cargo-containers

a documentation

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sept.2005

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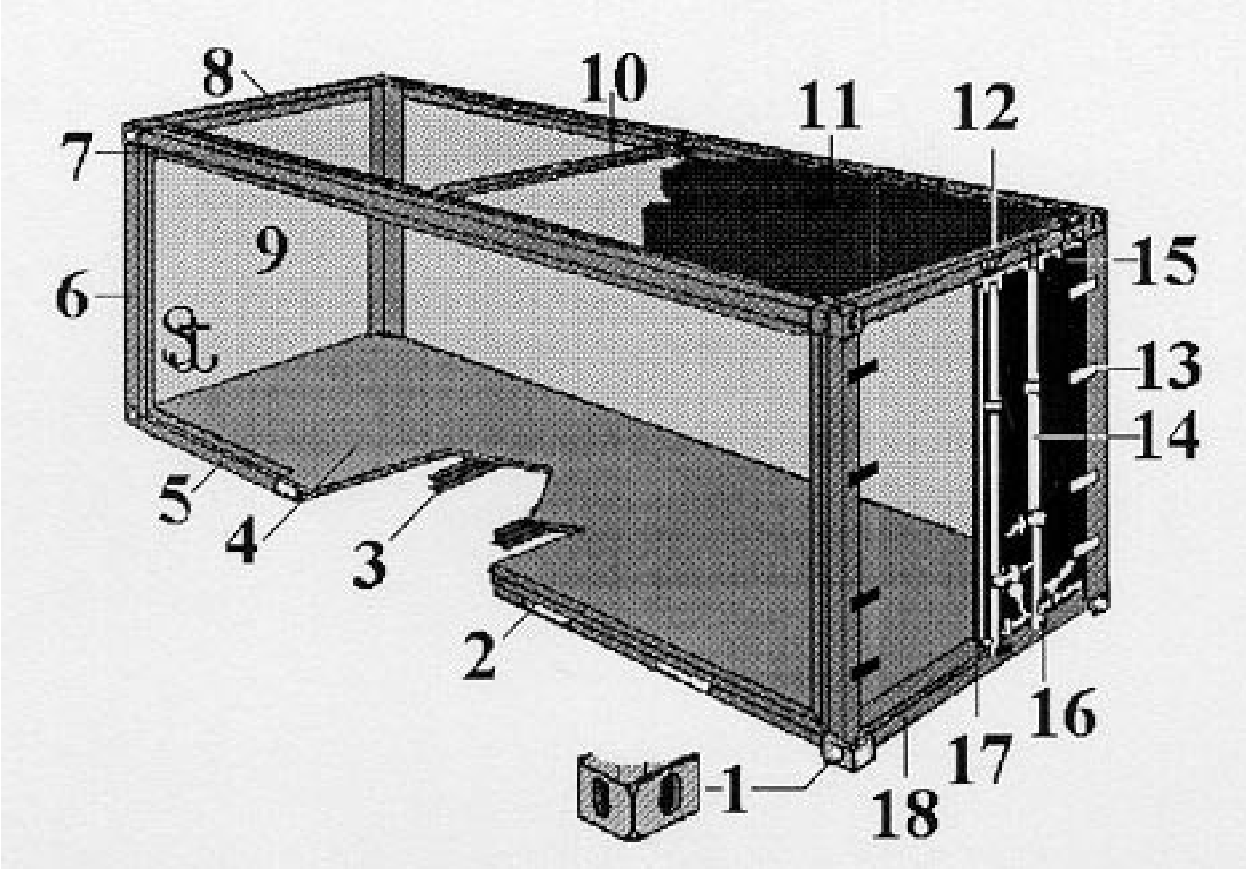
Introduction

There is growing interest in the use of shipping containers as the basis for habitable structures. These "icons of globalization" are relatively inexpensive, structurally sound and in abundant supply. Although, in raw form, containers are dark windowless boxes (which might place them at odds with some of the tenets of modernist design...) they can be highly customizable modular elements of a larger structure.

My design proposal is based on transportable and mobile dwelling-units. Containers seemed to be the ultimate answer to what type of unit was needed for multiple reasons, some of them mentioned above. This documentation can be of use for those thinking of designing with containers.

Even though container modification-examples are abundant, just 3 are chosen here to give an idea of the range and variety. First the spacebox, designed by 'De Vijf' and 'Holland Composites'. Secondly the architecturefirm LO-TEK. These two examples show the manipulation of a sinlge container-box and the different spatial and conceptual possibiliites.
Bluebase.MAS responds to issues raised by contemporary cities such as London, where our increasingly transient lifestyles are resulting in more work related communities in which living closer to the workplace and being able to move quickly a predominant factor in our choice of the home. This shift in emphasis will fundamentally change the way we view our cities.

standard container



1	-	Corner casting
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3	-	Bottom cross member
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5	-	Bottom side rail
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Standard containers are also known as general purpose containers. They are closed containers, i.e. they are closed on all sides. A distinction may be drawn between the following types of standard container:

- Standard containers with doors at one or both end(s)
- Standard containers with doors at one or both end(s) and doors over the entire length of one or both sides
- Standard containers with doors at one or both end(s) and doors on one or both sides

In addition, the various types of standard container also differ in dimensions and weight, resulting in a wide range of standard containers.

Standard containers are mainly used as 20' and 40' containers. Containers with smaller dimensions are very seldom used. Indeed, the trend is towards even longer dimensions, e.g. 45'. The principal components of a standard container are shown above in diagram of a 20' plywood container .

