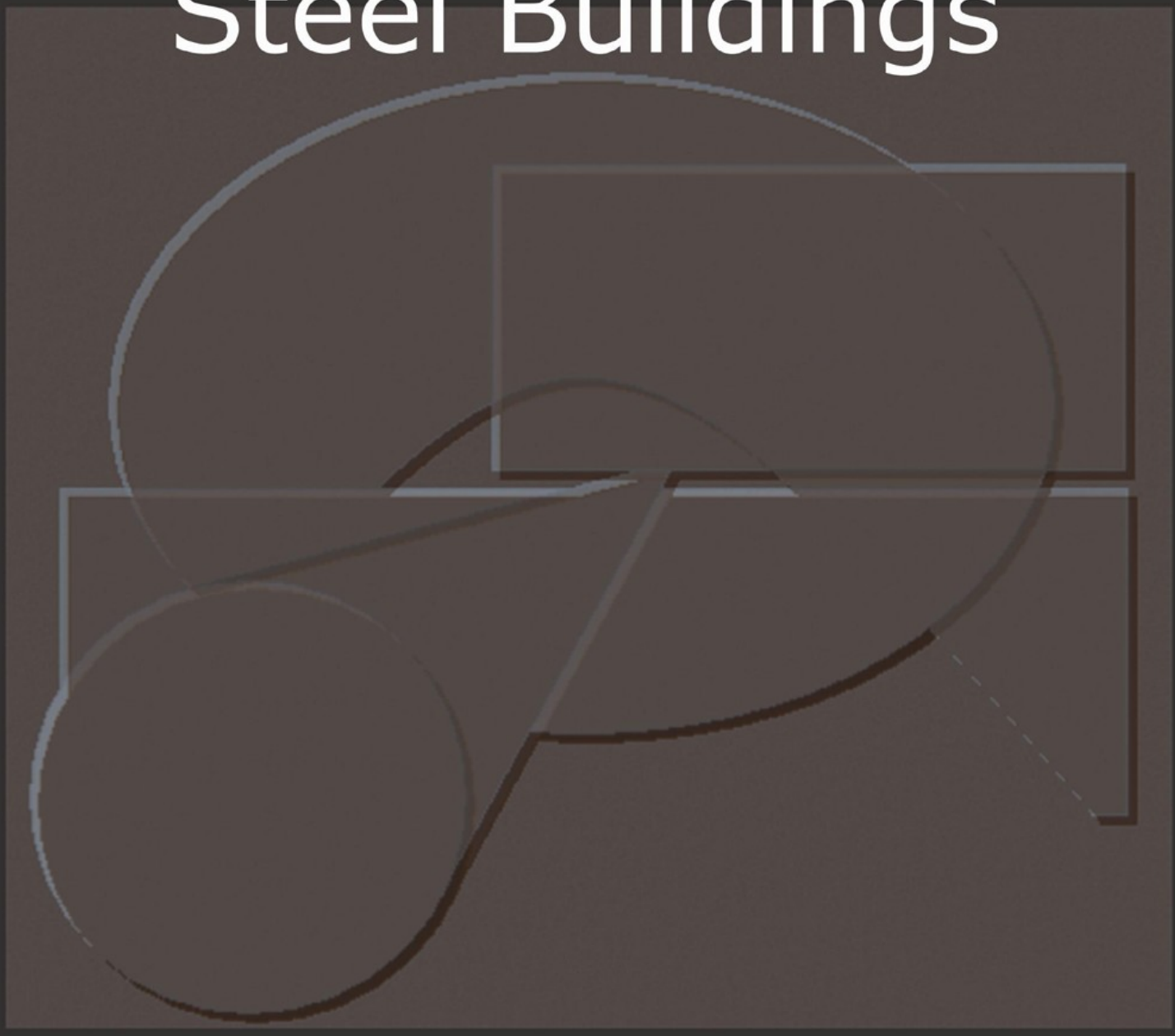
Intermodal Shipping Containers for use as Steel Buildings



Third Edition

by Paul Sawyers

Intermodal Shipping Containers for use as Steel Buildings

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Written & Illustrated by Paul Sawyers
Photography by Samantha Rose

Two 20 ft containers used to make a 20 ft x 16 ft Bldg.

About This Document

Intermodal Shipping Containers for use as Steel Buildings was originally released in January 2004 as a digital PDF document. Several updated and improved variations have replaced the original version since that time. This is the latest version. PDF has become a popular format for distribution of documents over the past 10 years. Most educational institutions, local, state, and federal governments all utilize PDF for forms, manuals, and documents.

Feel free to contact me via email if you have any questions about this manual, or just want to say hello.

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Contents

Parts of this manual are from the original 2004 document, but several chapters feature all new content. This content appears in Paul Sawyers new full length book **Intermodal Shipping Container Small Steel Buildings**. 103 pages, 11" x 8.5" soft cover. Available soon at major book stores.

Publishers website: http://www.lulu.com/paulsawyers

This PDF manual is designed for use, and packaged with the following PDF document: MIL-HDBK-138 PDF: 143 page handbook covering topics such as how-to inspect ISO shipping containers for damage and flaws, locating structural defects, repairs and welding, container designs in-depth, inspections checklists, and more. This is a distribution unlimited publication of the United States federal government.

Purchase and Delivery of Containers

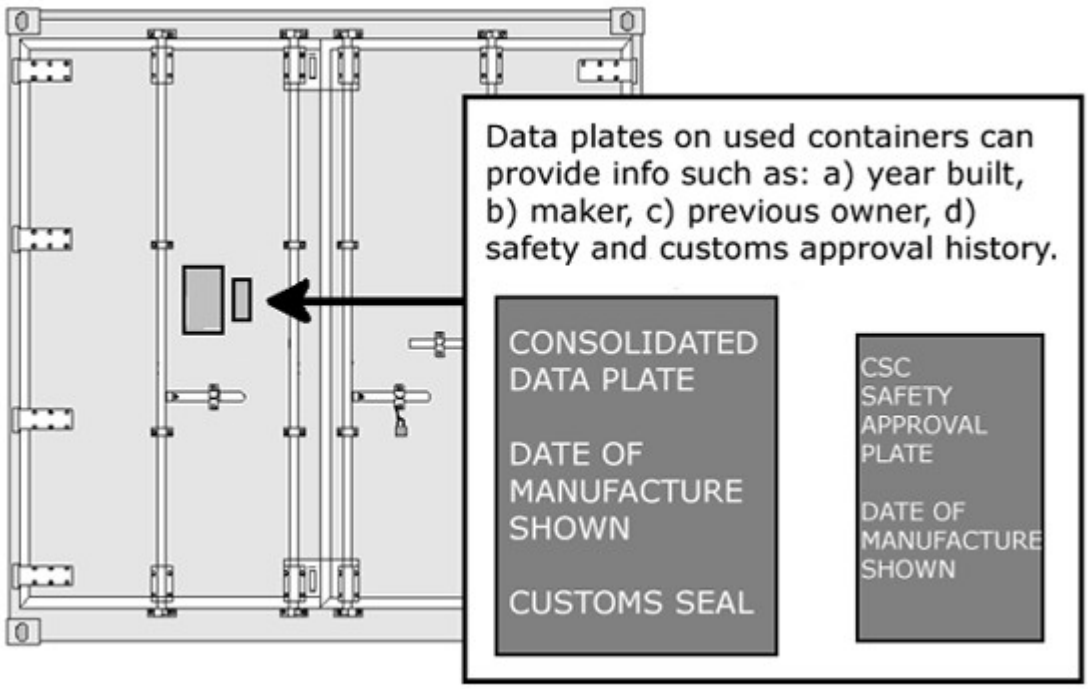
Foundation construction and delivery coordination: Concrete footings and slab foundations should be planned and installed prior to taking delivery of your containers. Builders need to consider what type of trailer their containers will arrive on, roll-bed or standard. Also, will a crane rental be on-site at the same time (for transfer of containers onto the foundation)? Will you need to rent the crane two separate times? How long will it take for your concrete foundation to cure (when can it support the containers)? Make sure to coordinate all the details of 1) foundation construction, 2) delivery date, and delivery vehicle, and 3) crane rental. All three aspects must work in concert for a smooth transition of your containers from delivery truck to permanent concrete foundation.

The logical way to start your container building project is to come up with a plan for your building on paper, deciding if you want to use 20 or 40 ft units. The next step is to locate possible containers for purchase. Once you have a source for purchasing your units, plan out and install your foundation. Then you can pay for the containers and arrange for delivery after concrete (if using a concrete foundation) cures. This is also a good time to reserve a truck mounted crane (if needed) to place units on the foundation.

Pre-Purchase Inspection

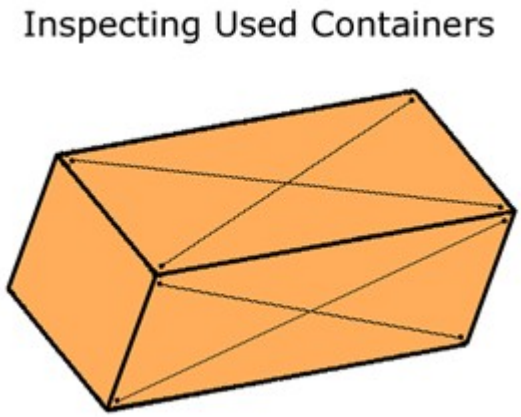
Buying containers can be looked at like buying cars. You can buy new, or used, from a dealer, or a private party. For the lowest prices, you should probably go the used route. A certain amount of searching is usually needed to dig up a really great deal. This is just like looking for a good used car, with the main difference being cars for sale are much more common than containers. It's also harder to get a 'lemon' when buying containers, as they have few mechanical aspects that can suddenly breakdown.

Check the ID placards on any container you are interested in purchasing. These are sort of like VIN numbers for containers.



There are also some possible points of damage that you should look at within the structure of the container, prior to buying. Give the container a complete visual inspection. Check for:

1) Cracks, breaks, cuts, tears, punctures, corrosion in corner fitting joints, sidewall joints, and floors cross member structure (pull out a few pieces of the plywood flooring or jack up the container to check the cross members).
2) Missing, cracked, or broken welds at any major structural juncture.
3) Loose or missing fasteners at any major structural juncture.
4) Any deformations such as dents, bends, or bowing.
5) Check for old repairs such as welded on steel patches.
6) Check to make sure that the container is square (see diagram).



Working on the top of the container, first measure the distances from the center of each corner post diagonally across the length of the unit. These distances should be the same within a 1-2" variable. Secondly, measure diagonally across the length of the unit (in the same manner) on the sides. If the distances are way off, the container is warped, and it may cause problems later on when you attempt to use it for building.

Container Sources

Regional classified papers such as trader publications, and little nickel press are good sources for buying containers. Titles of these newspapers vary from state to state, but most of you know the types of publications to which I am referring. The classified papers with just stuff for sale advertised.

You can also look through the phone book under 'shipping', 'containerized freight', 'mobile storage', 'shipping containers' or 'freight shipping' for local sales outlets.

I had originally considered listing the many websites that advertise containers and related products, but more often than not, a website possesses a 'here today - gone tomorrow' quality. Although, I have noticed an increasing number of containers being offered for sale on Ebay. Besides this and other auction websites, you can search google.com for current container wholesalers.

Google Trick

I found several 20 ft units in nice shape offered for $800 while surfing the web. You can probably find some good deals too. You want to find a single seller who placed a classified ad somewhere on the web. Somebody who would rather take less money for their containers just to get rid of them. Google.com is the only search engine I personally use, and I discovered a trick that will speed up your searches considerably on that website. With a little practice, you will quickly become proficient at this, saving yourself hours of wasted time scrolling through unrelated sites.

The trick involves using periods, or 'dots' to connect keywords. This prevents the search engine from returning a shotgun pattern of unrelated websites. For example, say I want to find a shipping container in Florida and begin searching the internet for one. The keywords 'shipping container Florida' might return what I need, but will also return two thousand other sites that have those 3 words anywhere in the first page. Adding a period between words likely to be together reduces this annoyance: 'shipping.container Florida '. You can go even further by adding ' in. Florida ', or try changing ' container ' to ' containers ', etc. Here are some examples:

iso.containers Seattle
intermodal.containers My.City
used.shipping.containers My.City
shipping.container lifting.hooks hardware
20 container.for.sale My.State
40 container.for.sale
intermodal.container.sales Chicago ... etc

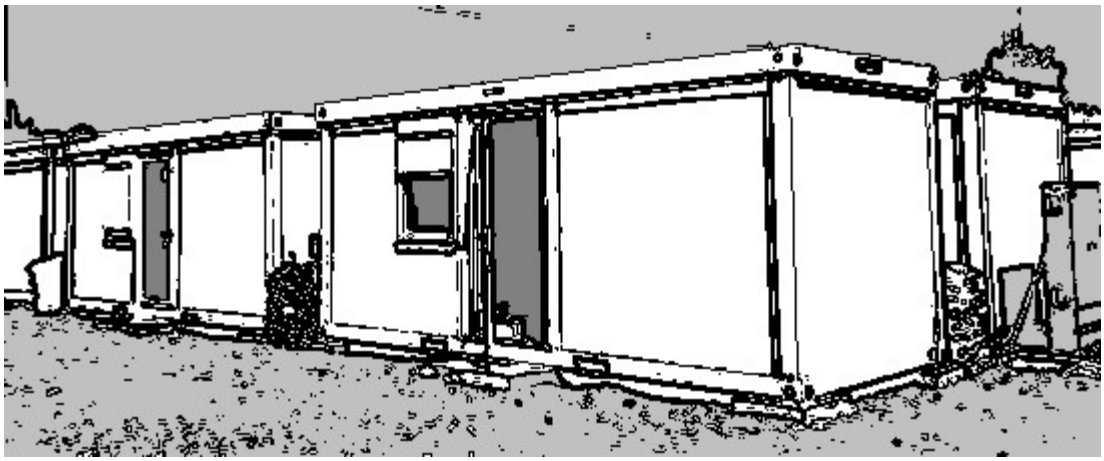
The number of word combinations you can come up with are amazing. Don't be afraid to get creative. Just remember that if you connect any two words with the period, those two words become a phrase in that order. You can go over- board with specialized search phrases, these will usually turn up no results, but occasionally you hit gold. Try connecting only two words with a third "loose" word at first. Then (by process of elimination) gradually refine your phrase.

Military Surplus Containers

Remember when your local army navy surplus store actually had U.S. Military surplus stuff? Most of these stores now offer old European surplus items at best. The US Military surplus now shows up mostly on Ebay for sale by small entrepreneurs who where smart enough to nab a few pallets of goods on www.govliquidation.com. This is a little outfit out of Arizona that scored a contract to serve as the official US military surplus liquidator. Government Liquidation LLC is essentially an Ebay Style internet auction website that's sole reason for existing is to sell military surplus from all braches of the United States Military to the highest bidder. It works like most auction websites, but when you win an item, or a 'lot", you must pick it up yourself from the military base. This pretty much limits the lots you can bid on to listings located at military bases local to you. If you live in an area with a high concentration of Military bases (like Seattle), you might consider shopping for surplus containers, and container hardware via this website.

I had noticed a lot of 20 ft containers for sale on this website before the two current mobilizations (Iraq & Afghanistan). These have all but dried up now, having most likely been put back into service for these conflicts. When you do see a shipping container for sale on this website, it usually has a starting bid (price) of only $100, and, unlike most of the highly desired re-sale surplus items, ends with no bids. Thus you can see how it is possible to purchase a unit for $100 on this website. You then simply hire a 3rd party trucking company to pick up your won containers from the army base and bring them to you.

Other surplus items of interest that you can search for are ISO Shelters. ISO Shelters are built on 20 ft Intermodal frames, but use a foam sandwich core rigid wall material in place of the standard corrugated steel side panels. This has the effect of insulating the units, and reducing the overall weight by 1000+ lbs.



ARMY ISO SHELTER CAMP

Brief History of ISO Shelters

JOCOTAS (Joint Committee on Tactical Shelters), along with The Defense Ammunition Center & School, is the entity responsible for designing, commissioning, and decommissioning of these units. JOCOTAS was formed in 1975 under office of the Secretary of Defense with purpose of streamlining the design and deployment of military shelter systems with implementation of ISO rigid wall (container) shelters and ISO deployment systems for non ISO shelters.

A sample of the JOCOTAS Charter from March 2003 states that their purpose is: A) to advance the state of the art in shelter design, and shelter ancillary equipment, B) search for common solutions to identified user needs, C) eliminate duplication of shelter RDT&E, D) create a standard shelter family and maximize it's use within DOD, E) share information and expertise to solve shelter problems, F) work to promote evolutionary change in processes used for shelter development, G) assist the services (branches of military) in procuring shelters in the most streamlined and cost effective way, H) assure shelters are compatible with commercial and military transportation equipment for worldwide deployment, I) provide a forum for interaction between JOCOTAS and the shipping container manufacturing industry.

The U.S. Military has utilized container shelters and intermodal movement systems at an increasing rate since the 70's. The Department of Defense was an originator of containerization concepts in WW2, but, as with any massive logistics design operation, it has taken 50+ years to work out bugs and consolidate techniques. The current line of DOD (Dept of Defense) shelters that have emerged have served their purpose quite successfully, but, as is the nature of a state of the art military, will likely soon evolve. Intermodal chassis will be the likely foundation for these new designs as well.

Prior to the formation of JOCOTAS, over 100 different types of shelters were being used by the four military branches, creating a severe logistics mess. Since it's creation, JOCOTAS has successfully condensed the active number of rigid wall tactical shelters to 17 styles. These include every type of shelter you could imagine, from portable hospitals, to one-man tents. A handful of these 17 shelter models are built on the standard (20 ft) ISO container chassis. These shelters are essentially civilian freight containers, painted desert or woodland camouflage, with some minor additions such as power hook-ups, air conditioning, and built-in leveling jacks.

