

Building a better BugE

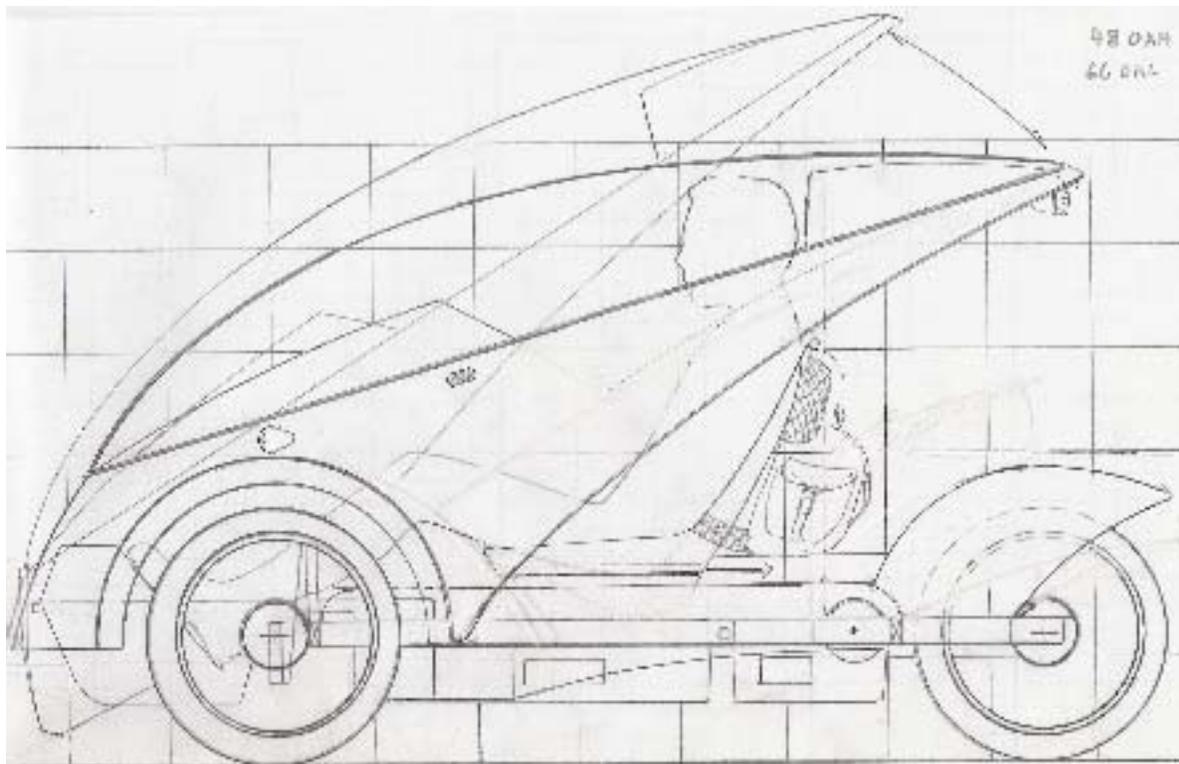
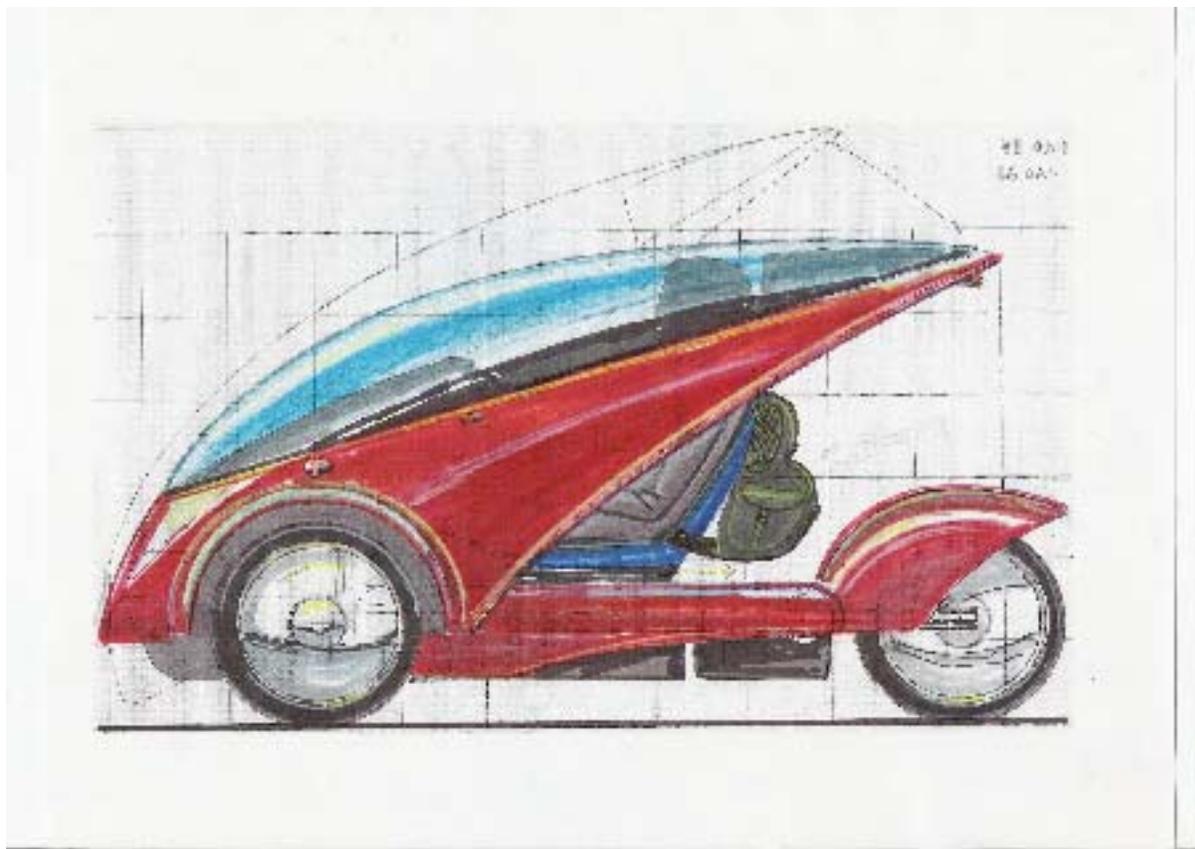
Mark Murphy/Blue Sky Design