Frame and bottom cross members are made of steel profiles, while three different materials are used for the walls:

1. Steel sheet, corrugated

Characteristics:

low material costs
easy to repair
high tare weight
susceptible to corrosion
difficult to clean owing to corrugated walls

2. Aluminum sheet in conjunction with stiffening profiles

Characteristics:

low tare weight
high material costs
easily deformed, very quickly dented

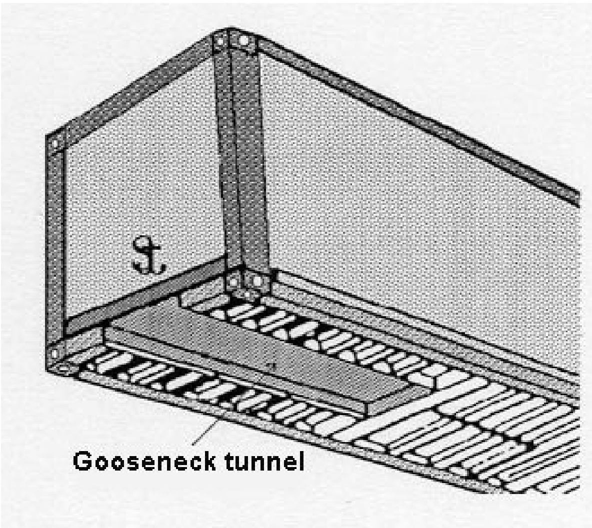
3. Plywood with glass fiber-reinforced plastic coating (plywood + GRP)

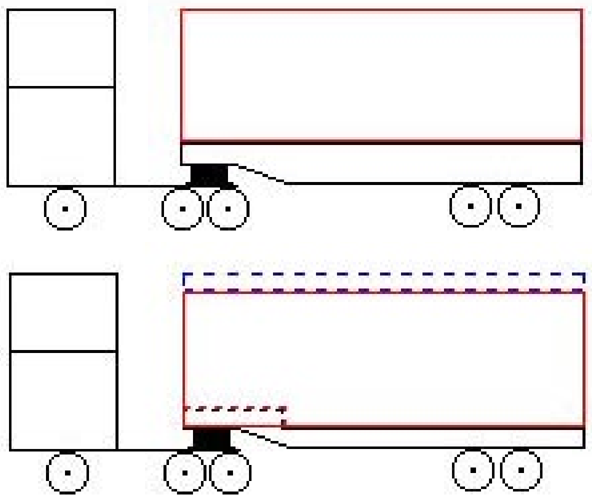
Characteristics:

easy to clean owing to smooth surfaces
easy to repair
strong and resilient, does not dent
moderate material costs
moderate tare weight

The cost advantages have led to the predominant use of steel for container walls. The floor is generally made of wood, usually planking or plywood. Although wood is relatively expensive, it has substantial advantages over other materials: it is strong and resilient, does not dent, may be easily replaced during repairs and, when appropriately finished, has an adequate coefficient of friction, which is important for cargo securing.

Forklift pockets
these allow handling of empty containers with forklift trucks. Packed containers must not be picked up in this way unless specifically permitted. Forklift pockets are installed only in 20' containers and are arranged parallel to the center of the container in the bottom side rails. 40' containers do not have forklift pockets, since the pockets are relatively close together and such large containers would be difficult to balance. In addition, the forklift truck travel paths are often not wide enough.

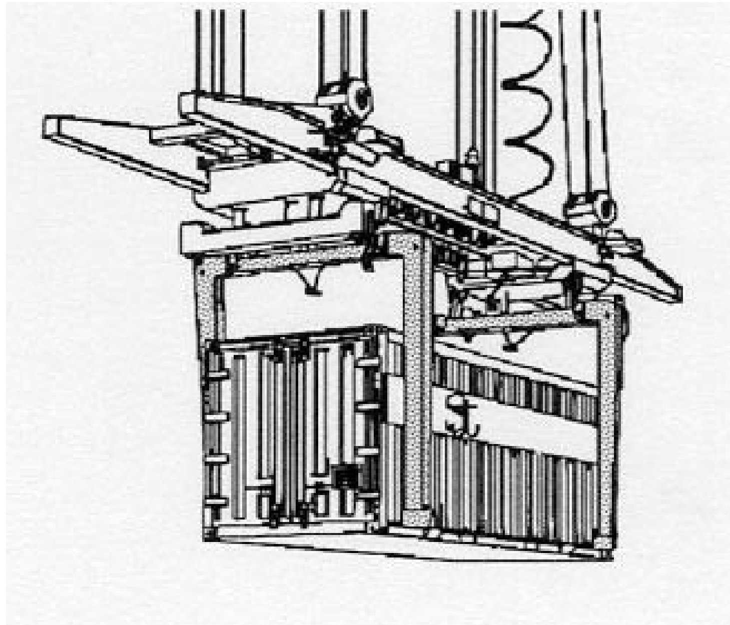




Gooseneck tunnel
Many 40' containers have a recess in the floor at the front end which serves to center the containers on so-called gooseneck chassis. These recesses allow the containers to lie lower and therefore to be of taller construction.Gooseneck tunnel in standard container.

The left figure shows the recess in the floor of the container into which the gooseneck of the chassis is fitted [source: Capt. Winfried Strauch, Hude].

The right figures show the gooseneck tunnel in standard container. As a result of the recess in the floor of the container (above), the latter lies lower than does a container without gooseneck tunnel (below), so allowing the transport of containers up to 9'6" in height.



Grappler pockets
In general, containers are handled by top spreaders using the corner fittings or corner castings. However, some containers have grappler pockets for handling by means of grapplers.