From the JOCOTAS catalog, here is a sampling of two shelter designs based on the ISO container chassis; a) ISO, Shelter, Tactical, Nonexpandable S-781/G (60 amp) Stock # 5411-01-136-9837, and b) ISO, Shelter, Tactical, Nonexpandable S-782/G (100 amp) Stock # 5411-01-294-6390. Sample of design specs for S-781/G and S-782/G model ISO Shelters include: interior dimensions of 19' 1" long x 7' 7" wide x 7' 1" high. Exterior dimensions of 19' 11" long x 8' wide x 8' high. Weight of 3900 lbs, payload of 11,100 lbs, gross weight of 15,000 lbs. Constructed with a standard steel ISO framework, foam honeycomb core wall panels, interior lights, breaker box, and leveling jacks. Entrance via single personnel door on one end.

Container Delivery

Containers are by their very nature, mobile, but designed mainly for sea travel. Yet, thanks to the increasing number of transport companies, units are now available just about anywhere in North America. Many of these companies offer delivery with a roll-bed truck similar to the type that picks up full size construction dumpsters. Delivery is offered with or without dropping the container to the ground, and is based on a per mile fee. Drop delivery operations require fair road access (gravel or dirt is ok), and a 75' cleared area.

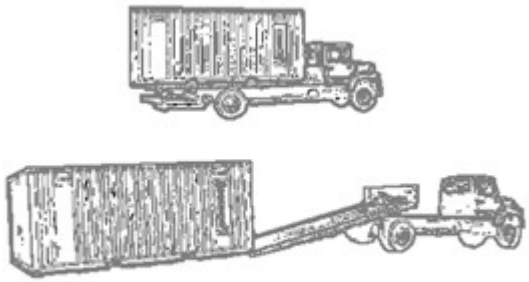
For the container purchaser who only requires the unit delivered to a firm surface, at the end of a easily accessible road (for a delivery truck), the process will be easy. On the other hand, if your destination is more off-the-beaten-track, logistical problems can arise. The seller will ask about this when you buy your units. Most companies will drop the unit as close as possible to the area you want, and let you wrangle it from there. The seller will discuss logistics with you before actual delivery.

Take care not be overcharged for delivery, or jump at a great deal on a container, and be hit with a high delivery fee. Expect to pay a dollar +/- per mile for delivery. If you find a superior deal on delivery fees, it is possible to purchase a container from one source, and have another trucking company pick it up.

Pick up Truck Trailer

You can also tow a 20 ft container yourself with a 3/4 ton pickup truck and a flat bed trailer of adequate size. Attempting to move a 40ft container via small trailer yourself is not advised.

Delivery drivers are often flexible, and may go off-road to drop your unit in the spot you desire. Of course there are limits to this. Expecting a semi truck to cross muddy fields or navigate your atv trails is wishful thinking. Many companies use specialized delivery trucks for 20' containers. These are called side-loaders and drop the container on the passenger side of the truck with miniature crane arms. These vehicles are usually able to reach a more back-woods locations than a semi towing a flat bed trailer.



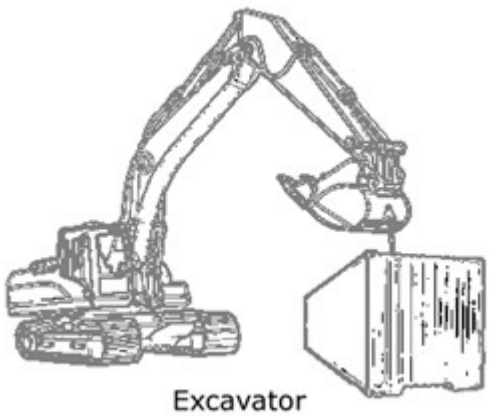
Container Delivery via Roll Bed Trailer

In general, a 20' unit will get into more spots than the 40', but dealing with the driver, and perhaps coaxing him, is always a possibility when taking delivery. Drivers do the best they can to get the container as close as possible to the location you want.

If no arrangements for a special delivery truck have been made, you will need to hire a crane capable of lifting the container off the flat bed trailer and onto your foundation, and have it waiting on site at delivery. The expense of hiring heavy equipment will be worthwhile, and still bring your structure together for a low cost.

Boom Truck Rental

Renting a crane is not as big a deal as you may think. Most local equipment rental yards have a truck mounted crane available for under $150 per day. These are usually the Terex telescopic boom crane type trucks, and can be operated by a normal person much like renting a U-Haul truck. The compact truck mounted crane or 'boom truck' is the preferred method of unloading a stacking containers for small scale building projects.



Excavator

A medium sized excavator is usually capable of lifting 20,000 lbs 30 ft high, and can also be used for container movement if a crane is not available. You can look in the phone book under 'excavating / back hoe' services for excavator rental. Chains, hooks, cables, and lifting straps are connected to the excavators shovel for lifting. The excavator can be used for 2 level container stacking, or for creation of underground container based bomb shelters, but a crane is required for most other container building projects.

Basic information you should convey when inquiring about crane or excavator rental:

For 20 foot single level buildings: lifting of 5000 lbs approximately 12 ft to ground (4 ft truck trailer height plus container) will be required.

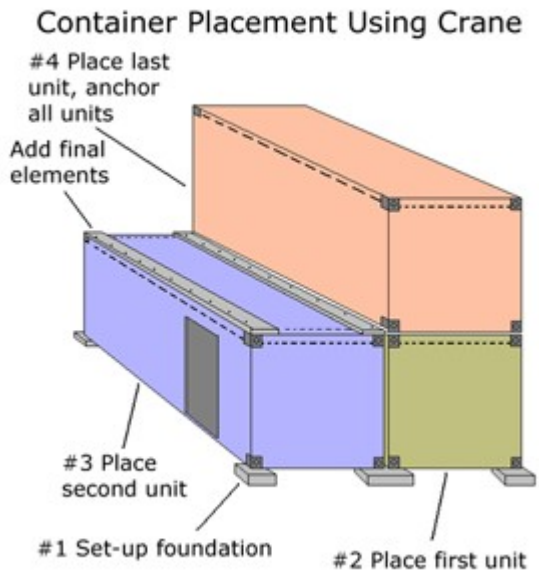
For 20 foot 2 level buildings: lifting of 5000 lbs approximately 12 ft to ground from trailer will be required. Then the container must be lifted another 8 ft (20 ft total) to set it in place as the 2nd level.

For 40 foot single level buildings: lifting of 8000 lbs approximately 12 ft to ground (4 ft truck trailer height plus container) will be required.

For 40 foot 2 level buildings: lifting of 8000 lbs approximately 12 ft to ground from trailer will be required. Then the container must be lifted another 8 ft (20 ft total) to set it in place as the 2nd level.

Typical Telescopic Boom Truck Mounted Crane Specs:

Terex Stinger Model	Maximum Lift Capacity	Maximum Boom Length
2000	20,000 lbs	57 ft
2400	24,000 lbs	63 ft
3000	30,000 lbs	63 ft



ISO corner fittings are designed to accept standard lifting hooks. Often times, a crane will come stocked with an assortment of hooks, and basic lifting equipment, but you may need to purchase some additional hardware yourself. You can inquire about this when you contact your local equipment rental yard. If you need to purchase lifting hardware, Northern Tool (www.northerntool.com) is a good source for hooks, straps, and general devices. They sell via mail order and offer a giant free catalog by request (I always keep a copy of the latest edition on my toilet tank for daily study).

Tip: Lay pieces of scrap 2x8 lumber down on top of concrete footings to absorb any sudden impact they may encounter during placement of the container via heavy equipment. Use a auto jack to raise your container and remove these later.

It is possible to tow containers short distances yourself in no-truck-access areas. Two words you should remember when planning to move a container without heavy equipment are physics and leverage. If you must move the container yourself, this task may prove the most difficult part of the project. With that said, the use of common everyday tools will be of great assistance.

Techniques and tools to assist a self mover include: winches, block and tackle set-ups, cables, hand-cranes, come-a-longs, pickup trucks, large diameter steel pipes or logs (to tow containers over), large casters, home-built buggies (inserted through high-low holes), jack stands, hydraulic ram lifters, tractor jacks, old axles with tires, etc. Many of these items are available locally. Also check into Harbor Freight Tools (www.harborfreight.com), and Northern Tool (www.northerntool.com) for low cost hydraulic jacks, tractor jacks, towing gear, and ram sets.

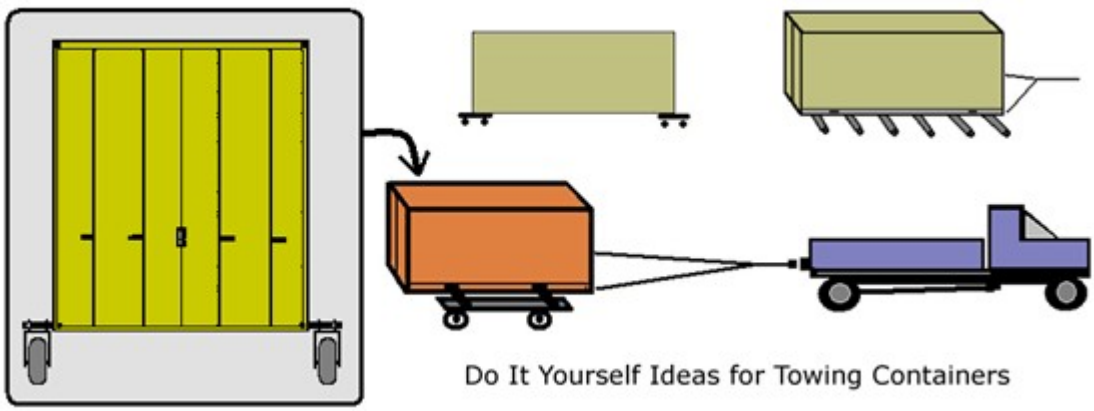
Sometimes moving the container yourself will not be possible. What I mean by this is, examine your scenario carefully when putting together the logistics of delivery and first day construction. Do not expect to move a 40 ft unit down the side of a mountain yourself. Placing a 20 ft unit on the back-forty of your semi level and accessible land is more realistic.

The simplest and most straightforward technique is to tow the container with a full sized pickup truck. This works best on fairly level terrain, and a half dozen or more 6-8" diameter steel pipes or uniformly round logs.

Enlist the help of one or two assistants to replace pipes or logs as the container moves forward. Use a thick slab of plywood or 1/4" steel as a base to rest a floor jack on and lift the leading edge of the container a few inches each time a pipe or log is replaced. Take care not to attempt this is very muddy or loose soils, as the pipes or logs may sink into the ground and lose their ability to provide forward motion.

Self movers can also build a container-buggy from steel stock that will insert through the forklift slots located on the bottom edges (of newer containers). This will require some engineering and assembly, but if you plan to relocate your container often, the buggy is a valuable tool to have available. You can purchase 12" casters and bolt, or weld them to the structural beams. Make sure to leave at least one side of the buggy assembly fastened with only bolts (so it can be removed from the high-low slots) if welding.

There are companies that manufacture container-buggies for the military, but these are expensive and designed for rolling units around on airstrip tarmac surfaces. The homemade buggy will function better on unpaved surfaces, towed with a full sized pickup truck or tractor.



Do It Yourself Ideas for Towing Containers

Industry Insider Interview Regarding Purchase and Delivery of Containers

Below is a question and answer interview I conducted with two shipping container sales and delivery companies. Answers courtesy of John from Container Outlet (www.containeroutlet.com), and Jim from Sea Box, Inc. (www.seabox.com). Special thanks to John and Jim for taking the time to participate in this interview.

Q: What are some of the factors that influence price fluctuation of new and used containers? **John:** Container pricing is affected by the following factors (among others): container location, condition, current supply and demand (especially including military demand), and the ability of China manufacturers to meet new containers demand.

Q: Does the current price of steel and the scrap steel market ever come into play? **Jim:** Of course, the current price of steel has dramatically affected the price of all new steel containers. Another factor that has caused a price fluctuation is the huge jump in new builds. This has caused a major increase in the price of used containers. The scrap steel market has no effect on the price fluctuation of used containers.

Q: What are the future expectations regarding shipping container use and overall availability in North America? **Jim:** The future of used container availability in North America should show a slight increase in supply. The current factors that will perpetuate this prediction are several major steamship lines have large quantities of aging equipment which must be replaced soon. What are the future expectations for ISO Container (land based) uses? More customers each month find ISO containers can be modified to transform into shelters, control rooms, work shops, structure container houses, art sculptures, large buildings, and special equipment enclosures, to house generator sets, water purification, sensing equipment and training centers.

Q: Do you sell container related hardware such as clamps and lifting hooks for iso corner fittings? **Jim:** We do sell container related hardware, such as deck mount twist locks and fastening devices, that are sold for boxes used as structures, not stacking on container ships. The more common accessories that we sell are HVAC, insulation, man doors, storage shelves and cabinets.

Q: What types (if any) of specialized container delivery trailers do you utilize? **Jim:** The types of delivery trailers that we utilize are 48' hydraulic tilt trailers and roll back and till back trucks, hook loaders, side loads and boggie towing. **John:** Tilt bed trailers (e.g., Landoll trailers).

Q: Do you see any new trends emerging in the trailer and delivery equipment area? **John:** Side loading trailers. **Jim:** I do not see any new trends (other than side loaders) emerging in the trailer/delivery equipment area.

Q: Do you deliver containers outside of the main highway network? **John:** Yes, to residences, businesses, schools, churches and farms. **Jim:** Sea Box does deliver containers outside the main highway network.

Q: What are your terrain requirements for rural delivery? **John:** Flat ground and firm, dry terrain. **Jim:** We ask that areas be dry and cleared.

Q: Do you have any tips or suggestions for customers to make delivery easier for both parties? **John:** Have a readily accessible alternate location available. **Jim:** The suggestion that I have for customers to make delivery easier is to have the doors of the container face the cab of the truck and for customers to plan ahead.

Q: Can buyers in land-locked states get a good deal on containers? **Jim:** People in land-locked states can still get a good deal on containers. Their prices average only 10% higher in large inland cities compared to port cities. They would only pay a big delivery fee if demand exceeded local supply.

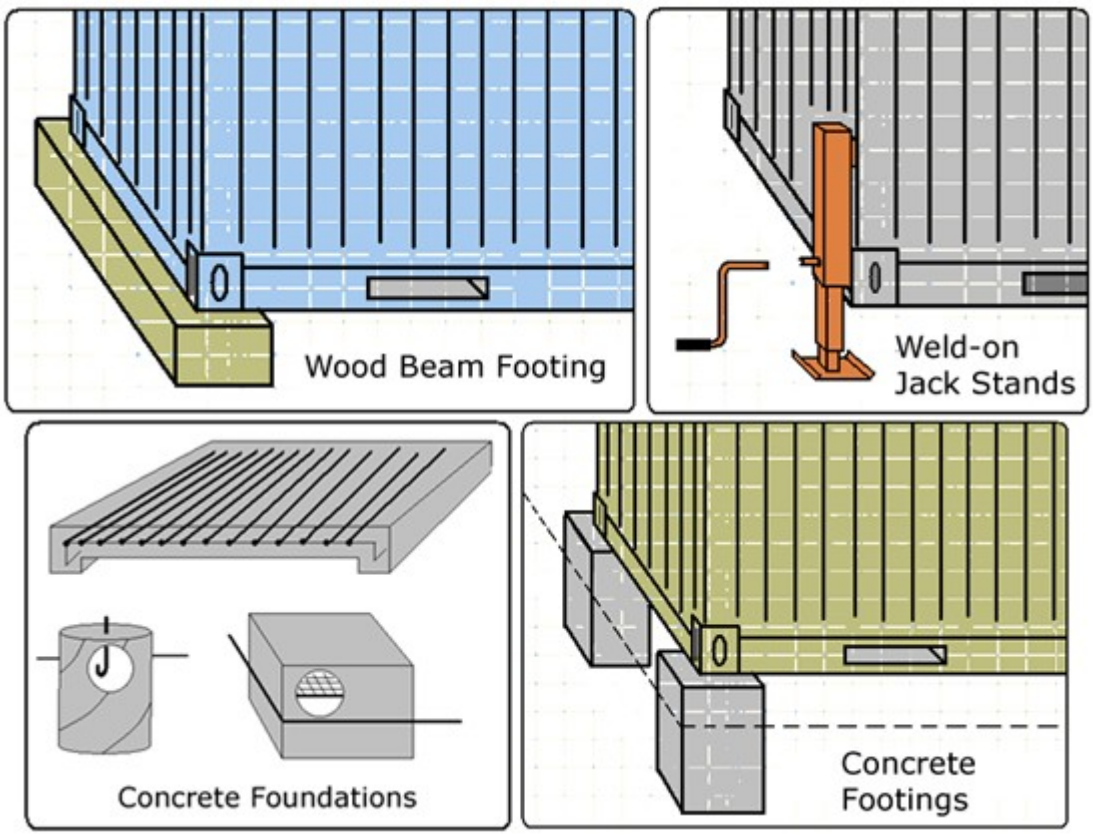
Q: Are there any significant container movement facilities located in non-coastal states? **John:** Yes... Atlanta, Chicago, St. Louis, Dallas, and others. **Jim:** There are container facilities in Chicago and Atlanta because containers end up in these type of cities which have larger railroad terminals.

Footings and Foundations

Foundation construction and delivery coordination: Concrete footings and slab foundations should be planned and installed prior to taking delivery of your containers. Builders need to consider what type of trailer their containers will arrive on, roll-bed or standard. Also, will a crane rental be on-site at the same time (for transfer of containers onto the foundation)? Will you need to rent the crane two separate times? How long will it take for your concrete foundation to cure (when can it support the containers)? Make sure to coordinate all the details of 1) foundation construction, 2) delivery date, and delivery vehicle, and 3) crane rental. All three aspects must work in concert for a smooth transition of your containers from delivery truck to permanent concrete foundation.

