COMBAT ZONE

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BUILD REPORT:

Trilobite — a Tough Beetleweight Brick/Wedge

● by Pete Smith

I have long held the opinion that a good wedge/brick is the best type of bot for most beginners in the sport. Too many people try to build a complex bot with a weapon before having acquired the experience and knowledge required to make one work at all, let alone well. Often, they end up with a bot with an ineffective or non-functioning weapon on a slow weak chassis. The result is usually a boring shoving match if two such bots meet — or worse — the rapid and total destruction of that first bot when it meets one of the more seasoned teams. This experience is not likely to encourage them to stay in the sport!

The best first bot is probably also the cheapest: hack a RC toy. That's what my son and I did when he wanted his first bot way

FIGURE 1.
CheepShot damage.

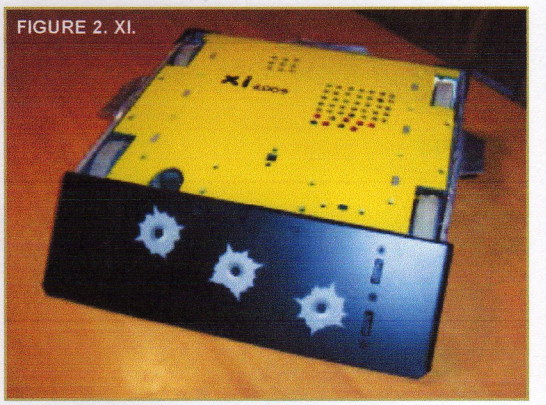

FIGURE 2. XI.

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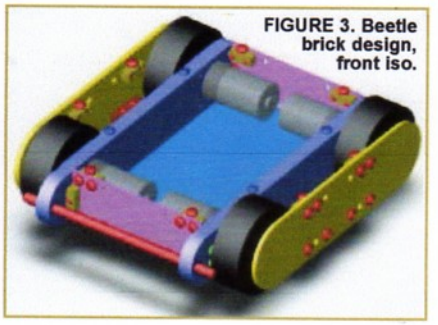


FIGURE 3. Beetle brick design, front iso.

FIGURE 4. Beetle brick design, rear iso.

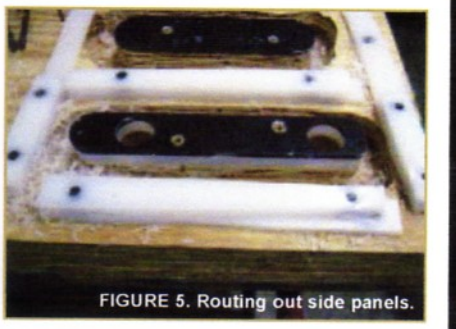


FIGURE 5. Routing out side panels.

back in 2003. We built a 12 lber called CheepShot (**Figure 1**). It never won a fight but was a "cheep" way to get my son competing, and soon led to requests for us to build something bigger and better. The new bot — a 30 lb class wedge/brick called Xhilarating impaX (**Figure 2**) — was the first robot I fully designed in CAD, and our first really successful design.

Eight years later, we have moved on to having only weaponed bots like Surgical Strike and Weta, God of Ugly Things, but those early bots were essential in making the steep learning curve in the hobby just a little smoother. I have designed and produced a range of weaponed bot kits over the last few years, but I felt an easier entry point to the sport was required: a 3 lb Beetleweight wedge/brick.

Brick/wedge bots are often accused of being boring, but that need not be the case. The first step in avoiding boredom is speed. A weaponless bot needs to be fast. There are two reasons for this. Firstly, slow is boring and since you have no weapon, you need to show aggression and take the fight to the opponent. If neither bot suffers much damage in the bout then you are more likely to win the judge's decision.

The second requirement is toughness. You need to be able to take the biggest hits and (not only keep working) show little visible damage. When a weapon blade strikes your bot, it applies an equal force on the bot that's doing the hitting. That's Newton's Third Law: For every action, there is an equal and opposite reaction. You can use that to your advantage but only if you can survive the hits yourself.

