

MATERIAL: PVC

DRAWN BY: BRANDON PETERSON, MUJADDED QURESHI

SCALE: 1:12

SHEET: 1 of 3

DATE: 11/28/2007

TOLERANCE UNLESS OTHERWISE SPECIFIED
.X = .5
.XX = .05
.XXX = .005
.XXXX = .0005
ANGULAR = ±1°

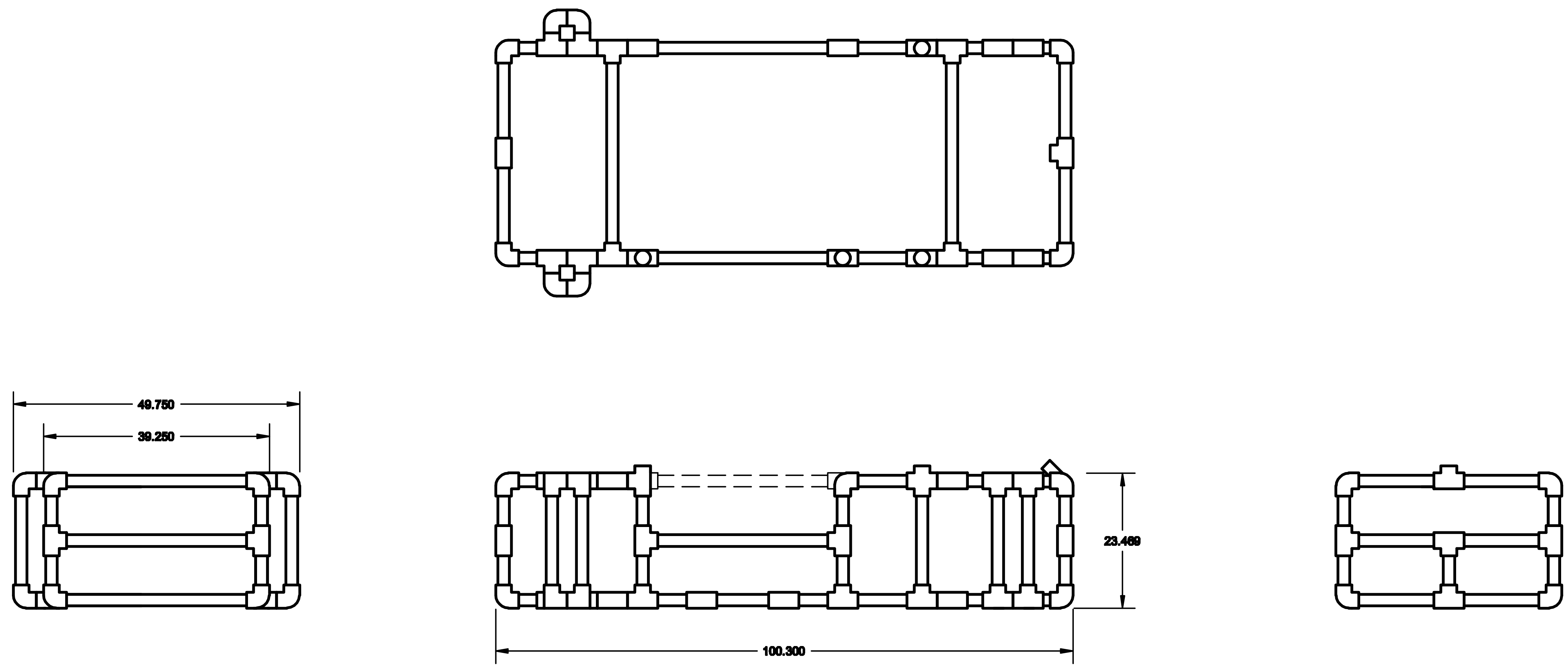
CHECKED BY:

PROJECTION: 3RD

ENGINEER: THE ABUSEMENT KART

DRAWING No.

REVISION:



ZONE	REV	DESCRIPTION	DATE	APPROVED

REVISIONS

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NO.	QTY.	DESCRIPTION	MATL.

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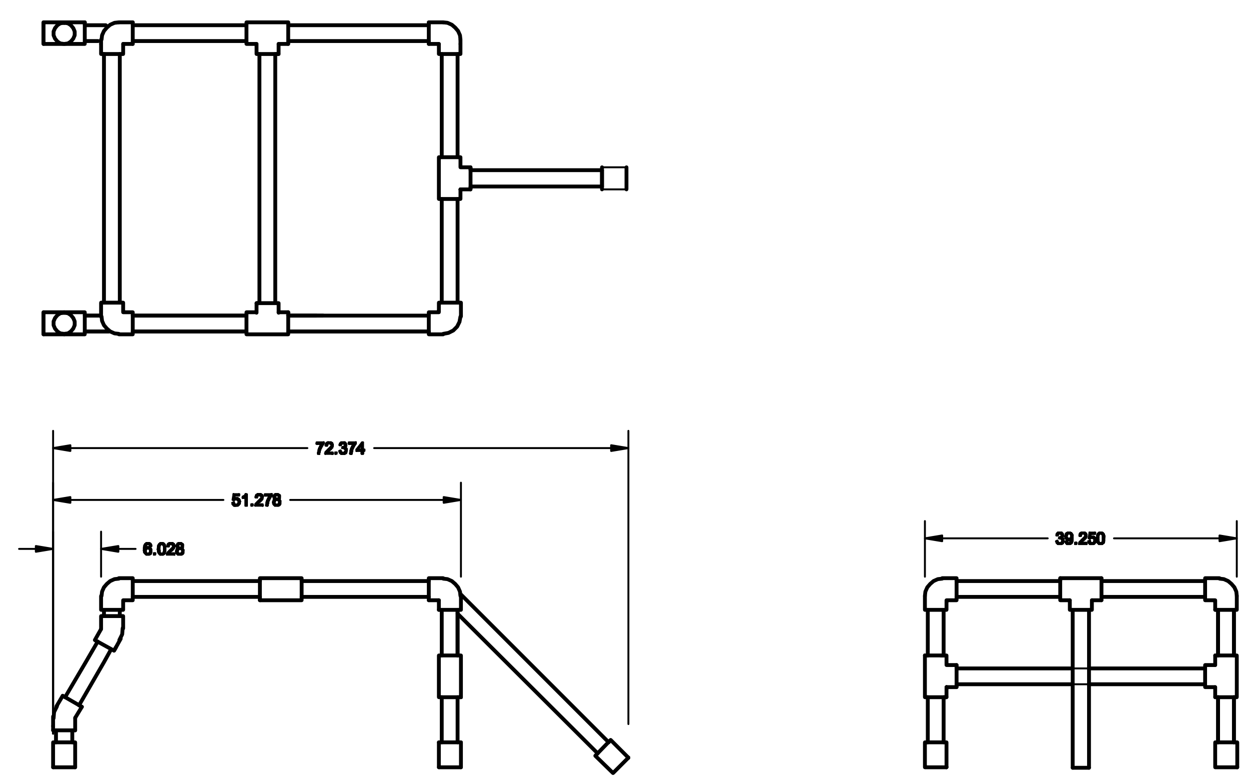
DESIGN TECHNOLOGY DEPARTMENT

PART NAME: POLY CONCEPT VEHICLE
CUSTOMER: DAKOTA HIGH SCHOOL
MATERIAL: PVC
DRAWN BY: BRANDON PETERSON, MUJADDED QURESHI

SCALE: 1:12
SHEET: 2 of 3
DATE: 11/28/2007
CHECKED BY:
PROJECTION: 3RD
ENGINEER: THE ABUSEMENT KART
DRAWING No.
REVISION:



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ZONE	REV	DESCRIPTION	DATE	APPROVED

NO.	QTY.	DESCRIPTION	MAT'L

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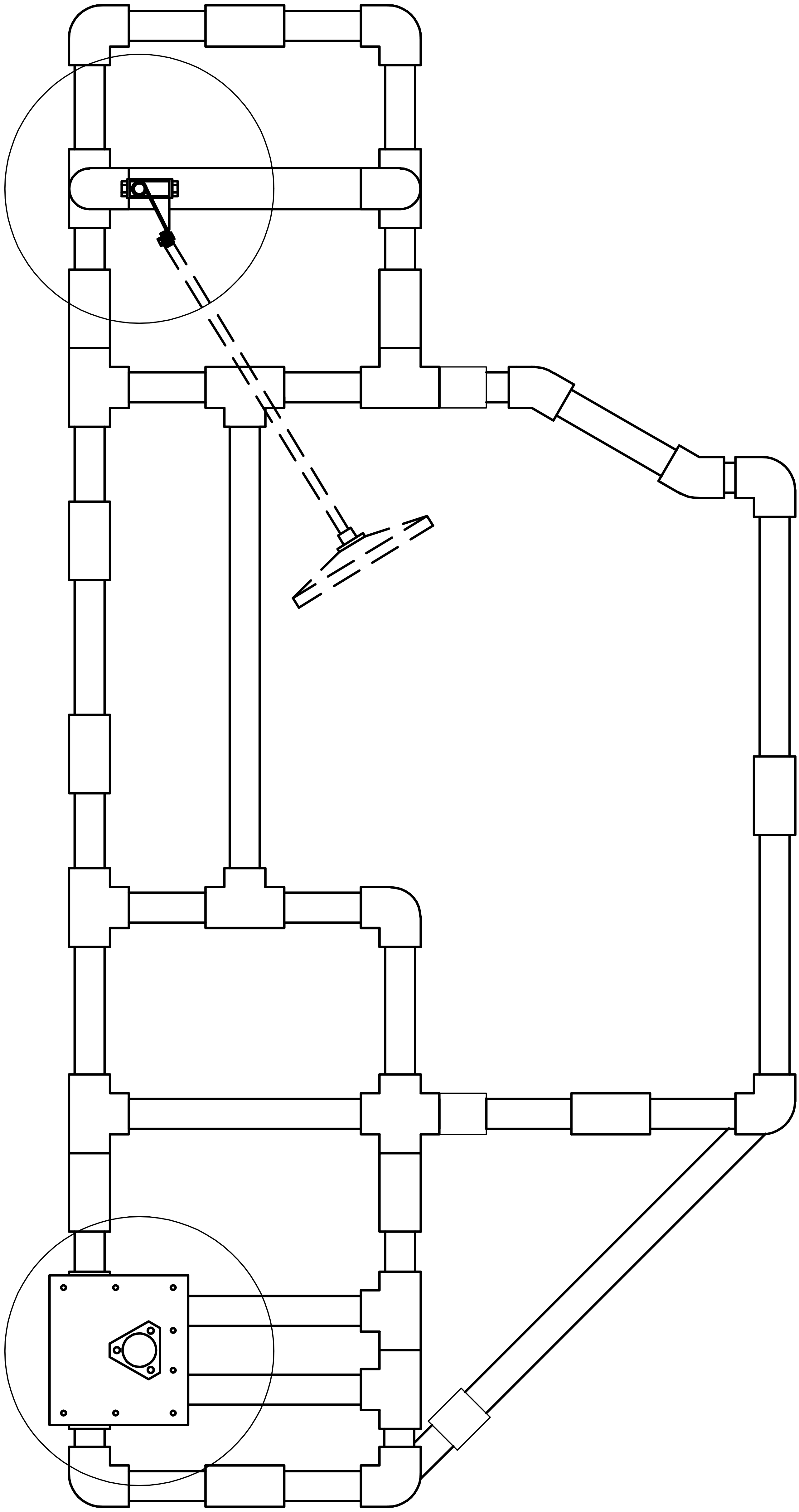
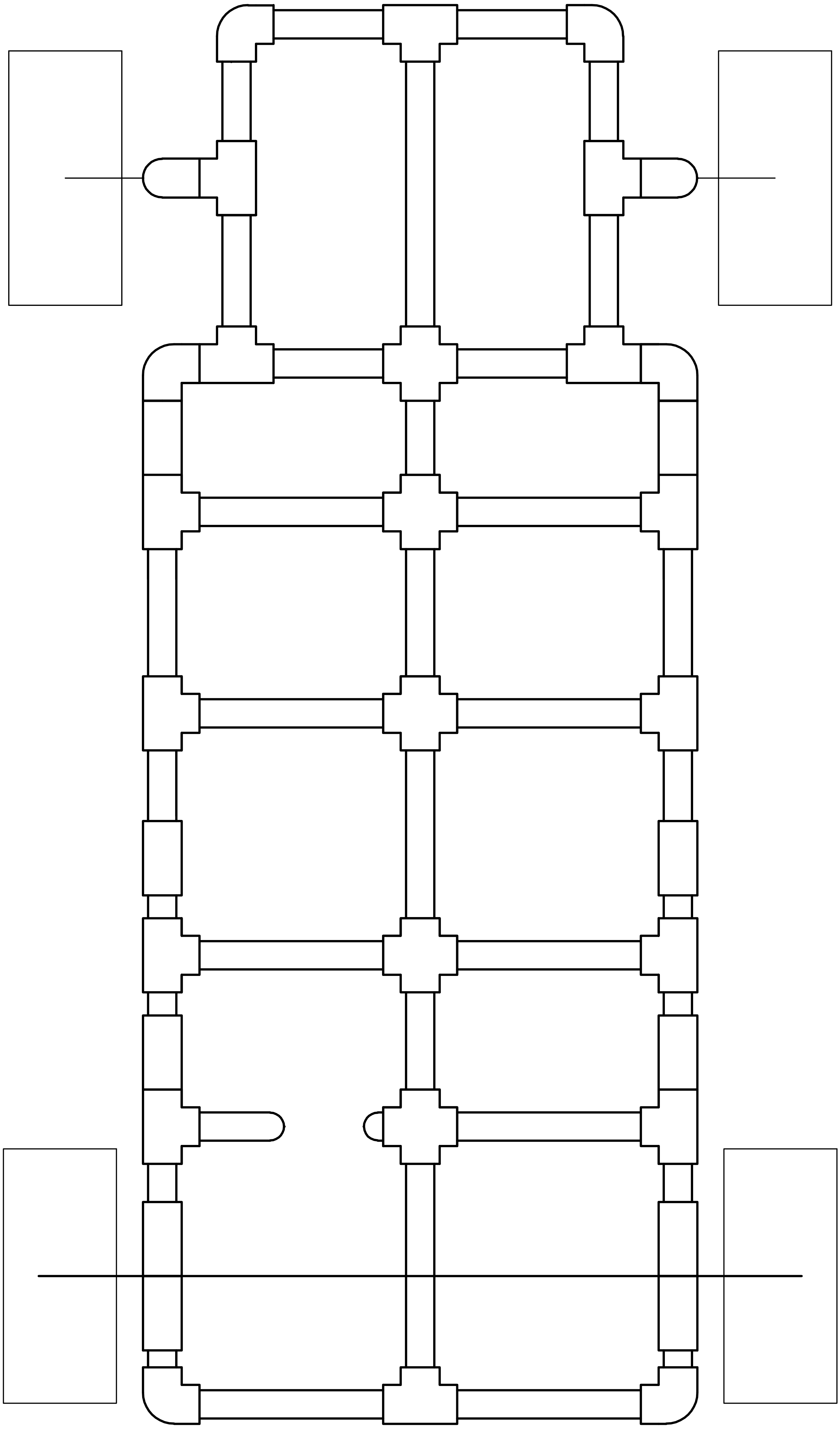
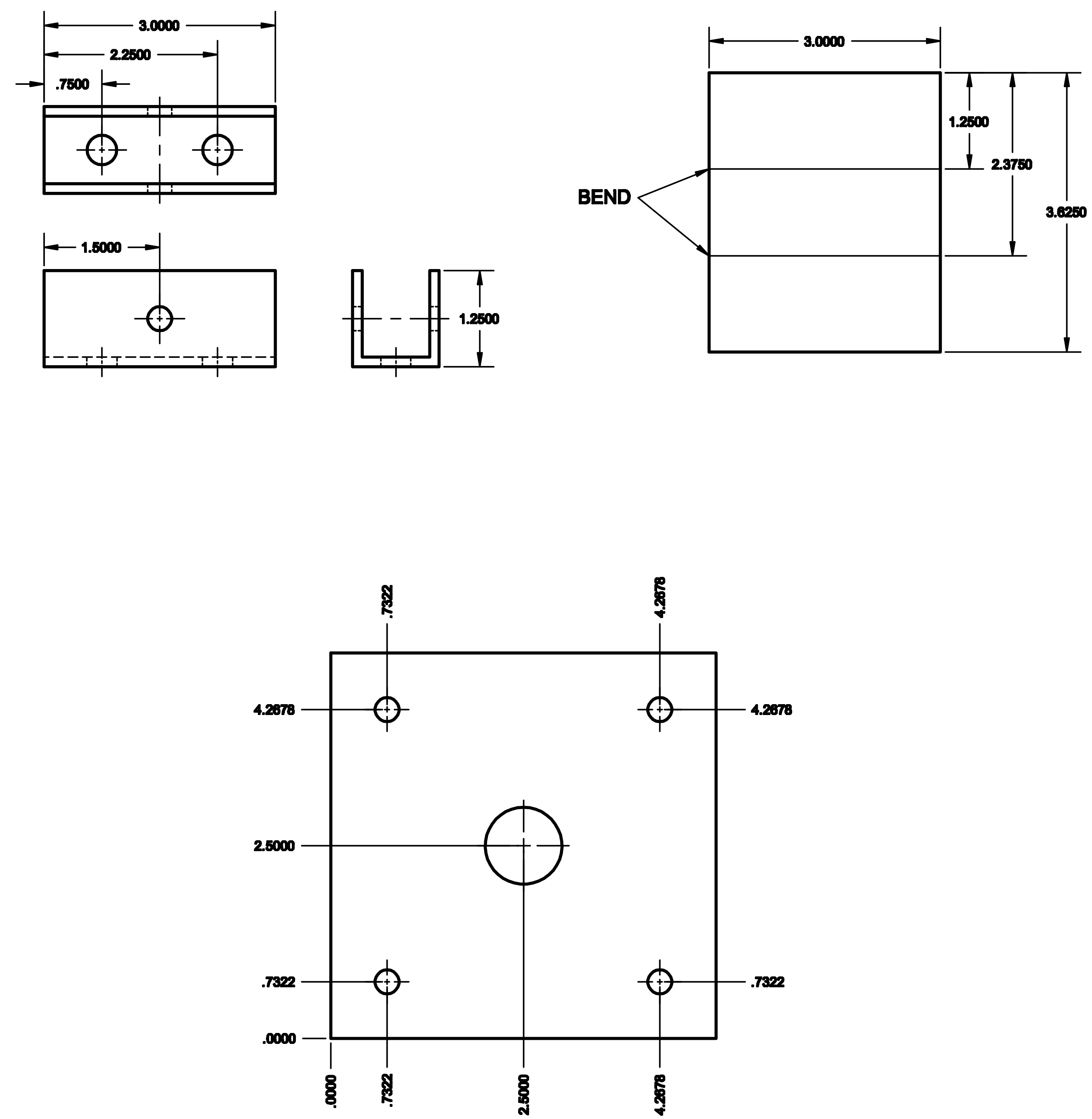
DESIGN TECHNOLOGY DEPARTMENT

