# Re: Branson and Bigelow to team up for a space hotel?

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You are arguing over details that would increase the structural fraction of the vehicle and reduce its capabilities. lol.

zoltan wrote:

> There are several advantages of the saucer shape.
>
> 1. The scaling of the pressure vessel cylindrical fuel and lox tanks is such that having several tanks side by side is not heavier than having a single large tank that stores the same volume.

This is manifestly NOT true! lol.

Any course on launch vehicle engineering will show you that you want the least amount of tankage material to hold the greatest volume of propellant. Now, this goes by area of tank and thickness of tank. The thickness of the wall is given by the hoop strength needed to hold the propellant, but you've also got dynamic loads to contend with if the propellant tank is going to be a load bearing structure.

Generally speaking you want as big a tank as possible rather than a lot of small tanks. And you want something approximating a sphere, since a sphere holds the most material for the least area.

The Atlas booster as originally designed was a big envelope that was pressure stabilized − and had very good structure weight for propellant weight. The space shuttle ET is another example − in both cases you got as big a tank as you could.

> On the way up we need
> low drag,

Yes, which is why you have long cylindrical shapes rather than spheres! lol for rockets.

> on the way down we need high drag.

Yes, which is why you put TPS on the side of a cylindrical shape that flies at an angle of attack during entry.

> The saucer can have both
> by flying edgewise going up and braking on the way down.

So can a cylinder with less surface area and lower strength requirements than a collection of tanks attached to a disc. With a single large cylinder you go up along the length of the cylinder and come back along the side at some angle of attack− controlling everything with quite modest winglets and eccentric weight distribution, which is achieved with engine placement relative to the centerline.

And you have a small set of deployable wings that unfold when you reach subsonic speed − to operate as a glider with minimal mass so you can glide to a landing.

> The capsule
> type vehicles also present a disc shaped surface during re−entry,

Yes, they're conical in shape − and sit atop large cylindrical tanks the same diameter as they. This works well if you have heavy loading which is the case with a manned payload, and if you have expendable tanks. In the case where we want to recover the tanks and engines to reduce cost by making a completely reusable system we have to use a different approach lol..

> because a blunt front shape directs heat away from the vehicle body.

Bluff body shapes can be attached to the nose of a long cylinder and used to protect a substantial mass behind the bluff shape with very little TPS area during ballistic re−entry. You speak as if loading were a big problem, but in reality, it isn't since the airframe is pretty much an empty tank by the time it re−enters the atmosphere.

> Having the fuel and oxidizer in multiple cylindrical tanks side by side
> allows us to have more surface area for both drag and lift.

You lack appreciation of the fundamental engineering involved in making an efficient propellant tank for a launch vehicle. I would suggest you go to a book store near any large engineering school and get a text book on the subject and read it with understanding before posting your thoughts.

> Very little
> structure needs to be added to the set of tanks to turn them into a disc.

Like I said, engineers with adequate funding, and access to high speed wind tunnels have solved the problem, disc shapes are interesting, but not the best − you haven't really answered in a defensible way why you are enamoured of discs.

If you don't wish to be troubled by looking at a text book on the subject I would suggest you look at Max Faget's original space shuttle design, and you'll see an airframe that's easily doable with modern materials, for the structural masses I've already quoted, two airframes of the same type each carrying different propellants, with the off−the−shelf engines I've described − would make a TSTO−RLV possible at very low cost.

While it is possible to make a disc with three to five cylindrical tanks housed within each disc, it would be done with an increase of structural fraction relative to a single cylindrical tank forming a structural component of an aeroshell with small winglets and minimal TPS designed for parallel launch as I've described.

> 2. The double delta shape of the shuttle is advantageous for horizontal gliding landing because it allows the air spilling over the edges of the front of the wing to turbulate over the main delta wing.

haha.. get a book on aerodynamics and read it along with your book on structural engineering. lol.

Large cross−range was a requirement to get the USAF to put in funding early on − this resulted in the double delta wing − quite different than original design. Those wings mass nearly 50 tons and must fly to orbit and back − the shuttle only carries 30 tons of useful payload! Getting rid of those wings is the whole concept behind the Shuttle C − where acargo module without wings was boosted by the ET and SRB set − so over 70 tons could be put into orbit. lol.

> This wing
> arrangement is good for pitch stability but not very efficient for
> subsonic flight.

Yep.

> The shape of the spirit bomber is much more fuel
> efficient for subsonic flight.

Okay.

> This is very close to a saucer shape.

Saucers can fly well subsonically − that's not the issue. The issue is what is the best system for putting things in orbit with stuff we know how to build. We know how to build saucer shapes, and can cover them with TPS on one side, and shape and load them so they can glide as well as the shuttle glides. This isn't the issue. The issue is, what is best? And that is a cylinder with winglets and deployable (or fixed) subsonic wings.

> The double delta has a lot of wing area behind the c.g. which makes it
> less efficient for lift.

Subsonically − but as a transonic plane that can fly from Mach 23 down to Mach 0 − the Shuttle design is a tour−de−force of engineering. Unfortuantely, it exacts a HUGE structural fraction to achieve that.

I propose something simpler − two identical parallel staged cylindrical airframes with winglets and deployable subsonic wings, with minimal TPS − one propelled by an MD−180 and another by 3 RL−10 engines − carrying 7 tonnes into LEO at very low cost. The L/D of these gliders in subsonic flight wouldn't be that good, and cross−range would be nearly non−existent compared to the shuttle, but with a recovery plane loitering downrange, and well chosen re−entry point for the orbiter, both pieces can come back intact to be reused at very low cost. Which is the point.

The same setup − with the same engines − and everything else the same − with parallel discs would have huge cross range, but payload would be reduced to less than 1 tonne, due to increased structural fraction − which is the point.