Although not an absolute requirement, the design of your container structure will be improved with a solid foundation for it to rest upon. Some type of foundation will also reduce the corrosive effects of moisture over time. Slabs, concrete footings, and simple wood beam footings are depicted in my illustrations throughout this book. There are a few other types of foundations (seen at the end of this chapter) that you can also use. You should choose one of these based on: 1) your budget, 2) your needs, and 3) the design of your building.

The designs presented in this book tend to favor concrete footings placed at a ratio of one per ISO corner. This way, all of the load bearing aspects of each containers ISO corners are transferred directly to the footing and into the ground. Besides being low cost, one of the (other) reasons concrete footings are favored by me, is that installing them is something the lone container builder can do in their spare time, perhaps one per weekend, in preparation for a future container delivery date. I also like the fact that, like the steel container that will be placed upon it, concrete footings are super tough, and will most likely survive for the better part of a century. I will cover detailed installation aspects of concrete footings later in this chapter, but first let's look at some of the other basic foundation materials you can use.



Wood Footings

Wood footings are your next upgrade from no footings at all. They are cheap and easy to install. Pressure treated footings, or 'skids', can be placed under a container after mild site preparation. Just make sure to create a level area of grade before your container is delivered. Containers only require support at each of the four corners, but many builders often install extra wood footings placed two at mid-level for added stability. This is optional. If building on raw grade, level grade (as just mentioned), then install a 4-6" deep bed of gravel under planned wood based footings. This will assist in water drainage and discourage rotting of the beams. Material for use as wood beam footings is readily available at most local lumber yards in the form of: 1) double stacked pressure treated 2x6's, 2) double stacked pressure treated 2x8's, 3) pressure treated 4x4's, 4) pressure treated or oiled railroad ties and other beams 6" x 6" or larger.

Wood footings can also be hand cut from raw timber using a chainsaw or portable milling device. This may be a cost effective route to take for those of you with available timber. A simple slab of log one foot by one foot, after assuring proper squareness, will serve as a strong footing under each ISO container corner. Treating the top and bottom of each log segment with hot tar or other such preservative is recommended.

Concrete Slabs

A poured concrete slab is the largest container foundation you can utilize. A slab is also an integral aspect of the 'Super Carport' design featured in this book. Since slab construction requires a large amount of ready mix delivered to your site, hiring a concrete crew to pour it is best. While it is possible to have all aspects, from site preparation, to form construction, rebar placement, pouring and finishing, handled by a cement contractor, keep in mind that container slabs require a slightly different design than standard slabs, thus, building your own form (the mold) is probably best. This way, you can simply pay the cement contractor to fill the form via a cement truck pouring, and finish the slab using a professional crew.

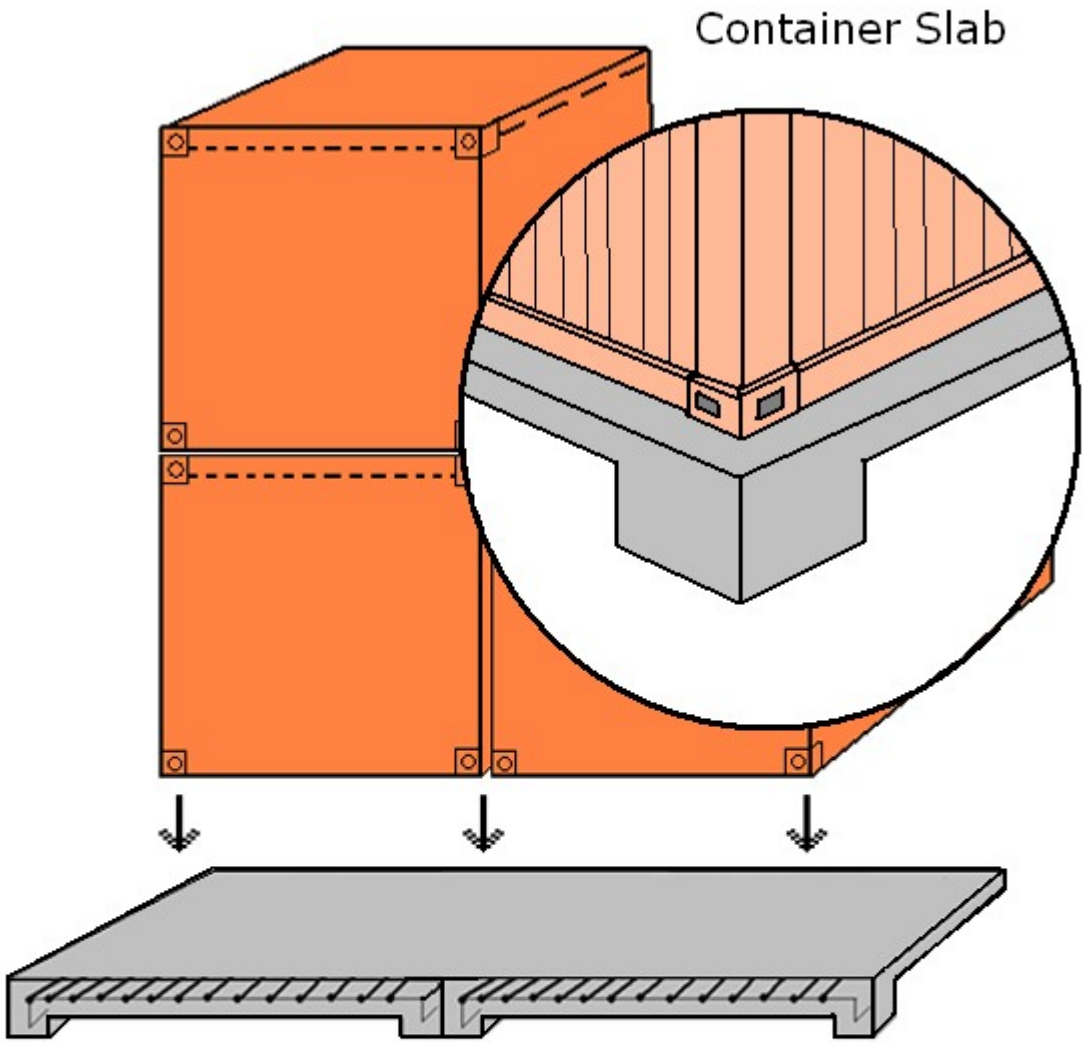
Regular building slabs are thicker around their outside perimeters where the slab will carry the weight of the structure. Slabs for container buildings use these 'thicker sections', but they are located under the containers ISO corners as opposed to all around the perimeter. To create these deeper or thicker sections of slab, the builder simply digs deeper into the ground when preparing the site and creating the form. The deeper sections of the form will allow more concrete to flow into the space creating a thicker segment of slab. Locating these thicker sections under the corner of each container is key. The remainder of your slab can be of regular thickness (4-6 in thick). In most cases, a container slab will require 20% less concrete then a standard slab due to this absence of a load bearing section on the full perimeter of the slab.

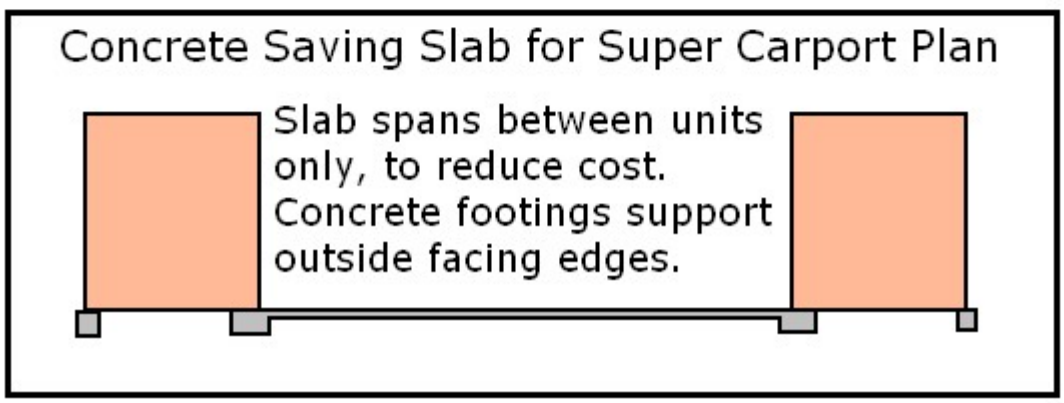
Container Slab Construction Process

1) Slab is decided upon, a plan is sketched on paper, and all aspects of construction are worked out.
2) Site is prepared by a) digging out grade to accommodate the form, b) compacting soil, and c) laying a 4 in. bed of gravel.
3) 2x6 lumber is installed around the edges of the form to contain poured concrete, and create a slab 4-6 inches thick.
4) Load bearing sections 1 ft long x 1 ft wide x 1 ft deep (under each container corner) are created within the form.
5) Reinforcement materials including #4 rebar, #10 welded wire mesh, and wire ties are installed resting on 2-3" tall bricks or stakes to create a 'floating' reinforcement system within the form (this will provide added strength when the concrete dries).
6) J-hooks, post anchors, and other (optional) hardware is installed within the form.
7) Everything is double checked before concrete is poured and smoothed.

Pre-construction considerations for slabs include: placement of post anchors for decks and balconies, j-bolt anchors for securing container to slab, PVC and conduit placement for utilities (if any), preparation of soil and site for proper drainage and possible freezing of ground in cold climates.

Estimating concrete for slabs: a single 80 lb bag of dry concrete yields a mere 2/3 of a cubic foot of finished concrete. For this reason, and as mentioned earlier, it is best to call in a pre-mixed concrete truck to pour your slab. You can estimate the total cubic yards of concrete you will need to order by measuring the inside dimensions of your form in feet using the following formula: *Length in ft x Width in ft x Height in ft, divided by 27 = Total Cubic Yards*





If building the 'Super Carport' design featured in this book, a 'concrete saving slab' can be used (see diagram on previous page). This allows you to take advantage of the containers pre-existing floors, which do not require a slab under them, by installing a shorter slab that only spans from inside edge-to-inside edge. Then install four independent concrete footings (two on each container) to support the outside facing edges.

Concrete Footings

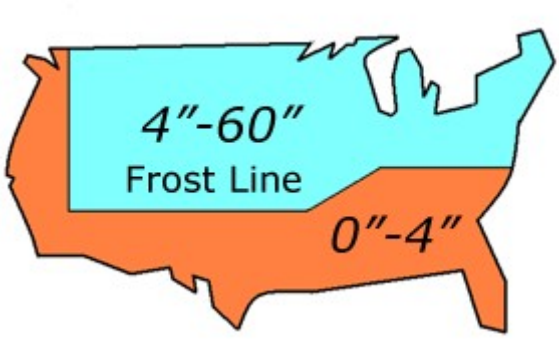
Many of my designs are depicted in the illustrations with slabs, and the 'Super Carport' plan really does require a slab, but I actually prefer concrete footings on most designs. Why? Because their just plain cheaper to build. In the case of the 'Super Carport' plan, the slab provides a great surface for working on cars and other projects, but in most instances, all that cement under an enclosed container building is sort of a waste. Footings are a much more cost effective choice for most applications.

You can purchase 80 lb bags of pre mixed dry concrete to make footings yourself. Fortunately bags of concrete only cost a couple dollars each, and a few trips to the builders store will provide you with your material. You might want to enlist the help of an assistant to carry concrete bags due to their excessive heft. Safety note: take care not to overload vehicles with sacks of cement. This can damage your suspension, and also create an unsafe driving situation. Remember, it only takes six bags of concrete to equal 480 lbs, and that can be a considerable weight in some smaller vehicles.

Local home improvement stores offer a variety of powdered instant concrete. Most are sold in the 80 lb bag size, and cost a few dollars each. The favored brand of instant concrete is usually Quikrete, but many other brands are available. Most of these products produce high strength concrete, reaching 3000-4000 psi of compressive strength when cured. They are made from a blend of portland cement, sand, and gravel or stone. To prepare these dry concrete mixes, you simply add the correct amount of clean water, and mix.

<u>Footing Sizes</u>

The first step in footing construction is deciding the depth of the footings you will install. Footings can be prone to frost heave, and this phenomenon will be the primary factor in early footing foundation design. If you live in an area where the ground does not freeze, you can skip over this step. Frost heave occurs only in cold areas where the ground freezes. This results in a slight movement of the soil that can push up on the footing and structure resting upon it.



When footing movement of more than one inch occurs on a container building, a noticeable tilt in leveling can be produced. This could result in flaws to the entire structure later on, and is best combated early in the design process. The only way to fully avoid this problem is to install footings six inches below the frost line. The frost line is the maximum depth where the ground will freeze in the winter. In super cold North Dakota for example, 50 inch deep footings might be required, while in balmy Florida, extended footings underground might not be needed at all.

The next step is to decide how big your footings will be. A very large size 2'x2'x2' footing would require about six 80 lb bags of concrete to fill the form, but you can usually get away with building footings much smaller than this. A good general size, that will support one and two level container buildings via ISO corner fittings, is 10" deep, x 20" wide, by x 20" wide. This will result in a 2.3 cu. ft. footing that will require 3.8 bags of concrete mix. Of course, you may need to extend the 10 inch depth of the footing to prevent frost heave as previously discussed.

The rule of thumb for square footing size, and (round footing) diameter is *one half-inch per foot of span*. Thus a container that spans 20 feet will stand comfortably on 10-inch-diameter piers, or 10 in. x 10 in. square footings, while a container that spans 40 feet will require 20-inch-diameter piers, or 20 in. x 20 in. square footings.

FOOTING SIZE AND STYLE	**CUBIC YARDS**	**CUBIC FEET**	**NUMBER OF 80 LBS BAGS**
8" x 16" x 16" SQUARE FOOTING	.044	1.2	2 BAGS PER FOOTING
10" X 20" X 20" SQUARE FOOTING	.086	2.3	3.8 BAGS PER FOOTING
12" X 24" X 24" SQUARE FOOTING	.15	4	6.75 BAGS PER FOOTING

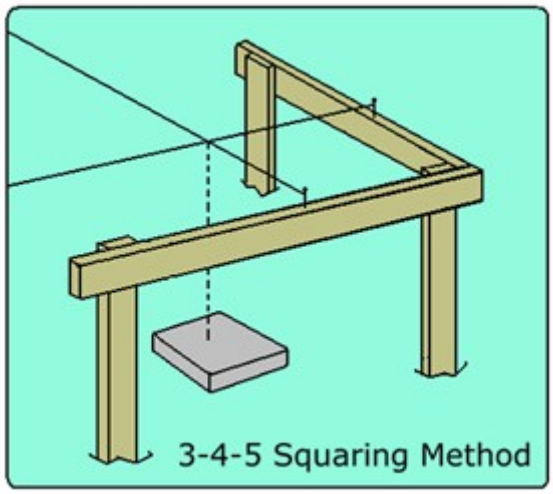
For other sizes of footings, you can quickly figure the amount of concrete needed by multiplying:

For square footings...
(measure in inches) Length x Width x Depth, divided by 1728 = cu. ft

For round footings...
(measure in inches) Radius x Radius x Height, divided by 1728 = cu .ft.

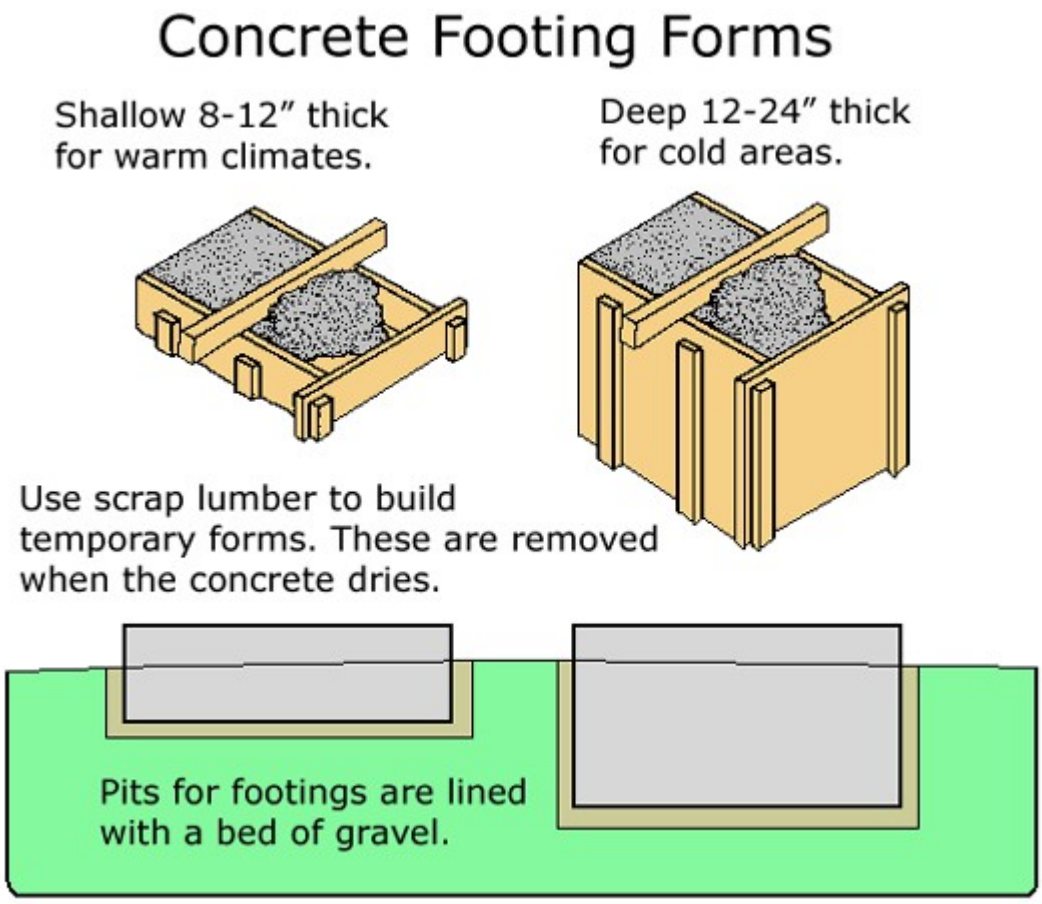
Each 80 lb bag of ready mixed concrete yields: .66 cubic feet, or .022 cubic yards, of finished product.

