

## Sustainable Containers: Cost-Effective Student Housing

Caroline Uittenbroek, Graduate Student, & Professor Will Macht

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A Dutch developer converts shipping containers into 1,000 units of student housing in Amsterdam.



Developing student housing is challenging because the low rents students can afford does not support the high operating expenses and construction costs usually encountered. The deficit in the balance of trade between western and Asian countries has created a surplus of shipping containers that has lowered their price because they are often more expensive to ship back empty than to build new in Asia.

Now a Dutch developer has shown how to use the latter problem to solve the former, cure a shortage of student housing and create a new lifestyle that students find desirable. Amsterdam has two universities and several colleges that attract many students to the city each year who find it difficult and expensive to live in the city. In the Netherlands the universities do not provide housing for their students. In addition to its rent control system, the city of Amsterdam requires that private, non-profit student

housing corporations be responsible for renting housing to students in order to protect students from paying too much rent.

Like most Dutch universities, the University of Amsterdam does not have a traditional campus, and demand for student housing is high. In 2004, more than 6,000 students were on a waiting list for student housing. To assist students in finding appropriate accommodation, the university has signed agreements with various social housing corporations. The major student housing corporations, such as Stichting DuWo and DeKey, both independent non-profit social housing corporations, did not have places to house the overload of students. The for-profit Dutch company, Amsterdam-based Tempohousing, devised the scheme to convert shipping containers into student housing.

The founder of Tempohousing, Quinten De Gooijer, originated the plan after two of his cousins came to study in Amsterdam but were unable to find housing. As a developer, De Gooijer thought this was a niche in the market he could fill.



Creating affordable housing for students is a particular challenge within the Dutch system because its complex point-based system of rent control does not allow raising rents to levels needed to support development costs. De Gooijer thought used containers could be converted to student housing at a low enough cost to be supported by controlled rents.

To promote the idea of the container housing, Tempohousing presented the concept to the city of Amsterdam, the universities and the housing corporations. All of them had to be convinced that a shipping container could be converted into a desirable living space for students.

Having located a site about 15 minutes from downtown on which the city had previously planned a prison that had been cancelled, De Gooijer asked the government if he could develop the site for container housing. Netherlands' law requires that development competitions be held. De Gooijer's plan won the competition. His Keetwonen project was the only project that was deemed feasible, defined as

one in which rents could support building costs.

Additionally, the municipality had required that the development needed to be a temporary solution. The project was only permitted to occupy the site for five years and then other redevelopment plans were to be made for this location. Shipping container construction is inherently mobile and after five years the units could be moved and reused on another site. The classification as temporary buildings proved auspicious because that subjected them to less restrictive building code requirements, an important consideration for a new venture.



Keetwonen is the first project of Tempohousing. The project consists of 1,000 container units, a laundry, a small supermarket, a bike repair shop and a restaurant spread over a land area of about 4.5

acres [1.8 hectares (300 by 60 meters)]. The converted container units were placed on the site at a pace of 20 to 25 units a day. It took just a few extra weeks to also place the additional amenities, such as the restaurant and an office for the caretaker. As one student observed, “Keetwonen has all the amenities of a campus – only the university is missing.”



1 We buy the containers straight from the factory;



2 Conversion into turnkey units in specialized factories;



3 Standard transportation and easy to stack and connect;



4 Building up to seven levels possible without additional structures;



5 With special couplings the building process is very easy;



6 External walkways provide access to the individual homes;

Containers are seismically stable, welded steel-framed modules that are stacked up to ten high and interlocked for stable shipment across rolling oceans. They can hold over 67,000 pounds and bear loads of over 210 pounds per square foot, far greater than any student use, or abuse, can generate.

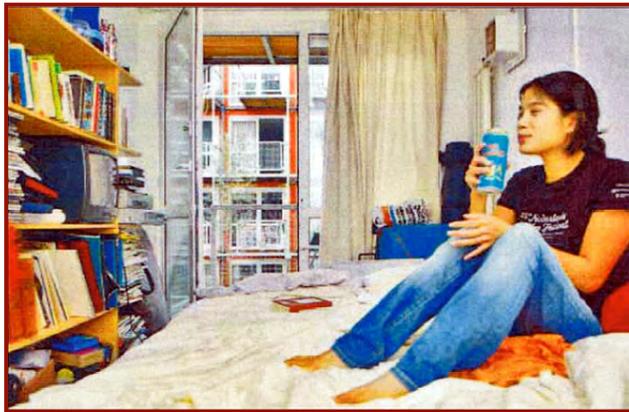
The 1,000 units at Keetwonen are stacked up to five levels high, bolted together and divided into 12 different buildings. Covered, but unenclosed, galleries and stairways connect the units. In between the buildings, there are courtyards between buildings formed by walkways, bridges and stairways, which also provide bike storage. Each unit has its own private balcony, or garden if the unit is on the ground floor.



Initially, De Gooijer was not sure if the size and location would appeal to students. The most common size and most economic containers were the 40-footers, which are 8 ft (2.4 m) wide, 40 feet long (12 m) and 8'6" high (2.6 m). He thought students might consider them too narrow and small. Second, the location was not perfect. It is located next to a jail and in an industrial area. Therefore, the company decided to add extra amenities.

However, common Dutch student housing was smaller than the 320 square feet (30 square meters) that containers provide to each student, without the need for roommates. In addition, there is cross ventilation between an entry from an open walkway at one end and a private balcony at the other end. The container is divided in two rooms separated by a small bathroom onto which is attached a kitchenette with a kitchen sink and a stove.