Above show grappler pockets on standard container: these allow handling of the container using "grapplers" [source: Capt. Winfried Strauch, Hude].

transporting special cargoes

Clothes rails for hanging garments
Special lashing rings attached to the top side rail serve to accommodate clothes rails on which textiles may be transported hanging on clothes-hangers. These are often used in the East Asia import trade. Additional lashing rings are installed on the bottom side rail and the corner posts.

Inlet (bulk bag or liquid bulk bag)
Plastic liners may be suspended in standard containers for transporting bulk cargo or nonhazardous liquids.

20 foot standard container

Interior	
Width:	2352 mm
Height:	2395 mm
Length:	5898 mm
Exterior	
Width:	2440 mm
Height:	2600 mm
Length:	6058 mm
Cubic Volume:	33.2 cubic m
Door Width:	2340 mm
Door Height:	2280 mm
Tare Weight:	2200 kg

40 foot standard container

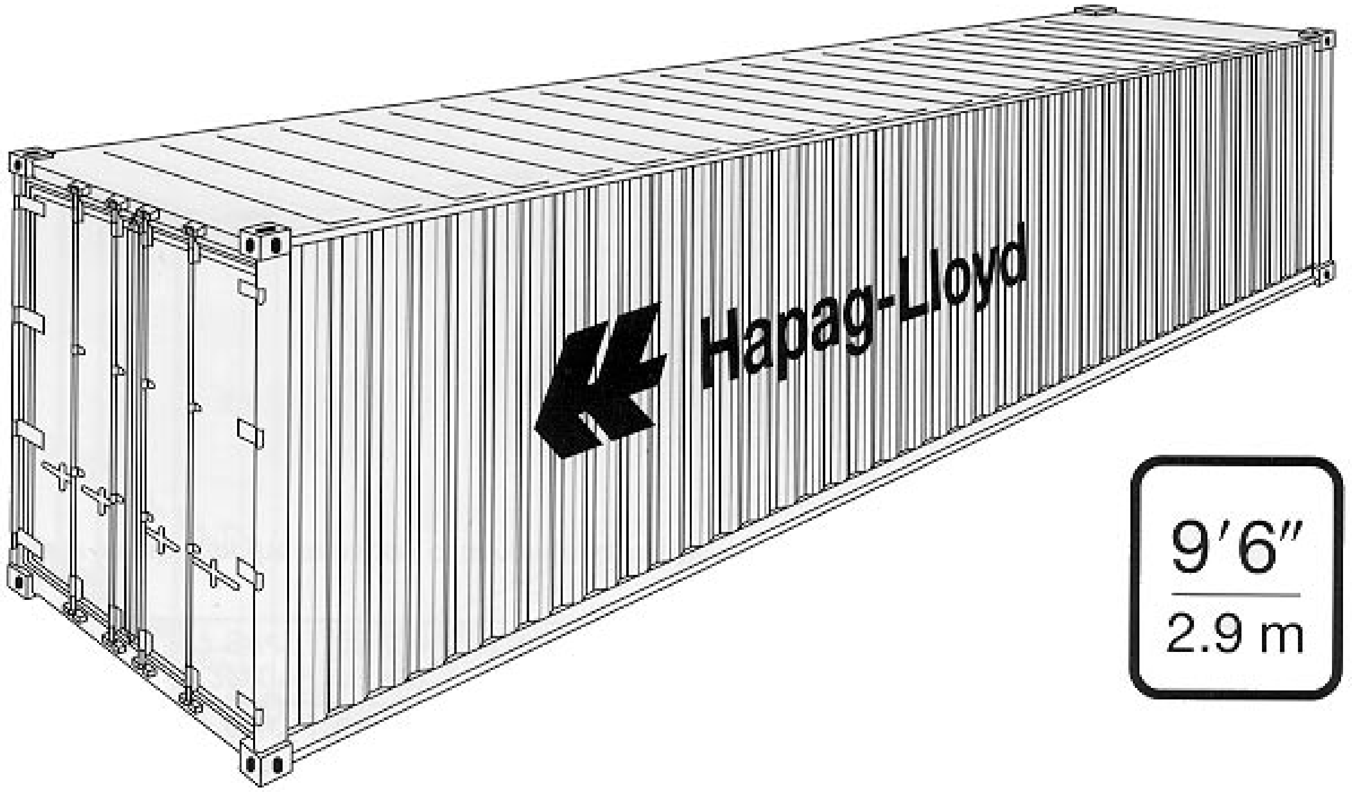
Interior	
Width:	2352 mm
Height:	2395 mm
Length:	12032 mm
Exterior	
Width:	2440 mm
Height:	2600 mm
Length:	12200 mm
Cubic Volume:	67.6 cubic m
Door Width:	2340 mm
Door Height:	2280 mm
Tare Weight:	3730 kg

high-cube containers

High-cube containers are similar in structure to standard containers, but taller. In contrast to standard containers, which have a maximum height of 2591 mm (8'6"), high-cube containers are 2896 mm, or 9'6", tall. High-cube containers are for the most part 40' long, but are sometimes made as 45' containers.

A number of lashing rings, capable of bearing loads of at most 1000 kg, are mounted on the front top end rail and bottom cross member and the corner posts.

Many 40' containers have a recess in the floor at the front end which serves to center the containers on so-called gooseneck chassis. These recesses allow the containers to lie lower and therefore to be of taller construction.



High-cube container of steel: 40' long and 9'6" high with corrugated walls and wooden floor

Interior

Width:	2350 mm
Height:	2697 mm
Length:	12024 mm
Cubic Volume:	76.3 cubic m
Door Width:	2340 mm
Door Height:	2597 mm

hard-top containers

The walls of hard-top containers are generally made of corrugated steel. The floor is made of wood.