I decided to develop the BugE as a street legal version of my Aerocoupe electric racer kits (ElectrathonAmerica.org) I've sold to schools around the country. These electrathon class racers have introduced hundreds of students to the efficient use of electric power. Perhaps I could do the same thing with the general public...

The key feature needed to be a suspension system, something the racers could not afford due to weight. Drawing inspiration from Buckminster Fuller's Dymaxion car of the 1930's, I designed a simple sissor action system that used one shock absorber to suspend the entire vehicle. It also provided the lateral stability so critical to a three-wheeled vehicle.

The design allows the front axle and wheels to support the vehicle upright, yet move vertically suspended by the shock absorber at the bottom. The rear single wheel along with the chassis rides over bumps and is suspended by the shock absorber from the top. This allows the shock to respond to either the rear wheel or the front wheels, or all of them together.



By using moped wheels, tires and brakes, which are D.O.T. certified and a simple handlebar arrangement for brakes and throttle, along with a small bucket seat, I had the basic chassis for a small electric vehicle.



The “cyclecar” layout of two wheels in front, one in back is based on the obvious fact that it is the more stable arrangement of wheels, providing two wheels for steering control and brakes.

The next step was to develop a pan for the batteries, and a support for the seat. These parts were modeled in place on the frame to ensure their fit, and then removed to have molds made of the patterns.

These molds are cast over the original pattern parts, to create a female impression of the part. They are built up to provide rigidity and strength so that many parts can be made from them.

From these molds were made fiberglass parts that fit over the frame. by designing each part one at a time, from the inside out, I built up the vehicle knowing each part would fit with the one it would interface with.

Since the person was the point of the vehicle, the ergonomics are critical design factors. Yet this vehicle had to be very simple as well. Positioning the rider so they were comfortable, yet could easily exit or enter the vehicle was a prime concern.