> 3. The saucer shape is advantageous in space because it can control how much radiation it absorbes from the sun and earth.

Radiation isn't an issue for LEO flight. Useful payload and the cost of getting payload into space is.

> It can point
> edgewise to minimize absorption or show some area to absorb heat.

You can do the same with a cylinder − you can even rotate it in barbecue mode! lol.

> 4. A saucer is sturdy and convenient to service when sitting on the ground.

As is a cylinder.

> 5. For a flight to a space station 400km up you will climb about at a 36 degree angle so the lift the saucer generates comes handy.

??? Your understanding of astrodynamics is on par with your understanding of structural engineering and aerodynamics − namely, non−existant. You might want to add a good book on astrodynamics to your reading list.

> 6. The saucer can approach the landing zone at a steep angle and land under power like the DC−X. This makes precision landings easier.

yes, a well designed saucer would have better handling characteristics than the shuttle at low speeds. Absolutely correct. But the cost in structure is a very high price to pay! Reducing useful payload from 7 tonnes to 1 tonne or less for an equivalent vehicle made as a disc.

> I can weld steel tubes together much cheaper than 10 million dollars.

What specification of steel? You might want to add metallurgy and materials selection texts to your reading list. lol.

When's the last time Boeing used steel tubes to build an airliner?

What makes you think you can build a spacecraft for less money than we build an airliner? lol.

Some people think I'm being wildly optimistic thinking I can build a spacecraft for the same cost per kg as an airliner − but I think with the right choices going in − choices informed by real live engineering and space vehicle practice − we have a shot.

Poor choices like, NASA's desire for wings on the space shuttle because the public are used to wings on airplanes, or your choice of saucers because − well, I don't really know what is motivating your enthusiasm for discs − lol − without any real understanding of the costs to structural fraction and loss of payload capacity − will guarantee a fiasco.

Why is it the people who no absolutely nothing about space engineering have so many strong opinions about how to do it? This is totally weird. I don't see people having such opinions about bridge construction! lol.

> When I use a pressurized header tank I don't need turbo pumps,

Yes, a pressurized system is possible. But at what pressure though? At any reasonable pressure with a 300 ton lift off mass (bigger vehicles have certain advantages) with steel especially, the mass of your tank far outweighs the mass of your turbo pump, so your structural fraction goes up again − this is covered in one of the chapters in your textbook in structural engineering of launchers you'll be getting and reading! That's why all space launchers in the 200 to 300 ton range use turbopumps. Turbopumps aren't that hard to build, and the ones used for the RL10 and the MD180 have a long history and are easily available.

Really big launchers, 2,000 tons and more, if they are ever built, or launchers built out of advanced composites, might not need turbo pumps − but saying that you don't need turbopumps and careful consideration of your airframe shape and materials and forming and so forth − you are just kidding yourself.

> I can
> just weld together tubes to form regeneratively cooled reusable thrust chambers.

Do you know what you're saying? If so you can answer the following questions easily.

What are your tubes made of? Steel? What specification of steel? What sort of welding technology are you planning on using? What sort of flux are you going to use? What is the yeild strength of the weld? What is the stress on the chamber? What is the flow rate through the pipes? What is their diameter? What is their thickness? What is the heat flux at the throat? What is the operating temperature of your throat? What is the specific impulse of the resulting engine.

You might want to add a textbook in propulsion engineering to your growing list of must reads!

> I can make a saucer shaped vehicle that goes to the Bigelow space station for next to nothing.

Well, since we all have next to nothing in our pocketbooks, I recommend you do it and fly it there, I'm sure you'll get a contract to carry folks there once you do. What do you need our input for? Quite writing and start building. You can even get hangar space at White Sands for next to nothing to do your construction and test flights.

> The reduced heat load that I computed

I'm sure you followed the procedures outlined in NACA report 1135 when you did so, so that the results were accurate.

http://naca.larc.nasa.gov/reports/1953/naca−report−1135/naca−report−1135.pdf

> comes from a factor of 25
> reduction in ballistic coefficient and a factor of 2 reduction in reentry velocity. In planning the system I designed for residual fuel and lox to be used during reentry.

What sort of structural ratio did you come up with. Why didn't you come up with a biconic shape as being optimal for a large volume low density structure, like everyone else? They looked at disc shapes too − and discs − don't fair well structure wise when compared to STRUCTURALLY more efficient shapes.

Just because YOU don't know a darn thing about designing spacecraft doesn't mean that other don't know how to do it right. While it may be cool to build a disc shaped craft, and even possible to build one that actually lifts useful stuff to orbit with modern materials − you're WAY ahead when you use REAL engineering knowledge to make your choices early on.

A slender biconic shape with winglets and minimal TPS − and deployable subsonic wings without TPS − gives the right mix of features needed for an efficient vehicle. The entire vehicle is sized using off−the−shelf engine sets. When we use a MD180 in the first stage, we're limited to 300 tons or so − and we can use 3 RL10 engines in the second stage, both operating from identical slender biconic airframes − the booster full of propellant, the orbiter not so full of less dense propellant − and you have 7 tonne to orbit capability.

The entire development program can be done for $350 million − each vehicle will cost around $65 million − with $10 million for the MD180 engine, and $12 million for the three RL10 engines − and aviionics, airframe, plumbing, electronics, power, etc., etc., etc. This REUSABLE system will cost less than $5 million to refurb after each flight − which is 1% of the the shuttle's cost − and put up 7 tonnes which is 1/4 of the original payload of the shuttle.

The system described here would be a marvel of costefficiency and have a very good track record going in. Lockheed or Boeing could build this at these prices in two years or so, and have it flying commercially in 3.

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