PART NAME: POLY CONCEPT VEHICLE	SCALE: 1:12	SHEET: 3 of 3
CUSTOMER: DAKOTA HIGH SCHOOL		DATE: 11/28/2007
MATERIAL: PVC	ENGINEER: THE ABUSEMENT KART	CHECKED BY:
DRAWN BY: BRANDON PETERSON, MUJADDED QURESHI	DRAWING No.	PROJECTION: 3RD
		REVISION:







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ZONE	REV	DESCRIPTION	DATE	APPROVED

NO.	QTY.	DESCRIPTION	MAT'L

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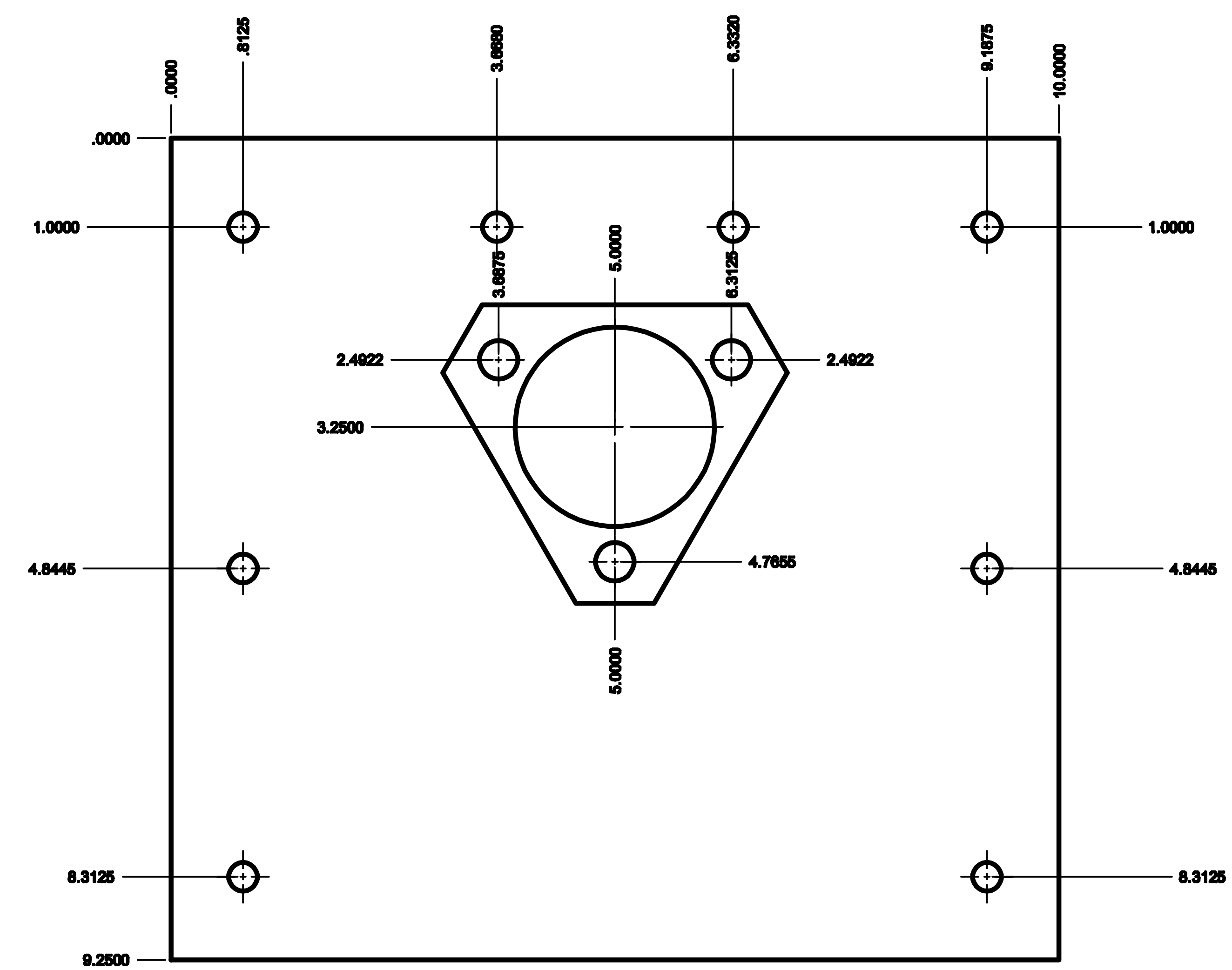
DESIGN TECHNOLOGY DEPARTMENT

PART NAME:	ENGINE SPACER AND PEDAL BRACKETS
CUSTOMER:	R&D ENGINEERING
MATERIAL:	PVC
DRAWN BY:	RYAN STEVENS
SCALE:	1:12
SHEET:	1 of 1
DATE:	4-25-08
CHECKED BY:	
PROJECTION:	3RD
ENGINEER:	RYAN STEVENS
DRAWING No.	
REVISION:	



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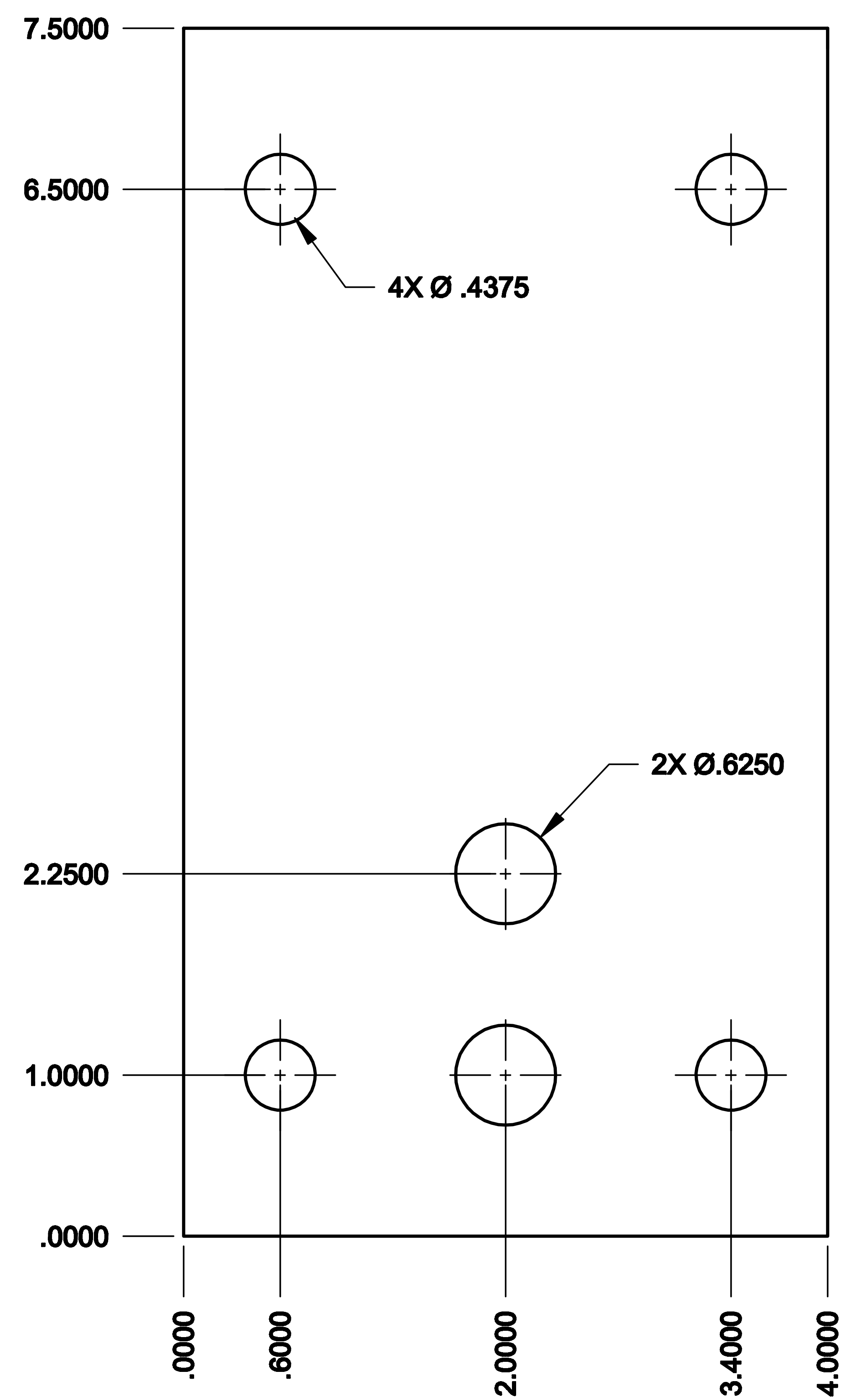
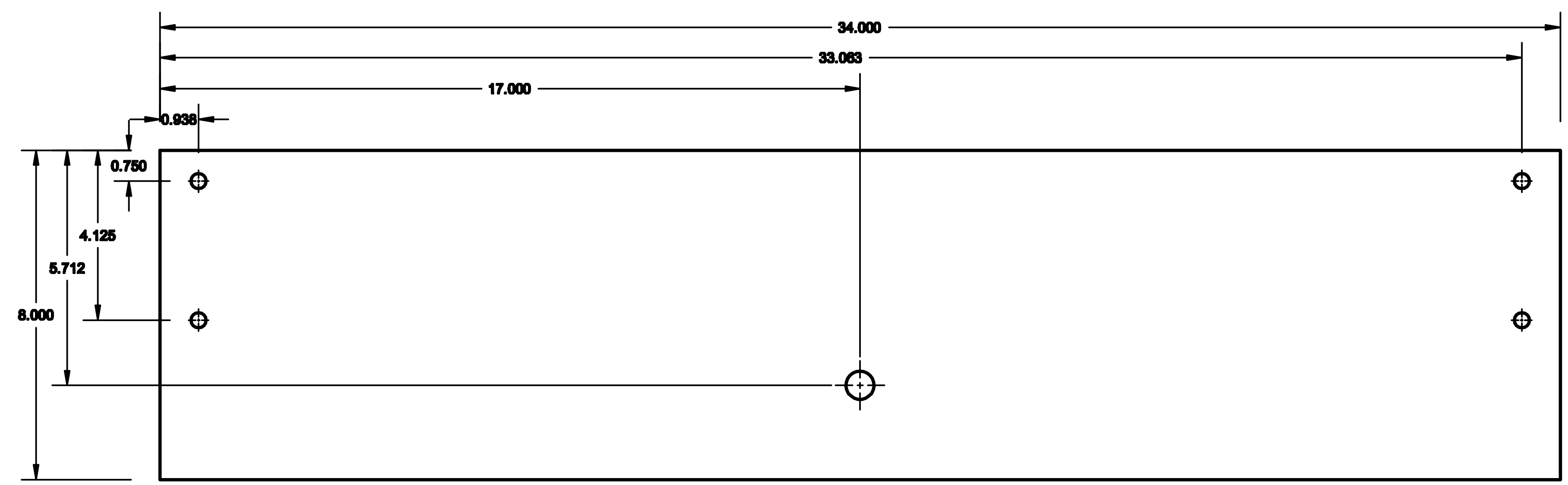
DESIGN TECHNOLOGY DEPARTMENT

SCALE: 1:1	SHEET: 1 of 1		
TOLERANCE UNLESS OTHERWISE SPECIFIED .X = .5 .XX = .05 .XXX = .005 .XXXX = .0005 ANGULAR = ±1°	DATE: 1/30/2008		
	CHECKED BY:		
	PROJECTION: 3RD		
PART NAME:	REAR AXLE PLATES		
CUSTOMER:	DAKOTA HIGH SCHOOL	ENGINEER:	RYAN STEVENS
MATERIAL:	ALUMINUM	DRAWING No.	REVISION: A
DRAWN BY:	RYAN STEVENS		



STEERING MOUNT PLATE



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REVISIONS				
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NO.	QTY.	DESCRIPTION	MAT'L

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DESIGN TECHNOLOGY DEPARTMENT

PART NAME:	DASHBOARD
CUSTOMER:	R&D ENGINEERING
MATERIAL:	PVC
DRAWN BY:	RYAN STEVENS
SCALE:	1:12
SHEET:	1 of 1
DATE:	4-25-08
CHECKED BY:	
PROJECTION:	3RD
ENGINEER:	RYAN STEVENS
DRAWING No.	
REVISION:	

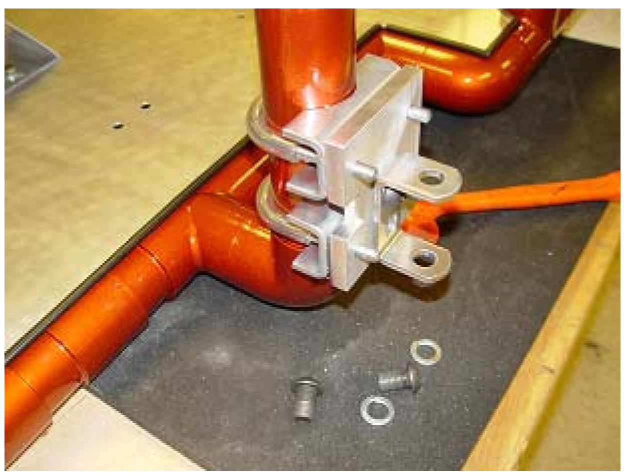
The Materials

Material

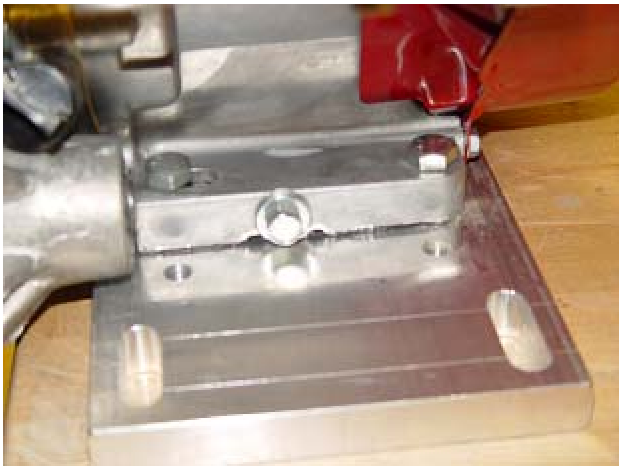
Aluminum:

- 1/8” Aluminum sheet for flooring, steering brackets, and rear axle plates.

- 1/2” Aluminum block for steering plates



- 3/4” Aluminum block for engine plate and idler pulley

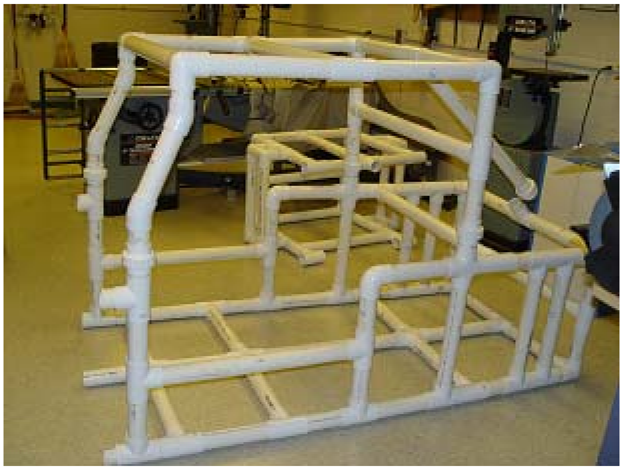


Steel:

- Floor Clamps, steering rod, tie rods, sprocket, rear axle, spring mounts, and u-bolts, spindle mounts.

PVC:

- Frame for vehicle



Rubber:

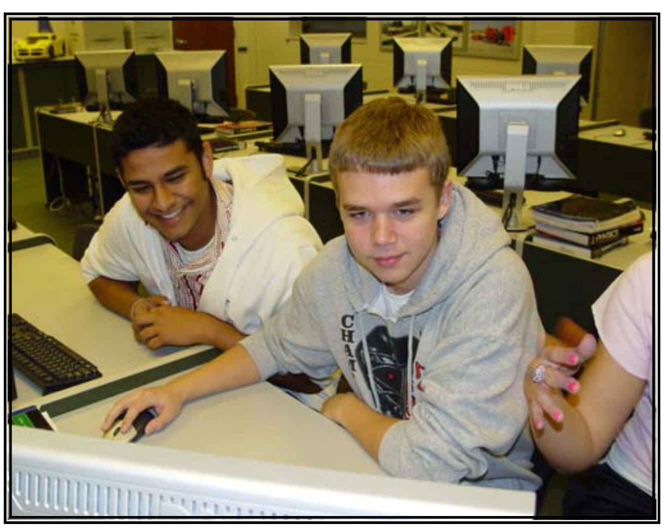
- Edging for aluminum flooring

The Build Process

The Build Process

The PVC Vehicle Project started with the idea of creating or improving a mode of transportation. We spent weeks researching all aspects needed for building a go cart. We started from scratch and everyone researched their own specific area. We bounced ideas off each other, and figured out exactly what everyone had in mind. As a class we ordered all the parts we thought were necessary to properly build a go-kart.