Site Preparation: First clear the building site of any rocks, foliage, and stumps, and level any obvious high spots. Then mark out the building's location with spray paint applied to the ground. Insert stakes at each corner, mapping out an area that's the exact size of the proposed container buildings foundation perimeter, then tie string on the stakes to mark out the site.

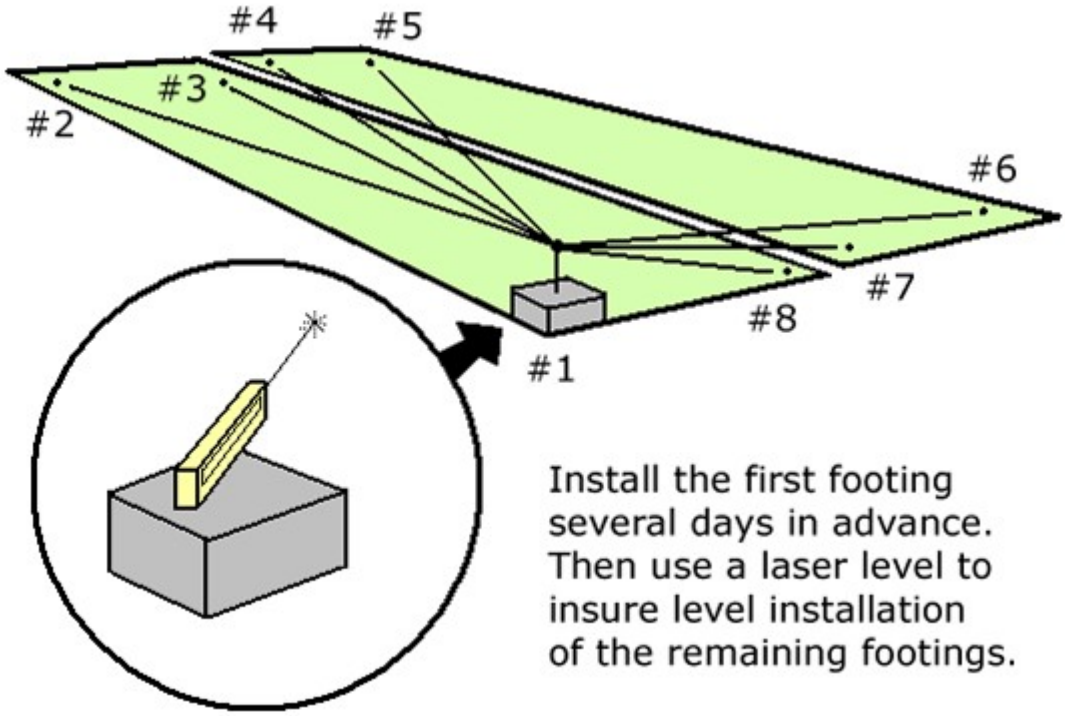


To insure that this large area is square, you can rely on the fact that triangles with sides of 3 units by 4 units by 5 units are right triangles. The corner opposite the "five side" contains the right angle. You can use this simple trick to check squareness of your foundation layout, it's called the 3-4-5 method. Stretch strings along what will be the path of the sides. Tie the strings to batter boards. Mark one string 3 feet from the corner. Mark the other string 4 feet from the corner. Have a helper stand at the far end of either one of the strings and slide it along the batter board until the diagonal distance between the 3- and 4-foot marks equals 5 feet. At this point, the corners are square.

Next, find the highest corner of the site and excavate for construction of the first footing. Plan on having 6 to 8 in. of the footing exposed above grade. Dig out an area several inches wider than the footing, and several inches deeper than the depth required. Compact loose soil in the bottom of the footing pit by tamping firmly with the end of a post or board. Add a 2-3" bed of gravel covering the floor of the footing pit. Next, begin to construct a wooden form that will create the footing when filled with concrete. You can use 1/4" plywood or OSB, secured at the corners with old 2x2's, 2x4's, or whatever you have on hand. Consider assembling the form with screws to aid in removal when the concrete sets-up (you will need to re-use this lumber - unless you build several forms).

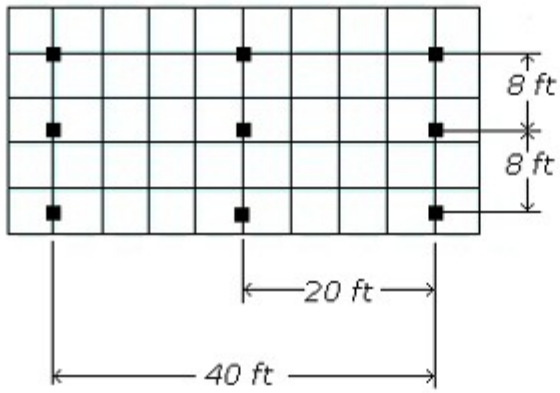


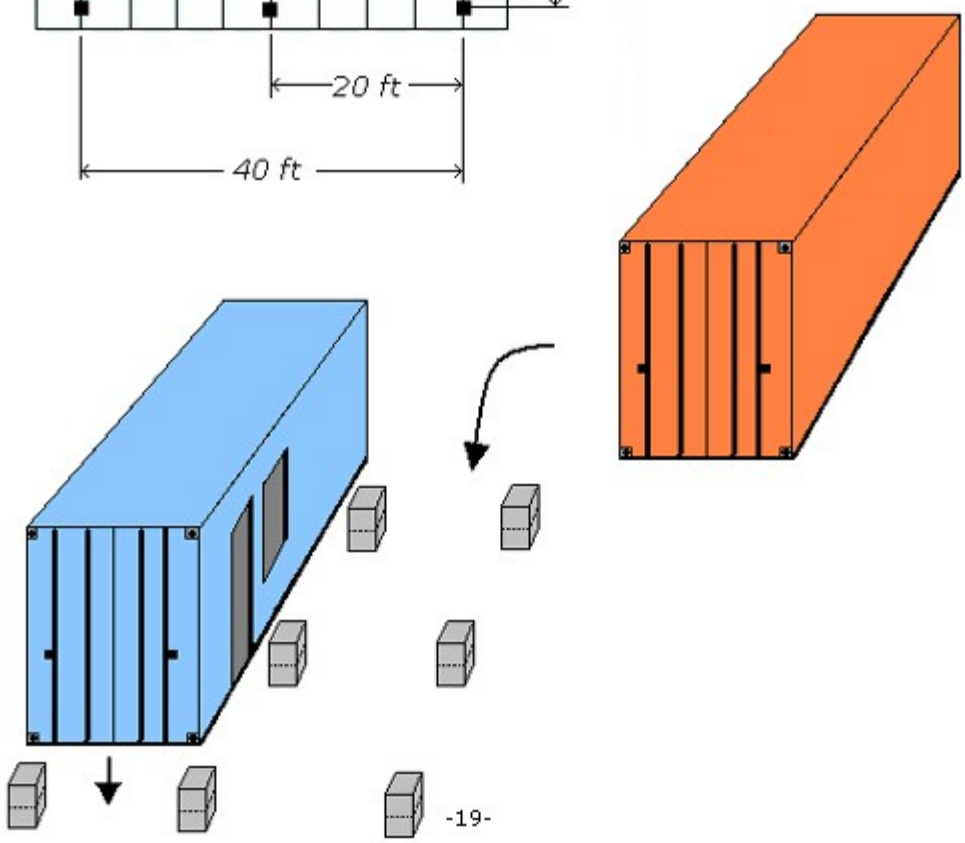
Proper alignment of all footings is key. The first footing 'sets the pace' so to speak. The remaining footings are installed based on this first one, so it must be correctly installed. After the first footing dries for 48 hrs, and the form has been removed, use a laser level to plot out the placement of the remaining footings (diagram on next page), and insure future footings adhere to the squareness of the first footing. Laser levels take the place of a chalk line and regular levels by emitting a red laser beam (from one end) that projects levelness up to 100 ft away. These laser levels cost about $30 and are readily available at your local builders store.



Install the first footing several days in advance. Then use a laser level to insure level installation of the remaining footings.

□ = 5 ft Footing Layout and Installation





Pouring Concrete Footings

Appropriate mixing containers are the key to consistency when preparing concrete from a bag. Use a wheelbarrow, or a large shallow plastic tub to mix your concrete in. An ideal setup would be three or four wheelbarrows that could be filled, mixed and then poured into the footing form in an assembly line fashion with the help of a few friends. Use a hose to gradually add water to your concrete, mixing it together in the wheelbarrow with a piece of scrap 2x2. The water hose is also used frequently to blast wheelbarrows, and other mixing vessels clean, preparing them for another load. Concrete should reach it's proper consistency during mixing; to much water will result in brittle concrete that cracks, while not enough water will produce dry spots that will remain powder. Make sure to read the products mixing instructions thoroughly.

I would advise you to visit your local equipment rental facility and rent a portable cement mixer if you plan to do several footings in the same day (it will make the job much easier). Finally, make sure you have shovels, trowels, floats, sponges, and extra mix on hand before starting a concrete job.

Note: allow concrete to cure before installing containers - keep in mind it may take several weeks to fully cure.

Reinforcing Footings with Rebar

All footings that are poured with concrete can be reinforced with rebar. Adding # 4 rebar (steel rod) to a concrete footing will increase the strength of the footing, and the footing will be less likely to crack or splinter. For each footing, cut two #4 rerods that are 8 inches longer than the depth of the footing hole. Insert the cut rerods vertically into the footing form (the rerods should be a few inches apart from each other). Push the rerods into the hole until the end of the rerod is below the top of the footing.

Concrete Footings Summary

Pre-made fiber tubes can be used for pouring concrete footings, or you can build square forms from wood. A footing can be kept flat to set the containers ISO corner on, or a j-bolt can be set into the cement for anchoring. Steel containers weight 5000+ lbs, and are not likely to move easily, so anchoring it to the slab or footings is optional. Installing a 3" bed of sand, a 3" bed of fine gravel, and a vapor barrier under all concrete is advised. Wire mesh or rebar should be added to all concrete container building applications for increased reinforcement.

Other Footings

Other options for footings include jack stands for use on a concrete pad or in a parking lot, or the installation of weld-on style jacks. These offer the advantage of being adjustable via a built-in worm gear and attachable hand crank. I looked at some trailer parts supply websites, and found that these are most commonly available in a price range of $50-$120 new in the box (per jack). Lifting capacity ranges from 7000 lbs to 10,000 per jack, and lifting range is from 22" to 54" depending on model. These are designed with a smooth surface on one side for welding to your trailer, or in our case, container, and will require a few steel fittings or plates be made to create a flush surface between the corner fitting and side rail. The Army and Marine ISO Shelters feature these type of built-in jacks for adaptation to a variety of terrain conditions. These might be a good choice if you are setting up on extremely soft ground and do not want to install permanent footings. You can simply give the corners a few cranks when the inevitable settling occurs.

Fitting Out Container Buildings

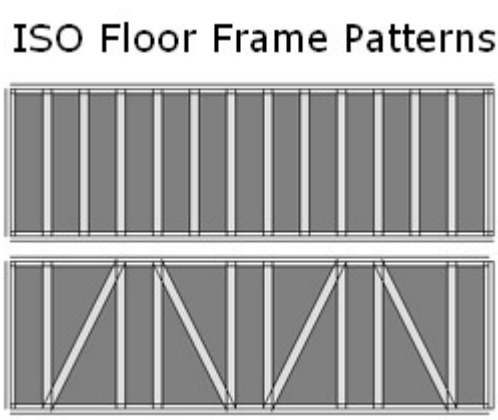
'Fitting out' containers is a term I use to cover all the finishing aspects of your container building. This can be anything from installing pre-hung doors, to building a bathroom inside. You can build walls inside to create rooms, run wiring or plumbing, even install a hot-tub. Many container builders like to install work benches, shelves, and fixtures for utility use. This is a very broad portion of the building process, which can be interpreted in many different ways. Most of you will have your own unique plan of *'fitting out'* your building for your specific use. Due to this fact, I have included a grab-bag of ideas in this chapter that you can use as you see fit. Some of these ideas may not be useful for your plan at all, but at least you will be able to get an idea of some ways you can fasten interior framing studs, hang doors, and windows, and even build a deck outside.

Framing Interior

Framing container interiors is an easy task. One way to do it, is to use the affordable and easy to work with 2x2. Since the container already possesses all of its load-bearing qualities built-in, strength of the framing material is not an issue. This interior framework merely serves to hold insulation, paneling, windows and doors. I recommend that you avoid fastening studs or other interior framing material to the corrugated metal of the container with drilled holes, bolts, or other fasteners. This is not necessary. Using bolt-through fasteners will fill your containers walls with holes.

I devised a method that calls for precise cut studs to fit snugly in place (they should require a light tapping into place with a hammer). Then run a bead of Liquid Nails style construction adhesive on each stud. Liquid Nails is effective on steel and wood. This method will produce more than satisfactory results, while saving time, effort, and money. Studs should be placed every 2ft-4ft to allow for easy attachment of standard 4x8 drywall or other interior paneling material. Thin layers of fiberglass insulation placed under the paneling will help retain heat in the winter time, and should be considered.

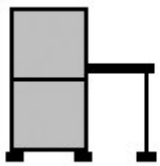
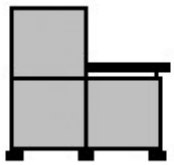
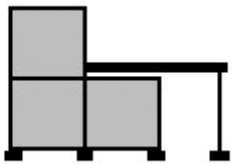
A 2x2 frame is adequate to support and mount a standard vinyl pre-made window. For windows and pre-hung doors requiring a wider mounting surface, you should build-up the frame using 2x4's or 2x6's inside the openings.

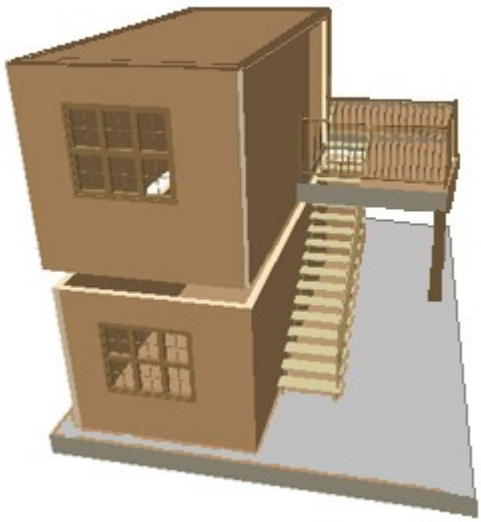


Stairways If you are building a 2-story structure, and are considering a ladder or stairway (inside) leading to the upper level, the cross-member floor of the top container may present a problem. Cutting a pathway through any load bearing steel (on the 2nd floor) should be ok if you do not plan on placing heavy equipment or machinery up there. You can probably get away with removing a section of the cross members to install stairs if a bedroom or office is planned, but I would not advise setting up a 2000 lb lathe on a container (second) floor modified in this fashion.

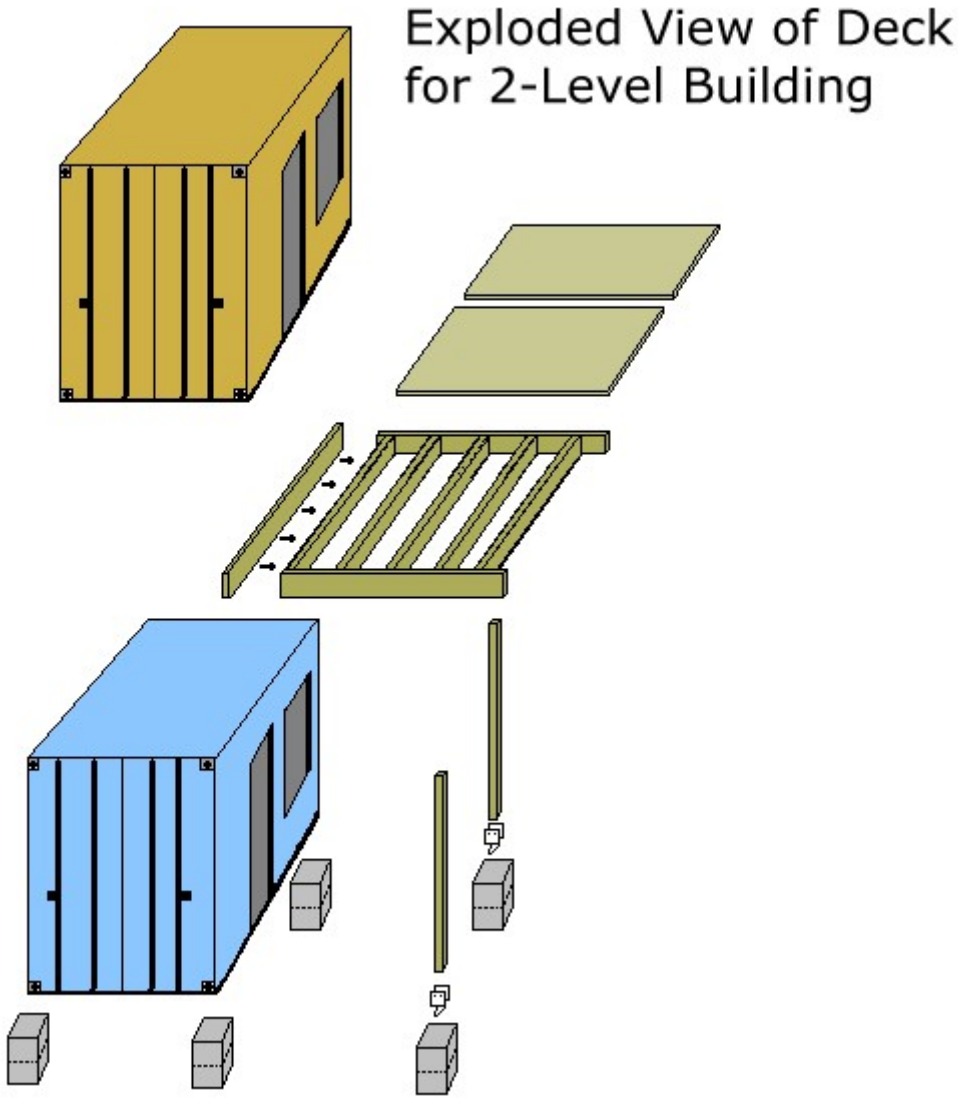
Exterior Decks and Balconies

Decks and balconies, made from pressure treated lumber, are a natural addition to container buildings. Most hardware and home improvement stores stock a wide range of stamped steel fittings suitable for all sorts of decking applications. Specialized achors, or wood beam ledgers can easily be attached to your container (with heavy duty self expanding bolts) creating a strong point of attachment for decking. The materials required to complete your pressure treated deck or balcony will vary depending on design.