It was obvious too that such a vehicle needed to offer some protection from the wind and rain if it was to be anything more than just another scooter. the three wheel layout provided a stable structure to support a fairing large enough to enclose the rider, without the tippy instability of a two wheeled machine.

I needed these seat parts in place so I could design the faring around the person and enable access to the vehicle.



The Seat Pan was designed to tilt up for access to the motor and electrical parts underneath, and included a small tray in front of the seat. It also comprised the rear fender as well

The Battery Pan is covered by the Seat Pan, which protects the batteries themselves. The battery pack is designed to accommodate up to four standard size batteries, mounted low and forward to improve stability. The Battery Pan also includes the footwell for the riders feet positioned on either side of the shock absorber structure and steering column.



The motor was fitted to the chassis, and connected to the rear wheel with a chain. The remaining space under the Seat pan houses the controller and battery chargers, and other electrical parts. This enables all the parts to be located together to simplify the wiring and servicing.

The next step was to design the Fairing. Based on my initial drawings, I wanted the Fairing to be a one piece part that would include the fenders. The Fairing needed to be very aerodynamic, yet not hinder access to the vehicle. It had to be both body shell and door.

Ventilation is a very difficult problem in any vehicle, particularly in small vehicles. by cutting away the rear sides, the Fairing would allow ventilation but minimal exposure of the rider.

By pivoting the Fairing on the front axle, the Fairing would rotate around the front wheels as it tilted forward, enabling the rider to easily enter the vehicle.

The Fairing design was made simpler because I used a racer body shell as the form, along with fenders from a Gizmo (a small electric vehicle I had designed some years before. www.nevco-ev.com)



The Fenders and Fairing shell were bonded together, and then sculped to blend into one piece. Once this part was finished, we made a lower portion in front to be a storage compartment. This part would also locate the Fairing to the front axle and form inner fenders that would strengthen the structure.



We test fitted the parts to have our first look at the new BugE. The Canopy is from our Aerocoupe racer, but we would have to use a clear plastic version to be street legal.

The Canopy is heated and then blow formed out of cast acrylic plastic, creating a large rigid bubble, like used on sailplanes and other small aircraft.



Here you can see the grey Fairing plug, the Fairing mold upside down to the right, one of the Fairing parts, and the Chassis with the Seat Pan on it.

Fiberglass parts are strong, light and do not require the massive equipment, money or energy required for mass production processes. Fiberglass is best for low production products since each new part must be made one at a time from the mold.

The process does require strict environmental controls to control fumes and dust and uses polyester resin and cloth which harden into a rigid part. While recycleable into other types of products, it is nontoxic but not biodegradable.



Finally the lower portion is bonded to the Faring to complete it. A hole is cut in the front to provide storage access and a door will cover the opening of course.

The final step was to assemble all the electrical parts, wiring and source the various fittings, fasteners, motorcycle and automotive components needed to make the BugE work.