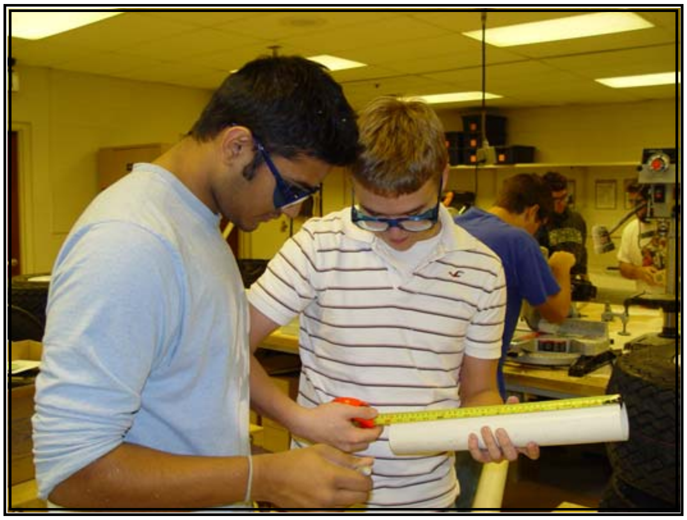
After brainstorming, we had to put our ideas onto paper. We drew out sketches and fabricated drawings in AutoCAD. We had to design go-karts resembling vehicles and with constraints for the parts we had purchased. Everyone created their own drawings and we combined them for the best vehicle we could design. Before going into the fabrication lab, we create a list of all the pieces of PVC we needed to cut to make the body of our vehicle.



We took our finalized drawings into the lab. Our first step was to make the frame, which we decided to make out of PVC, polyvinyl carbon, pipes. All the pipes were cut to specific measurements with tolerance previously accounted for. We used the chop saw for most pipes, and everyone did an equal part in measuring and cutting the pieces of PVC.

We would alternate the tasks of measuring, cutting, and sanding the PVC pipes. Sanding was the most tedious job; however it was necessary for the glue to properly seal the pieces together.

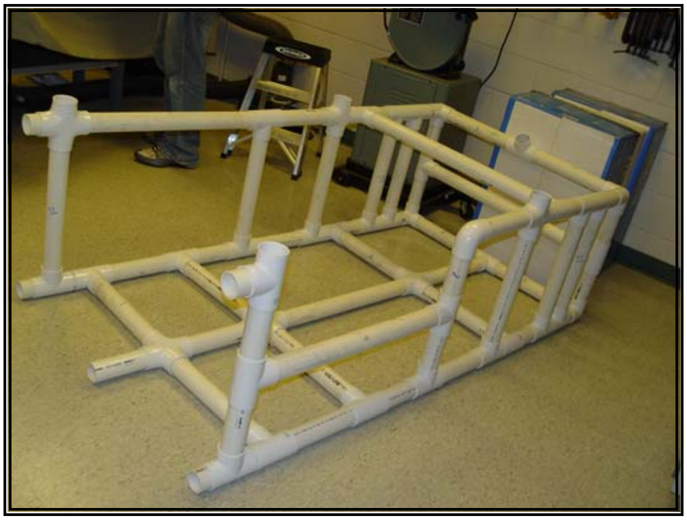
It was pertinent to double check our measurements and make sure we had all the pieces needed to begin the actual building of the frame.



Once the parts began to arrive, we felt a little overwhelmed with the project. Mr. Mitchell guided up and gave us good suggestions of where to begin. The first parts to arrive were the wheels, the seat and the axles.

We laid out the parts to get a visual of what our vehicles were going to look like. We had all our pieces of PVC cut and began to dry-fit the sides, front end, floor, and roll cage.

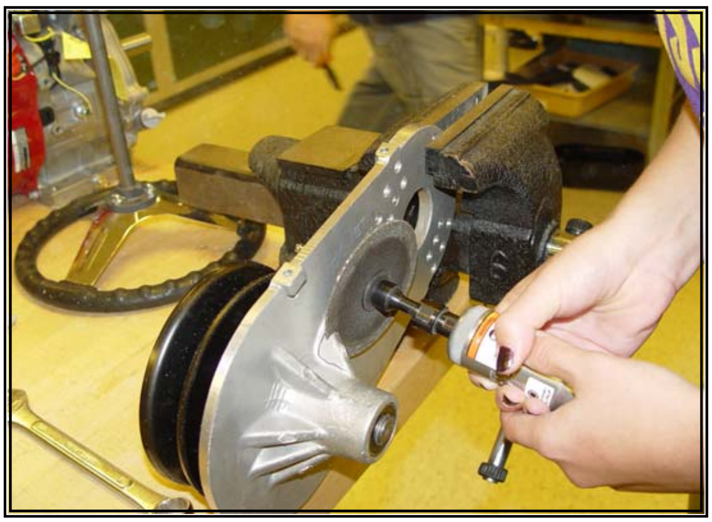
It was necessary for all our pieces to fit together with the fittings, so there were no problems when we began to glue the body together.



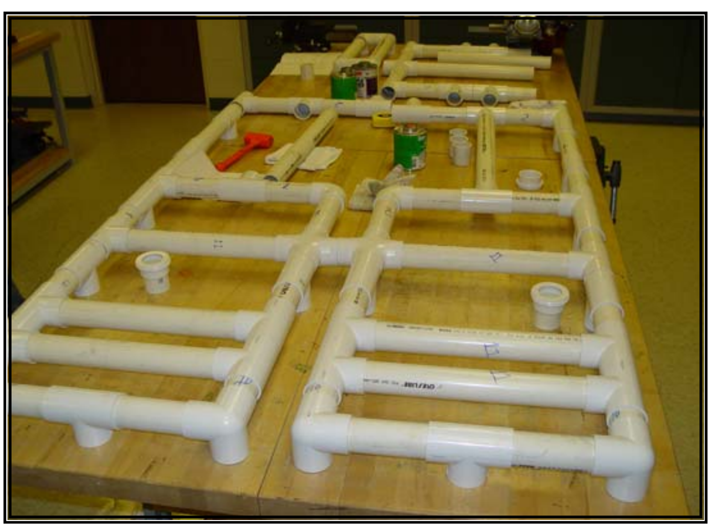
We had some slight modifications then we began gluing. For every part we had to apply primer and then glue. As we glued parts together, we would repeat the dry-fitting.

As we progressed, we tried to visualize how our axle would fit and if our estimates were correct.

We realized we needed to modify the torque convertor to fit securely on the engine. We grinded out one of the supports on the torque convertor, which solved the problem.



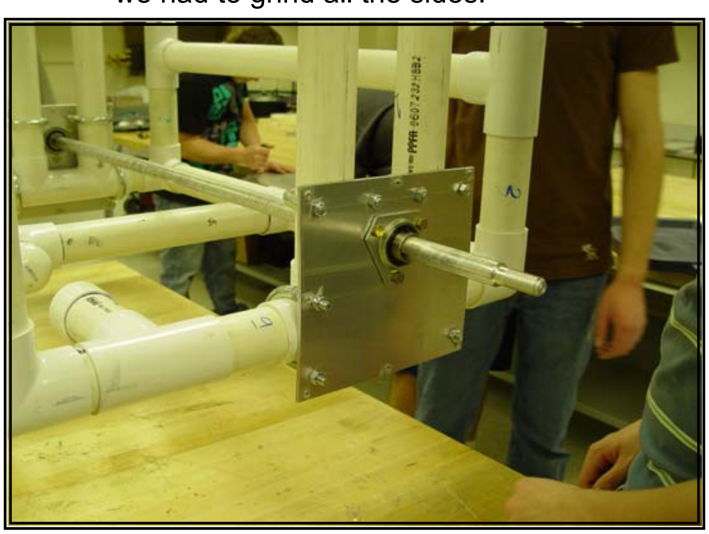
Adjustments to the frame were necessary through the building process. We learned what ways worked better, like properly aligning the sides before gluing the floor.



After the chassis was complete, we fabricated a prototype for the floor out of matte board.

We used aluminum for the actual floor, so we had to cut three separate pieces to all fit into the vehicle.

The rear axle plates were also made out of aluminum. After cutting the aluminum plates, we had to grind all the sides.

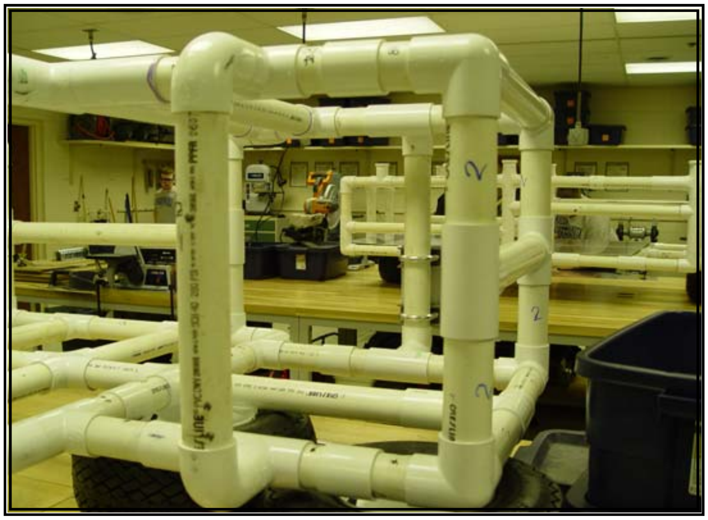


We used the file for slight modifications and to smooth out rough edges.

We drilled holes in the floor for the engine plate to fit and for all the clamps to secure the plate.

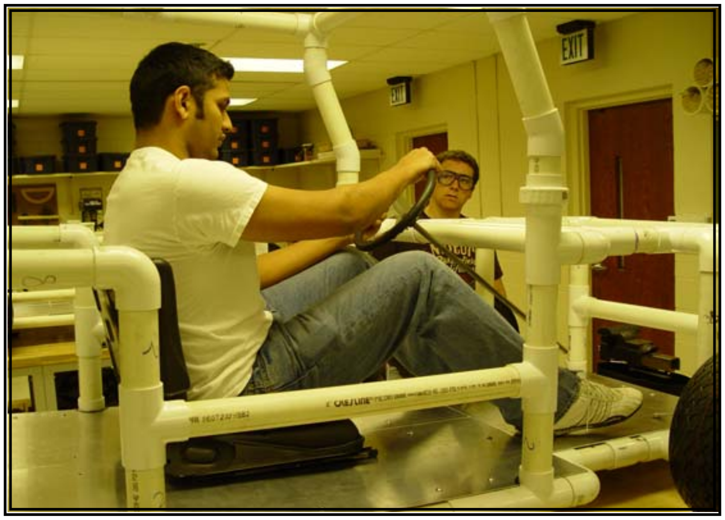
We were fortunate to have such precision tools in our lab like the mill and the drill press.

After problems with the front end, we had to change our plans. We switched to a single bracket front end which worked much better for steering.

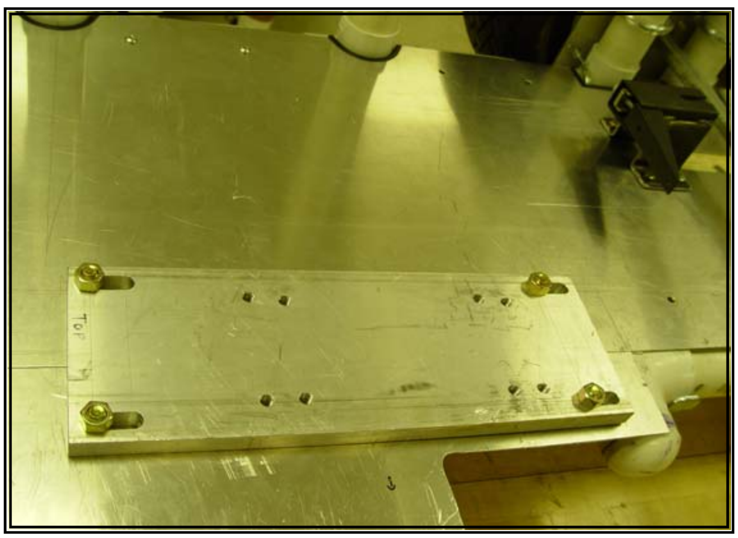


Apart of steering was the arrival of the pedals. We constructed pedal brackets to effectively tie down the pedals to the floor.

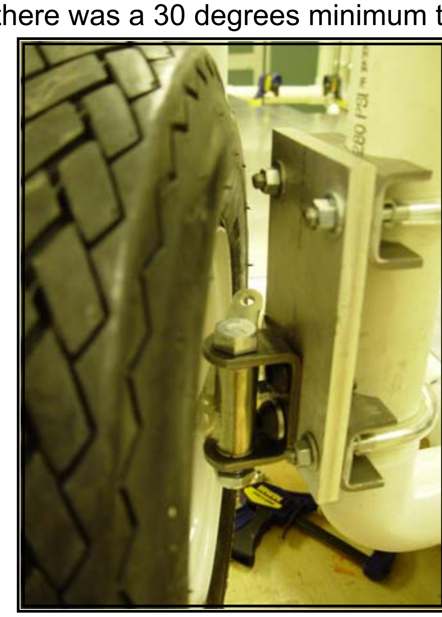
As a class we decided on getting new seats, with arm rests and the capabilities of leg room adjustments. This came with slight changes to the placement of the seat in the go cart.



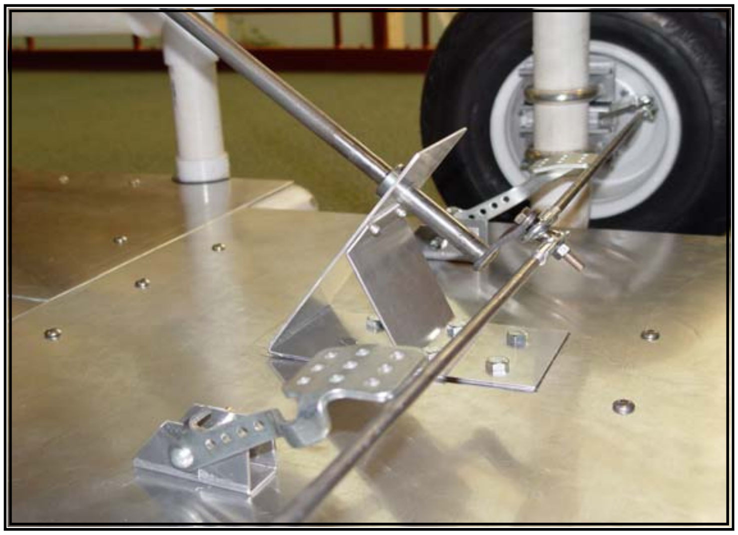
To properly place the engine we fabricated an engine plate to bolt the engine to.



For steering we created front axle plates and there was a 30 degrees minimum turning radius requirement.



We then came up with a steering bracket to finish the steering system.



With our vehicles completed we applied chrome paint to the steering components, and painted the brake assembly.

The pedal brackets, steering shaft support, dashboard, and axle plates were all clear-coated.

We decided to get the vehicles painted and the first time was not what we had in mind. So we went to another shop, and we were very satisfied with the results.

We had to change all the nuts and bolts to lock nuts and bolts and tighten everything down for the last time.

After we took it to the Parts Store, we completed the final assembly and weighed the vehicles.

We had an initial shakedown and then began the long anticipated testing.

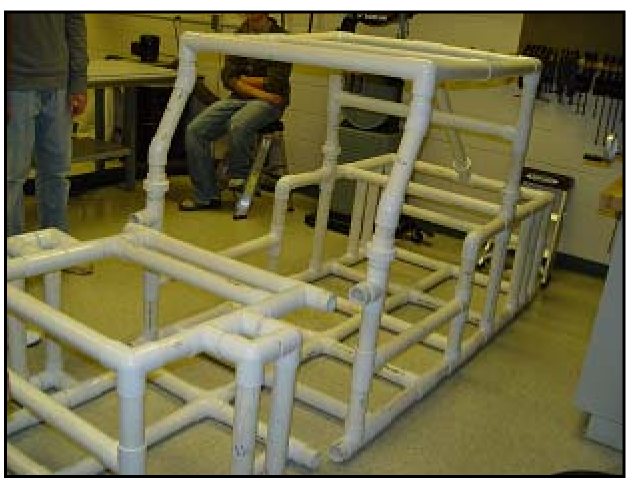
The Successes

Successes

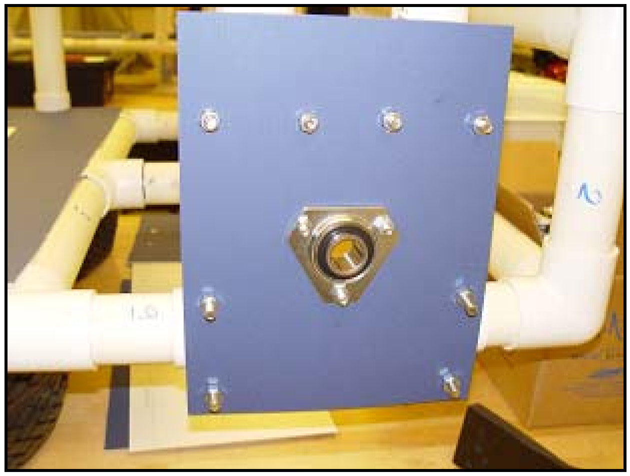
Ravage

When this project started, none of us thought it would be hard to succeed at building a PVC Vehicle. We soon found out how wrong we were. Our successes came far and wide because this was our first time building a project of this magnitude. Every part that we designed and built went through several phases of design changes and mistakes before it could be considered done.