Side View Diagram	Building Style Description	Decking Description	Columns and Footings Required
	Shipping container bldg stacked two-high. (2) containers	Pressure treated 2x6 lumber is affixed to the tubular steel (bottom) frame of top unit. Railing and outside staircase are installed.	Yes. 4x4 columns and concrete footings placed every 8 feet.
	Shipping container bldg two-high, and two-wide. (3) containers	Pressure treated 2x6 lumber is affixed to the tubular steel (bottom) frame of top unit. Deck rests on ground level container. Railing and outside staircase are installed.	No. Deck is fully supported by ground level container.
	Shipping container bldg two-high, and two-wide. (3) containers	Pressure treated 2x6 lumber is affixed to the tubular steel (bottom) frame of top unit. Deck rests on ground level container and additional concrete footings. Railing and outside staircase are installed.	Yes. 4x4 columns and concrete footings placed every 8 feet.
	Shipping containers placed in parallel. (2) containers	Pressure treated 2x6 lumber is affixed to the tubular steel (bottom) frame of both units creating a deck that spans area between.	No. Deck is fully supported by ground level containers.



Exterior decks, terraces, and support beam aspects of your building can be built using standard readily available pressure treated decking lumber and connecting hardware. 4x4 beams and the corresponding anchoring hardware should be used for support of overhanging second story decks, and balconies. If using concrete footings, a separate footing is recommended under each 4x4 support beam.



Doors & Windows

You can cut the 14 gauge (.075") corrugated steel side panel material using a reciprocating saw or angle grinder. Air powered shears are usually not able to cut sheet steel thicker than 16 gauge, but if you have a model that can (cut the 14 gauge side panels), this would probably be the fastest method. Carefully measure and mark door and window placement prior to making any cuts in the steel.

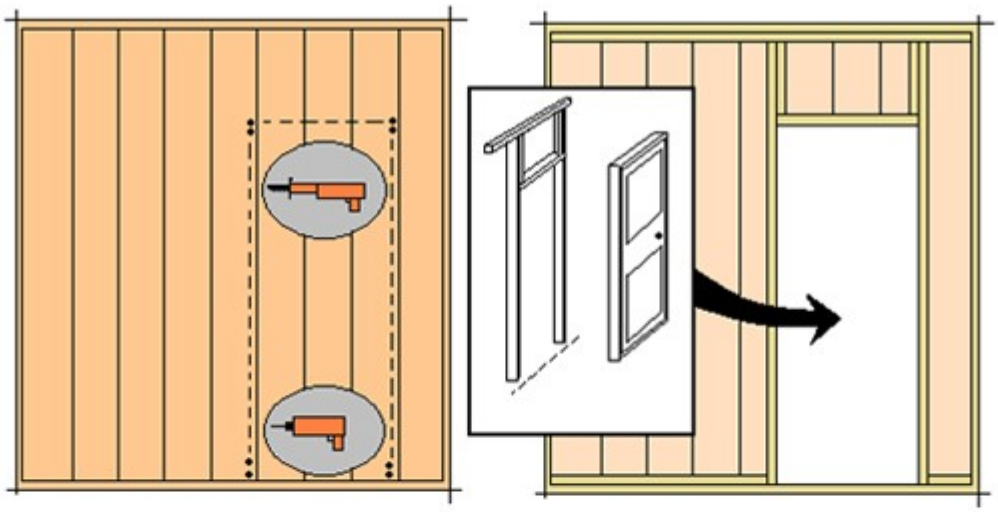
Pre-hung doors can be purchased for about $80, and installed in your container using a simple 2x4 frame. Vinyl type windows are also readily available for under $50, and can be installed in a similar fashion. Metal storm windows may be substituted, and as in a regular home, these are installed from the outside using screws.

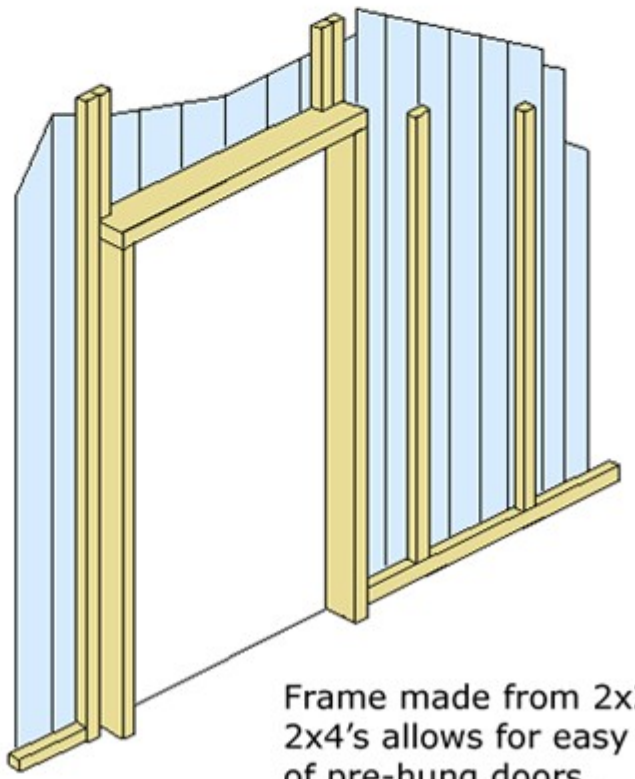
An obvious problem you will encounter as a container builder; filling the gaps around door and window frames. These are a natural result of the peaks and valleys in the corrugated steel side panels. Steel roof flashing, installed on window and door trim, can often cover most of these small gaps. You can also use expanding foam. This product (expanding foam) has come a long way since the days of the *stuff* that blew up three times its original size and warped your door jams. Several companies now make minimal expanding foam that provides a water resistant paintable surface, and expands less offering greater control of application.

Forty foot unit awaits window installation.

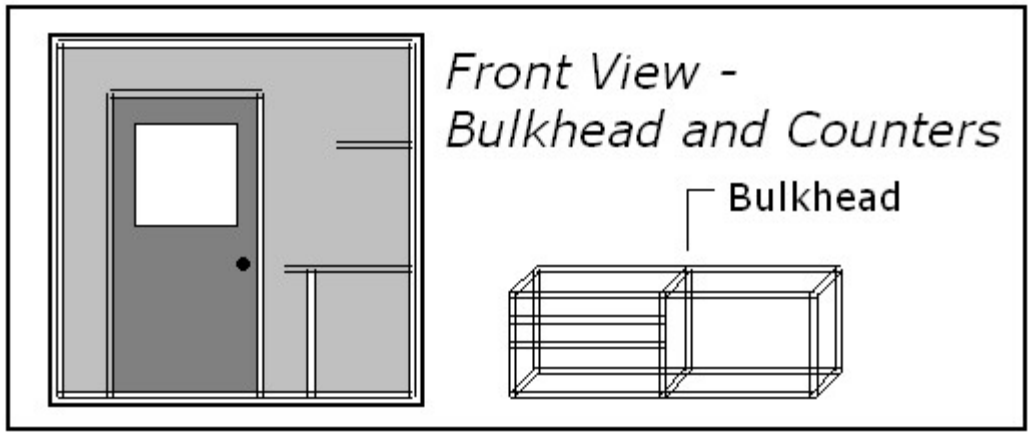
Door security tip: standard foam filled pre-hung doors are not the most secure in the world, as they can be kicked-in fairly easily. To increase security when using these doors, install them so they open out, then weld or bolt hinged steel swing-arms to the containers existing steel side walls material. These door securing rails can be pad locked down to prevent door from opening outwards.

Window security tip: standard vinyl pre-hung windows are not the most secure in the world, as they can be broken-into fairly easily. To increase security when opting for extra windows, installation of steel security bars is recommended. 1/4 in up to 1/2 in steel bars can be bolted or welded to the existing steel side wall material to prevent break-in's.

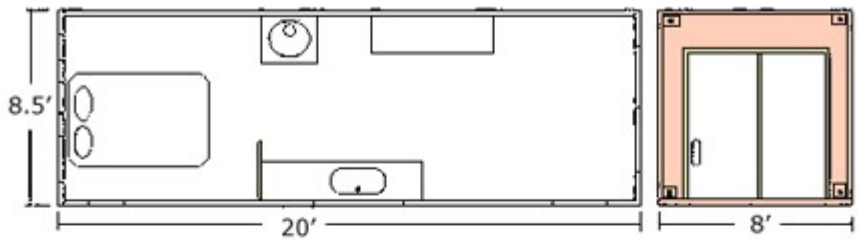


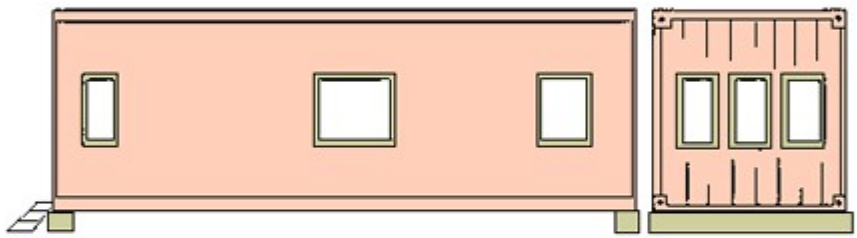


Frame made from 2x2's and 2x4's allows for easy install of pre-hung doors.

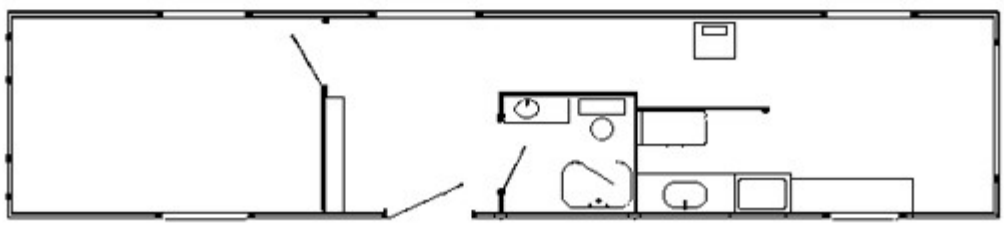


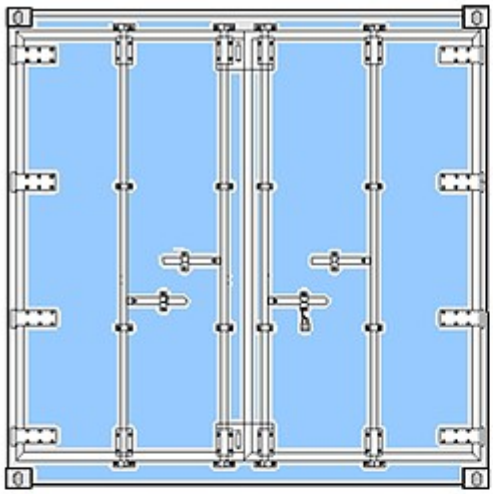
20 foot Container Cabin

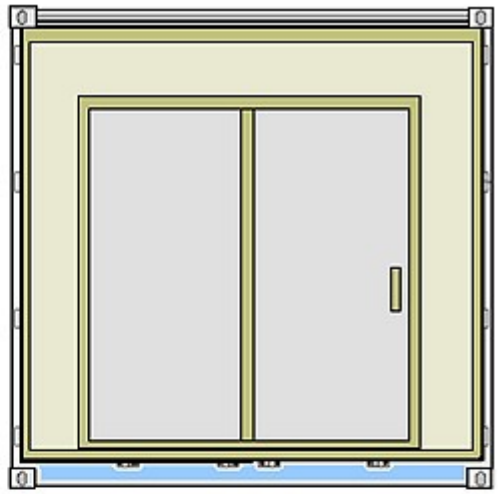




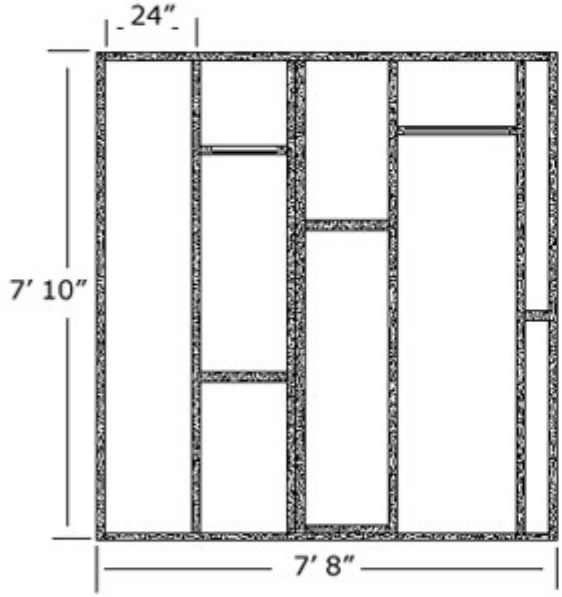
40 foot Container Cabin







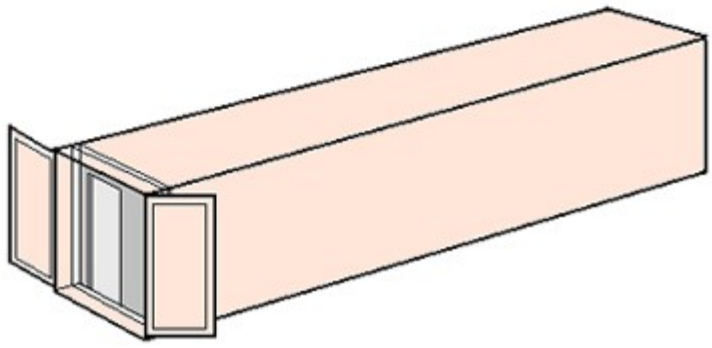
Sliding Glass Doors

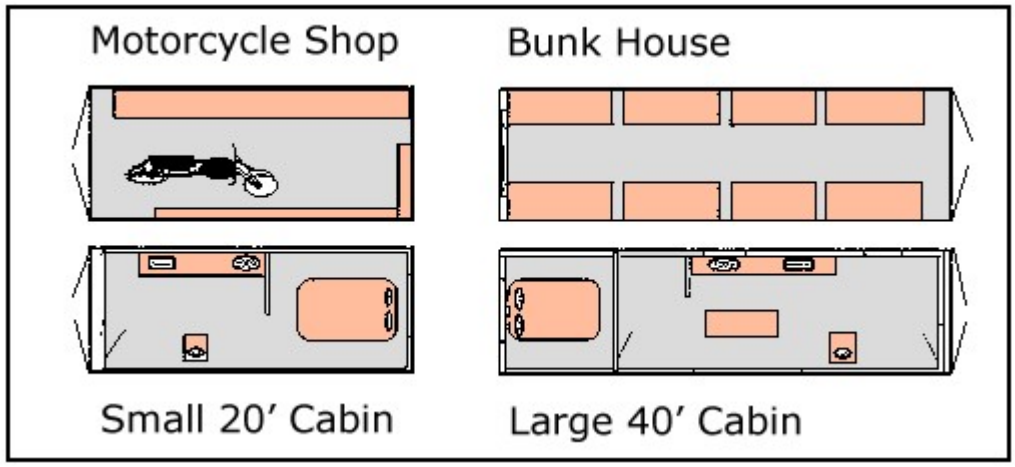


Replacement of open end steel cargo doors with a 2x4 framework and pre-hung door.

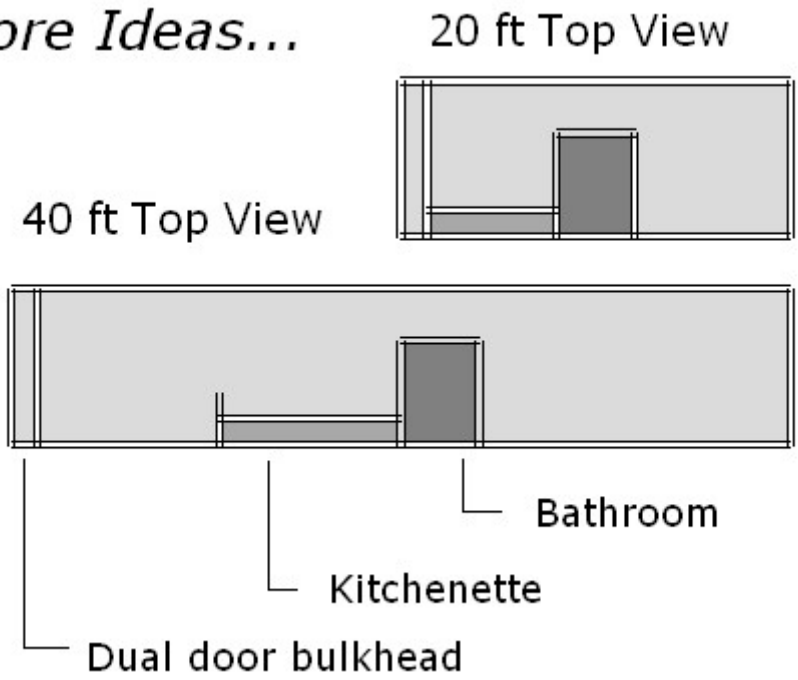
Optional: keep steel doors on unit, and install this framework set back 2 ft from opening.