The ventilation of the units is controlled by a combination of natural cross ventilation and a manual switch system that regulates mechanical ventilation. One natural gas-fired central boiler



per building provides heating. The hot water for the shower and the kitchen is fed by the each unit's own hot water heater. Recognizing the penchant for long student showers, Tempohousing intentionally chose to reduce operating expenses by providing a 50-liter (13.2-gallon) boiler per unit that gives the student the option to shower for up to 15 to 20 minutes before the water turns cold. After this period the boiler needs time to reheat. The shower is also supplied with a water saving showerhead.

High-speed Internet service and security via a central audio phone to open doors for visitors at the main door are included. The rent for a student to live in a container is 425 Euros per month (\$595 at current exchange rates) including the Internet service, water, gas and electricity costs. Students living in a container obtain the right to monthly rent subsidies from the government. This subsidy is approximately 130 Euros (\$182) and therefore makes the rent only 295 Euros per month (\$413).

Reusing shipping containers is the ultimate in sustainability, using far fewer materials and far less embodied energy than any kind of construction. Although that was its initial goal, Tempohousing decided not to reuse used shipping containers for this project because the company found it difficult to find 1,000 containers that were in reasonably similar condition, and reconditioning and conversion costs with local labor would be too expensive.

Therefore, the company chose to use an existing container factory in China to construct and convert the containers in a continuous sequence, which lowered the costs significantly. The containers were all adapted to make the infill construction fit better and make it easier to build the containers. The factory that Tempohousing used is capable of building 12 units a day. Transporting the prefabricated units to the Netherlands was not difficult because standard modules easily fit container ships and a single ship can carry up to 7,500 40-footers.

For insulation the company uses a box within box system. The walls and roof are insulated within each unit using rigid XPS extruded polystyrene insulation material covered with drywall. Between the walls,

gaps are closed with a sealing band, but only at the façades. The units are designed to maintain average temperatures of 21 degrees Celsius (70 degrees Fahrenheit), are soundproofed and fire resistant with one-hour construction. Extra attention was paid to fire resistance of the building after the fire at Schiphol (the airport of Amsterdam) four years ago, where thirteen people were killed at a temporary detention center. An extra roof is placed on top of the containers in order to control the rainwater and to add extra insulation the top level of the containers.

The costs per unit for Tempohousing were approximately 20,000 Euros (\$28,000), according to De Gooijer. This was without tax, but including the stairways, balconies, galleries and the connections to the electricity, water and gas network. At current prices, a project of 250 units would be more expensive, De Gooijer says. Due to increased building costs a unit would now cost about 26,000 Euros (\$36,400). A project of 1,000 units gave the advantage of economy of scale, which lowered the building costs of the project.

Because the units need to be rented out by a social housing corporation, DeKey, which owns over 27,000 housing units and almost 7,000 student units primarily in Amsterdam, has an agreement with Tempohousing to manage and lease the units. However in this case, Tempohousing retains ownership of the units and is the leasehold owner of the ground for at least the five years promised after the units were completed in 2006. The development agreement provided that after the first five years Tempohousing was obligated to remove the units to another site selected and offered by the city. The site is intended to be developed into a live-work complex. The area where the containers are standing will be developed in the last phases. If the city fails to provide a site, the municipality will pay for any losses that would occur. However, the project has already received an extension to ten years, to 2016, and De Gooijer believes that even after that period, the project will be permitted to remain on that location.



Keetwonen has proven to be the second most desired complex within the 7,000 units that DeKey manages. Separate bedroom and living/study areas, private bathrooms and kitchens, private balconies,

natural cross ventilation, sound and thermal insulation, security, privacy, no need for roommates and affordable rents have combined to overcome any perceived shortcoming of containers being too narrow. And the students find container living to be “cool” observed one University of Amsterdam student.



Jantien Hijne has been living in the containers for six months and prefers it. She realizes that the narrow width of her unit could be somewhat inconvenient to some people, however she says that it is perfect for her alone. According to Hijne, “there is enough space and more important it is all for yourself”. This is not often the case in Amsterdam.

Hijne’s container has two rooms divided by a narrow hallway, plus a kitchen and bathroom. In the room with the kitchen she has room for a dining table. In the other room there is a bed, a bureau, a closet for her clothes and a seating area with a couch and a television set. She explains that it is very convenient that there are two rooms. “I do not cook in the same room where I sleep and people can visit me but I do not have to welcome them in my bedroom”



In the future, Tempohousing will concentrate on doing more student housing projects in the Netherlands. For developers and universities, converting shipping containers for student housing has proven to be economically and ecologically sustainable.

In addition, the company is also developing housing for the young urbanist. De Gooijer calls it the urban city apartment or loft. The units will be about 640 square feet (60 square meters), which is double the size of the student container housing.

There has been a variety of experimental housing built with containers, mostly in small quantities. At over 1,000 units, the Amsterdam container project is far larger and demonstrates both its utility and economy. Especially important, by confining units to the size of a single container, the developer was able to avoid the higher costs of cutting and fitting that has plagued other aspirants and escalated conversion costs. Moreover, by providing more space and amenities for lower costs at sizable scale for a population that finds the unusual space attractive and affordable, the developer has shown that developing student housing may be the ideal market for feasible sustainable container development.