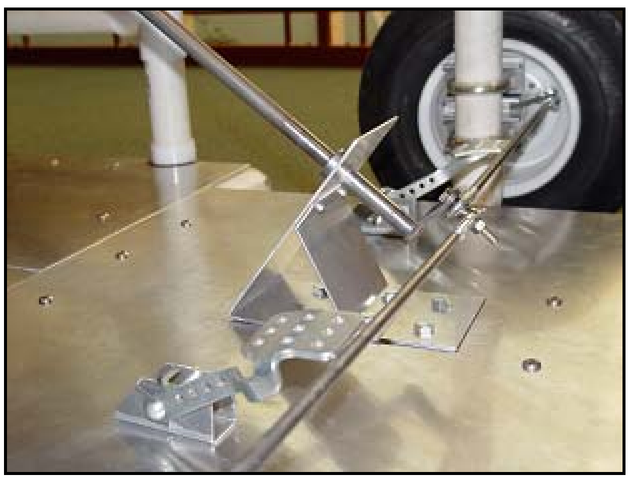
The first week we had succeeded at a very important portion of our car, the PVC. We had cut all of the correct PVC lengths and it all fit together for mock-up. Although our car design would be changed later due to design conflicts, our car body was a success to its original standards.



Our rear drive plates were a major success. We only made them once, after a few design changes of course. They never once moved or failed under the pressure of the entire car. They lasted the entire testing without sliding or a bolt becoming lose.



Another major success was our steering system. After a long couple months of on and off design changes, Muj and Ryan finally finished the steering leaving it in perfect working order. The dashboard and steering support system was all part of the success of the steering. While testing, nothing with the steering failed.



This process helped our group overcome many difficult situations. When we ran into a problem, our group would assemble and discuss what was wrong and why it wouldn't work. We would then verbally brainstorm some ideas about what we could change or remake so that it would work. Once we had a verbal idea, we would go to the computer and draw it so that we could make a prototype. Once the new prototype was made and worked, we could make a new part and see that it would work.

We also learned many things from our successes. The first thing we learned was that it takes a long time and a lot of work to succeed. The second thing we learned is that it takes mistakes to learn how to do something right. This was also probably the most important thing we learned. We will always make mistakes and nothing will ever be perfect, so when you succeed, cherish it.

The Failures

Failures

With any new and inventive project, you have to try and test out different ways of doing things until you finally find something that works. This is true for this PVC vehicle project more than anything. We have had a lot of tries at some things, and then had to go back to the drawing board to re-do the whole thing again. Even after re-designing the whole part sometimes, it still didn't work. We had to just take these experiences and use them as experiences to learn from.

Our first failure came in the designing of the front end. We designed the front end to have a double bar for the steering assembly to fit on. Unfortunately, we didn't find out until it came to assemble the steering components, when we realized our turning radius was not even close to being good enough. That is when we had to completely cut off the front end and go to a single bar system.. Our first front end, was a complete failure, but we were able to go back to the drawing board and learn from our mistakes and re-do it.

We were able to go through the rest of the build process pretty failure free. We ran into some problems, but they were all minor issues we were able to fix pretty easily. Our only other failure came up after we started testing. We had troubles with our chain almost immediately. Our chain kept popping off of our sprocket and we couldn't figure out what was causing this. Our sprocket was perfectly aligned with our torque converter but the chain still kept coming off. After a while, we were able to figure out that our sprocket hub came bent from the manufacturer, and that was our problem. We went to the Parts Store, to buy a new hub, but they were out and weren't getting any in until after our testing would be done.This ended up turning into a really big problem. Our only choice now, was to install an idler and hope it helps the chain stay tight and on the sprocket. After we installed the idler, the chain started holding on a lot better. It still did pop off though. We had to deal with the fact that the chain was going to keep giving us trouble until we got a new sprocket, which we couldn't get so we had to deal with the chain problem.

There are always going to be those unforeseen problems that will pop up in any project you do. We had one of those problems in the sprocket. We never thought to check if the sprocket was level, just because we expected it to come level form the manufacturer. It didn't turn out to be. Those are the issues you have to take in stride, and try finding a solution best you can, like we did in installing an idler on the chain. One of the biggest things I learned from this project was that mistakes and failures are going to creep into your project no matter what, you just have to be prepared that when they do show up, you can think of a solution to them.

The Mistakes

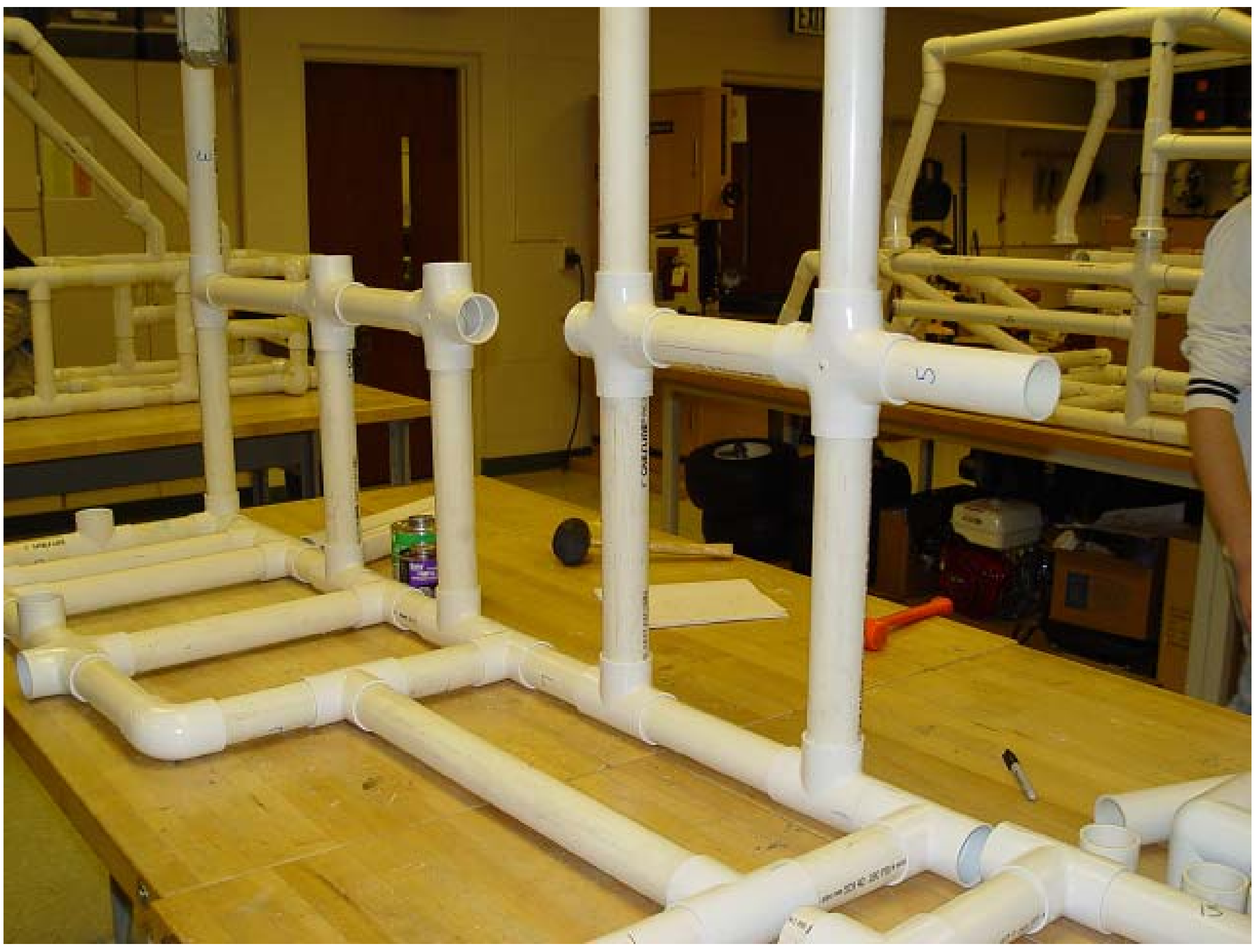
Mistakes

Our group was confident going into the assembly of the chassis which was probably one of the reasons we made so many mistakes. The problems started when we realized that the engagement is a very important part of the assembly process. We noticed that on some of our unions, we didn't engage properly, which throws everything off down the line. One of our larger problems occurred when the PVC glue dried faster than expected and the union we were gluing dried in the wrong position. This was a devastating mistake because it involved the possibility of replacing many parts, which would have been very costly. Thankfully, with the help of the PVC monsieur, Mr. Mitchell, we were able to fix this mistake and move on.

Engagement problem seen in front end

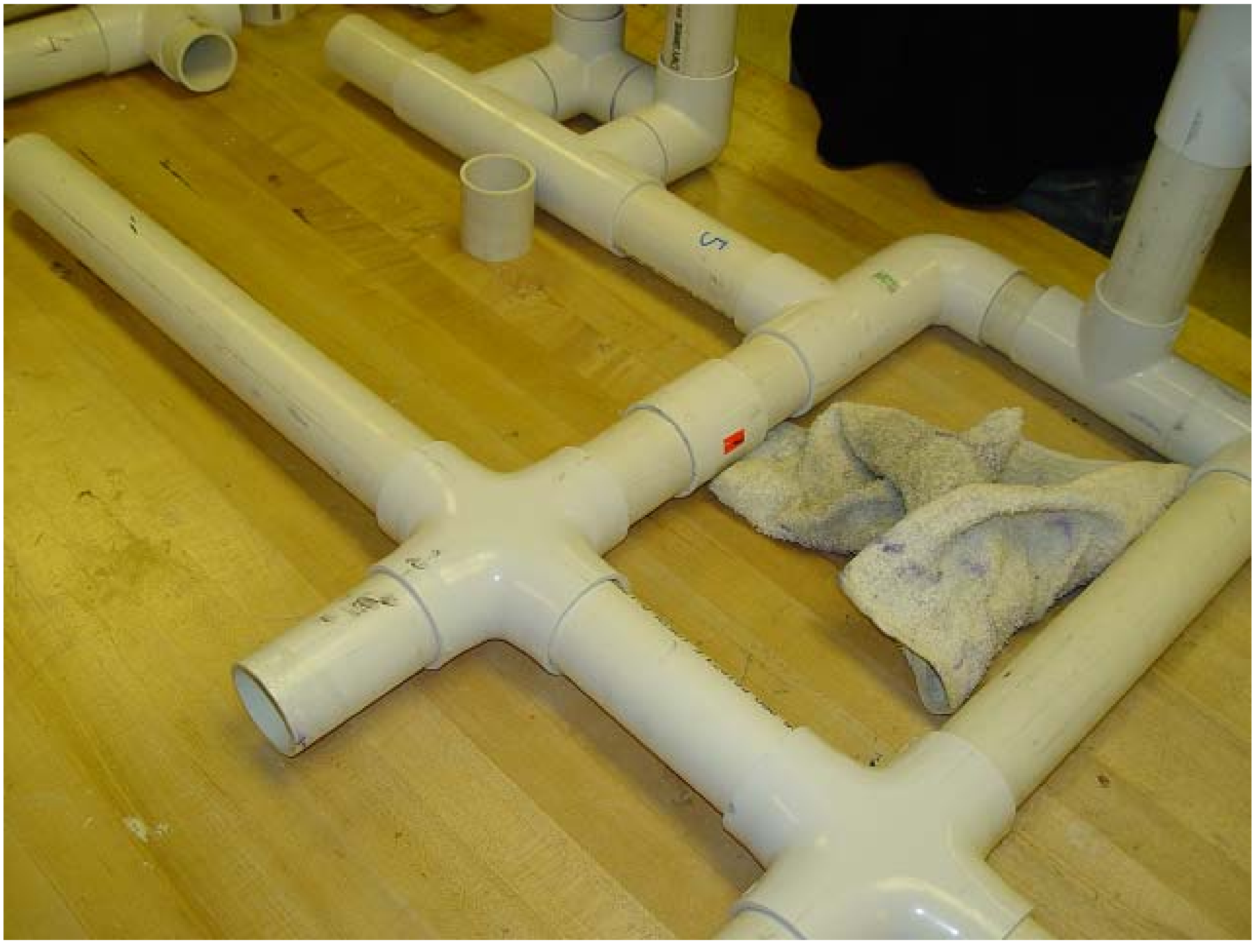
We encountered another problem when we forgot to put the fastening part of the coupler on the proper side before we glued it. We had to completely redo this part because there was no way to fix this mistake. We luckily had an extra coupler and an extra T-socket union so this mistake didn't cost us anything extra. This seemed to be a common mistake as other groups were faced with the same problem. This shows that you have to take your time and check, and double check what you're doing.

Another problem that every group seemed to face was the issue concerning the difference in sizes between the unions. Many groups, including ours, didn't account for the Cross-socket unions being larger than the T-socket unions. This made the bottom of the frame uneven and made it so we weren't able to get full engagement on the unions. We also didn't account for the T-socket unions being larger than the 90° socket, which created problems in our front end. This was a fairly large problem because it involved our front end/steering which is a very important part of our vehicle. We fixed this by manipulating the connecting pieces and eventually got them to fit together.



Working through size difference in cross-unions and T-unions

We encountered another problem when we went to assemble the front part of the vehicle to the rest of the vehicle. Since we did the front first, before we knew about the size differences, it didn't fit together so we had to cut the front apart and use couplers to resize it so it would fit together. We did the same thing when it came to the roll cage. We glued some of the sections of the roll cage before we did a mock-up/full dry fit of the vehicle. This was a problem because we noticed that our roll cage height is a little out of scale and should be shortened, which will be complicated due to the fact that some of the sections are already glued.