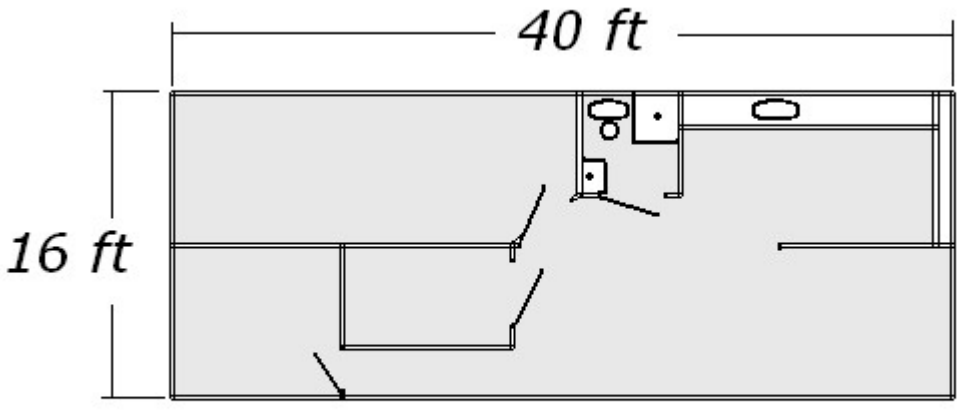
This will create a dual door system: 1) daytime entry door, and 2) steel security doors that can be closed at night.





More Ideas...





Doublewide 40 ft Residential

Cost Saving Tips for Fitting Out Containers

Up until the fitting out portion of your container project, you really didn't have too much control over the cost of the required material. While you probably did shop around for the lowest container price, other materials such as concrete for foundations, and lumber for roofs, are usually at a fixed price (when purchased new) wherever you go.

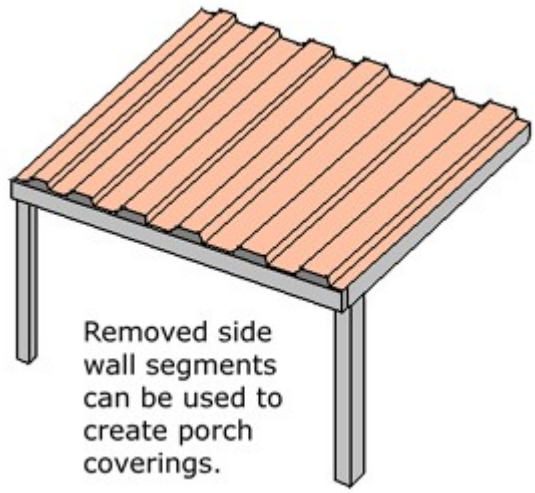
Now that you are ready to add final aspects to your building, you should take extra precautions not to go hog wild at the home improvement super store. Small fittings and fixtures such as lights, wiring, outlets, plumbing, etc, can add up quickly amassing into a several thousand dollar tab.

Before setting out on a plan to add these elements to your building, take a moment and summon the *Fred Sanford* that dwells within us all, allowing yourself think about possible sources for low cost or free materials.

Used building material shops have begun to spring up, perhaps there is one near you that has materials you could use. Classified papers, hotel liquidation sales, neighbors, friends and family could also be queried for salvage items. Maybe your uncle Bill has a 100 ft roll of romex (copper electrical wire) he never used? Also check out Craig's List (www.craigslist.com), a community bulletin board that has a category for free stuff, much of which is building material folks want rid of (they're usually happy just to get rid of it).

Recycling (removed) Side Wall Steel Panels

As discussed in Chapter 4 (Joining Containers), the steel side wall paneling can be salvaged if removing walls. It's best to have a plan for this material in mind before you join your containers so as to avoid haphazardly cutting away side walls in a non-uniform manner. When you trim out your side walls in neat squares, you can use the saved steel for a wide variety of applications that fall within the cost saving category.



Recycled side wall material uses:

- make a shower stall
- make new interior walls
- make porch coverings
- cover small roofs
- cover smaller outbuildings
- build a dog house
- storage tank for solar water heater
- line drainage ditches
- make gutters

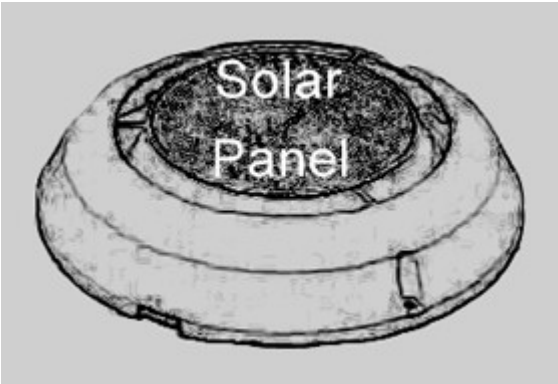
Avoiding Condensation

I tend to sometimes think of containers as land based sailboats. What I mean by that is, they possess a similar lengthy body and relatively short beam (width). I often catch myself referring to a wall built inside a container as a 'bulkhead', or the bathroom the 'head', all nautical terms. One thing a container has in common with a sailboat, besides dimensional, is the need that measures be taken for reduction of condensation or moisture, inside the sailboats cabin, and inside the container.

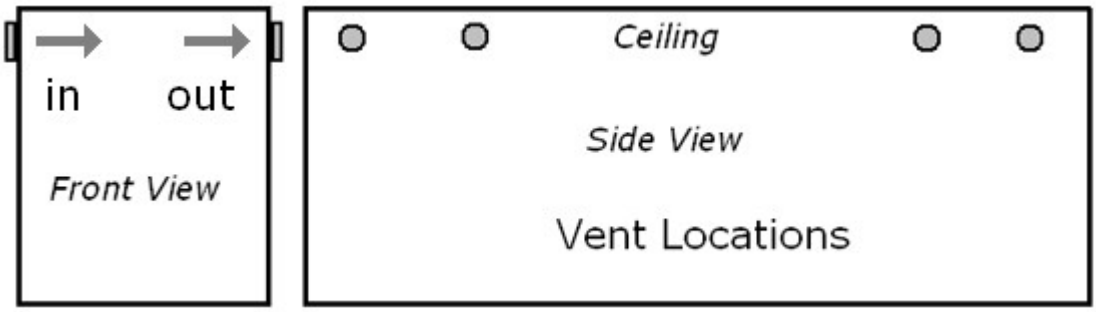
The shipping industry even has a term for container condensation....it's called 'container sweat'. Container sweat is less of a problem for us the container builder, because we will have doors, windows, and other sources of constant ventilation, but this problem should still be considered.

'Container Sweat' occurs when the outside temperature drops (at night time) and cools down warm air inside a sealed container. When the interior temperature of the sealed container falls below the dew point, condensation droplets form on the containers ceiling and walls. The worst sweat formations take place during sunny weather, if the (sealed) container is exposed to direct solar rays during the day, then is subject to outward radiation (cooling) at night.

A gable roof can help prevent this heating via the suns rays, but the best defense against condensation or 'container sweat' is constant use of your building. If you are in and out, opening doors and windows, providing lots of ventilation, you probably won't experience much of a problem. Still, it's a good idea to take a lesson from the many seasoned boat and RV owners, and install a series of small closeable vents for those times when you can't be there to open windows yourself.



These vents can be un-powered, or powered with small AC or DC motorized fans, and all should have a seal or louver that can be closed in cold weather. Check out RV and boat supply catalogs or websites for these type of vents. They make some great solar powered models that require no attention after installation, see diagram left. You can also use just about any other type of closeable vent, just make sure to follow the manufactures installation directions. Vents are best installed on the upper part of side walls, see diagram below.

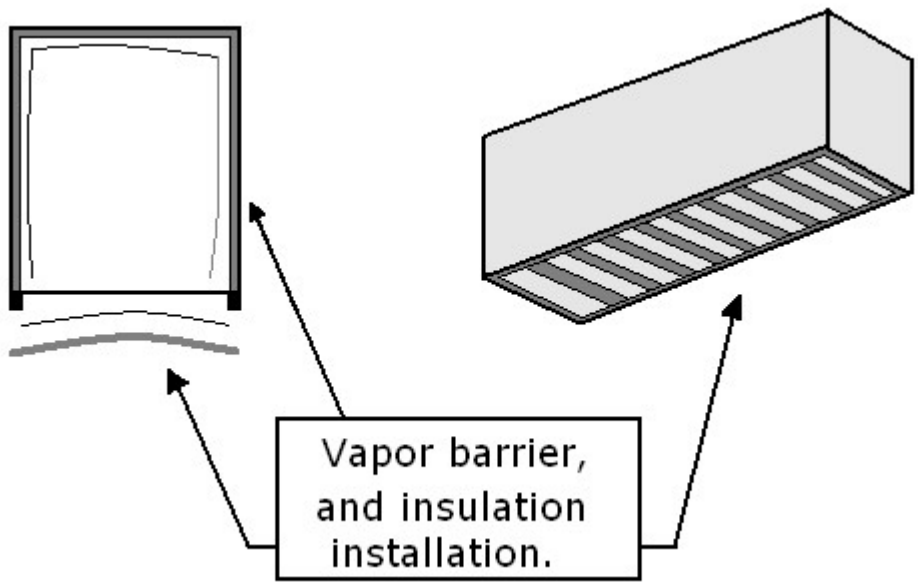


Heaters and Insulation

Most of us in North America endure temperatures below 50 degrees Fahrenheit for a good part the year. If your container building will be used as a workshop, studio, or residence, and you live in a cold region, installation of a heater will make for a much more pleasant environment. You can use wall mounted LP heaters, cast iron wood stoves, and electric radiant heaters to warm your building.

Container buildings can be insulated in a variety of ways. For containers that will have an interior framework of 2x2's, standard rolled fiberglass insulation can be used. For containers without a framework, foam panel insulation will have to be used. Application of insulation is critical regardless of which type you install. Insulation should be applied to: a) exterior underside between cross member support beams, b) interior side walls, and c) interior ceilings. The exterior underside insulation should be installed on top of *visqueen* or other vapor barrier material to prevent moisture infiltration. All insulation should have a vapor barrier that faces toward the living area. For example, rolled fiberglass insulation is backed with a paper vapor barrier that must face in towards the living area when installed.

Insulation Type	R-Value per inch	Materials	Use	Installation	Comments
Rolled Fiberglass	3.3	Glass fiber batts or blankets bundled in rolls	Lumber framed container walls, ceilings, and between cross beam floor supports.	Fit between wood frame studs, joists, and beams.	Common, easy to install, and effective.
Rigid Panels	4.0 5.0 7.4 4.5	Molded polystyrene Extruded polystyrene Isocyanurate board Fiberglass board	Non-lumber framed container walls, ceilings, and between cross beam floor supports.	Cut to fit and secure in place; should be covered with finishing material for fire safety.	High insulating value for relatively little thickness. Note: material can be flammable.



Utilities

If you've gotten this far with your container building, why turn back now.... you might as well go the whole nine yards and install electricity, water, and a sewage line. Just don't make the mistake of informing the building department of your plans, as addition of these aspects is usually what makes an ordinary utility building into a residential structure... vulnerable to all codes and restrictions on the books (as far as their concerned). Electricity is not such a big deal, but the building inspector will really turn red over unregulated water and sewage lines being installed. For these reasons, and so as not to attract the attention of a passing building inspector, I advise running utilities underground.

Rural builders can connect a simple PVC sweage line to a septic system or cesspool. Water lines can be run underground via PVC. Electricity can be delivered via nonmetallic sheath wire run inside steel conduit (pipes). Steel conduit and PVC water and sewage pipes should be installed in trenches 6-8 inches deep. Electrical wiring must be buried in trenches 24 inches deep when steel conduit pipe is not used. Utilities should enter a container through the bottom edge of the floor or the lower portion of the side wall.

The basic level of electrical service for your structure should be 120/240-volts delivered via a single 3-lead wire (2 hot wires delivering 120 volts each, and 1 ground wire) with a 100 amp breaker box installed inside. You will also need to establish a ground (point of zero voltage) for your container building. This will connect to all ground wires (in the building) ensuring a safe electrical system. The old way of creating a ground was by connecting ground wires to the steel water pipes most buildings had. Since we're using low cost PVC, we will have to purchase a special grounding rod, and burry it 12 inches underground near the buildings foundation. This rod must be wired to the breaker box, ultimately connecting to the buildings entire electrical system. *See utility connections diagram on next page.*

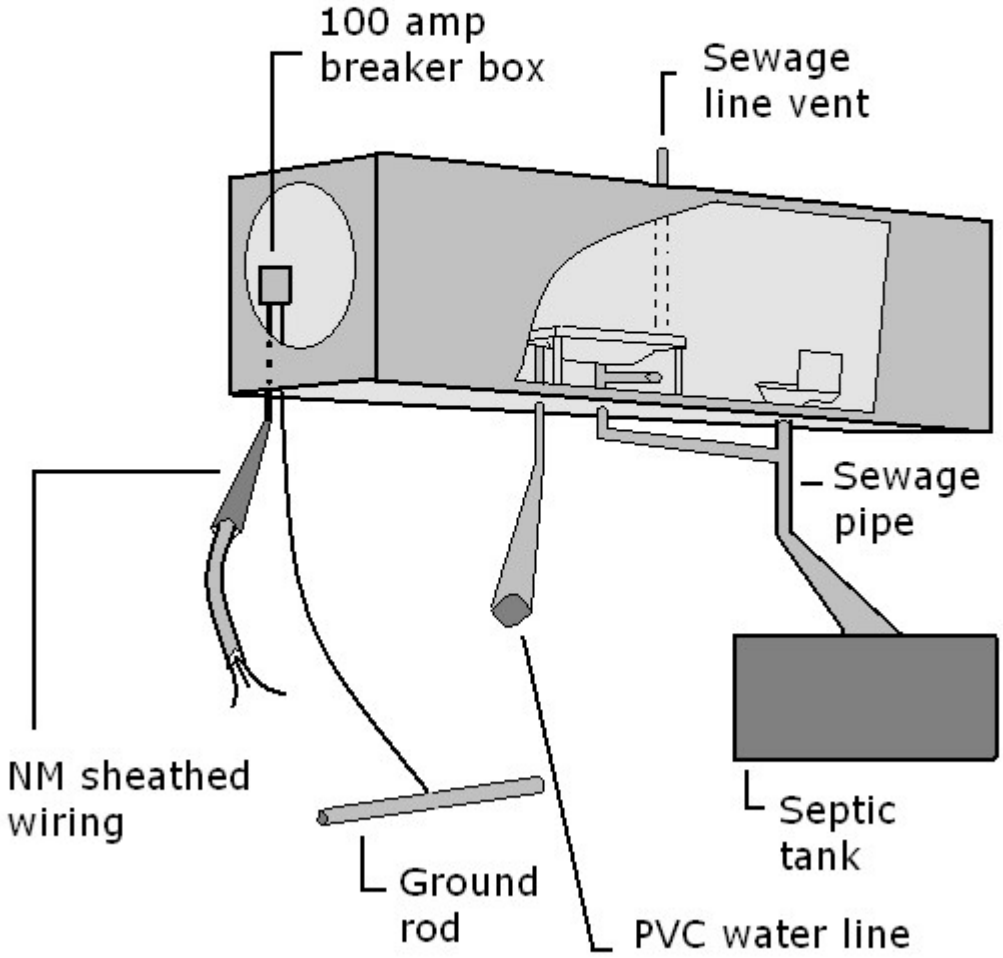
Painting Container Buildings

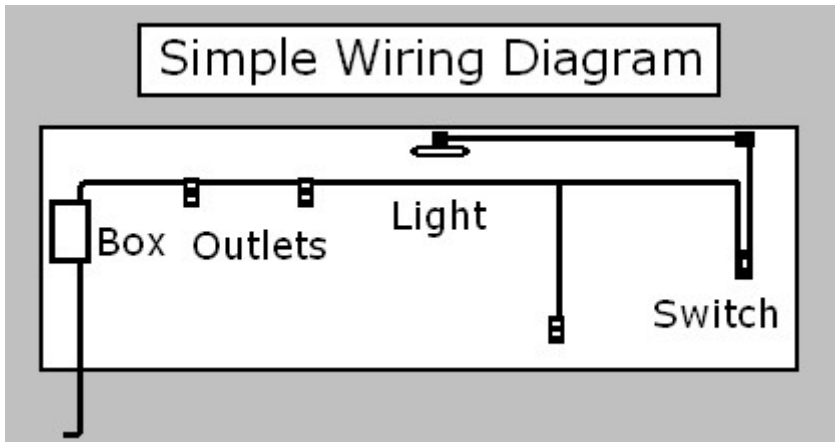
Hopefully, your containers will not require painting and refinishing when you obtain them, but if they do, don't panic, here's the scoop on container coatings. Steel containers should be painted with a rust-inhibiting urethane enamel on the exterior, and an acrylic rust-inhibiting enamel for the interior (steel surfaces). The most common brand that comes to mind for this task is good old 'Rust-Oleum' brand paints and primers, but there are many others available, and you can investigate these further.

You get what you pay for when it comes to paint, and quality paint can cost you. I'm a big believer in opting for a high quality product, and devoting most of the time (for the task of painting), on surface preparation and priming. The easiest part of the job should be applying the paint onto a perfectly prepared surface.

You should prepare your container for painting by removing all rust and scale with rotary sanders, steel wool, and sand blasting (if needed). Pressure washing can then be used to rapidly clean the unit and blast away any loose material. After drying, apply the proper primer, lastly, apply the paint from gallon or five gallon containers using either an air sprayer, airless sprayer, electric sprayer, or rollers and brushes.