The third requirement is power. The best way to stop a weaponed bot is to push it into the arena wall, so your bot needs to have more power and traction than your opponent. You have the advantage in not having to put so much weight into a weapon system, so some can go towards a more powerful drive, and one that drives more wheels in contact with the ground.

The UHMW wall and 7075 aluminum panel design in Weta had proved so solid that I used the same structure in the new design (**Figure 3** and **Figure 4**). Designed using SolidWorks, two 3/8" thick UHMW walls would run the full length of the bot; these would be the major load bearing members. I decided to use the same 1,000 RPM motors that I use in Weta and mount them the same way. To keep the overall bot size down, I went with 2.25" wheels and planned to use 4S LiPo to keep the speed up despite the smaller wheels (Weta uses 3" wheels and 3S).

The wheel base was kept reasonably long since that helps the bot drive in a straight line and makes it easier to control. Too short a wheelbase makes a bot very tricky to drive fast. Too long and it can make turning on the spot hard on the motors and speed controllers — if it can turn at all.

The rear wheels are exposed at the back so that they will still make contact even if the nose of the bot is lifted up. This is useful if you are getting pushed by another wedge; you can still reverse quickly and turn aside to avoid the other bot. My previous wedge designs like Xhilarating impaX and CheepShot 3.0 both had the wheels fully protected, but were very vulnerable against wedges since once the nose was lifted up even a few degrees,

FIGURE 6. Trial build of Trilobite chassis, less the top.

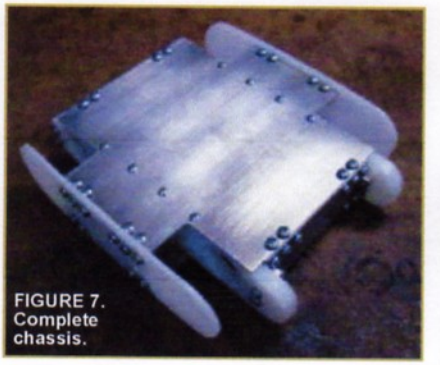


FIGURE 7. Complete chassis.

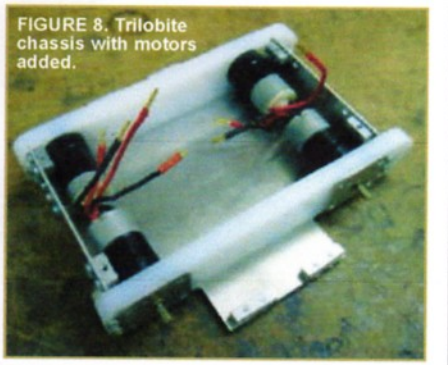


FIGURE 8. Trilobite chassis with motors added.

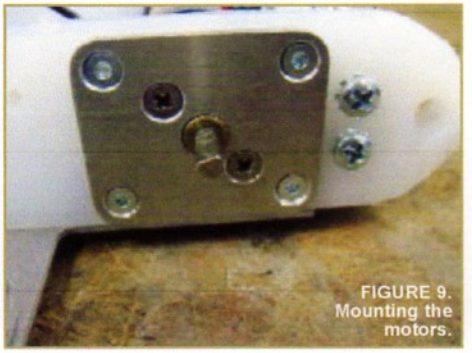


FIGURE 9. Mounting the motors.

FIGURE 10. Dave's hubs and Liteflite tires for Trilobite.

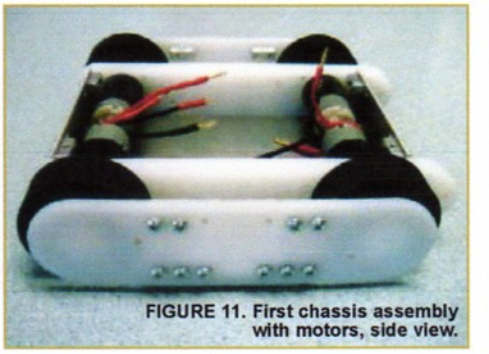


FIGURE 11. First chassis assembly with motors, side view.

the bot wheels lost contact with the ground and the bot was easily pushed about.