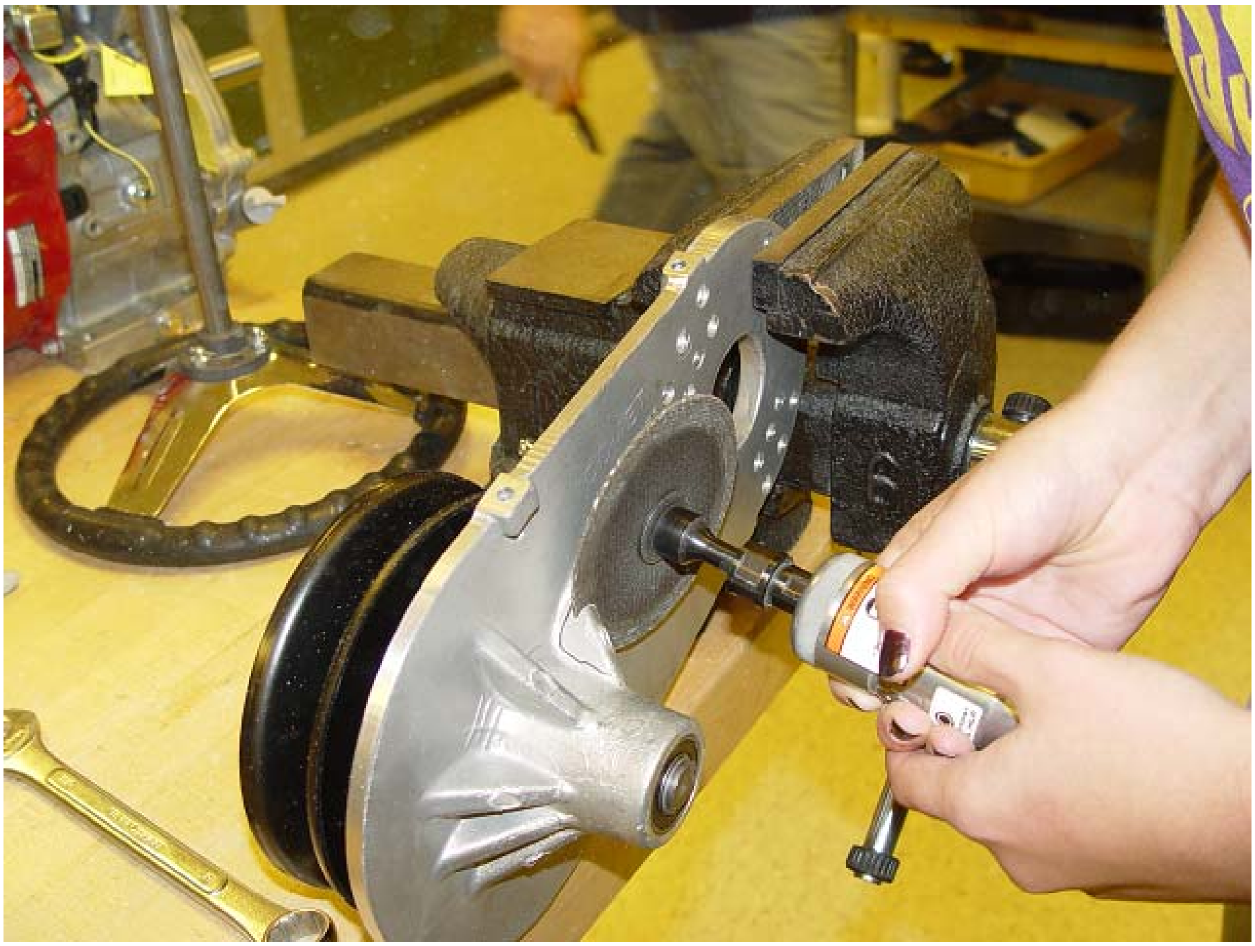
Fixing front-end problem with couplers

Roll cage isn't quite level because we glued things in the wrong order

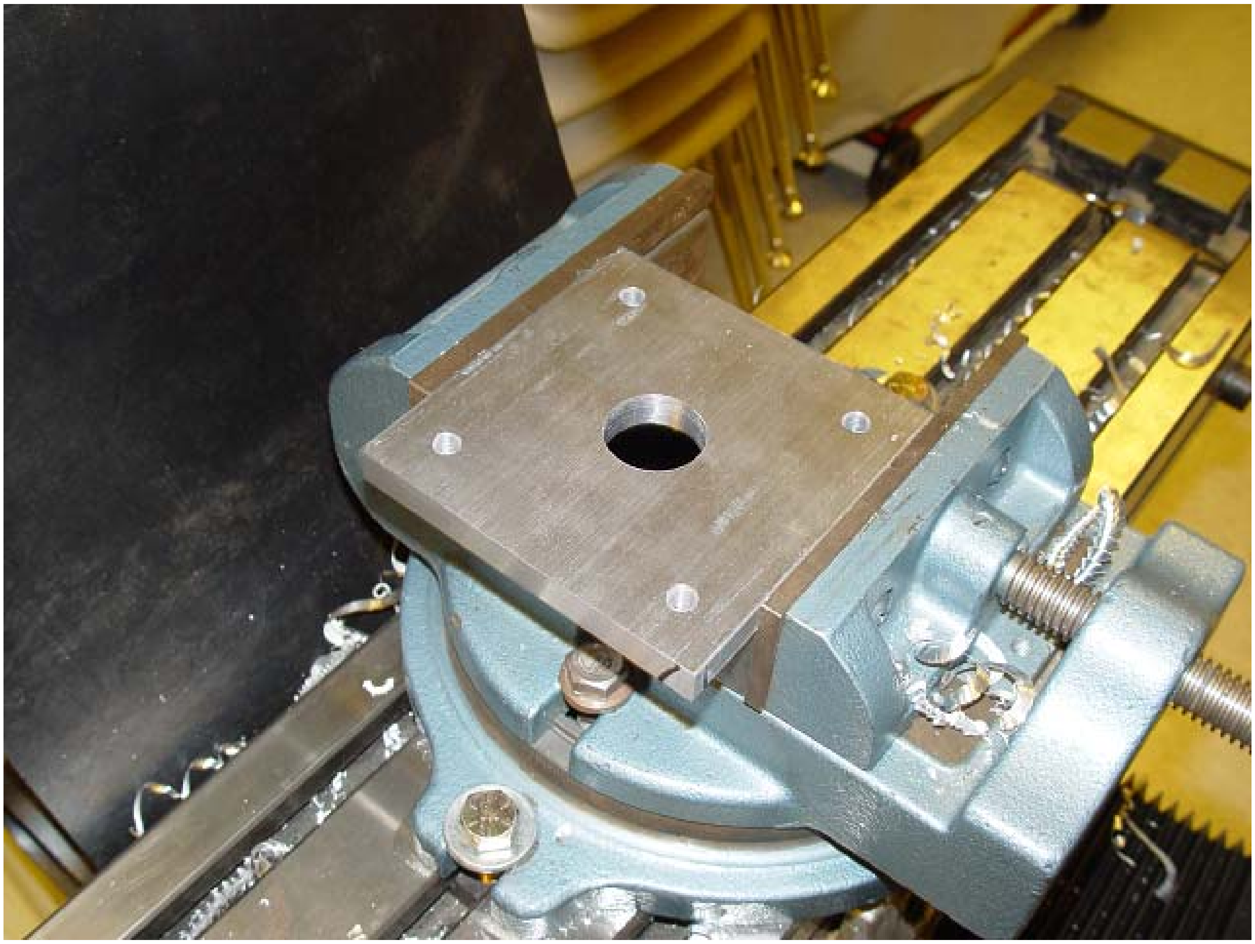
Late into the building of the chassis, we ran into another problem with our front end. We broke a section of the front end that holds the steering mount, so it was a problem we couldn't really fix, it was something we had to completely redo. This set us back a day having to remake a part that we already had done. Our front end has caused many problems for our kart, even after we thought we were done with the building process. After we "thought" we had completed our chassis, we discovered that our two-bar brace for our steering wouldn't work. So, we had to completely cut the front off our vehicle and re-do everything using unions, with using a single-bar brace for the steering.

Broken front end piece

Once we placed our torque converter on the engine, we noticed we had a few problems we had to fix. The first thing was that the torque converter had support pieces that were in the way. Once we noticed this, we placed the torque converter the way we wanted and cut the support down so it would fit on the engine. Then, we noticed that the torque converter was too close to the engine so we were going to need to make a spacer plate that would go in between the engine and the torque converter. We used a half inch think aluminum and found the schematic for the engine so we could drill the holes in the appropriate places. And lastly, now that we had a spacer plate and the way the engine was designed, the torque converter wasn't perfectly in-line so we needed to make a bushing longer than the one that was supplied. We did this by buying a large bushing and using the lathe to trim it down to the right size.



Cutting torque-converter support so it will fit on engine



Drilled spacer block for the engine and torque-converter

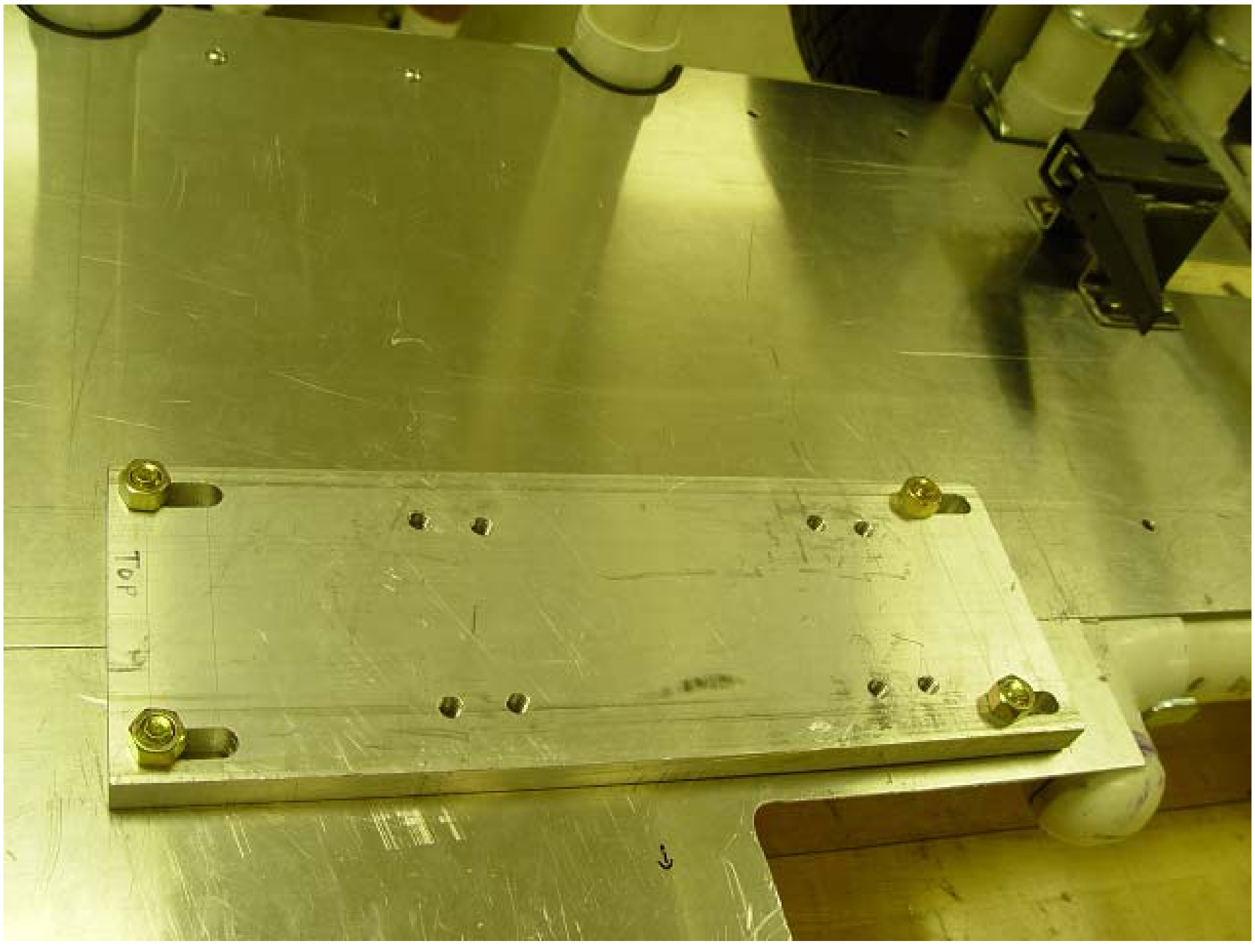
Once we got far enough into the build to start designing and placing the engine mount plate, we discovered that out original floor design was flawed. We had a PVC pipe right in the way of where our torque converter needed to be, so we had to make a modification. We had to take the Sawzall and cut one of the pipes to allow room for the torque converter to hang through. We then put PVC end caps on the cut ends to give a more finished look.

Floor cut to accommodate torque-converter

Once we changed our front end to the single-bar for our steering, we thought we were going to be all set. We designed our front plate and ran into another problem. We built our front steering plate to be too large and the U-bolts holding the plate were rubbing against the tires. From this, we had to make the plate shorter so that the U-bolts were lower, thus the U-bolts will no longer cause a problem for the tires.

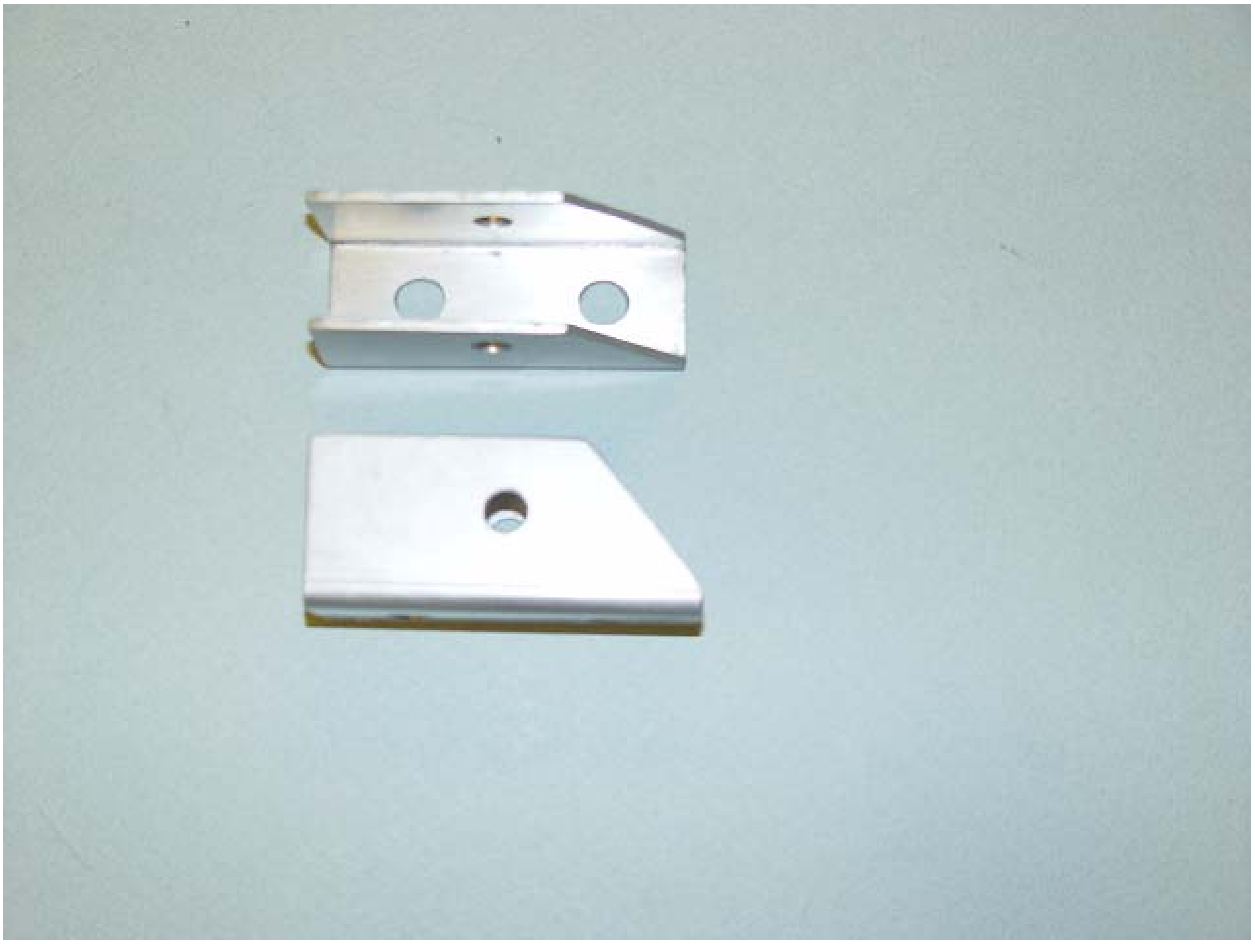
Front steering plate was too large and U-bolt rubbed against tire

The next thing to go wrong for our group was the engine plate, which is a very critical part of the vehicle. Everything was correct on the mock-up and the design, but when it came to the machining of the plate, one of the tapped holes became inaccurate by approximately 1/16 – 1/32 of an inch. When it comes to precision parts, this will cause things to go wrong, which they did. What we had to do was take the tapped holes (that secure the engine to the plate) and drill new ones, doing this allowed the engine to fit on the plate but now the engine will be a little closer to the seat.



Engine plate with the re-tapped holes for the engine

The last problem that we encountered was with the gas and brake pedal brackets. The problem we had with them is that after we made the brackets, we noticed we needed to incorporate a return spring on the brackets so that the gas a brake wouldn't get stuck. We had to make the brackets skinnier because the return spring added width and the pedal thread didn't reach through to the other side of the bracket. Once we re-made the brackets to accommodate the return spring, the pedals worked perfectly.



Old pedal brackets

New pedal brackets installed in vehicle

The Testing Analysis

Ravage
Testing

Wednesday, May 14, 2008

Today was the first day we were able to start our engines, and test to make sure that the cars worked on a small scale level. We were able to drive the car from the loading dock to the road. When our car turned, the chain popped off of the sprocket. We concluded that this problem is caused by the sprocket on the axle being misaligned with the sprocket on the torque converter. This was the only malfunction from our initial testing.

Monday, May 19, 2008

We performed our initial "shake down" test today. Slowly driving laps around the track we were able to see that our cars actually run. After the first few laps, we were able to increase our speed and make multiple laps at one time. We started to notice that our chain was still misaligned. Upon further investigation, we found that the sprocket and the hub were not round causing the chain to jump and sway which made the chain fall off.

Figure 1 Fixing the chain after it popped off.

Tuesday, May 20, 2008

This was our first day we were able to full out test our cars. The class decided that we would do the relay race. The first race we participated in was against the Blue car. Right off the bat, the blue car popped the chain. We got out to a great start with just more than a one lap lead. All of a sudden, on our third lap, our chain popped off. When Murphy got out to replace the chain, he was surprised to see that the chain had been eaten up by the torque converter. The chain had popped off the small sprocket and got lodged in the metal ridges in the torque converter. Our car was inoperable for the rest of this day so it was removed from the track and we started maintenance.

Figure 2 Ryan Stevens & Eric Murphy fixing the chain after it was stuck in the torque converter.

Wednesday, May 21, 2008

The turning test and the driver maneuverability test were performed today. We started with Mujadded driving for the steering test. We were able to make the first turn radius at 10ft. Any test with less than a 10ft radius was a failure. Our rear end would follow closely on the inside and run over the inside cone. After the turning test, we did maneuverability. Our car was able to perform very well completing every turn without any problems.

Figure 3 Completing the 10ft turn.

Figure 4 Failing the 8ft turn.

Friday, May 23, 2008

Today was a pretty free day. There were a few people missing from every group. A few parents showed up to watch our cars. To put on a show for the spectators, we did a head to head race consisting of three laps. Once again, we had chain problems caused by our sprocket. We replaced it and took a few more laps, but the chain popped off again and got stuck in the torque converter. We pushed our car back to the docks to fix again.

Thursday, May 29, 2008

Today was the final day of testing. We didn't have a specific test today. We did some joyriding, drag racing, and a passing race. We started with the passing race. Each car started at a different quadrant of the track and we drove until you passed a car. If you were passed you were out. We finished third due the chain popping off and getting stuck in the torque converter. After a quick fix, we competed against the red car in a drag race. We won by two car lengths. We ended the day with a little joyriding just enjoying the final moments with our car. We ended the day as a group with a group hug and a class picture.

Figure 5 Taking the car out for the last time.

Figure 6 Group hug.

Figure 7 Final group photo.