It has two typical distinguishing structural features. On the one hand, it is equipped with a removable steel roof. In some types, this roof has points for accommodating forklift trucks, allowing the roof to be lifted by forklift truck. The roof weighs approx. 450 kg. In addition, the door header may be swivelled out.

These two structural features greatly simplify the process of packing and unpacking the container. In particular, it is very easy to pack and unpack the container from above or through the doors by crane or crab when the roof is open and the door header is swivelled out.

In the case of transport of an overheight cargo, the container roof may be left open and fastened directly to a side wall on the inside of the container. To do this, the roof only needs approx. 13 cm (5 1/8") of space.

Lashing rings, to which the cargo may be secured, are installed in the upper and lower side rails, the corner posts and the middle of the side walls. The lashing rings on the side rails and corner posts may take loads of up to 2000 kg. The lashing rings in the middle of the side walls may take loads of up to 500 kg, provided that the roof is closed.

Usual hard-top container dimensions are 20' and 40'.

Flatrack containers

Flatracks consist of a floor structure with a high loading capacity composed of a steel frame and a softwood floor and two end walls, which may either be fixed or collapsible. The end walls are stable enough to allow cargo securing means to be attached and several flatracks to be stacked on top of one another. Flatracks are available in 20' and 40' sizes.

A number of lashing rings, to which the cargo may be secured, are installed in the side rails, the corner posts and the floor. The lashing rings may take loads of up to 2000 kg in the case of 20' flatracks or up to 4000 kg in the case of 40' flatracks.

Some types of 20' flatracks have forklift pockets.

40' flatracks have gooseneck tunnels at each end. In addition, they are sometimes equipped with lashing winches with 2 metric ton lashing belts.

For transport of certain cargoes, flatracks may be provided with stanchions.

Flatrack:
steel frame with fixed end walls and softwood floor, 20' long and 8'6" high

internal dimensions:

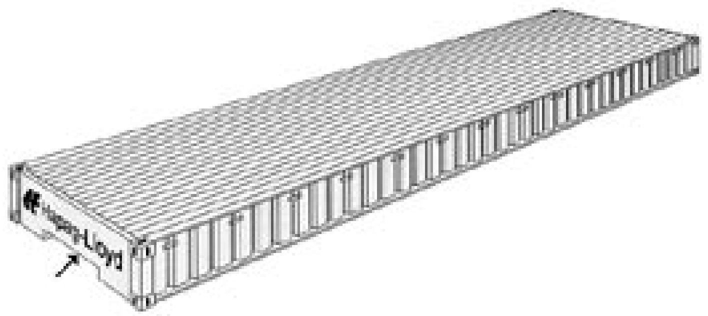
floor length	5980
length between corner posts	5698
floor width	2230
widht between stanchions	2245
height	2250
height of floor	336
max. gross weight	24000
tare weight	2500
max payload	21500

platforms

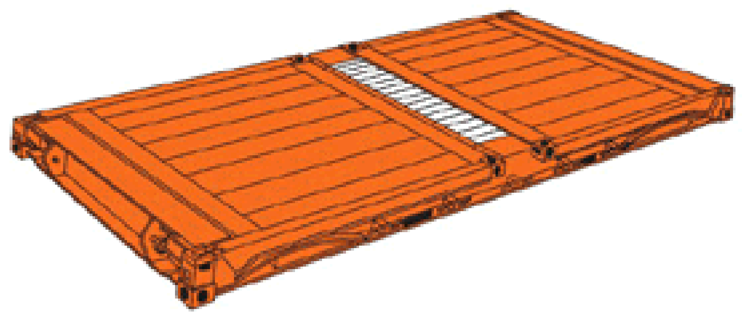
Platforms consist solely of a floor structure with extremely high loading capacity; they have no side or end walls. This high loading capacity makes it possible to concentrate heavy weights on small areas. A platform consists of a steel frame and a wooden floor structure.

Platforms are available in 20' and 40' sizes. 40' platforms have a gooseneck tunnel at each end.

Lashing rings, to which the cargo may be secured, are installed in the side rails. The lashing rings may take loads of up to 3.000 kg.



40' platform: floor structure with high loading capacity. The arrow shows the position of the gooseneck tunnel. (Hapag Lloyd AG, Hamburg)



20' platform, converted from a 20' flatrack with folding, removable end walls. (Hapag Lloyd AG, Hamburg)

Platform: steel frame with softwood floor, 20' long and 1' 1 1/4" high

dimensions:

length	6058
width	2438
floor height	370
max. gross weight	30480
tare weight	2520
max payload	27960

transport of containers

Lift/Stacking

Containers have fittings on top and bottom which assist in their handling and which enable them to be stacked-as much as eight high in terminals and on some ships.

These fittings consist primarily of oval-shaped holes at the lift points. For transport or storage, containers are stacked and connected to each other with IBCs-inter-box connectors. These are pieces of hardware which fit into the oval holes of the container above and below and which are then turned to lock the two together.

Some containers can also be handled by oversized forklifts. However, this is generally discouraged because this is more likely to result in damage to the container.

movement by highway

Highway movement of containers takes place on chassis.

A chassis is a framework equipped with wheels, which, when loaded with a container, results in something very similar to a normal highway trailer.

Chassis are often adjustable--via a telescoping (sliding) center beam which can be locked in multiple positions. So, one type of chassis may be used for both 20 and 28 ft containers; another may be used for any containers between 40 and 48 ft. Adjustable chassis are often called “sliders” by people in the intermodal business.

Chassis have reporting marks that end in Z, just as intermodal trailers that are approved for intermodal loading.