Utility Installations for Container Bldgs

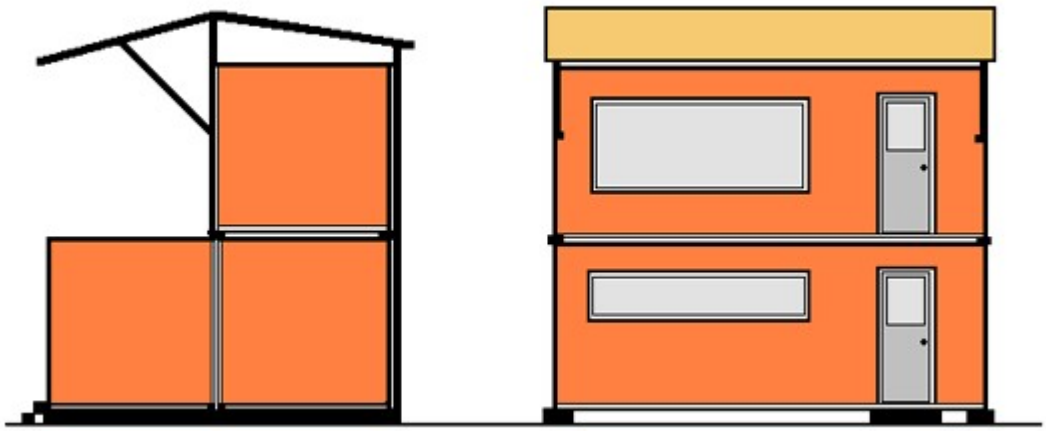




12 Intermodal Container Building Plans

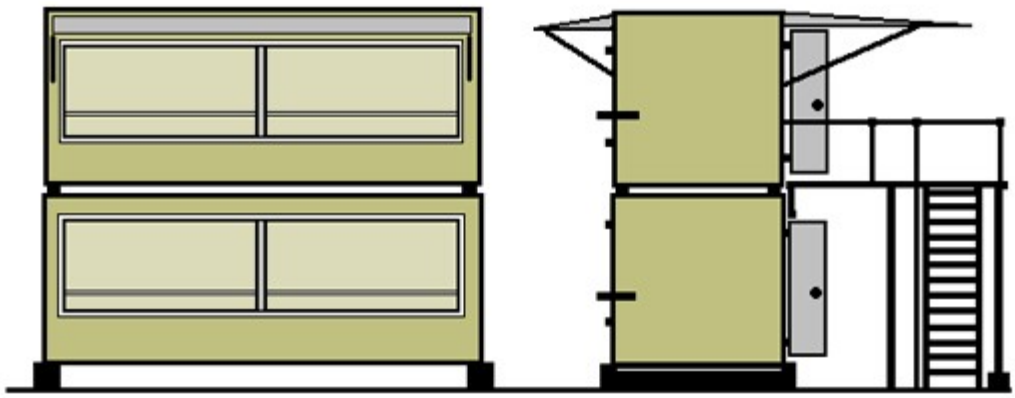
#1 Mini Triple

Three 20 ft containers. Smaller 20 foot variation of The Triple 40. Useful as a multi-level cabin, cottage, or guest house.



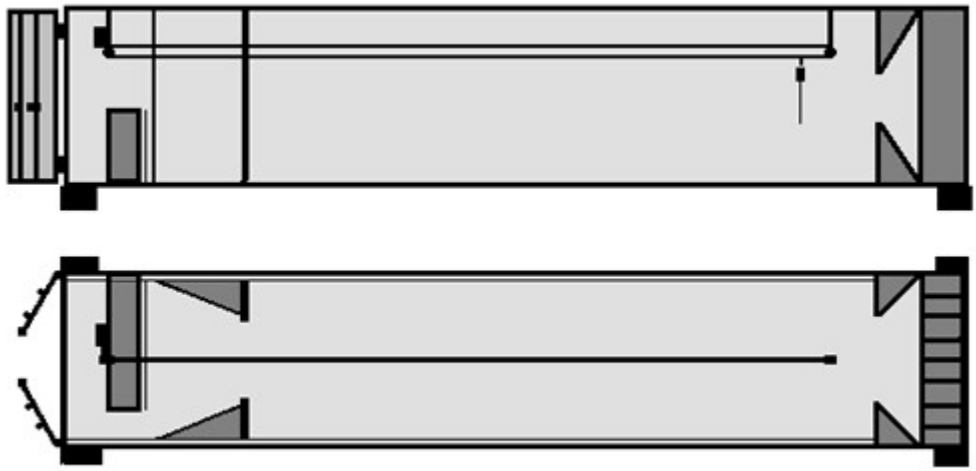
#2 Sports Building

Two 20 ft stacked containers. Could be used for sporting events, announcers booth, concessions stand, or equipment storage. Possible applications: high schools, skeet and trap clubs, dirt-bike, horse, or dog racing facilities.



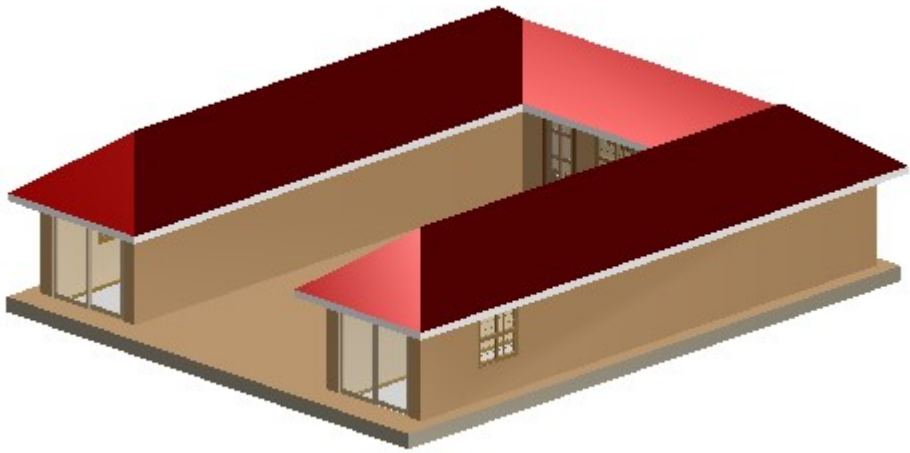
#3 Handgun Range

Fortified 40 ft container. Temporary low cost shooting range for police departments. Other possible configurations: ballistics testing lab, archery range, single lane bowling alley.



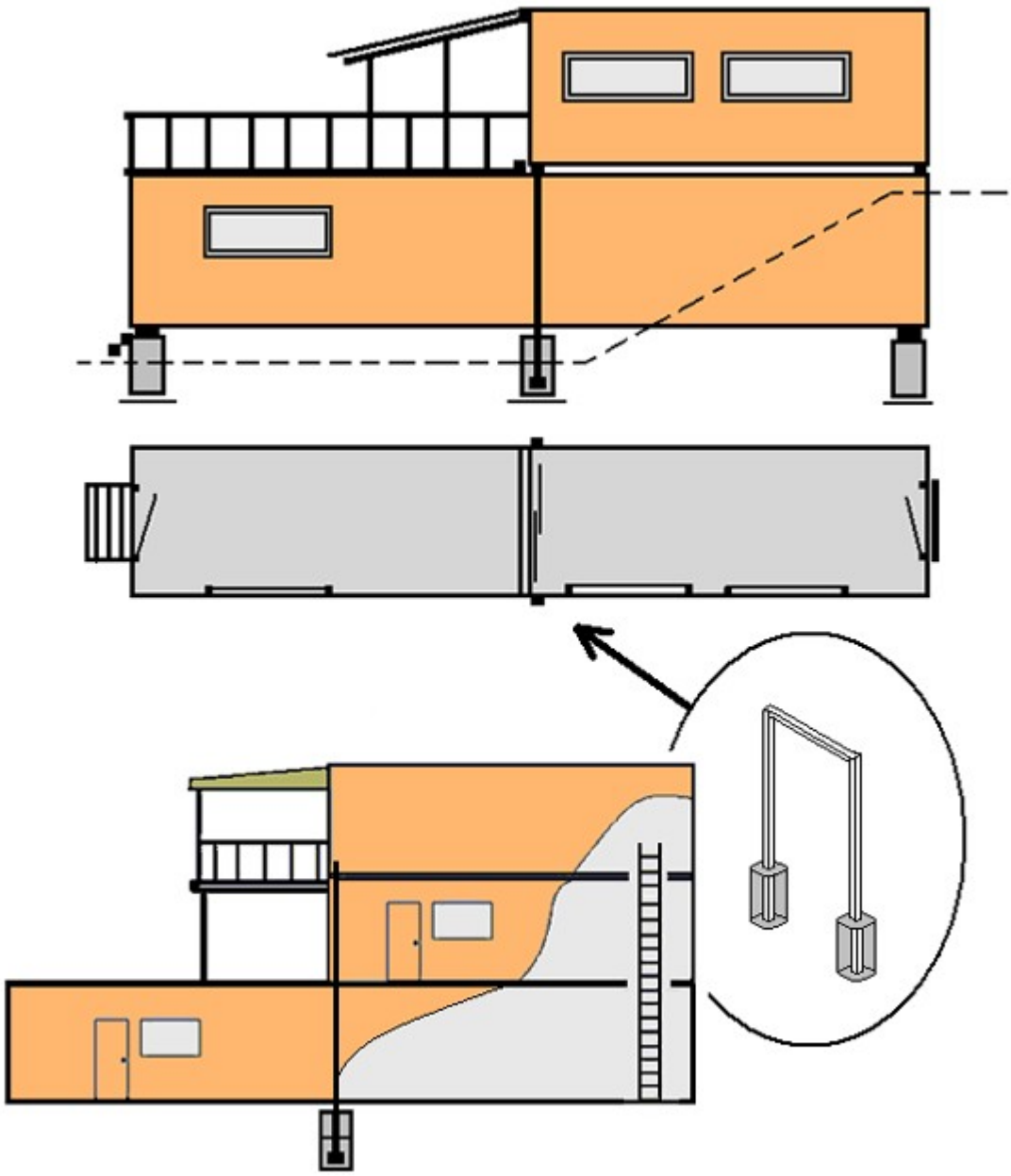
#4 Ranch House

Two 40 ft containers, and one 20 ft container. The single 20 ft unit is bridged across the end of two parallel 40 ft units to form a horseshoe shaped, three room building with a rafter built roof.



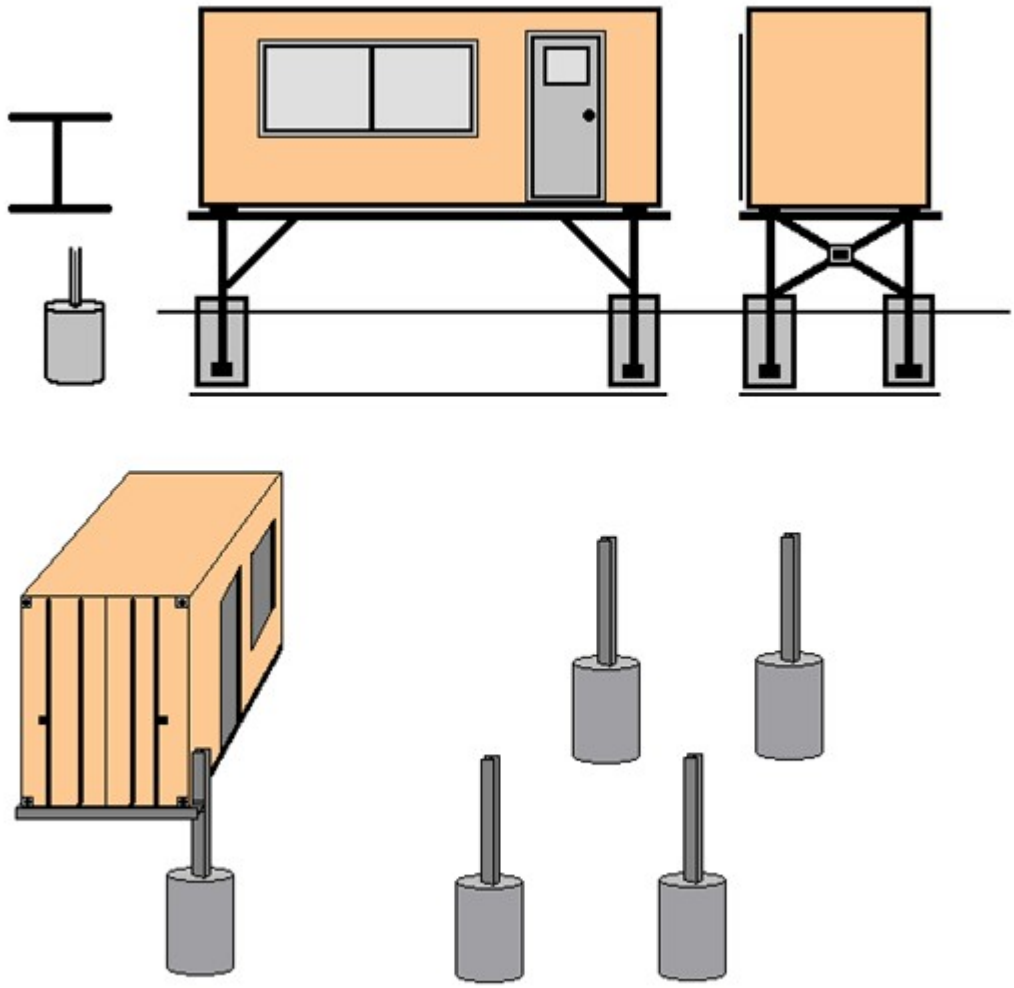
#5 Split Level

One 40 ft container, with an additional one, or two 20 ft containers stacked on top. Upper level 20 ft containers are braced at the midway point with a steel I-beam suspension system. This transfers the weight of the second, and optional third floors to the ground, bypassing the (non load bearing) center of the 40 ft base unit.



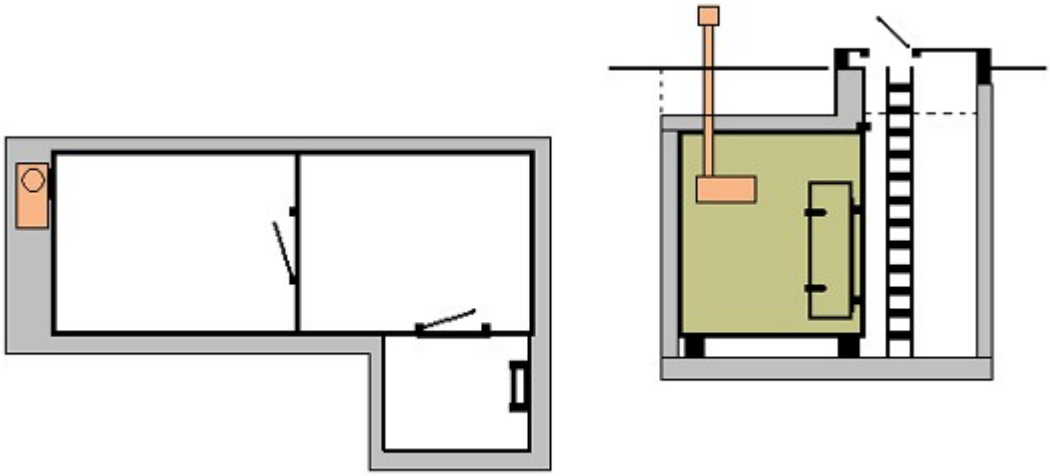
#6 Flood Proof

A single 20 ft x 8.5 ft container is attached to a steel I-beam framework foundation (container can be raised 6-12 ft above ground level using this system). May be useful in deep snow, flood or tsunami prone regions. Four vertical I-beams are sunk into underground (2 ft x 3 ft concrete) footings providing a high strength foundation for container mounting.



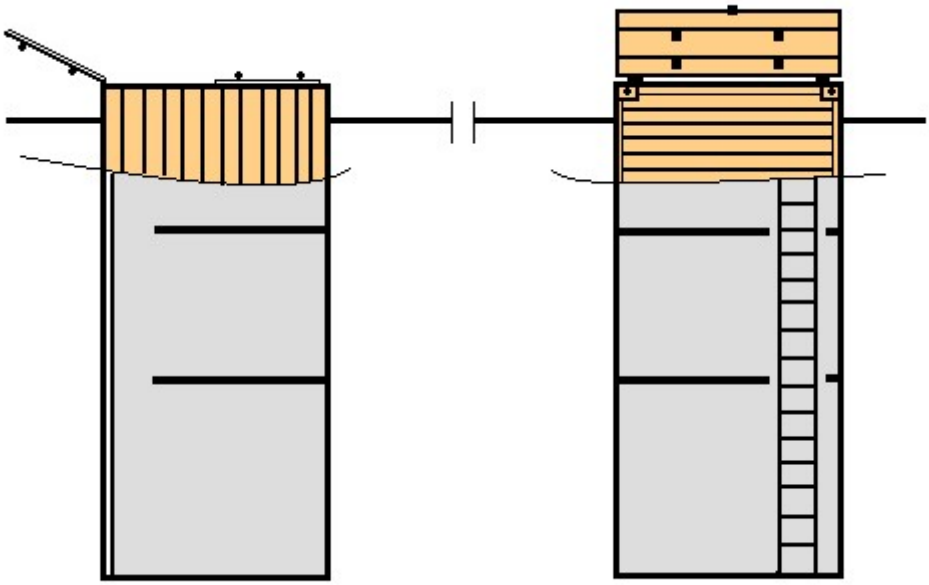
#7 Underground Shelter A

One 20 ft container painted with rubberized undercoating spray to prevent corrosion. A large excavator digs the hole, lowers the container in, then fills the remaining 1 ft wide gaps with gravel creating a drainage wall around the unit. Steel beam framework and 1/4" plate is used to create the entry space under ladder and hatch. Note vent tube on container. Loss of oxygen is a risk with this design if not properly constructed. Vents are required. Use at your own risk.