The Cost

2007 - 2008 Research and Development
PVC Vehicle Price Sheet

Total Price

No.	Description	Part Number	Qty	Unit Price	U/M	Total
1	**Steering, Brake and Throttle Package**		**1**	89.99	PKG	**$ 89.99**
2	left side spindle (to fit golf kart wheel)		1			
3	right side spindle (to fit golf kart wheel)		1			
4	25" splined steering shaft		1			
5	splined-hub with two bolt circles		1			
6	pitman arms with 5/16" bolt holes		2			
7	collars w/set screws		2			
8	½-20 slotted hex nut		1			
9	¼-28 x ¾ bolts w/hole		3			
10	¼-28 slotted hex nuts		3			
11	cotter pins		4			
12	snap ring(2) Solid tie rods 5/16-24 x 11" long. Adjustable & trim		1			
13	Rod End Bearings		4			
14	Jam Nuts		4			
15	Throttle Pedal		1			
16	Brake Pedal		1			
17	Throttle Rod - 1/4" x 30", 1/4-28		1			
18	Brake Rod - 1/4" x 40-1/2", 1/4-28		1			
19	Throttle Cable - 1/16" x 54" Cable, 50" Conduit		1			
20	Nylon Cable Guide		1			
21	Wire Stop		1			
22	Spring - 1/4" x 1-7/8"		1			
23	Tinnerman Nuts		2			
24	Hex Nut - 1/4-28		1			
25	Forged Clevis - 1/4-28 Thread		1			
26	Clevis Pin w/hole		1			
27	Cotter Pin - 1/16" x 1/2"		1			
28	Control Rod Anchors		2			
29	**Axle/Bearing Package**		**1**		PKG	
30	Solid Steel **54"** overall length x 1" OD Axle		1	59.95		**$ 59.95**
31	Axle Bearing Kit		1	25.00		**$ 25.00**
32						
33						

34						
35						
36						
37						
38	**Sprocket and Hub Package**	2555C	**1**	20.00	PKG	$ **20.00**
39	Steel plated Unihub for 1" live axle with #35 72 tooth steel sprocket					
40						
41	**Miscellaneous**					
43	Golf Kart Style Tires,18-8.50x8 Fairway Pro		1	113.16	ea	$ **113.16**
44	Golf Kart Wheels, 8x7		1	73.00	ea	$ **73.00**
45	Brake Assembly w/o Disc	1822	1	42.95	ea	$ **42.95**
46	Disc Only, 8" Diameter, 1" Bore	1823	1	22.95	ea	$ **22.95**
47	60" Boxed Chain w/Connecting Link	4313	1	8.80	ea	$ **8.80**
48	Front Wheel Hubs	2292	2	38.25	ea	$ **76.50**
49	Rear Wheel Hubs	2282	2	32.40	ea	$ **64.80**
50	8HP Honda Horizontal Engine	GX240K1QA2	1	516.00		$ **516.00**
51	2" 90° Elbows	44162330	10	1.09	ea	$ **10.90**
52	2" Cross Socket	44162658	7	2.69	ea	$ **18.83**
53	2" Threaded Union Socket	44772203	5	8.09	ea	$ **40.45**
54	2" Tee Socket	44162616	49	1.29	ea	$ **63.21**
55	2" Side Outlet Elbow 90	413-020	12	2.69	ea	$ **32.28**
56	2" 22.5° Elbows	416-020	4	1.79	ea	$ **7.16**
57	2" PVC Pipe 10'	*40	130	0.80	per ft	$ **104.00**
58	2" End Caps		2	1.66	ea	$ **3.32**
59	2" Unions		9	2.79	ea	$ **25.11**
60	8HP Honda Horizontal Engine	GX240K1QA2	1	516.00		$ **516.00**
61	Comet TAV-30 Torque Converter	1365	1	169.99		$ **169.99**
62	Metallic Paint Job (supplies and labor)		1	250.00	ea	$ **250.00**
63	.10" Sheet of Aluminum	26802050	1	127.66	ea	$ **127.66**
43	Fuel Charge		1	1.84	ea	$ **1.84**
44	.5" Aluminum	21439150	1.29	8.64	per ft	$ **11.15**
45	Fuel Charge		1	2.00	ea	$ **2.00**
46	3/4" Aluminum	21440400	1.42	16.12	per ft	$ **22.89**
47	Fuel Charge		1	2.16	ea	$ **2.16**
48	Grizly Seat	278302	1	96.46	ea	$ **96.46**
49	Killswitch		1	14.98	ea	$ **14.98**
50	Chain Idler		1	9.98	ea	$ **9.98**
51	Black Floor Trim		2	8.00	ea	$ **16.00**
52	Zip Ties		4	1.00	ea	$ **4.00**
53	Longer Steering Tie-Rods		2	2.00	ea	$ **4.00**
54	Wire Connectors		4	0.30	ea	$ **1.20**
55	Black Wire Tubing		6.5	1.00	per ft	$ **6.50**
56	Wire		7.5	0.30	per ft	$ **2.25**
57	Angle Iron		1	267.00	per ft	$ **267.00**
58	Floor Straps	2165066	21.5	0.49	ea	$ **10.54**
59	Small U-Bolts	7848260	8	1.25	ea	$ **10.00**
60	Large U-Bolts	5za52	4	1.72	ea	$ **6.88**
61	U-Bolt Lock Nuts	67337485	12	0.35	ea	$ **4.20**
62	Foam		11.4	0.18	per ft	$ **2.05**
63	Floor Strap Lock Nuts	67337444	37	0.19	ea	$ **7.03**
64	Floor Strap Button Head Screws	67563320	37	0.31	ea	$ **11.47**

65	Loctite		1	7.50	ea	**$ 7.50**
66	7/16" x 2" Hex Head Class 8 Bolts		4	0.37	ea	**$ 1.48**
67	1/2" X 2.5" Hex Head Class 8 Bolts		4	0.48	ea	**$ 1.92**
68	3/8" Class 8 Hex Head Bolts		13	0.31	ea	**$ 4.03**
69	3/8" Class 5 Hex Head Bolts		2	0.26	ea	**$ 0.52**
70	3/8" Washers		25	0.31	ea	**$ 7.75**
71	Keyway		0.3	1	per ft	**$ 0.30**
72	1/2" Large Washers		8	0.42	ea	**$ 3.36**
72	7/16" Washers		4	0.28	ea	**$ 1.12**
73	7/16" Lock Washers		4	0.34	ea	**$ 1.36**
					Total:	**$ 3,025.92**

The Daily Log

Daily Log

9-14-07

Discussion of Abilities:

Megan: Researching

Muj: AutoCAD

Eric: Inventor and Shop Tools

Brandon: Drawing

Sarah: Researched steering system

Go Cart Test: handling – weave through cones

9-17-07

Megan: Researched how to connect an engine to PVC; created a design of a go cart

Muj: Researched frame design

Eric: Researched brake system; sketched a 3 wheel go cart

Brandon: Researched steering; created design of a go cart

Sarah: Created individual design of go cart

9-18-07

Megan: Absent

Muj: Sketching

Eric: Sketching

Brandon: Sketching

Sarah: Researched steering and braking system

9-19-07

Megan: Sketching; Parts List

Muj: Research steering component

Eric: Absent 1st hour; design frame 2nd hour

Brandon: AutoCAD design of go kart

Sarah: Researched parts list and retailers

9-20-07

Megan: Set up binder; worked on defining the problem

Muj: Researched parts; worked on defining the problem

Eric: Researched parts and design

Brandon: AutoCAD design of go kart

Sarah: Researched comparative prices for common elements and came up with 2 team names

9-21-07

Megan: Researched parts list

Muj: Helped with defining the problem

Eric: Worked on defining the problem

Brandon: Researched design of go kart

Sarah: Researched comparative prices for common elements

9-24-07

Megan: Made cover sheet

Muj: Worked on defining the problem

Eric: Absent

Brandon: Worked on AutoCAD design of frame; researched steering system

Sarah: Drew quick sketches; created and discussed limits and constraints

9-25-07

Megan: Researched parts on gokartgalaxy.com

Muj: Researched how to connect engine to PVC; sketching

Eric: Worked on defining the problem

Brandon: Researched parts list; sketching

Sarah: Researched clutch; revised defining the problem

9-26-07

Megan: Made Price List

Muj: Made PVC Fitting Price List

Eric: Researched Prices

Brandon: Made PVC Pipe Price List

Sarah: Created parts list and double check prices

9-27-07

Megan: Revised Parts List

Muj: Designed 3D Pipe Fittings

Eric: Designed 3D Pipe Fittings

Brandon: Worked on AutoCAD design of frame

Sarah: Revised parts list

9-28-07

Megan: Revised Parts List

Muj: Worked on 3D Drawing

Eric: Worked on 3D Drawing

Brandon: Worked on AutoCAD design of frame

Sarah: Converted price list to Excel

10-1-07

Megan: Worked on revising 2D drawing on AutoCAD

Muj: Leader for Common List

Eric: Worked on 3D Model

Brandon: Worked on AutoCAD Design

Sarah: Researched revisions to parts list

10-2-07

Megan: Sketching; worked on bulletin board

Muj: Dimensioning 2D Drawing

Eric: Worked on Inventor drawing

Brandon: Revised Parts List

Sarah: Revised parts list; worked on bulletin board

10-3-07

Megan: Dimensioned 2D Drawing (kicked butt); asked questions about kart

Muj: Revised parts list; helped with master parts list

Eric: Inventor Drawing

Brandon: Revised Parts list

Sarah: Figured out mathematically how many PVC tubes needed

10-4-07

Megan: Dimensioned 2D Drawing

Muj: Revised Parts List

Eric: Worked on Inventor drawing

Brandon: Revised Parts List

Sarah: Researched bids for parts list

10-5-07

Megan: Worked on bulletin board

Muj: Gave input on bulletin board

Eric: Worked on Inventor drawing

Brandon: Worked on redesigning the frame for steering

Sarah: Worked on bulletin board; researched bid prices

10-8-07

Megan: Worked on bulletin board

Muj: Looked over AutoCAD drawing

Eric: Gave input on bulletin board

Brandon: Sketch for frame for steering

Sarah: Worked on bulletin board

10-9-07

Megan: Revised AutoCAD drawing to fit tire

Muj: Revised AutoCAD drawing to fit tire

Eric: Revised AutoCAD drawing to fit tire

Brandon: Researched how to connect steering

Sarah: Researched project names

10-10-07

Megan: Worked on bulletin board

Muj: At the math test

Eric: Got binder, helped move cabinets, CAD work

Brandon: At the math test

Sarah: Worked on bulletin board

10-11-07

Megan: Worked on bulletin board

Muj: Worked on AutoCAD and fitted tires

Eric: How to connect brakes to PVC and how they will work

Brandon: Worked on AutoCAD drawing and fitted tires

Sarah: Worked on bulletin board

10-12-07

Took day off

10-15-07

Megan: Worked on bulletin board

Muj: Worked on AutoCAD drawing

Eric: Looking up parts for rear axle

Brandon: Worked on AutoCAD drawing

Sarah: Worked on bulletin board

10-16-07

Megan: Fixed daily log and cover sheet; worked on bulletin board; group discussion on how to lower price

Muj: Group discussion on how to lower price

Eric: Absent 1st hour; group discussion

Brandon: Group discussion on how to lower price

Sarah: Group dissolved and was put into our group; worked on bulletin board

10-17-07

Megan: Absent

Muj: Measured track and developed testing plans

Eric: Measured track and researched driving techniques

Brandon: Developed go – kart testing plans

Sarah: Wrote and revised defining the problem

10-18-07

Megan: Worked on bulletin board

Muj: Researched how the torque converter works

Eric: Absent 1st hour;

Brandon: Test write up

Sarah: Worked on bulletin

10-19-07

Megan: Worked on bulletin board

Muj: Researched gas mileage

Eric: Researched components

Brandon: Test write up

Sarah: Worked on bulletin board

10-22-07

Megan: In the Lab

Muj: In the Lab

Eric: In the Lab

Brandon: In the Lab

Sarah: In the Lab

10-23-07

Megan: Finished bulletin board;

Muj: Dimensioned new kart drawing

Eric: Researched components

Brandon: Adding components to CAD drawing

Sarah: Finished bulletin board; test write up

10-24-07

Took day off

10-25-07

Megan: Worked on super mileage test

Muj: Worked on endurance test

Eric: Researched torque converter

Brandon: Worked on endurance test

Sarah: Worked on super mileage test

10-26-08

Took day off

10-29-07

Megan: Determined name; researched how to connect seating

Muj: Rechecked dimensions on CAD drawing; worked on improving design

Eric: Assigned specific parts to work on for each group member

Brandon: Researched the correct torque convertor

Sarah: Researched how to assemble a rear axle

10-30-07

Megan: Researched how to connect seating; helped with testing

Muj: Worked on cut list

Eric: Worked on cut list

Brandon: Worked on cut list

Sarah: Researched how to assemble a rear axle; typed out testing

10-31-07

Megan: Completed Super Mileage Test

Muj: Assembly drawing; completed cut list

Eric: Researched proper aluminum

Brandon: Assembly drawing; completed cut list

Sarah: Typed out Super Mileage Test chart

11-1-07

Megan: 1st hour = worked on seat connection; completed relay test directions 2nd hour = lab

Muj: 1st hour = dimensioned and reviewed full assembly or go kart 2nd hour = lab

Eric: 1st hour = Research 2nd hour = lab

Brandon: 1st hour = Assembly drawing 2nd hour = lab

Sarah: 1st hour = Helped with relay race 2nd hour = lab

11-2-07

Megan: Revised relay race

Muj: Worked on assembly drawing, measured

Eric: Research

Brandon: Worked on assembly drawing

Sarah: Researched how to assemble rear axle

11-5-07

Megan: Researched seat connection

Muj: Worked on assembly drawing

Eric: Researched how to mount the engine

Brandon: Measured engine; worked on assembly drawing

Sarah: Researched how to assemble and connect rear axle

11-6-07

Took day off

11-7-07

Megan: Research seat connection to the PVC

Muj: Worked on assembly drawing

Eric: 3D Drawing

Brandon: Researched braking system

Sarah: Researched how to assemble and connect rear axle

11-8-07

Megan: Separated parts in the lab; measured and tested parts in lab

Muj: Measured and tested parts in the lab

Eric: Measured and tested parts in the lab

Brandon: Measured and tested parts in the lab

Sarah: Separated parts in the lab; measured and tested parts in lab

11-9-07

Megan: In the lab

Muj: In the lab

Eric: In the lab

Brandon: In the lab

Sarah: In the lab

11-12-07

Megan: Connected seat mounts to bucket seat; found kart assembly directions

Muj: Assembly drawing; checked steering wheel; tested steering components to wheel

Eric: Put steering wheel together

Brandon: Assembly drawing; tested steering components to wheel

Sarah: Helped assemble seat; checked steering wheel

11-13-07

Megan: Researched steering components; checked parts on engine researched components

Muj: Revise assembly drawing

Eric: 3D drawing

Brandon: Revised cut list

Sarah: Researched steering components; checked parts on engine researched components

11-14-07

Guys brought PVC up from store room.

Girls worked in the computer lab.

11-15-07

Megan: Researched components; in the lab; learned how to glue PVC

Muj: Revised and finished cut list; in the lab; learned how to glue PVC

Eric: 3D Drawing; in the lab; learned how to glue PVC

Brandon: Revised and finished cut list; in the lab; learned how to glue PVC

Sarah: Researched components; in the lab; learned how to glue PVC

11-16-07

Megan: In the lab (cut, measured, and sanded PVC)

Muj: In the lab (cut, measured, and sanded PVC)

Eric: In the lab (cut, measured, and sanded PVC)

Brandon: In the lab (cut, measured, and sanded PVC)

Sarah: In the lab (cut, measured, and sanded PVC)

11-19-07

Megan: In the lab (cut, measured, and sanded PVC)

Muj: In the lab (cut, measured, and sanded PVC)

Eric: In the lab (cut, measured, and sanded PVC)

Brandon: In the lab (cut, measured, and sanded PVC)

Sarah: In the lab (cut, measured, and sanded PVC)

11-20-07

Took day off

11-21-07 to 11-23-07

Thanksgiving Break

11-26-07

Megan: In the lab (cut, measured, and sanded PVC)

Muj: In the lab (cut, measured, and sanded PVC)

Eric: In the lab (cut, measured, and sanded PVC)

Brandon: In the lab (cut, measured, and sanded PVC)

Sarah: In the lab (cut, measured, and sanded PVC)

11-27-07

Megan: Substitute (didn't go in lab)

Muj: Substitute (didn't go in lab)

Eric: Substitute (didn't go in lab)

Brandon: Substitute (didn't go in lab)

Sarah: Substitute (didn't go in lab)

11-28-07

Megan: Substitute (didn’t go in lab)

Muj: Substitute (didn’t go in lab)

Eric: Substitute (didn’t go in lab)

Brandon: Substitute (didn’t go in lab)

Sarah: Substitute (didn’t go in lab)

11-29-07

Megan: Sanded PVC

Muj: Cut pipes, put together kart

Eric: Cut pipes, put together kart

Brandon: Cut pipes, put together kart

Sarah: Sanded PVC

11-30-07

Megan: Sanded PVC put together kart

Muj: Cut pipes, put together kart

Eric: Cut pipes, put together kart

Brandon: Cut pipes, put together kart

Sarah: Sanded PVC put together kart

12-3-07

Megan: Cut and sanded torque converter

Muj: Put together kart

Eric: Put together kart

Brandon: Put together kart

Sarah: Cut and sanded torque converter

12-4-07 to 12-11-07

Megan: Glued PVC together

Muj: Glued PVC together

Eric: Glued PVC together

Brandon: Glued PVC together

Sarah: Glued PVC together

Checked and rechecked the perfection of the kart. Made sure the sides of the kart line up.

12-12-07

Revised drawings, worked on completing binder, recorded problems we have had on the kart, made a PVC fittings and pipe list.

12-13-07

Re-cut PVC for bottom of go kart. Dry-fit bottom of go kart.

12-14-07

Glued bottom of PVC together. Checked and rechecked the perfection of the bottom and sides of go kart.

12-17-08

Snow Day

12-18-07 and 12-19-07

Glued bottom of PVC together. Checked and rechecked the perfection of the bottom and sides of go kart.

12-20-07

Cleaned the lab

12-21-07

Took day off

12-24-07 to 1-4-08

Christmas Break

1-7-08

Glued PVC together. Checked roll cage. Discussed problem with the front of the kart.

1-8-08

Took go kart out in the hall and discussed the dimensions of the body and the roll cage. Glued PVC together.

1-9-08

Megan: Glued roll cage together

Muj: Cut and measured front end

Eric: Glued roll cage together

Brandon: Cut and measured front end

Sarah: Glued roll cage together

1-10-08

Dry-fit the front of the go kart.