In some cases, containers may make part of their rail movement already loaded on a chassis, just like an intermodal trailer. This may be due to the type of handling facilities available at the loading or unloading point of the rail leg, the availability of chassis at that location, or other factors.

Intermodal operations often move chassis between one terminal and another within a flat rack (see description under container types above). A flat rack can hold up to four collapsed chassis.

Movement by Rail

Containers of the types described above can be moved by rail by virtually all standard-gauge and broad-gauge systems in the world. Some narrow-gauge (less than 4 ft 8.5 in) lines can also handle containers.

Railcars used for this type of service include both purpose-built cars designed to handle only containers or multi-purpose cars which can also carry highway trailers or other equipment.

Because of differences in loading gauges and operating practices, the equipment used to move containers in North America and Europe is quite different.

Only some North American routes have sufficient clearances to handle stacked containers-one on top of another-in well cars. These cars are called well cars because the center into which the bottom container(s) fit(s) is below the top of the wheels.

Some routes can handle two standard (8 ft 6 in) containers on top of each other; other routes can handle two high cube containers (9 ft 6 in) containers. Routes which meet AAR plate H specifications allow for loaded cars with a maximum height of 20 ft 2 in above the top of the rail.

When different-sized containers are double-stacked on railcars, the smaller container usually goes on the bottom-typically just fitting the well area, while the larger (but lighter) container on top has some overhang.

When a 40/45/48 ft container is combined with two 20 ft containers, the 20s always go on the bottom for two reasons:

* The already mentioned fact that the smaller containers will be heavier and will provide a lower center of gravity, and
* The fact that it would not be possible to secure or support the smaller containers on top.

The big containers (40/45/48/53/56 ft) have connecting points 40 ft apart (20 ft from the center of the container); you could only connect one end of each of the 20 ft containers. On the other hand, with the two 20s in the well, the well itself keeps the 20s from shifting from side to side. And, both ends of the larger container can be securely connected and supported-one on each end of one of the 20s.

Various combination of the 40 ft or longer containers can be stacked on top of each other in any order as all of these have the connecting points 40 ft apart and can therefore be locked together. The size of the well is obviously a factor, but two other factors are also likely to be considered:

* Putting the heavier container on the bottom for a lower center of gravity
* Putting the container that needs to be removed from the train first on top

A “Land Bridge” train is one that carries through containers between North American east and west coast ports. For example, an ocean carrier may move container traffic between Asia and Europe in three legs-(1) Container ship Asia to U.S. west coast port; (2) land bridge train to east coast; (3) container ship from east coast to Europe-rather than face vessel size restrictions of the Panama Canal. Modern super container ships do not fit through the canal.

Movement by Vessel (Ship or Barge)

The use of large container ships capable of carrying large numbers of containers and being loaded and unloaded quickly at special container ports has drastically changed the movement of ocean cargo over a relatively short time.

Though most container traffic is on the super container ships between major ports, even most smaller vessels now have provisions for carrying some containers on deck.

On the larger container vessels, the containers you see above deck are only part of the load. A large number of containers are also carried below deck. The container cranes used in major ports to quickly load and unload containers are also capable of lifting off the deck plates of these ships for access to containers below decks.

When stacked on ships, containers are not only locked together with IBCs but also braced with heavy cables, usually in an X-pattern.

Nevertheless, it is not unheard of for a container ship to lose one or more containers overboard in a very severe storm.

Not all container ships are equipped to carry all sizes of containers. Super container ships are typically capable of carrying at least 48/45/40/20 ft containers. Smaller container ships, particularly ones which also carry non-containerized cargo, sometimes may only be able to handle the more common 40 and 20 ft units.

Container capacities of ships are given in TEUs or FEUs. These stand for twenty-foot equivalent units and forty-foot equivalent units. In other words, the TEU number is the total number of 20 ft containers of the standard height the ship is theoretically capable of carrying, though not all parts of the ship may actually be set up for holding 20 ft containers.

Due to so-called vessel-sharing agreements, where carriers pool equipment on a given route, you may find containers of one carrier aboard the vessel of another. Also, in cases where no single carrier serves the entire route of a container’s travel, a container may also be interchanged from one ocean carrier to another.

Containers are also often carried inland on barges on navigable rivers.

Transfer of Containers (Terminals)

One of the clever aspects of the container standards is that the required lift and connection fittings allow containers to be handled by both very sophisticated container handling equipment and by very simple equipment. In essence, as long as you have a crane capable of lifting the weight of the loaded container, you can handle the container. In this case, cables with hooks are attached to the four top lift points, coming together at the main hook of the crane. Usually one or more lines are attached to the lower connection points to keep the container from twisting and to manually maneuver it into place at its new location.

This technique is still used at smaller third-world ports where labor is more readily available than complex equipment or when ship-board cranes of smaller vessels have to be used to load and unload containers at smaller ports.

Some mid-range container ships have their own loading and unloading equipment that functions similar to dock-side container cranes. These ships have lifting equipment that runs on overhead rails that extend far enough out over the sides of the ship to be able to lift the containers on and off the dock. This type of equipment is expensive to maintain, however, because, being located atop the ship, the equipment is exposed to the elements while the ship is at sea.

So, most ship to shore transfer of containers involving large container ships and large ports is done with large land-based container cranes.

These cranes lock onto the containers with a piece called a spreader. The reason it’s called that is that it can adjust to different lift-point spreads.

These cranes allow very precise placement of containers and can usually also verify the actual weight of each container as it is being lifted (via equipment in the spreader-with this data being sent back through one of the control cables attached to the spreader).