The UHMW and 1/16" thick 7075 panels are joined together using mini nutstrip and 6-32 screws, plus a few #6 x 1/2" Plastite screws are used between the bottom and the UHMW walls.

The top and bottom are the same panels that are on the front and rear bulkheads.

The top and bottom extend out past the wheels on either side so that 1/8" UHMW side armor can protect the wheels. This thickness had proved effective in Weta, so it should prove adequate for this application.

Two holes in the main UHMW walls are used for locating a 1/4" bar than will be used as the pivot for the front movable wedge.
The thickness of the UHMW and titanium bar should prevent this hinge from being a weak point in the design.

I kept track of the weight of each part in an Excel spreadsheet. This is important because it's too easy to get your bot almost complete and find yourself overweight. Better to get it right from the start.

SolidWorks will work out the weight for you if you input the material's density, and it's worthwhile investing in an accurate electronic scale to weigh the other parts. If your budget does not allow for buying a scale, you can usually find one at your neighborhood post office or UPS agent. Ask politely at a quiet time and they are usually quite happy to let you use theirs.

Once I was happy with the design, I made dxf files of the aluminum panel and UHMW parts, and had a set of panels and templates water-cut by **www.teamwyhachi.com**.

They arrived within a week, and I set the templates up and routed out several sets of UHMW parts (**Figure 5**).

I had previously made all the required sections of nutstrip, cutting them to length on a chopsaw and then trimming to size on my mill. Putting all the chassis together for a trial build took only a matter of minutes (**Figure 6**). A cordless screwdriver comes in very handy here as there are a lot of screws!

Once all the panels are together, the holes for the Plastite screws can be drilled using the holes in the aluminum top and bottom panels as guides (**Figure 7**). The result is a remarkably strong and rigid chassis.

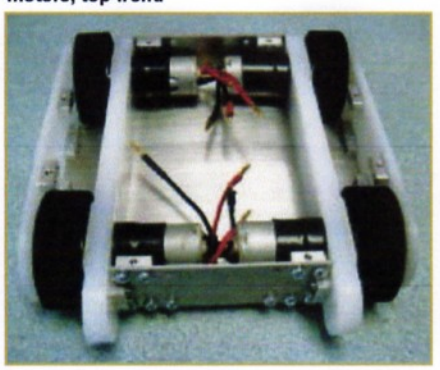
Stripping the chassis back down, I could then fit the drivemotors (**Figure 8**); each motor was secured in place using my standard "1000RPMMNT" mounting plates (**Figure 9**). Standard 4 mm "Dave Hubs" and 2.25" inch Liteflite wheels (**Figure 10**) — all from **www.robotmarketplace.com** — were added and the side armor refitted (**Figures 11 and 12**).

I originally intended to use one ESC per motor but when two of the four ESCs died shortly after installation and with time running out before the next event, I changed to using one of Banebots BB-12-45 per side with the two motors running in parallel. I had the ESCs prewired for use in Surgical Strike, so there was a lot of extra wire and weight over the four smaller ESCs but I had enough to spare for that. A standard BR6000 receiver (I mix for tank steering in the DX6 transmitter) and a Thunderpower 850 mAh 3S LiPo completed the wiring, and the bot was ready for its first drive.

Performance — even on 3S — was excellent, certainly fast enough for the smaller arenas, and the bot was easy to drive.

I used a holesaw to cut a large hole in the top panel to allow access to the battery connection, so this could be used to power the bot up for a fight. A strip of duct tape is used to keep the electronics in

FIGURE 12. First chassis assembly with motors, top front.



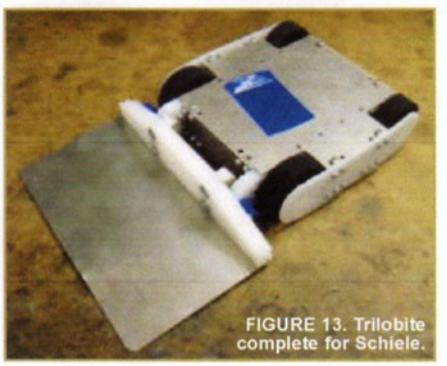


FIGURE 13. Trilobite complete for Schiele.

and shrapnel out.