1-11-08

Took day off

1-14-08

Megan: Glued front end together; cut out floor from mat board

Muj: Glued front end together

Eric: Glued front end together, fixed damage on PVC

Brandon: Glued front end together; cut out floor from mat board

Sarah: Glued front end together, fixed damage on PVC

1-15-08

Megan: Glued front end together; cut out floor from mat board

Muj: Glued front end together

Eric: Glued front end together, fixed damage on PVC

Brandon: Glued front end together; cut out floor from mat board

Sarah: Glued front end together, fixed damage on PVC

1-16-08

Worked on Mid-Term Exam

1-22-08

Substitute Teacher

Megan: departed from class

Muj: Researched steering

Eric: Researched engine placement

Brandon: Researched brake and rear axle

Sarah: Researched brake and rear axle

Ryan: Joined group and researched seating

1-23-08

Muj: finished gluing together front end

Eric: finished gluing together front end

Brandon: finished gluing together front end

Sarah: finished gluing together front end

Ryan: designed and cut out rear axle plates

1-24-08

Muj: cut out and modified engine plate

Eric: modified matte board floor

Brandon: redesigned and cut out rear axle plates

Sarah: modified matte board floor

Ryan: redesigned and cut out rear axle plates

1-25-08

Muj: worked on steering components

Eric: de-burr the engine plate and assembled torque convertor

Brandon: redesigned and cut out rear axle plates

Sarah: modified matte board floor

Ryan: redesigned and cut out rear axle plates

1-28-08

Muj: worked on front-wheel steering

Eric: assembled engine in cart; choose cart modifications

Brandon: worked on front-wheel steering

Sarah: finished modifying matte board floor

Ryan: finished rear axle plate prototypes and aligned axle

1-29-08

Muj: worked on front-wheel steering

Eric: modified chassis for engine

Brandon: modified matte board floor to accommodate for engine placement

Sarah: modified matte board floor to accommodate for engine placement

Ryan: learned how to cut aluminum floor

1-30-08

Muj: redesigned front end of cart

Eric: sanded cut-off PVC fittings

Brandon: created matte board floor for rear end of cart

Sarah: created matte board floor for rear end of cart, sanded cut-off PVC fittings

Ryan: designed rear axle plates in CAD

1-31-08

Muj: dry fitted front end

Eric: sanded cut-off PVC fittings, dry fitted front end

Brandon: modified matte board floor for rear end of cart

Sarah: measured brackets for cutting

Ryan: cut plastic tubing and inserted U-bolts

2-1-08

Took Day Off

2-4-08

Muj: sanded and glued front end

Eric: Cut out floor board for brakes and brake disc

Brandon: sanded and glued front end

Sarah: counted and recorded all pieces of PVC

Ryan: Cut out floor board for brakes and brake disc

2-5-08

Muj: Absent

Eric: measured and cut brackets

Brandon: re-cut front floor plate

Sarah: counted and recorded all pieces of PVC, typed up recordings

Ryan: Cut base plate adjustments for floor

2-6-08

Substitute Teacher

Muj: Revised drawings

Eric: Reorganized binder, helped with pictures

Brandon: Updated problems and solutions

Sarah: Updated and made captions for pictures

Ryan: Updated drawings

2-7-08

Snow Day

2-8-08

Muj: Drilled front brackets for steering

Eric: drilled brackets for steering

Brandon: fixed front matte board sheet

Sarah: Revised PVC count

Ryan: Absent

2-11-08 to 2-15-08

Mid-Winter Break

2-18-08

Muj: Drilled and de-burred front brackets

Eric: traced and cut metal base plate

Brandon: traced and cut metal base plate

Sarah: Constructed front axle plates

Ryan: traced and cut metal base plate

2-19-08

Muj: constructed front axle plate

Eric: traced and cut metal base plate

Brandon: traced and cut metal base plate

Sarah: Constructed front axle plate

Ryan: traced and cut metal base plate

2-20-08

Muj: worked on front axle

Eric: traced and cut metal base plate

Brandon: traced and cut metal rear axle plates

Sarah: sanded and de-burred metal base plate

Ryan: traced and cut metal rear axle plates

2-21-08

Muj: worked on steering

Eric: cut engine plate

Brandon: cut and drilled metal rear axle plate

Sarah: sanded and de-burred metal base plates

Ryan: cut metal rear axle plates

2-22-08

Muj: worked on front plates

Eric: sketched braking system

Brandon: Absent

Sarah: sanded and de-burred metal base plates

Ryan: absent

2-25-08

Muj: drilled and tapped steering plates

Eric: cut and sanded engine mount plate

Brandon: drilled rear axle plate

Sarah: sanded and de-burred metal base plates

Ryan: drilled rear axle plate

2-26-08

Muj: drilled slots into engine plate

Eric: Assisted with rear axle and rear axle plates

Brandon: finished rear axle plates

Sarah: sanded and de-burred metal base plates

Ryan: mounted rear axle plates

2-27-08

Muj: Grinded front steering plates

Eric: Absent

Brandon: Cleaned clamps

Sarah: sanded and de-burred metal base plates

Ryan: Cut foam and applied to clamps

2-28-08

In the classroom

Muj: Revised chassis drawing

Eric: Drawing engine plate in CAD

Brandon: Updated overall cost analysis and PVC price list

Sarah: Updated PVC Count and binder

Ryan: Revised rear axle plate drawing in CAD and Inventor

2-29-08

Muj: Modified and cut U-bolts

Eric: Modified and cut U-bolts

Brandon: chamfered U-bolts

Sarah: Put tubing on clamps

Ryan: Put tubing on clamps

3-3-08

Muj: Modified and cut U-bolts

Eric: Modified and cut U-bolts

Brandon: Modified front axle

Sarah: Modified front axle

Ryan: Cut and glued PVC cap

3-4-08

Muj: Cut and modified front axle plates

Eric: Tapped clamp holes

Brandon: Marked clamps holes for cutting

Sarah: Deburred clamp holes

Ryan: Drilled clamp holes

3-5-08

Snow Day

3-6-08

Shortened hours

Muj: took off plastic seat cover

Eric: Absent

Brandon: unpacked new seat

Sarah: took off seat covers

Ryan: test fit seat into PVC vehicle

3-7-08

Substitute

Muj: Updated assembly drawings

Eric: Revised drawing of new engine plate

Brandon: Update problems and modifications

Sarah: Update pictures and cleaned out binder

Ryan: Updated new front end drawing

3-10-08

Muj: Worked on front axle plates

Eric: Cut front axle plates, got engine plate approved

Brandon: Researched and worked on seat

Sarah: Cleaned and applied foam to new clamps, cut and sanded clamps

Ryan: Design gas and brake pedal brackets

3-11-08

No school; ACT testing

3-12-08

Muj: Worked on front axle plates

Eric: Absent

Brandon: Laid out seating and steering placement

Sarah: Put foam pieces on chassis

Ryan: Created gas and brake pedal brackets

3-13-08

1/2 day hours 4-6

3-14-08

Speed Schedule

Muj: Made to do list

Eric: Absent

Brandon: Absent

Sarah: Clean out bins and wrote bin list

Ryan: Made to do list

3-17-08

Muj: Absent

Eric: Fabricated engine plate

Brandon: Deburred pedal bracket holes

Sarah: Drilled holes in pedal brackets

Ryan: Readjusted brackets and got bolts for seat

3-18-08

Muj: Cut notch in front steering plates

Eric: Fabricate engine plate and template

Brandon: Designed steering setup

Sarah: Measured and planned seat mounting

Ryan: Measured and planned seat mounting

3-19-08

Muj: Filed front steering plates

Eric: Fabricate engine plate and template

Brandon: Filed front steering plates

Sarah: Deburred seat mount holes

Ryan: Drilled seat mount holes

3-20-08

Muj: Adjusted front steering plates

Eric: Worked on engine plate

Brandon: Mounted seat

Sarah: planned brake system and welding

Ryan: designed brake system in AutoCAD

3-21-08 to 3-30-08

Spring Break

3-31-08

Muj: Helped asses issues in engine mounting

Eric: Worked on engine plate

Brandon: assisted with engine plate

Sarah: Absent and not in charge of daily log

Ryan: measured and drew up dashboard

4-1-08

Muj: Designed dashboard in AutoCAD

Eric: Worked on engine plate

Brandon: Trimmed engine spacer to size

Sarah: Absent

Ryan: mocked up dashboard, made modifications

4-2-08

Muj: Worked on dashboard

Eric: Worked on engine plate

Brandon: Put new clamps on floor

Sarah: Absent

Ryan: mocked up dashboard, made modifications

4-3-08

Muj: Connected and locked up tie rods

Eric: Drilled and Threaded holes in engine plate

Brandon: Helped with engine plate

Sarah: Worked on brake plate welding plans

Ryan: Absent

4-4-08

Muj: Helped drill slots on engine plate

Eric: Drilled slots on engine plate

Brandon: Absent

Sarah: Worked on brake welding plans

Ryan: mocked up floor steering plate

4-7-08

Muj: Cut out steering brackets

Eric: Finished drilling and de-burring engine plate

Brandon: Grinded steering brackets

Sarah: Filed steering brackets, planned brake brackets

Ryan: Cut out steering brackets

4-8-08

Muj: Cut new steering shaft

Eric: Modified engine plate

Brandon: Mount engine and engine plate

Sarah: Threaded tie rods

Ryan: Create drawings for new tie rods

4-9-08

Muj: Worked on support for floor bolted steering shaft

Eric: Redrew engine plate designs and laid out holes for drilling

Brandon: Updated problems paper, grinded steering shaft support

Sarah: Threaded tie rods, redrew braking system mount

Ryan: Chamfered steering rods, dry mock up of steering assembly

4-10-08

Muj: Drilled holes on engine plate, mocked up steering

Eric: Finished engine plate, drilled and threaded holes

Brandon: Bended and riveted floor mounted steering support

Sarah: Finished design for braking system

Ryan: Made collar for steering shaft extension, mocked up steering

4-11-08

Muj: Absent

Eric: Mocked up engine, align engine and chain

Brandon: Grinded pedal plates

Sarah: Cut pedal plates

Ryan: Mocked up engine, align engine and chain

4-14-08

Muj: Aligned floor and steering, drilled holes in steering support

Eric: Align engine

Brandon: Fabricated brake plate support for under floor

Sarah: Marked and drilled holes on brake plates

Ryan: Assisted in steering, drilled holes in floor for steering

4-15-08

Muj: Work on steering system

Eric: Drew out holes in floor for engine plate

Brandon: Marked and drilled holes in brake plate support

Sarah: Deburred holes in brake plate

Ryan: Work on Steering system

4-15-08

Muj: Finished steering

Eric: Drilled holes in floor for engine plate

Brandon: Absent

Sarah: Bolted brake plate, slotted brake plate support

Ryan: Absent

4-16-08

Muj: Drilled holes in floor for brakes

Eric: Lined up engine

Brandon: Deburred holes

Sarah: Final mock up of brake

Ryan: Assembled brake and gas pedals

4-17-08

Muj: Drilled holes for clamps

Eric: Final mock up of engine with engine plate

Brandon: Lined up and marked chain for cut

Sarah: Cleaned clamps, put foam on clamps

Ryan: Final mock up of steering

4-18-08

Muj: Disassembled and sanded cart

Eric: Disassembled and sanded cart

Brandon: Disassembled and sanded cart

Sarah: Disassembled and sanded cart

Ryan: Disassembled and sanded cart

4-21-08

Substitute

Muj:

Eric: Cleaned out bins, separated papers

Brandon: Updated problems and modifications and added pictures

Sarah: Updated binder, printed pictures

Ryan:

4-22-08

Muj: Grinded, sanded and lacquered parts

Eric: Grinded, sanded and lacquered parts

Brandon: Grinded, sanded and lacquered parts

Sarah: Grinded, sanded and lacquered parts

Ryan: Grinded, sanded and lacquered parts

4-23-08

Muj: Grinded, sanded and lacquered parts

Eric: Absent

Brandon: Grinded, sanded and lacquered parts

Sarah: Grinded, sanded and lacquered parts

Ryan: Grinded, sanded and lacquered parts

4-24-08

Teacher In-Service, No School

4-25-08

Muj: picked up painted parts

Eric: Brainstorming car name

Brandon: Absent

Sarah: Printed pictures

Ryan: Revised drawings

4-28-08

Muj: Absent

Eric: clear-coated aluminum

Brandon: clear-coated aluminum

Sarah: Modified pictures

Ryan: clear-coated aluminum

4-29-08

Muj: Painted tie-rods

Eric: Clear coated aluminum

Brandon: Painted tie-rods

Sarah: Modified pictures

Ryan: Sanded the front base plate, clear-coated aluminum

4-30-08

Muj: Picked up go cart from Lakeside Collision

Eric: Absent

Brandon: Cleaned out bins

Sarah: Took pictures of all the parts

Ryan: Separated extra parts

5-1-08

Muj: Picked up go cart from Lakeside Collision

Eric: Added more pictures to binder

Brandon: Updated binder

Sarah: Absent

Ryan: Designed binder cover

5-2-08

Muj: Picked up go cart from Lakeside Collision

Eric: Absent

Brandon: Measured tubing for floor plates, created list to buy

Sarah: Printed new pictures

Ryan: Modified brake brackets and pedals

5-5-08

Muj: Absent

Eric: Applied foam to vehicle, placed black trim around aluminum plates

Brandon: Applied foam to vehicle, placed black trim around aluminum plates

Sarah: Applied foam to vehicle, placed black trim around aluminum plates

Ryan: Applied foam to vehicle, placed black trim around aluminum plates

5-6-08

Muj: Final assembly of vehicle

Eric: Final assembly of vehicle

Brandon: Final assembly of vehicle

Sarah: Final assembly of vehicle

Ryan: Final assembly of vehicle

5-7-08

Muj: Final assembly of vehicle

Eric: Final assembly of vehicle

Brandon: Final assembly of vehicle

Sarah: Final assembly of vehicle

Ryan: Final assembly of vehicle

5-8-08

Muj: Final assembly of vehicle

Eric: Final assembly of vehicle, modify torque convertor cover

Brandon: Final assembly of vehicle, work on new brake pedals

Sarah: Final assembly of vehicle

Ryan: Final assembly of vehicle, work on kill switch

5-9-08

Muj: Final assembly of vehicle

Eric: Final assembly of vehicle

Brandon: Final assembly of vehicle

Sarah: Final assembly of vehicle

Ryan: Final assembly of vehicle

5-12-08

Muj: Absent

Eric: Cleaned out bins and lab

Brandon: Cleaned out bins and lab

Sarah: Cleaned out bins and lab

Ryan: Cleaned out bins and lab

5-13-08

Muj: Worked on final exam portfolio document

Eric: Worked on final exam portfolio document

Brandon: Worked on final exam portfolio document

Sarah: Worked on final exam portfolio document

Ryan: Absent

5-14-08

Muj: Test-drive vehicle

Eric: Test-drive vehicle

Brandon: Test-drive vehicle

Sarah: Test-drive vehicle

Ryan: Test-drive vehicle

5-15-08

Cardboard Boat Regatta

5-16-08

Muj: Final assembly, weighed vehicles

Eric: Final assembly, weighed vehicles

Brandon: Final assembly, weighed vehicles

Sarah: Final assembly, weighed vehicles

Ryan: Final assembly, weighed vehicles

5-19-08

Muj: Initial shakedown

Eric: Initial shakedown

Brandon: Initial shakedown

Sarah: Initial shakedown

Ryan: Initial shakedown

5-20-08

Muj: Absent

Eric: Relay Race test

Brandon: Relay Race test

Sarah: Relay Race test

Ryan: Relay Race test

5-21-08

Muj: Testing turning and driver ability

Eric: Testing turning and driver ability

Brandon: Testing turning and driver ability

Sarah: Testing turning and driver ability

Ryan: Testing turning and driver ability

5-22-08

Muj: Work on final report

Eric: Work on final report

Brandon: Field trip to Cedar Point

Sarah: Field trip to Cedar Point

Ryan: Field trip to Cedar Point

5-23-08

Muj: Absent

Eric: Relay race and tested turning

Brandon: Absent

Sarah: Relay race and tested turning

Ryan: Relay race and tested turning

5-26-08

Memorial Day

5-27-08

Muj: Absent

Eric: Fixed chain and began to fabricate idler

Brandon: Fixed chain and began to fabricate idler

Sarah: Worked on build process

Ryan: Fixed chain and began to fabricate idler

5-28-08

Muj: Fabricate and install idler

Eric: Fabricate and install idler

Brandon: Fabricate and install idler

Sarah: Fabricate and install idler

Ryan: Fabricate and install idler

5-29-08

Muj: Final testing

Eric: Final testing

Brandon: Final testing

Sarah: Final testing

Ryan: Final testing

5-30-08

Muj: Final Exam Portfolio

Eric: Final Exam Portfolio

Brandon: Final Exam Portfolio

Sarah: Final Exam Portfolio

Ryan: Final Exam Portfolio

The Lessons Learned

Sarah Mozdrzech

Live and Learn: The Final Project

Four years ago walking into technical design class, I had no idea the effect this class would have on me. I was so unprepared and I have learned so much more than I could have imagined. The classmates I have come to know so well have influenced me greatly. Mr. Mitchell with his hard work and dedication has been a worthy role model throughout high school. This year alone has changed my perspective of engineering as a whole and made me realize those important life lessons, like teamwork. Even in my wildest dreams, building a go-cart did not seem a likely choice for our senior project.

The experience I gained through this project has shown me engineering at its finest, and possibly its worst. This isn't any small engines class and we weren't building a dinky barstool racer. Our Research and Development class built four full-sized go-carts. Still saying that now makes me so proud of all the work we've done. I learned the meaning of the term "research and development."

After working on this project the entire year, I would say the most solid base for any project is the research. You cannot do the bare minimum and expect logic to cover the rest. The more you have prepared yourself with research, the more successes you will have in the long run. I have learned to compromise, and communication is key for any successful team or group. Everyone is in for the long haul and you have to learn to get along or there will be big problems, especially a lack of productivity.

Having successfully run all the PVC vehicles several times, I would be quick to say I absolutely loved this project. It is a once in a lifetime opportunity. What I like is the fact we have an instructor so passionate about the engineering field, he is willing to put his neck on the line for his students to have an experience as awesome as this. Another instructor in the department tried something like this before and ended in failure. Not because of a lack of qualifications as a teacher, but students without the drive to work hard. We learned the meaning of hard work and I've put more hours into this school year than any other year previous.

Of course it was worth it, and we kept with this project because if Mr. Mitchell believed in us, we knew we would have to believe it too. What I liked about this project, but sometimes disliked as well, was the freedom we were given. There was no manual or easy instruction guide. It was like a puzzle and every step was a new piece to solving it. We would not have been successful without Mr. Mitchell's guidance, patience, and extra long hours he put in. Every group made mistakes, but we were able to learn from those mistakes. It wasn't about right and wrong. Every group had a different style in areas such as the frame, engine placement, and steering shaft placement. It was literally us students making these vehicles, which in retrospect is almost unbelievable to many of my peers.

When things hit a rough patch, it was easiest to blame your group members for the way things went. Sometimes I would dread coming in to see my group. But we would work through the difficulties and in a day or two, the troubles would be forgotten. With the project completed, I do not have many complaints for the process. No one knew what to expect from beginning to end, and it has exceeded many expectations. This project could not be done on an individual basis for many reasons. From my experience, group projects haven't always been the best idea either. As a member coming from another group, I feel wholly apart my current group. We have camaraderie, and the class as a whole has a deeper level of trust and friendship with one another. Within my group, I have learned to pick my battles.