Containers are normally not transferred directly from a ship to a railcar, though there are some exceptions. The reason for this is that the most logical sequence for unloading a container ship (which has to remain in balance!) may not match with the most logical sequence for loading a double-stack train. Additionally, containers from one ship may go on different trains to different destinations.

Similarly, trains reaching a port may carry containers destined for different locations-which are served by different ships, or which, at the very least, need to be loaded on a ship in a very specific sequence.

So, there is usually a rail intermodal terminal close to the actual dock, with transfers being made on a road chassis. Containers may be stored in transit on the chassis or stacked several-high.

The equipment at a port-adjacent intermodal rail facility is much the same as at inland intermodal facilities where containers and trailers are moved on and off intermodal trains. The equipment falls into two general categories-straddle cranes which span one or more tracks and paved areas for chassis placement and side-loaders. Straddle cranes may operate on fixed rails or with large rubber tires.

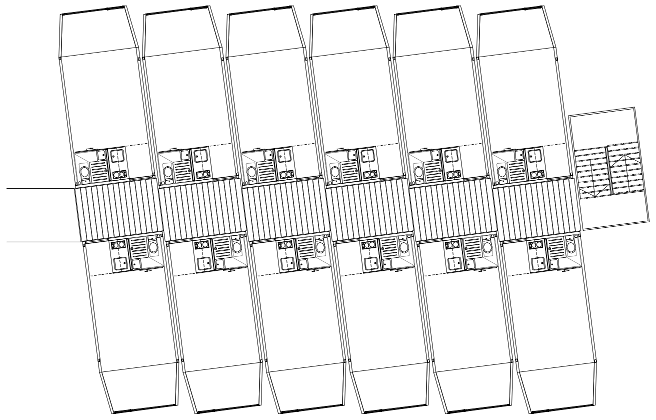
Smaller intermodal facilities often have only side-loaders because straddle cranes are very expensive and require a lot of operating space. Side loaders resemble oversized fork-lifts, but are normally equipped with spreaders, so that the containers are actually picked up by their top lift points. They have telescoping columns so that they can stack containers three or four high for intermediate storage.

3 project examples

spaceboxes

Architecture office 'De Vijf'
Holland Composites

DUWO
Holland Composites Industrials BV
www.spacebox.nl



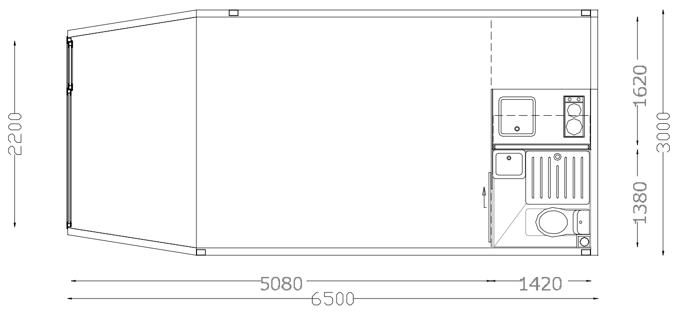
bovenaanzicht woonblok

Spacebox concept:

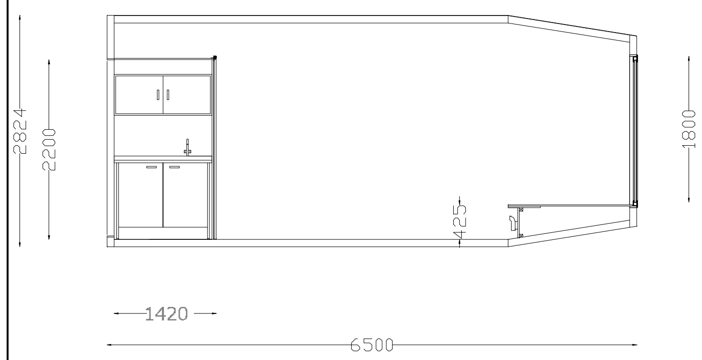
- Eenvoudig (de)monteerbare units
- Plaatsing op frames en stelcon platen
- Koppelbaar en stapelbaar (tot 3 woonlagen)
- Bovengronds leidingwerk
- Prefab trappenhuizen en bordeselementen
- Verschillende kleurstellingen
- Voldoet aan bouwbesluit en brandeisen
- Variatie in opstelling, afmetingen, indeling, uitvoering en kleur mogelijk (in overleg)

Basisunit:

Bruto vloeroppervlak:	17 m2
Inwendig volume:	42 m3
Totaal leeggewicht:	ca.2500kg
Voorzieningen:	Keukenblok met spoelbak en elektrische kookplaat Sanitair met douche, toilet en wastafel Boiler (30 liter) Elektrische verwarming Mechanische ventilatie
Prijsindicatie:	€16.500,- per box turn-key opgeleverd (prijs is exclusief btw en afhankelijk van aantallen en uitvoering)



plattegrond



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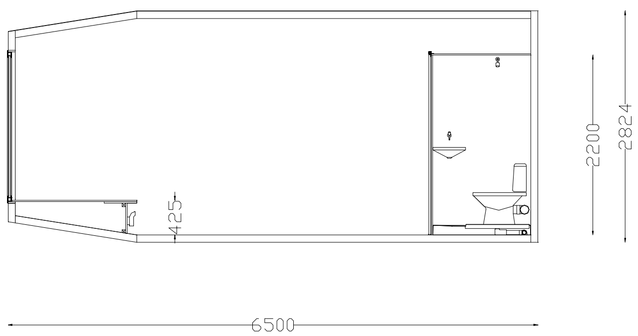