There was only one day left before the bots debut at the Schiele Museum back in July, so I quickly put together a wedge using two chunks of 1/2" nutstrip, some UHMW, and a sheet of 1/16" 7075 aluminum. This was attached to the bot using a short length of 1/4" titanium rod. This was a tight fit in the holes and I thought it would hold up alright, but combat was to prove otherwise. The bot – now named Trilobite – was ready to go (**Figure 13**).

The bot performed reasonably well at the event. The wedge proved more a hindrance than a help as it kept getting stuck under the bumpers and the axle came loose. The bot was thrown about by both Weta and Grande Tambor but it suffered no more than a few scratches, A better wedge and some snowplow type attachments are needed, but I think it will perform well at its first big test at the Franklin Museum in October.

Kits of the chassis will be available from **www.kitbots.com** by the time you read this. I hope they help newbies get a good start in the sport. SV

BUILD REPORT:

A Team Building Exercise

● by Pete Smith

My Kitbots bot hockey team "Team Scotch Pies" had competed in one event and taken part in a couple of demonstrations, but the bots were retasked for a summer camp and were less than ideal. The bots were four wheel drive, but only used two cordless drill motors and they only weighed 8 lbs each (rather than the allowed 15 lbs). It was clear when they first met other custom-built hockey bots that they were simply outclassed.

A planned demonstration at the Durham Museum of Life and Science in March '11 gave me the impetus needed to build a new fleet of competitive bots.

To save time, I used as many standard Kitbots parts and familiar processes as I could. The finished design (**Figure 1**) uses template routed polycarbonate panels joined to together with my 3/8" nutstrip and four 18V cordless drill motors in the budget motor mounts, plus 3" Colsons with the standard hubs. The top and bottom are identical as are the two sides and the front and rear panels. This reduced the number of templates required and the work setting each one up. The top and bottom are 1/4" thick while the sides are 3/8".

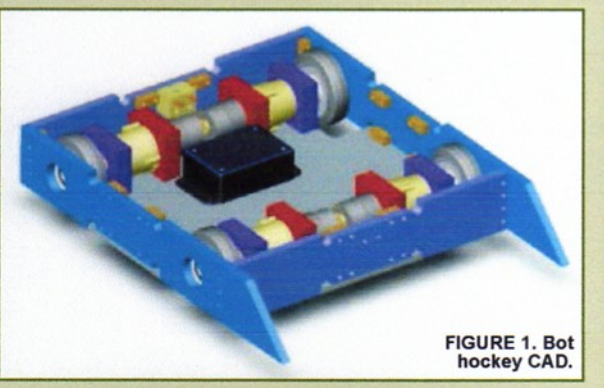


FIGURE 1. Bot hockey CAD.

The watercut templates were ordered from **www.teamwhyachi.com** and once they

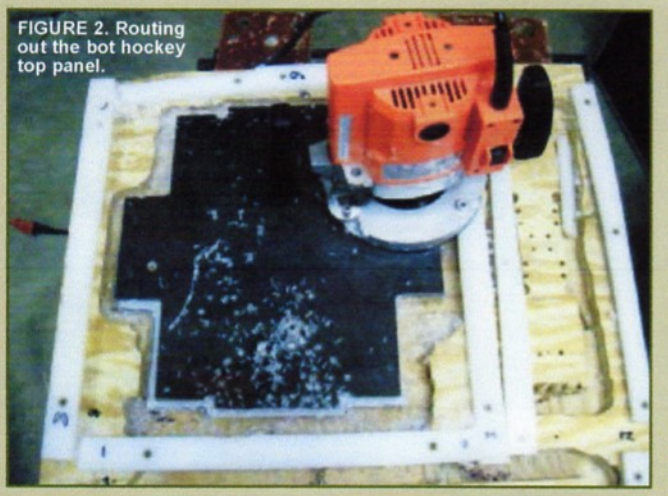


FIGURE 2. Routing out the bot hockey top panel.

FIGURE 3. Routing out the bot hockey side and front rear panels.