If I disagree with what everyone says constantly, then I seem to be more of a hinder than a help. Sometimes you have to be able to say, "I was wrong." Everyone has their say on how a task should be done, but you have to be willing to listen to your group's input. We are all still working on the same project, and you have to be willing to step up if someone isn't being a help. I think everyone in my group pulled their own weight, but there were times when people should have stepped up. Some members in our group weren't always willing to accept the input of others either.

Time management was a big skill we learned the importance of during this project. There were days you came into class and you would rather take a nap then anything else. We had to get past that and diligently work every single day. There was not a minute to waste, and the result was outstanding.

To repeat this project, I would say don't be afraid to do something different. If you have an idea that isn't what everyone else is doing, go for it. You have to realize once you start the project, you have to fully commit. 50% isn't good enough; you have to come every day with 100% effort. Another piece of advice would be to fully understand your research. We split the project into areas, like steering and engine, but you have to know what's going on in all areas of the vehicle. Don't just look up a few websites from Google and call it good. Talk to local vendors and businesses, go to library for books. Everything is so much easier if you know what you're doing.

I loved this project so I would definitely want to recommend this project to future Research and Development students. However this isn't a blow off class; this class was serious hard work. At times it was very challenging for me, and I have had A's for the last 3 years of Engineering and Architecture classes. This was the one class in my entire high school career that will leave a lasting impression. This project was way above and beyond all other high school activities. Any high school football team can win a state championship, but how many schools have the advanced technical design program to build go carts? My guess would be slim to none.

I have decided to go to college to prepare for a career in the engineering field. This class is one of the main influences in my decision. This year building the go carts has given me so much momentum to pursue my future in engineering. Having the great success of the go carts has shown me how much I am actually capable of. It definitely has shown me the value of hard work and diligence. We never gave up on this project and it was the sole project we worked on the entire school year. There were many modifications and changes then we had originally planned for our go carts. In this process and in life you live and you learn. Mr. Mitchell has taught me the importance of both.

Mujadded Qureshi

Lessons Learned

When looking back on your high school experience, what is one moment you will always remember? For me, it's not going to be just one moment, it is going to be the whole experience I had building these PVC vehicles. This is easily the most memorable and the biggest project I have ever been a part of. We all put so much time, sweat, effort, and pride into these vehicles, they have become a part of us this year. It's going to be hard just leaving them here and forgetting about them. However, I'm leaving them knowing they have taught me more or in a single year then I could have learned doing a different project for several years.

I learned so much from this project, I don't even know where to begin. One of the biggest things I learned is plan ahead. You have to account for everything. Sometimes even things you have no idea what they are or how they're going to be incorporated. We learned this in designing our floor plates since we had to account for all the brackets and the engine and pretty much every component sitting on top of the plates. I also learned just everything about go karts. I came into this project not even know how a sprocket worked, but now I have very good knowledge on all the components on the kart. It really is amazing how much I learned. Even using all the machines we have in the lab. I think every machine was utilized in this project, and I was able to learn how to use everyone because of the project. The knowledge I gained is immeasurable.

There were all of fun times, and a lot of times I hated throughout this project. The best times came when are whole group was working together and we were getting things done quickly, but we were able to still joke around and have a fun time. Testing was a really good time just because we were able to finally see all our efforts go to work. Most of the things I disliked come from mistakes that we made and had to fix. I always hated fixing the mistakes because they were always hard to fix once we messed up once. They were pretty tedious to fix and got really frustrating. It was our fault for messing up in the first place though. Just more moments we got to learn from.

Anytime you work with a group, you have its ups and downs. I got lucky and got put into a pretty decent group. In the beginning, everyone pulled their own weight and everything was moving smoothly. As graduation got closer however, people started getting lazier. There were also fewer things to do, so someone couldn't always be doing something. People had to wait for other people to get done, so that slowed the process down a little bit. Overall, everyone in the group did pull their own weight though. Sometimes it just took a little yelling and force to get them to do it. I had a good time with my group though.

If I was to perform this project again, I would give the advice of always think ahead. A lot of our mistakes came simply from us not thinking ahead. Also, account for everything in the budget. We went way over budget because we didn't account for a lot of things simply because we weren't exactly sure what we would need going into the project. I would definitely recommend this project to other fellow students. This has been the best project of my high school career, and I would want other students to experience this too. Also, because there's so much from this project that will help me in my future academic and career endeavors. If nothing else, just the character it built, and all the teamwork it incorporated is good to take into the real world. I learned how to work in a group, and you have to learn to trust everyone in your group, because you can't do all the work by yourself. I also learned just that you have to try and figure out something that you can do when other projects are being done. It's really hard to stay on the timeline if everyone is doing the same thing, so each person has to try and do something different.

This project has been an amazing learning experience for me. I would definitely do this project again, and I'm sure we would do a lot better job if we did do it again. That's just learning though. It's always easier the second time around, but I'm glad we were able to pave the way for future classes. This opens up the opportunity for other classes after us to maybe have the same opportunity as us, and learn as much as we did. I'd just like to thank everyone that was involved in this for helping and most of all, Mr. Mitchell because he is the best teacher ever. He put a lot of things on the line for us, and we will be forever grateful for that. He was always there when we needed help and without him we would have never been able to do this project. So thank you Mr. Mitchell. Hopefully there will be a lot more big projects like this for future generations.

Brandon Peterson

Lessons Learned

The PVC vehicle taught me a lot about the building process and complications involved with researching and developing products in the field of engineering. I enjoyed this project for many reasons because, even though we didn't succeed at everything, we were able to accomplish something that hasn't really ever been done before. We were able to work together as a group to overcome obstacles such as designing something no one had experience in. every mistake we made set us back in the building process but every mistake also taught us what not to do and how to plan for complications in the future.

Some things that I disliked about this project were things like our focus. We didn't have any real experience with vehicles or how to design them, so in the beginning, we didn't even know where to start. We weren't able to focus on the project fully because we were searching randomly for things we did not know. Another thing I disliked about thins project was the time constraints. If we would have been able to work on the project for more than 2 hours a day, would could have accomplished a lot more. Since we could only work on it for 2 hours a day, we couldn't get a lot done because we had to fit in start-up time to get the tools out and clean up time at the end, so we were very limited on how much we could get done in a day.

I do feel that working in a group was a good experience because even though group members would argue over ideas or conflict on designs, that's what made our vehicle better. With different ideas coming together, we were able to get the best out of all of the ideas and make the vehicle the best to our abilities. Even though we had limited time to get the project done, I feel that we had enough time to get it done, especially because we often stayed after school to get things done.

If we were able to do this project again, we could make so many improvements on what we did the first time. First, I would do more research in the design process on things like engine placement and sizes and at least understand how the components work, such as the steering components. If you have a full understanding on how the parts all work, then you can design around them to make things work properly and effectively. I would recommend this project to fellow students because I actually learned a lot about the research and development stages in engineering. I also learned a lot about how to fabricate things and work around problems.

Overall, the PVC vehicle project has taught me a lot on how the engineering process operates. This has given me more insight on how things in the real world get developed and I now understand the difficulties that engineers face. This will help me in the future because I now know what to expect when facing a problem. I will be able to encounter problems with a better perspective and be able to encounter them easier.

Eric Murphy

Lessons Learned

The end of the year is here and our project is finished. We had many troubles building and operating our vehicle. These troubles, along with our successes have taught me so much. At the beginning of the project, I could've never imagined the vehicle coming together as it did. After redesigning the frame numerous times, we finally realized what needed to be done with the front end and other important points.

I have learned so much more than this as well. To start off, I learned to operate many shop tools that I have never used before. Air tools were new to me, I used them to smooth out the edges on the aluminum floor plates. I also learned how to use a lathe when I had to cut down a PVC cap. I was the only one im my group that used the metal-cutting band saw. This was a pretty neat tool, it was used to cut through the thicker aluminum that we used for our steering and engine plates. The engine plate took much longer to fabricate than expected. I learned the hard way how precise this part must be. I messed up the holes for the engine mount the first time and I had to flip over the plate and start over. The last tool I learned how to use was the mill. Since my first holes in the engine plate were bad, I decided to use the mill to drill my holes more precisely. This was a success and my engine plate was finished. In testing, I learned how important it is to have a perfect alignment of the chain. We aligned our sprocket as best as we could, but it was bent. The bent sprocket and our chain being too loose were the root of all of our problems when testing. We put in an idler to tighten up the chain before the last day of testing. This would've been a success with a straight sprocket, but we still had problems.

There wasn't too much about this project that I didn't like. The biggest issue was the time. I have trouble getting motivated in the morning because I can never seem to get enough sleep. I come in every morning from Chippewa, sometimes I miss the shuttle, which is also a pain.

Team Abusement Kart was a solid team to work with. Every group member pulled their weight just fine. They were a fun group to work with as well, most of the time morale was very high.

If I was to do this project again, there are so many things I would do differently. First of all, I would keep the frame exactly the same because ours was the most comfortable. Other than that, the first thing I would do is make sure I have all the right parts. Our chain was smaller than it should've been and our sprocket was a two-piece. We should've had a solid one-piece sprocket. I would also like to open up the throttle on the engine, other groups did it and their car moved much faster. I would also have bought the upgraded disc assembly. Our brake wore down very quickly and it had mediocre stopping power.

I would not hesitate to recommend this project to other students. I already told the juniors at Chippewa about it and it is a possibility that they will take R&D next year. Everyone that has heard about this project and seen pictures thinks this is the coolest thing. I feel extremely lucky to have had this opportunity. I learned so much and had so much fun with this project. Anyone who passes up a chance like this is just plain lazy.

Mechanically, I learned so much. I know have a better vision for what will work and what will not. I want to be a mechanical engineer in the future, and I would prefer to be automotive. I feel confident in my abilities and I am ready for college. No hesitation.

Ryan Stevens

Lessons Learned

Throughout the course of this year, I have learned many new things. Some experiences that I learned include the following. First, you can't always trust somebody to do what they say they will. Sometimes you just have to take the initiative to do it yourself. Not only do you not have to worry about somebody else doing it, you know that it is done to your specifications exactly as you want it. The second major thing I learned is that part designs don't stay the same for too long. When you draw something on the computer, it looks great. However, when you make the prototype and put it in the car you see all of the problems that you have. You then go redesign it and finally end up with a product after several trial and errors.

I enjoyed many aspects of this year. This project brought many things that were fun and I thoroughly enjoyed. One thing that was pretty cool was being able to use all of the machines in the lab. I learned how to use the lathe and a little bit of the mill. It was also a new experience to work with aluminum and other metals on all of the tools. Another thing that I enjoyed was how close this was to real world experience. We were able to build a car and see it go from nothing all the way to a working drivable car. That was one of the coolest things about this project. It took a little longer than expected, but it was worth it in the end. One thing I will never forget is driving our car for the first time and feeling the wind as I pushed the gas pedal.

Even though there were more enjoyable moments, there were also things that I disliked about this project. The first thing I disliked was first semester. First semester I was in Synergy. While in this group, I was involved in an argument almost every day about something we were designing for the car. Once second semester started, I was switched into the Abusement Kart group. This group has been a much better experience. We still have arguments, but they occur far and few.

In our group, The Abusement Kart, we had no problems with anybody working. Everybody did their own work. I cannot remember one time when somebody in our group was slacking. Whenever we needed to go buy something, we alternated picking it up and everybody pitched in to pay for the new parts. I would definitely recommend this project to fellow students. This was the best experience of my high school career. Not only designing and building, but testing this car was awesome.

This project has been a great learning experience for my future in engineering. It has taught me to think beyond the design process. You have to realize that even though it works on the computer, doesn't mean it will work in real life. Making a prototype is the best way to get an idea of the part before making the real thing. These things and many more will stick with me through college and the rest of my life.

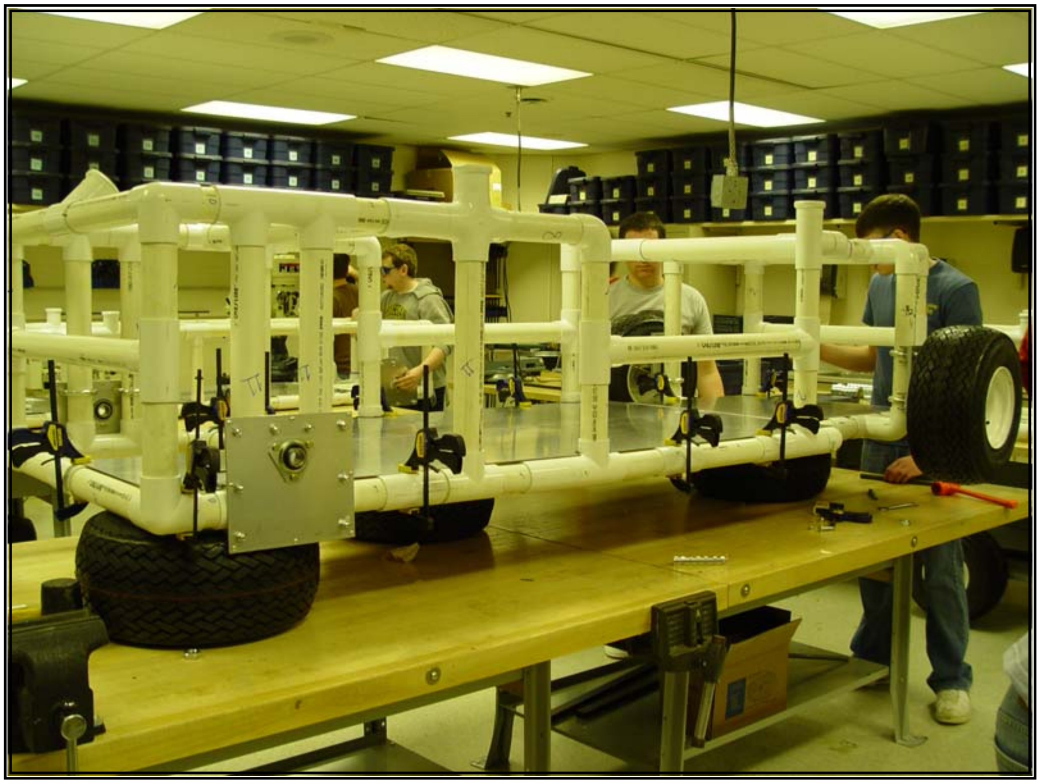
Photo Documentation

Photo Documentation

A picture is worth a thousand words. This project was carefully documented and we took pictures at every oppurtunity. Here are some extras not included in the Building Process.

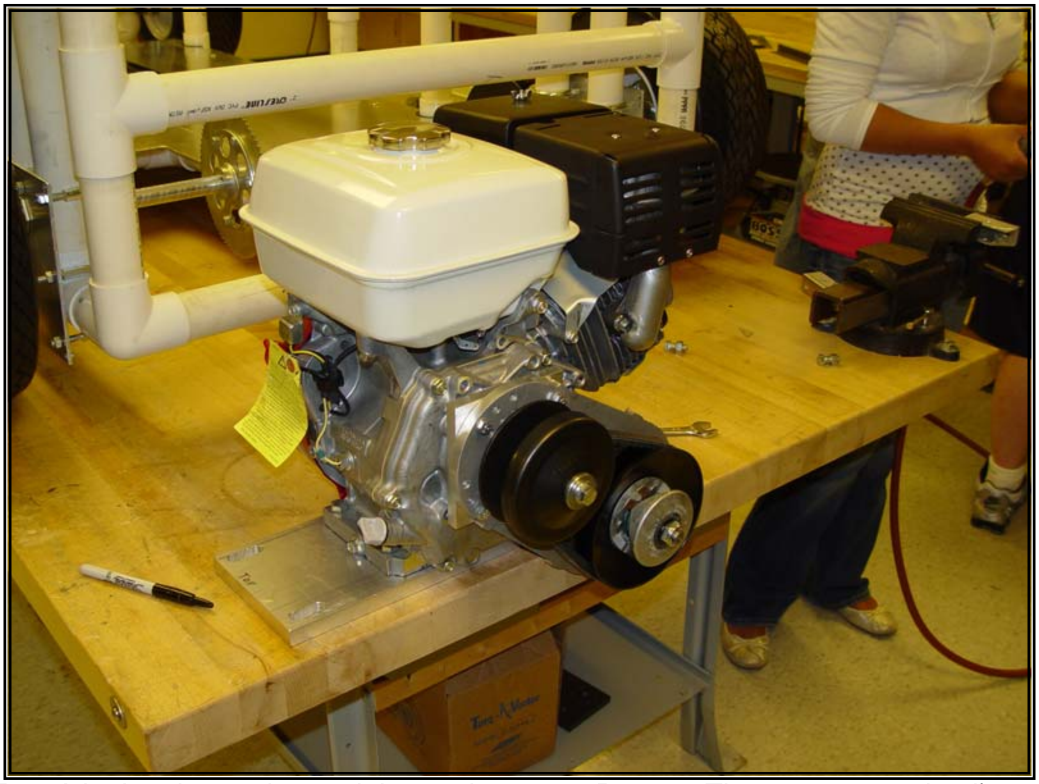
(Top: Eric Murphy using the Chop Saw. Bottom: Dry-fit of vehicle)

(Top: Assembly of engine with the modified torque convertor. Bottom: Eric Murphy gluing the PVC)



(Top: Aluminum floor completed, Bottom: Ryan Stevens cutting the floor plate)

(Top: Brandon Peterson grinding the rear axle plate, Bottom: Eric Murphy drilling the engine plate)



(Top: Aligning the engine and the engine plate, Bottom: The new seat arrived)

(Top: Mock up of rear axle, Bottom: Sarah Mozdrzech grinding the pedal brackets)

(Top: Making room for the torque convertor, Bottom: Megan Felcyn and Sarah Mozdrzech displaying teamwork gluing together the rollcage)

(Top: Our group: Megan Felcyn, Eric Murphy, Brandon Peterson, Mujadded Qureshi, Sarah Mozdrzech, and Ryan Stevens, Bottom: Eric Murphy using the drill press)

(Top: Brandon Peterson drilling holes in the floor for the engine plate, Bottom: Research and Development class of 2008)

Thank You

The PVC vehicles were made with a lot of hard work and dedication. We also would like to thank parents and our sponsors without whose help; this would not have been possible. Thanks for all your help!

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