

- The hâB -

A report on building a shipping container habitat



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[VIDEO TOUR of the hâB](https://youtu.be/2pmTRcLDs_c)
https://youtu.be/2pmTRcLDs_c

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If you are curious about building your own shipping container house, this might be of interest to you. This report describes how I proceeded and what I have learned. I am sure there are better ways to do this, but this document simply explains how I did it.

I wanted to build a small house on my brother's property in Florida. After looking at many plans and juggling ideas with the wifie, I settled on recycling a shipping container into a small habitat. A container is an all steel structure made for ocean shipping and can carry up to 70,000 pounds of pretty much anything. The rationale is if my brother sells his property or simply wants to get rid of me, then I can leave with my mini-house. I could have decided on an RV, but I wanted something that feels more like a home and would provide a great space to perform occasional software engineering development.

When I told the family about my plans to put a large steel structure on my brother's property, my mother was not convinced this was a great idea, Dad thought it was super cool, and brother seemed totally fine with the prospect of getting more permanent on-site support to help raise his three kids.

The US imports more stuff than it exports, or rather, we export a lot of software and not that much manufacturing products. The consequence is a surplus of shipping containers across the country. If you are ready to shop around, you can find good deals on containers.

I went on craigslist and found Rick Illch and his son Joel. They specialize in buying and making custom modifications of shipping containers. I asked them if they could get me a used container and transform it according to my specifications. After smooth negotiation with some good comments on what I had in mind, we agreed on the task.

Shipping containers come in two heights, 9.5 feet (high-cube) and 8 feet (standard). They also normally come in two lengths, 20 feet (half) and 40 feet (full). Following Rick and Joel's advice, I went for the high-cube and I do not regret this decision. I am now convinced a standard container at 8 feet high would have been too low since you need space for a few inches of insulation. The



additional height also procures a better feeling when inside the container.

I wanted this to be a habitat that was heavy duty strong, with an industrial look and low on maintenance. For this reason, I left the exterior appearance pretty much intact as I like the shipping container look. I did not want to disguise a shipping container into something that appears like a house. It remains a sea shipping container. This taste in beauty was probably hammered down on me from over twenty years of engineering work.

The container I bought is over ten years old and shows scuffs and dings from battling the oceans. This is something that I enjoy knowing. It is after all a recycled structure.

The container

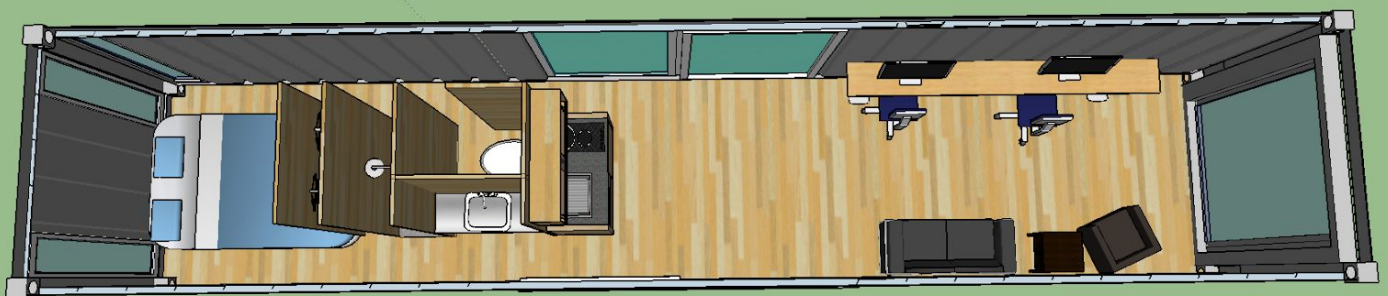
I ordered a 40ft high-cube shipping container. The external dimensions are 40 feet long, 9.5 feet high by 8 feet wide. Rick drove to Miami, found the one, and texted me the pictures.



I created some schematics using Google Sketchup and presented it to Rick and Joel along with a Google Document with all my specifications and measurements. To my delight, Rick edited the file straight online via the Google Drive cloud space, and made some necessary adjustments.

I wanted two large sliding glass doors in the middle of the container and four small narrow windows at the back end of it, where the bedroom would be. Those window openings would have to be cut out from the steel walls, and a solid steel frame would need to be welded all around the windows openings. Everything was executed as planned and I am totally pleased with the quality of the work and the final result.