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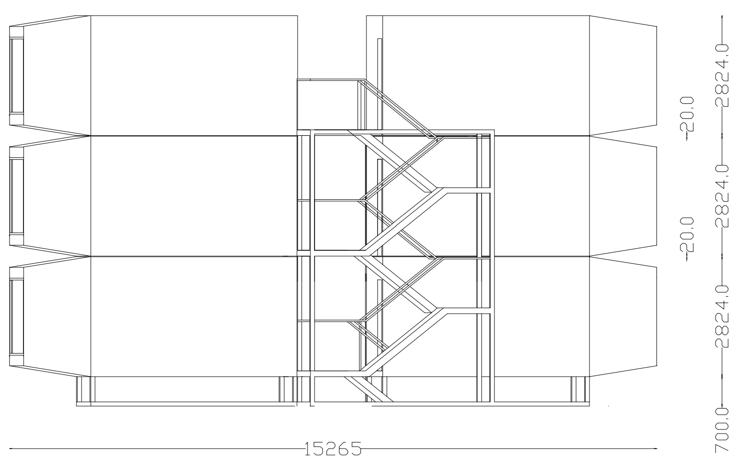
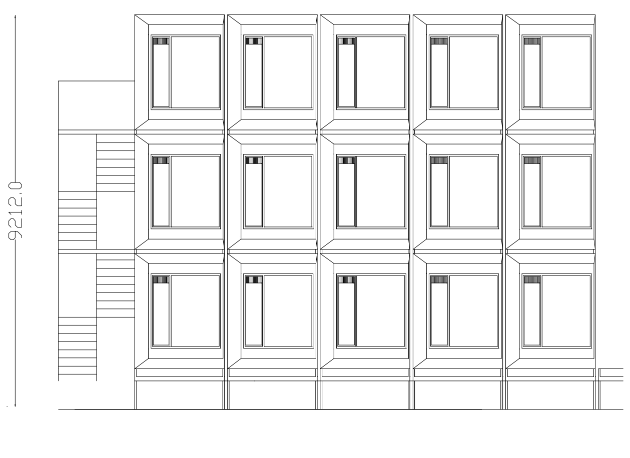
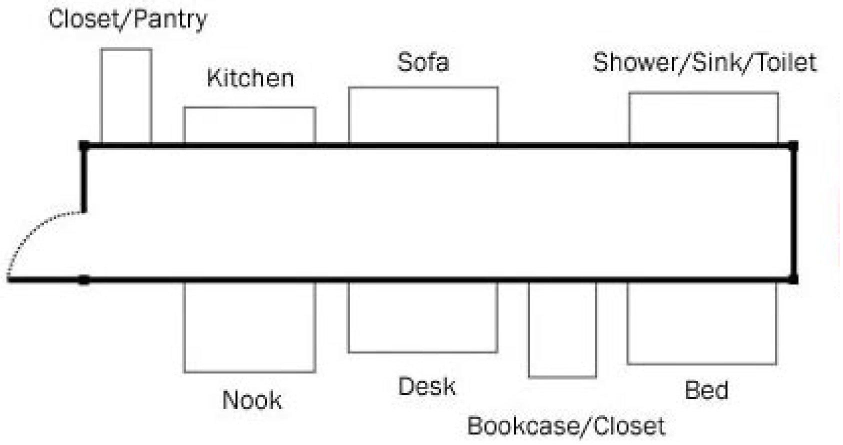
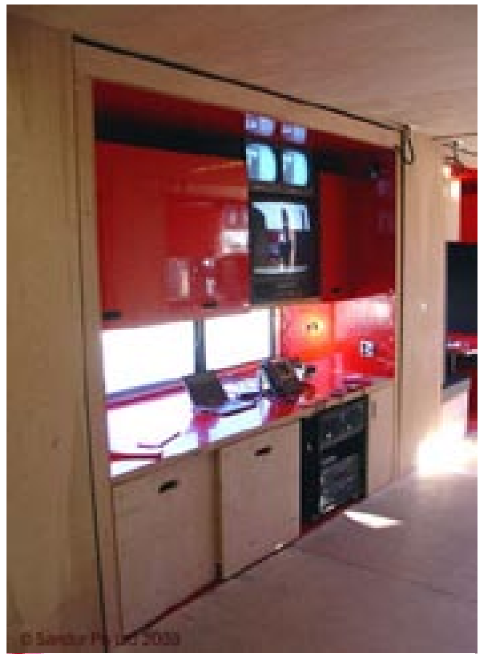