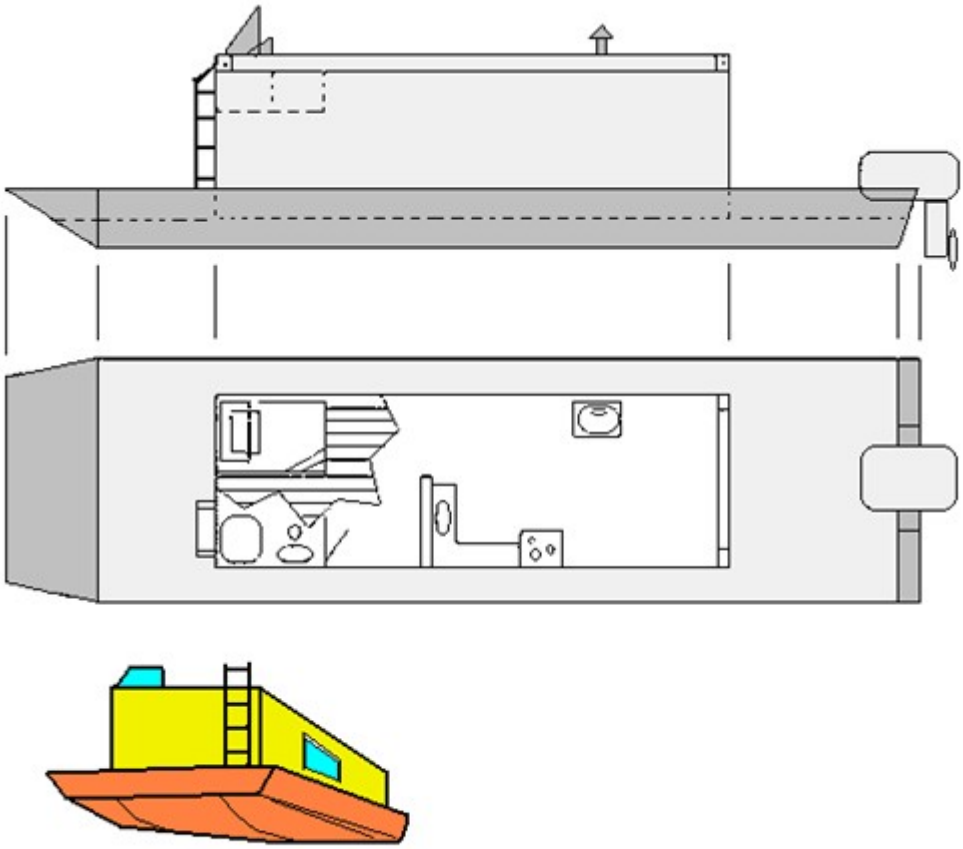
#8 Underground Shelter B

One 20 ft container painted with rubberized undercoating spray to prevent corrosion. A large excavator digs the hole, then lowers the container 3/4 of the way in. Open end and ISO doors remain exposed 2 ft above grade. Loss of oxygen is a risk with this design if not properly constructed. Vents are required. Use at your own risk.



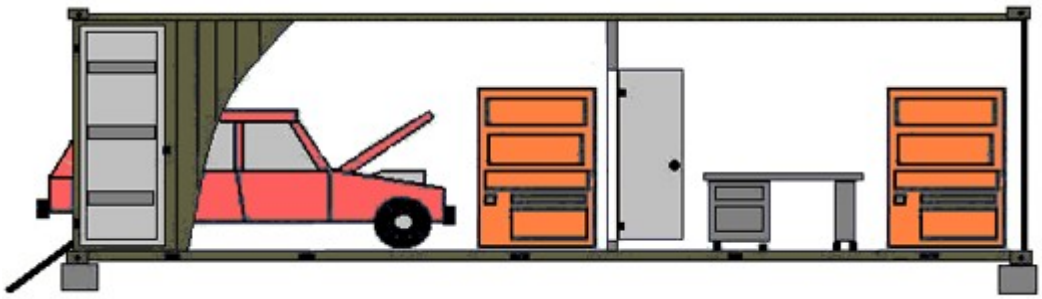
#9 House Boat

A 20 ft container is mounted (with ISO doors facing to the rear), onto a steel houseboat or small barge hull.



#10 Mechanics Strongbox

One 40 ft container with a bulkhead dividing wall. Useful as a small car or motorcycle repair facility offering a high level of security for expensive vehicles and tools.

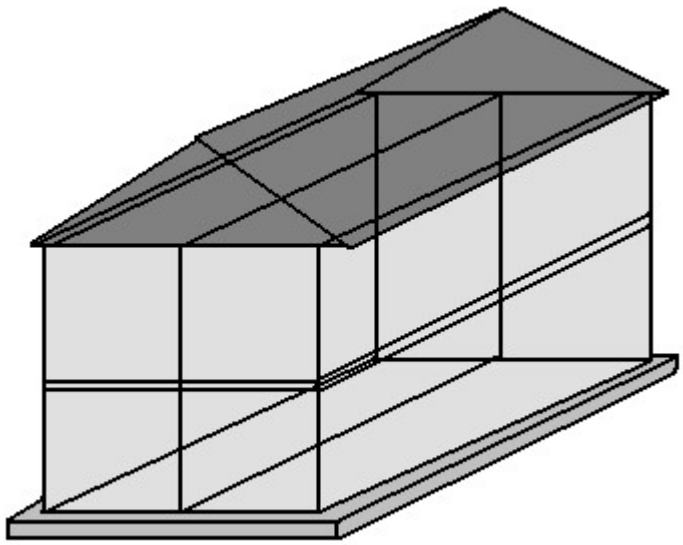


#11 Solar Cabin

One 20 ft container with art deco style metal roof and solar panels. Roof shades the container from hot sun, while simultaneously generating all required electrical power for the occupant. Use 12 volt deep cycle batteries connected to a DC-to-AC power inverter. Unit has steel shipping doors intact (these can be opened to provide a breeze and 'outside patio' feel). Another option is to replace cargo doors with a 6' glass patio slider, or install a glass patio slider behind the ISO doors for a dual-use door system.

#12 Cube

Four 20 ft containers joined, and stacked to form a cube. Building is set on concrete footings, and covered with a gable roof.



Photos

Carport made with two, twenty foot containers and bridged aluminum covering.

Twenty foot container used as office, and secure tool crib.

Pair of container boats sailing into the Port of Seattle.

Seattle bound container boat is dwarfed by 14,410 ft Mt. Rainier.

Forty foot container utility building with basic door addition.

Above: forty foot storage containers. Below: forty foot container en-route on a trailer.

TOP 25 U.S. CONTAINER PORTS 1998 - 2003

(Thousand of TEU'S)

Port	1998	1999	2000	2001	2002	2003
Los Angeles	2293	2552	3228	3428	4060	4664
Long Beach	2852	3048	3204	3195	3184	3091
New York City	1884	2027	2200	2355	2627	2803
Charleston	1035	1170	1246	1159	1197	1250
Savannah	558	624	720	813	1014	1124
Norfolk	793	829	850	885	982	1093
Oakland	902	915	989	963	979	1064
Houston	657	714	733	783	851	933
Tacoma	496	581	647	612	769	931
Seattle	976	962	960	824	850	815
Miami	602	618	684	717	752	764
Port Everglades	474	473	439	417	370	423
Baltimore	255	255	276	273	302	307
New Orleans	219	237	229	217	216	237
Portland	188	210	212	206	185	210
Gulfport MS	113	123	156	159	173	204
Wilmington DE	127	132	123	128	133	195
San Juan	137	141	152	150	159	185
West Palm Beach	121	128	130	119	142	140
Jacksonville	207	148	110	104	114	113
Philadelphia	115	89	83	83	115	103
Boston	68	79	74	64	80	93
Newport News	74	80	74	45	57	80
Chester PA	42	46	52	54	59	73
Wilmington NC	84	74	72	67	71	72

TOP 6 FOREIGN CONTAINER PORTS 2003 DATA

(Thousand of TEU'S)

#1 Ranked	#2 Ranked	#3 Ranked	#4 Ranked	#5 Ranked	#6 Ranked
China	Hong Kong	Japan	Taiwan	Korea	Germany
Volume	Volume	Volume	Volume	Volume	Volume
5656	1619	1603	946	898	650

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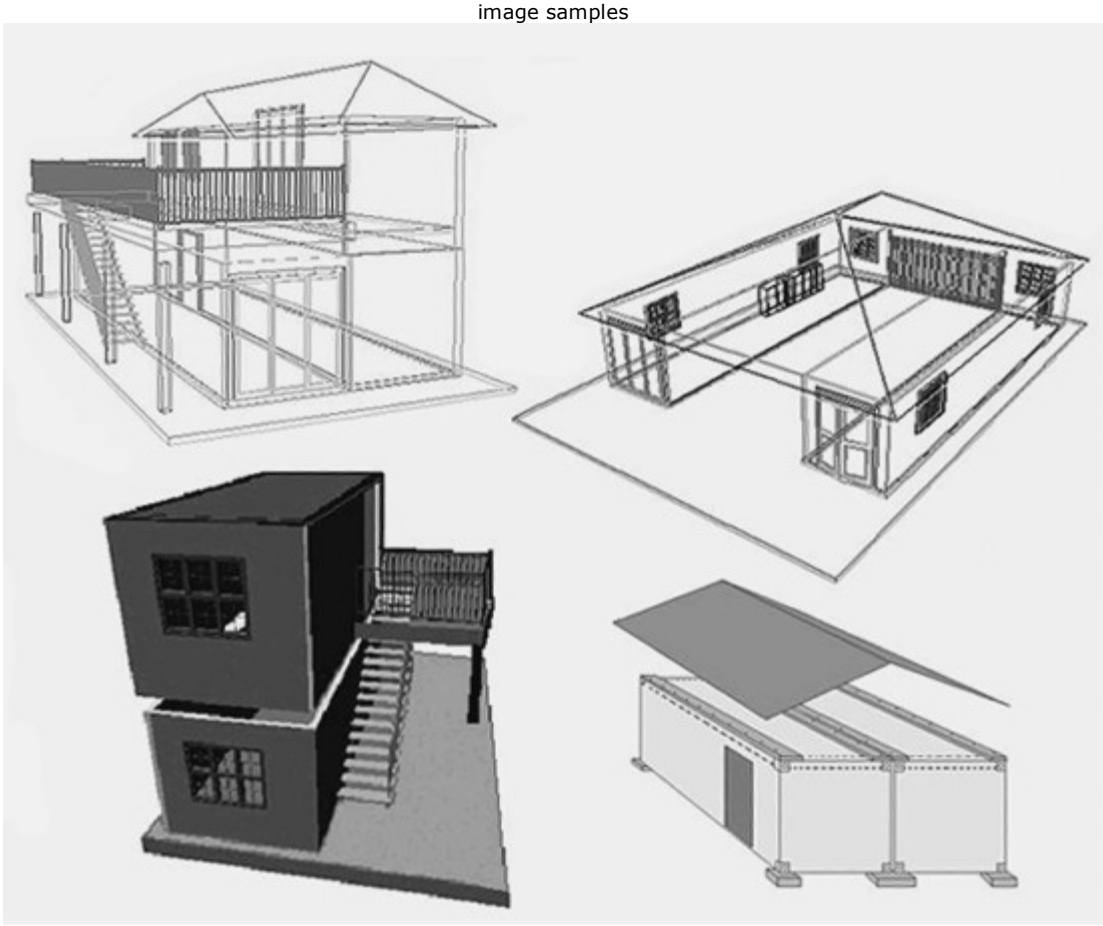
image samples



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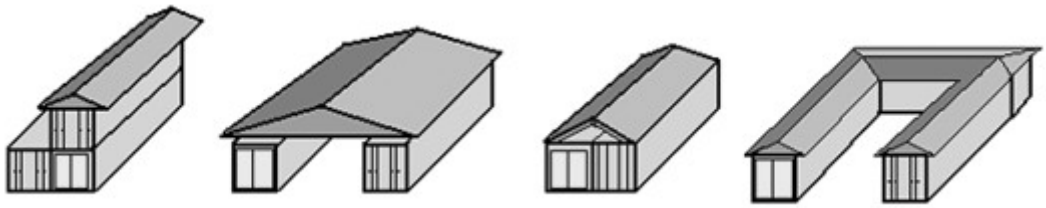

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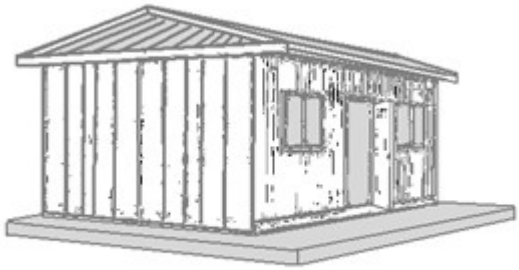

2 Wide 20 ft Gable Roof on Slab

Small utility or residential structures under 1000 sq ft can be costly to build. This book is designed for those of you who are searching for a way to cut this cost without sacrificing the strength or visual aesthetics of your structure. I recommend you the reader, consider using heavy duty welded steel boxes, (containers) as the building blocks of your new structure. The Intermodal Shipping Container, designed and manufactured to transport goods safely over the high seas, but also a low cost, easy to construct, and super strong building solution.

My first glimpse of shipping container buildings was during a late night cable TV viewing of the 1986 low budget science fiction movie *Space Rage: Breakout on Prison Planet*. This B movie featured an extensive set built entirely from 20, and 40 foot shipping containers. The movies plot was a wild-west space-age shoot-em-up, and utilized a futuristic old west town (saloon, general store, etc) all made out of containers. The Sheriff even lived in a 40 ft container house that was especially nice inside. The prison escapees ended up shooting it full of bullet holes in one scene...but I digress.

Seeing that movie many years ago was officially my first sighting of container buildings, but now I see them all the time. This is probably due to the non-stop growth of Intermodal container deployment, and the fact that container sales and delivery companies have sprung up coast to coast. So naturally you tend to see more containers used as buildings scattered across the countryside.

Budget conscious builders traditionally tend to use materials that appear in abundance. Over produced materials, or material that is considered excess stock, can usually be purchased at a discounted price. Often times, a used container is considered a nuisance by the seller, something just taking up space, and can be purchased for a few hundred dollars with the buyer providing pick-up via a 3rd party trucking company.

As you can see, I have developed an interest in gathering information and devising simple building plans for containers to be used as land based steel buildings. So much so that I wrote this book on the subject. My motives may of been somewhat selfish (I wanted to be the first container buildings author), but I feel the content is sound.

The plans and information contained here are geared towards the individual builder working on a budget. In a nutshell, this book will strive to provide the bulk of it's content in the following two areas: 1) plans for constructing three different super strong steel buildings under 1000 square feet in size, and 2) plans for foundations, roofs, framing, movement, and other universal aspects of container building that are interchangeable on these and other small scale container building projects.

Sample of **Intermodal Shipping Container Small Steel Buildings**
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Many North Americans are learning what ocean freight insiders, and port city dwellers have long known; cargo boxes make great low cost buildings. Paul Sawyers, author of 'Intermodal Shipping Container Small Steel Buildings', envisions people creating everything from fifth wheel covers to bomb shelters using these units. "The fact that so many folks are interested in these buildings really says a lot. People are on a tight budget these days, and some can't afford pre-fabricated steel buildings. Plus, lumber just keeps going up in price". With real estate being the hottest thing going now, it only stands to reason that all things real estate related, such as building materials, lumber, and labor, are skyrocketing in price.

Savvy do-it-yourselfers have found another alternative; used ocean cargo boxes. The general public can purchase these units used, and pay a trucking company to deliver them via roll-bed truck. The units are pre-built, and ten times stronger than factory made steel buildings (and usually ten times cheaper too). "It's not uncommon to see someone set up a 8' x 40' or 16' x 20' Intermodal Container building for under $1100. You also have to keep in mind that these boxes are designed to hold up in a really brutal environment...the high seas". So, just how strong are these containers? You may be surprised to hear that one single twenty foot unit, can support ten similar units stacked on top of it.

The author says the most difficult task in setting up a shipping container steel building is probably building the concrete footings for a foundation. "But you really don't even need a foundation. It's completely optional. Some people just lay down some pressure treated 2x8's." Is taking delivery is ever a problem? "Sometimes, if the delivery truck is not able to reach semi-isolated acreage, you will have to move the unit into place yourself. This sounds difficult, but using steel pipes or logs and a truck, they tow pretty good. Once in place, you have an instant weather proof steel building". Minimal amounts of extra building materials (optional; for interior framing, insulation, paneling, windows, etc) can be used to fit-out your container building.

So who builds shipping container structures? Farmers and rural folks mostly, but one of largest emerging groups of builders are classic car and motorcycle re-builders. "These guys usually own about $20,000 worth of tools, and have a few vehicles that can't be replaced. They want a good theft and vandal proof building. Even in a twenty foot unit with two big street bikes, you still have room for a shop area near the front doors". Containers are made from fourteen gauge corrugated steel on the sides, belly, and roof, with seven gauge tubular steel frames on each of the four corners, plus one and a half inch thick marine grade plywood over welded load bearing beams for the interior flooring.

If you are considering the idea of buying a used shipping container, keep in mind that the price you pay will vary greatly depending on the source and condition of the unit. You can find deals if you look around. New and used containers are available nationwide. "A realistic cost per unit ranges from $500 and up, depending on size, condition, and source. You can often find containers with 2-3 years of travel on them, being liquidated at bargain prices to make room for new models. Check your local classified ad papers, or do an internet search for shipping containers near your city. You probably drive by a trucking company with containers for sale everyday and don't even realize it". Port city dwellers have a distinct advantage over people located far inland. Never the less, Intermodal units have become so prevalent in recent years, they are beginning to turn up in Wyoming, Indiana, and other places nowhere near either coast.

These buildings are as unique as the people that build them, no two ever look the same, but cost savings and high strength is inherent in all Intermodal Container structures. If you really need a steel building, but lack the funds for a new pre-fab affair, Intermodal Container Buildings might be right up your alley.