Joel and Rick soon started the hard work: buffing, cutting and welding. They also painted the entire structure and applied a thick elastomeric reflective paint on the roof.







They delivered the freshly painted container on a trailer pulled by a pickup truck. An empty shipping container weighs about 8,000 pounds and they easily glided it off into its more permanent place.



I am extremely happy with the work that Rick and Joel did. That is certainly the one thing I could have never done myself.

Ground installation

The first step was to set up the shipping container away from the ground. I thought of many things; concrete slab, gravel, membrane, sonotubes, etc. I finally decided on the simplest approach. Since this structure is extremely rigid, I choose to install the container 14 inches above ground and simply resting on its four corners. I like the look and it seems to be quite stable, even if this thing stands on the Florida sandy ground.

To raise the container, I used a regular bottle jack (25 ton) and my brother's help. The tricky part was to put the jack under the container since it was resting straight on the ground. We had to dig down to make room for the bottle jack. I thought it would take a few hours to do all this, but in total it took about two days.



One thing you have to be very careful of, is to place the jack in the middle of the end wall. I initially thought I could raise one corner at a time just like a car, but since the structure is extremely rigid, both corners lift at the same time. So it is much better to place the jack in the middle. If you ever do this, watch closely for the container side movement. Since lifting is done at the end of the entire 40 feet length, it has a tendency to move sideways and swing down to one side. If that happens, don't even think about retaining it, and be ready to jump away. We also used pieces of 4"x6" wood beams carefully placed under. This was to make sure a jack failure would result in no more than an inch of displacement.



Each of the four corners stands consist of two big concrete blocks of 4 inches thick, placed side-to-side, with a concrete deck block sitting on top. The shipping container is isolated from the concrete blocks with a layer of 0.5 inch heavy duty rubber pad sandwiched between two pieces of Trex material. The result is a "floating" shipping container which makes it pleasant when walking inside. Because the container is now isolated from the ground, and also due to some rather convincing arguments from my uncle Bernard, I made sure the container was electrically connected to ground with a cable to a steel rod hammered deep into the soil. I also added a surge protector for the entire electrical system (also upon uncle's recommendation). However, I did this only after a capacitor of the AC system blew during a lightning storm.



I regularly monitor the leveling of the container and often inspect the bottom of the structure for deterioration. After one year, it still looks great. I also think the spray foam insulation on the bottom helps to preserve the structure (against humidity and rust). So far, no exotic critters have established their home under there.



Windows and sliding doors

The window frames consist in 2 inches by 1 inch steel 90-degree angles welded on the container walls. The windows would be installed from the inside and simply pushed against the frame and glued in place with black silicone. A wood frame would then be built on the inside and the windows screwed to that wood frame. This turned out to work pretty well. The interface between the windows and steel frame remains flexible and consists of a thick layer of silicone. If someday I have to move the container, I am confident the windows would not crack due to this somewhat flexible interface.



The same system was used for the two large sliding doors on each side of the container. Each of those sliding doors is 10 feet wide by 8 feet high and are enclosed in an aluminum frame. The large sliding doors are made of double pane tempered glass, without Low-E treatment (Low-E can form streaks after a few years: bad!). The sliding doors are also installed from the inside and their aluminum frame is pushed and glued with silicone against the steel frame.

Above the two large sliding doors, we welded a gutter that is about one inch deep. If I would have to do this again, I think 4 inches would have been more appropriate because the rain water often spills over and comes down on the glass doors. Fortunately, this can easily be fixed and is something I plan on doing soon.

The windows are aluminum framed, double panes, and custom ordered from Home Depot and produced by PlyGem.com.

Framing

The next step was to frame the interior, put in insulation and finish with drywall. I did hire professionals to spray foam the insulation.

When framing, I had to plan for the electric wiring, switches, outlets, etc. All the plumbing would be located in what I call the service block (see other section below).

For framing, I used regular 2x4 glued sideways to the walls. This means they would provide no less than 1.5 inches of space for the insulation. The ceiling frame is also made with 2x4 resting on the walls 2x4. That gives over 6 inches of ceiling space to add insulation.