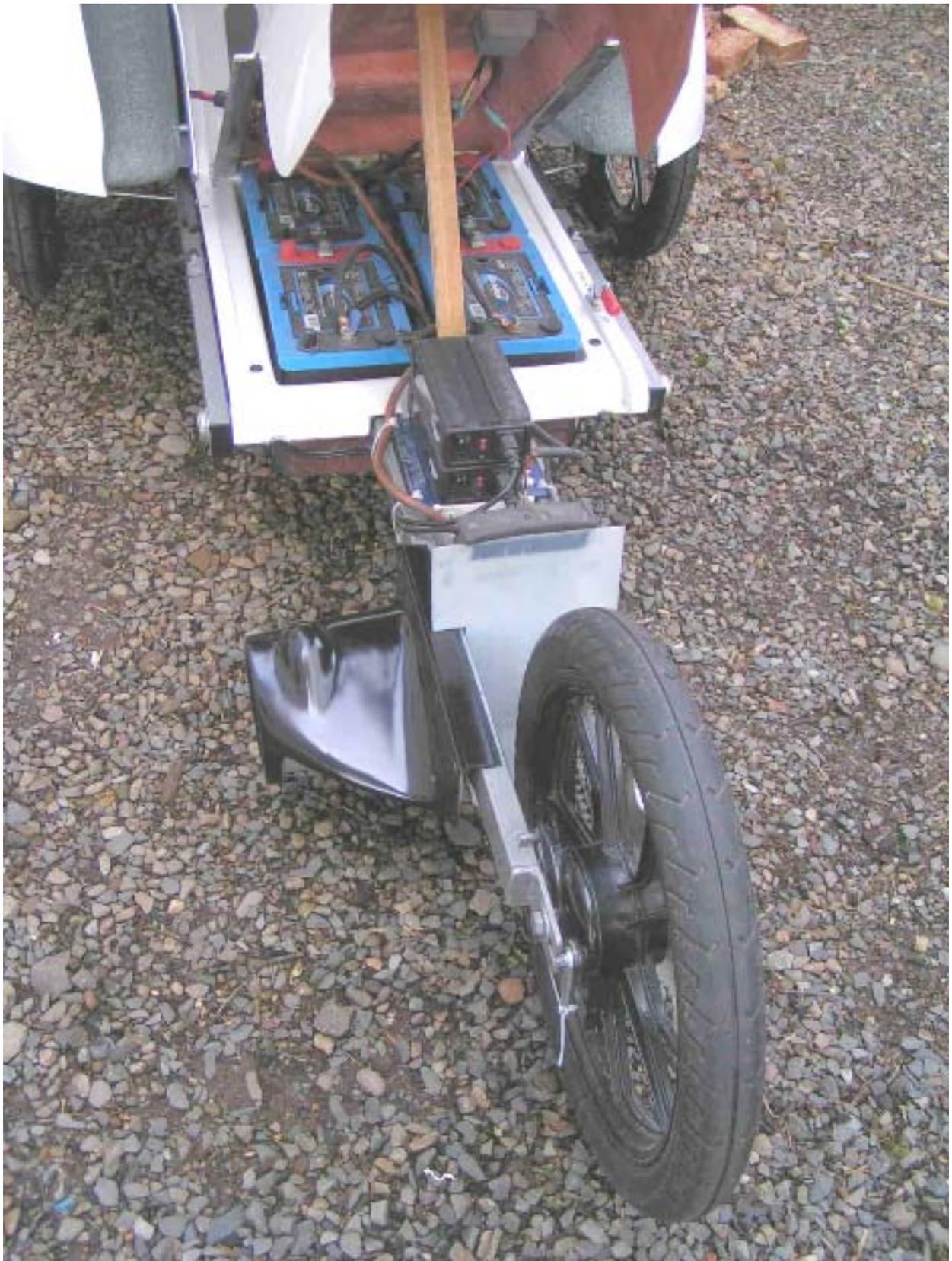
At the same time, I had to write the Assembly Manual step by step, describing how to put the BugE together.

It was very important that the BugE be as easy to build as possible, using parts that were 'off the shelf' and either readily available from existing suppliers, or common parts that could be found locally by the builder.

Important as well was that the electrical parts had to be compatible with each other, reliable, and low cost.

The BugE had to be a balance of cost, performance and efficiency in a simple but useful vehicle.

Finding these parts was made simpler however since the BugE did not require exotic technology to work. A vehicle much heavier or larger would get expensive fast since the cost of components climbs quickly.





The prototype has proven itself to be reliable and exceeds our expectations. It has a top speed of over 50 mph and a 30 mile range at 30 mph.

As we sell kits and get feedback and ideas from owners, the BugE will evolve with the innovations of builders and benefit as technology trickles down.

The BugE kit costs \$3300 and vendor parts add approx \$2500 more.

The BugE takes about 40 hours to build, although most hobby builders will assemble their BugE over two or three months part time.

While many people will find the BugE within their abilities, others may want to have someone put their BugE together for them, creating a small business opportunity.

There is also the opportunity for local co-ops to buy components and share working space and tools helping each other and sharing the costs.

Non profit organisations and schools can build BugEs for educational or skill building programs, or could provide work for displaced workers and disabled employees.

www.BugEv.net