zijaanzicht woonblok



vooraanzicht woonblok





LO-TEK

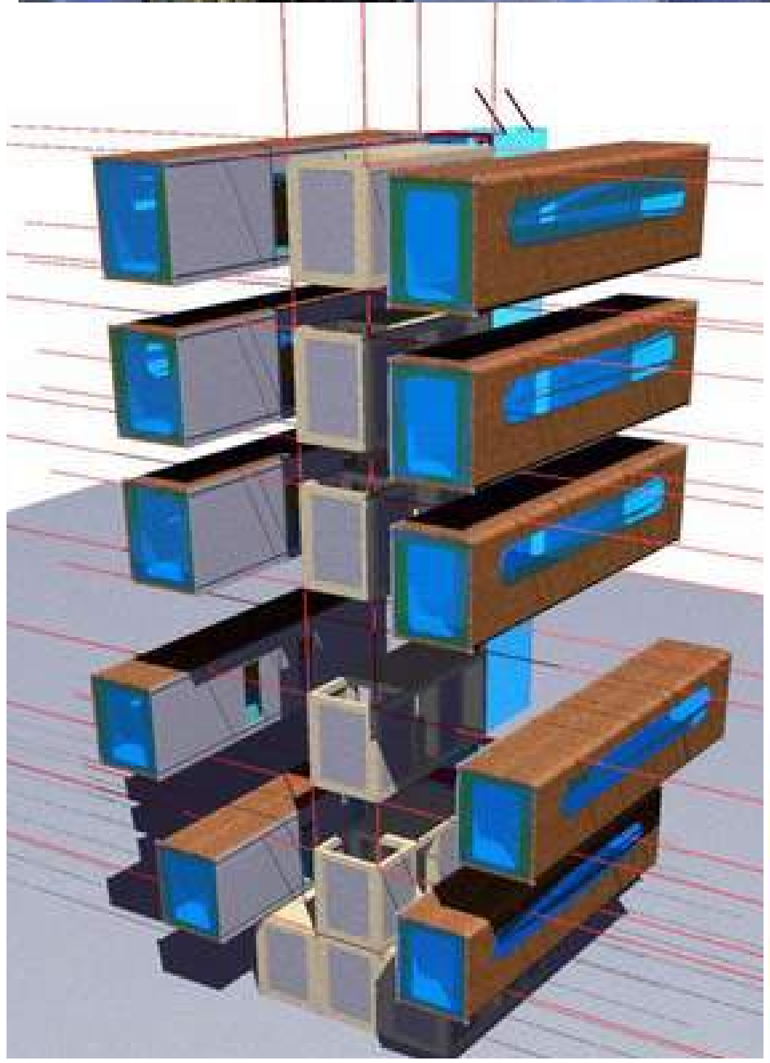
M.D.U. Mobile Dwelling Unit

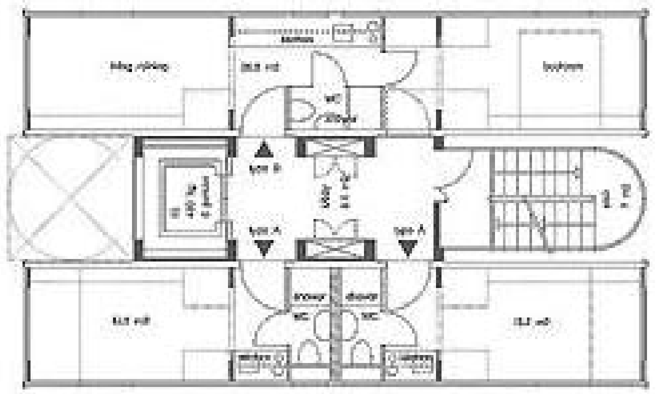
One shipping container is transformed into a Mobile Dwelling Unit. Cuts in the metal walls of the container generate extruded sub-volumes, each encapsulating one live, work or storage function. When traveling, these sub-volumes are pushed in, filling the entire container, interlocking with each other and leaving the outer skin of the container flush to allow worldwide standardized shipping. When in use, all sub-volumes are pushed out, leaving the interior of the container completely unobstructed with all functions accessible along its sides. The interior of the container and the sub-volumes are fabricated entirely out of plywood and plastic coated plywood, including all fixtures and furnishings.
MDUs are conceived for individuals moving around the globe. The MDU travels with its dweller to the next long term destination, fitted with all live/work equipment and filled with the dweller's belongings. Once it reaches its destination, the MDU is loaded in MDU vertical harbors located in all major metropolitan areas. The harbor is a multiple level steel rack, measuring 8 feet in width (the width of one container) and varying in length according to the site. Its stretched linear development is generated by the repetition of MDUs and vertical distribution corridors. Elevators, stairs and all systems (power, data, water, sewage) run vertically along these corridors.
A crane slides parallel to the building, along the entire length, on its own tracks. It picks up MDUs as they are driven to the site and loads them onto slots along

BLUEBASE

Modular accommodation system

Bluebase.MAS responds to issues raised by contemporary cities such as London, where our increasingly transient lifestyles are resulting in more work related communities in which living closer to the workplace and being able to move quickly a predominant factor in our choice of the home. This shift in emphasis will fundamentally change the way we view our cities, which will need to become more adaptable to meet short-term change in demand. This more flexible approach will result in a less clustered, more efficient urban environment.
Bluebase.MAS consists of two mass-produced elements: The accommodation module, based on the external dimensions and performance of a 40ft cargo container, and the core module based on a 20ft cargo container. All elements can be easily plugged together and taken apart. A specialist lift / hoist is able to move individual accommodation modules on and off the core tower so a standard container truck can deliver a module without additional handling equipment. The construction and finishes are comparable to a yacht or high speed train.





Key features:

10 No. one bedroom apartments - 100% factory built

26.8 m2 accommodation module

passenger lift / escape stair

50m2 minimal footprint on 200m2 site

fast and independent relocation

sustainable technology

use of existing global distribution system

compliant to statutory requirements

international patent pending

external 10 unit tower dimensions: 19m(h) x 12m(l) x 7.5m(w)

websites / links

containers:
http://www.Seabox.com
http://www.Factory Containers Direct.com
http://www.shippingcontainers.com
http://www.iport.com
http://www.container.com
http://www.onsitestorage.com
http://www.addis.co.nz/
http://www.ponl.com/topic/home_page/language_en/about_us/useful_information/cargo_care/container_talk
http://www.tandemloc.com/asdf
http://www.mobilestorage.com
http://www.tandemloc.com

container-architecture
http://www.lot-ek.com/
http://www.archpaper.com/feature_articles/shipping_news.html
http://www.hollandcomposites.nl
http://www.fabprefab.com

inspiration
http://www.headmap.org/
http://www.cs-ar.nl/