Insulation

The insulation was done with closed cell spray foam on all walls and ceiling. There is now 1.5 to 2.5 inches of insulation on the walls and 3 inches on the ceiling. I also had them spray one inch of foam under the container. That was the right thing to do since the floor can get quite cold in the winter.

Once the foam insulation dries, it really keeps everything solid and tight. This foam material basically turns into glue, so now all the framing feels firmly set into place.



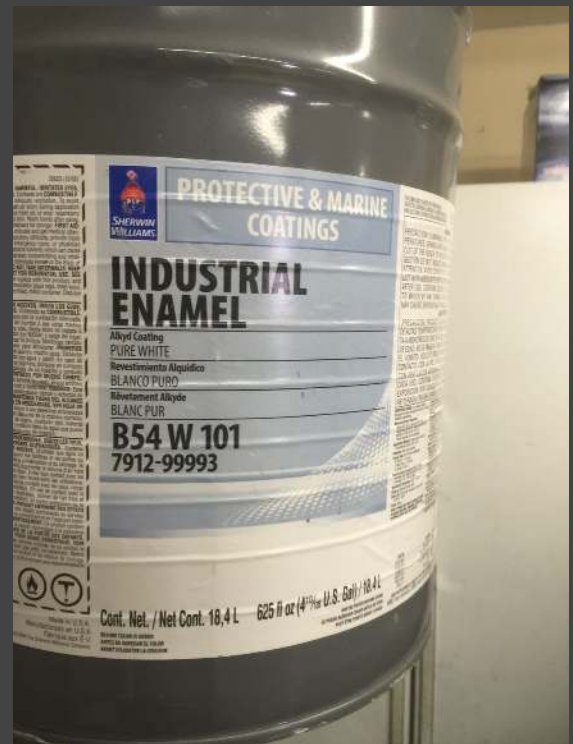
Roof

When I got the container, there were a few depressions on the roof and small pockets of water would accumulate after the rain. Before the insulation was sprayed, I used a 4"x4"x8' beam and pushed it against the ceiling with my bottle jack resting on the floor and pushing the beam upward against the ceiling. I did this under every depression I could see from inside, and it worked really well. Using this

technique, I was also able to create a slight upward shape to the roof which helps drain water away.

The roof of a shipping container is not that solid. By simply walking on it, you can feel the metal buckle under your feet, so you have to be careful not to create dents. What I found out after applying spray foam insulation on the ceiling, is the roof feels very solid now. That foam material is pretty awesome. The foam cost more than other types of insulation, but it is well worth it since it becomes much more than simply insulation. The solidified foam also procures some structural element to the wall framing and roof.

Before delivery, Rick applied a thick layer (3 coats) of reflective paint. The paint used is a type of protective marine coating. That stuff is thick and is be perfect for the job.



Drywall

Next came the drywall and the mud. Even after watching hours of youtube videos to learn how to apply mud and make smooth walls, the result is far from perfect. I think no matter how many hours you watch, it still takes a lot of practice to be decent at it, there is

no way around that. The walls are not perfect, but I am satisfied with the final appearance, it's certainly good enough.



Climate control system

The climate system is an HVAC mini-split thermo pump made by Pioneer and capable of producing 18,000 BTU of cooling. The indoor unit consists of an 8-way ceiling cassette. I wanted something located in the middle of the container that could blow air in every direction. Having 18,000 BTU is barely adequate on a hot Florida summer day. When the Sun is pounding on the container walls all



day, the cooling unit works constantly. I do not recommend a smaller unit, a couple more thousand BTU would be better. The indoor unit connects to the outdoor unit via a conduit running along the ceiling which exists through the back wall of the container. I was told to never drill a hole in the roof of a shipping container, and I am glad I followed this advice.

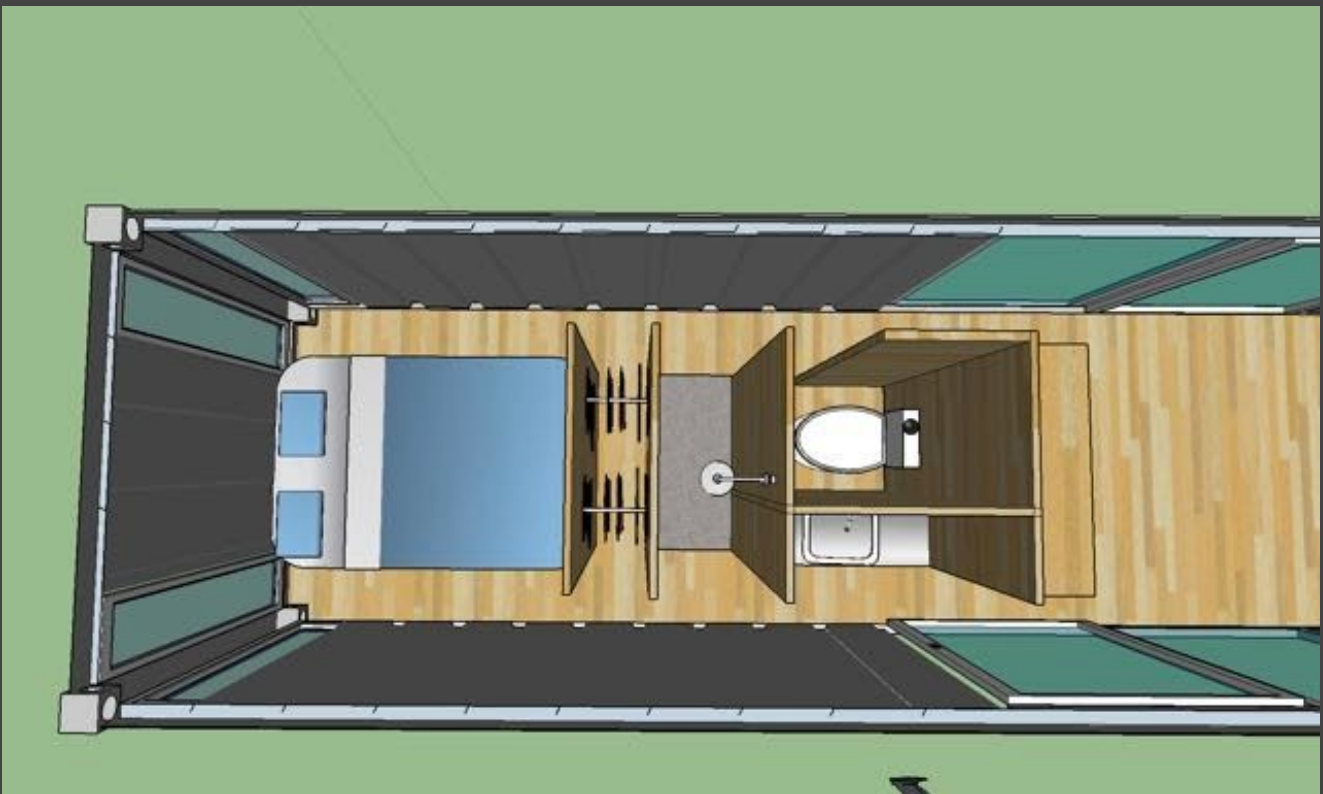
The outdoor unit is bolted on the outside back wall. Four large bolts go all the way through the wall and inside the bedroom. I added large rubber spacers on each end due to concerns with vibration and noise. When the unit is in cooling mode, the vibration and noise is minimal. When in heating mode, it does make more noise but not too much. I am satisfied with this setup.



Service block

This is an 8 feet long by 7 feet high and 40 inches wide module which stands in the middle of the container and therefore is not touching any walls or the ceiling. The service block receives power and water from the floor of the container, through a hole in the one-inch thick marine grade plywood floor.

The service block contains a mini kitchen, toilet, shower, hot water heater, small vanity with sink, and two small closets. This makes a very compact and efficient unit accommodating pretty much everything one needs.



The Toilet Project

After long hours of intense discussion with my father-in-law, mostly about venting a toilet, we opted for a Saniflo Sanibest Pro upflush macerating toilet. I think this is their high end commercial model and also their most powerful. The manufacturer claims it can shoot up to 25 feet high and 150 feet away through a 3/4 inch pipe. I have no desire to try this, mine is connected to a septic tank.

The grinder/pump noise is loud, so much that I am sometimes a bit scared when it starts. It sounds like it could be used by gangsters to

get rid of evidence. It does have a very industrial noise to it, which goes in complete harmony with the subtle look of the shipping container.

All grey water is connected to the small tank behind the toilet, that includes two sinks and the shower. When this small tank fills up, the macerating pump automatically starts and pushes everything far away to the septic tank. As for the vent, there is only one, and it goes up a few feet from the toilet tank and then back down through the floor. This seems to work just fine, and I never detected any odors from inside or outside.



Finally

Once I got the container shell delivered, it took me 288 hours to complete the project. I know, I am no carpenter. I had to watch a lot of youtube videos to learn how to do all that stuff.

I did pretty much everything myself with occasional help from my brother, his friends, and the entire family including the kids!

This project was an excellent excuse to get away from looking at a computer all day long. I also made a total of 57 trips to Home Depot, that comes down to one trip per 5 hours of work... keep in mind I was learning everything on the fly. After about twenty trips to HD, I granted to myself the right to park in the "pro parking" spaces. I came to love going to HOOOOOOOME DEEEEEPOOOOOT!

Total cost: \$25k + 288 hours of inexperienced labor including mistakes, redos, and various other life distractions.

2020 Updates

Lessons learned after 4 years of use.

1. The small deck behind the steel doors started to rot a bit, so I fibreglassed the surface. This small wood deck is not made to be exposed and its slope is not outwards.
2. Definitely use a bigger gutter above the large sliding windows.
3. The A/C system works well, but is a bit overwhelmed on very hot sunny days in Florida.
4. Humidity control is not ideal. I would prefer an A/C system that runs more often in the winter to get rid of more humidity. Humidity in the summer is not a problem since it runs almost continuously.
5. The EcoSmart inline water heater failed after 4 years, bought a new one (the exact same). It works really well.
6. The energy cost (electricity) of living in it is about \$1.50 per day, and a bit less in winter.
7. Make sure you get a container with a perfect roof. Mine was a bit rusted and I have to check on corrosion progression and carefully seal the small cracks. This caused no issues and it looks like it is not getting worse, but it is a concern.









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DATA SHEET**

- High-cube 40 feet long shipping container.
- 10 years old shipping container previously owned by French company GOLD.
- Installed 14 inches off the ground and resting on four concrete floating stands.
- 2 large glass sliding doors (10' wide by 8' high).
- 4 long narrow windows (13" wide by 8' high).
- 1 large glass sliding door behind the container steel doors.
- Toilet: Saniflo Sanibest Pro macerating upflush toilet, powered with 110 volts.
- Plumbing: Pex, Sharkbite, and regular PVC.
- Flooring: Allure Trafficmaster bamboo light (vinyl).
- Framing: standard 2x4 installed sideways (leaves at least 1.5 inches of space for the insulation). Framing is glued to steel walls with liquid-nail.
- Insulation: polyurethane closed cell spray foam: 1.5 to 2.5 inches thick on the walls, 3 inches thick on the ceiling, and 1 inch thick on the bottom (underside).
- Hot water: Ecosmart ECO 11, electric inline tankless water heater running on 220 volts.
- Climate system: HVAC Pioneer mini-split 18,000 BTU (more BTUs would be better) with a 8-way ceiling cassette powered by 220 volts.
- Service block: stand alone module that is 40 inches wide by 8 feet long: mini-kitchen, shower, toilet, hot water heater, vanity and closets accessible from two sides.
- Usable interior width (drywall to drywall): 7'5"
- Usable interior height (floor to ceiling): 8'3"
- Usable interior length: 37'4". This distance is from the far back wall to the front sliding door. The front sliding door is recessed by 25 inches behind the large steel doors, this creates a small entry deck.
- Total usable indoor area: 277 square feet.
- The hâB has four external connections:
 1. Power: 220 Volts, 60 amps
 2. Ground rod connected to container structure
 3. Potable water from a 1/2 inch Pex pipe
 4. Sewer discharge into a 3/4 inch Pex pipe
- Climate system and two power outlets can be controlled remotely from anywhere in the world via smartphone.
- Amenities: shower, mini-kitchen, fridge, toaster oven, microwave, Nespresso machine, hot plates, hot water, toilet, a/c, heating, closets, queen size bed, storage, workspace, tool chest, computer desk, wifi, buoy tree swing and a helpful bro.

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