CONTAINER ATLAS

A PRACTICAL GUIDE TO CONTAINER ARCHITECTURE

SLAWIK, BERGMANN, BUCHMEIER, TINNEY (Eds.)

gestalten

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FOREWORD

Starting out from the original intention of collecting my own buildings and projects under the title of "*Container*Architecture", the dramatic increase in the number of container buildings worldwide led to the development of the idea of producing an atlas that would serve as a manual and present an overview of the state of "*Container*Architecture". With the uninterrupted boom in container projects, interest in this subject and the demand for information regarding aspects of the design and construction of containers have also increased.

As the head of the "Experimental Design and Construction" department within the Faculty of Architecture and Landscape Sciences at Leibniz University Hanover, I was able to draw on my academic and research staff as an expert team to help with the creation of the first container atlas in the world. For a number of years now, container architecture has been the explicit focus of our research activity. This has been accompanied by student designs and seminars with the deliberate aim of increasing our store of "container knowledge".

I would like to sincerely thank the research workers Julia Bergmann, Matthias Buchmeier and Sonja Tinney for their enthusiasm and unwavering dedication. Our tutors Anja Iffert and Lisa Lüdke also deserve thanks for their contribution.

We would also like to thank the Dutch engineer Douwe de Jong for his guest article that provides more detailed information on the structural aspects of building using freight containers. Special thanks go to the entrepreneur Dr. Christian Seidel, the architectural sociologist Heino Sandfort and the architect Carsten Wiewiorra for their valuable suggestions regarding the manuscript. Last but not least, we would like to expressly thank the architects themselves and their photographers for their willingness to allow us to use their material.

We invite you, the reader, to take a trip through the world of alternative, "non-bourgeois" architecture. We hope that the *Container Atlas* will help to increase awareness and understanding of this subject, and that this work will serve as a manual for building using containers for specialists and interested laypeople alike.

Prof. Han Slawik

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BACKGROUND
THE HISTORY OF THE SHIPPING CONTAINER

While young Malcom McLean sat behind the wheel of his truck at the pier in Hoboken, New Jersey, waiting hours for bales of cotton to be unloaded from his truck, he couldn't possibly have known what an impact the idea he had dreamt about that night would have on the world. Rather, he was bored and frustrated because as the owner of a trucking company, every wasted hour cost him hard cash.

Malcom Purcell McLean was born in North Carolina in 1913 and grew up on a farm during the Great Depression. The hard physical work on the farm made him realize from early on, that he wanted to do something different with his life. With only a high school diploma, he left the farm and started to work at a gas station in a town close by. When a construction manager came in one day looking for a driver with a truck, McLean simply went to the local Ford dealer's, bought a used pick-up for $120 and started working for him. He soon realized that he would be able to make good money with a haulage company and started to set up a fleet of trucks. Back then it was hard to imagine that "McLean Trucking Co." would become the second largest trucking company in the USA with 1770 vehicles and 32 terminals. But on his way to the top, there were a couple of setbacks such as the heavy ice storms in 1936 that caused accidents and the cancellation of orders, thus forcing the successful start-up entrepreneur to get back behind the wheel himself. On the aforementioned tour in the following year, he had a revolutionary idea while he was impatiently waiting for the longshoremen to unload his freight of cotton from the truck onto the ship, bale by bale, with a hook. How easy would it be if one could only take off the whole truck mounting and then, at the ship-to location, just put it on another truck or freight train?

The idea of transporting goods in containers in order to facilitate the process of loading and unloading wasn't new at that time. Since the beginning of the past century, metal boxes had been used for transportation of goods. On the route between Dover and Calais, vehicle-comprehensive modules were even already in use, but none of these systems had made it out of their niche. McLean was seeking a universal solution. The idea of introducing standardized containers the size of a truck's loading space suitable for all major means of transportation was born at that moment, but the path to implementing this system was very long and difficult. None of the sectors whose participation would have been required for the inter-modal container's success were willing to venture out on this new trail. The traditional shipping industry, in particular, was reluctant to accept the bare sheet metal box. Apart from the fact that they did not believe in the concept of mechanically unloading goods, a system such as the one proposed would completely turn existing logistics upside-down. The handling of individually packaged goods was very lucrative for shipping companies because the transport price was composed of many different parameters such as quantity, size, weight and value as well as fees for special handling. Basically, contractors did not have any price transparency or alternatives for sending their goods. And here was this Malcom McLean telling them that with his new system, ships wouldn't have to stay in harbors any longer than a couple of hours because machines were going to do the unloading. Instead of 20 longshoremen, only one would be needed. Transportation prices would become fairer and more transparent; freight would be handled in bundles and in closed boxes so that the chances of losing goods or having them stolen would be minimized. This whole new way of handling goods would lead to a loss of jobs as well as the cherished harbor romanticism that had a great appeal to many workers in the shipping industry. It would mean the end of extensive shore leaves and the vivid quayside bar culture; no more chances to secretly pocket a carton of cigarettes, a tin of coffee or a few oranges. It was unimaginable that a country boy wanted to eliminate all that.

Like any revolutionary idea that is born, its realization couldn't be stopped. At best, the process could be slowed down—in the case of the shipping container, it took about 20 years. First of all, McLean had to rescue his trucking company. He took his sister Clara and his brother Jim on board and started building terminals throughout the country. Every employee he hired had to begin by going on the road for half a year, because McLean was convinced that only those who had driven themselves and thus had learned how to handle freight, change oil, and maintain the engine were really able to evaluate freight prices. He kept developing new training programs because he regarded well-trained employees as the key to a successful business. Part of his philosophy was the rule that no one was allowed to give trucks names or place nametags inside the driver's cab. This was because he didn't want his drivers to become attached to a particular vehicle as they would then give "their" truck special treatment and wouldn't want to drive other trucks of the fleet. He believed that a company that allowed its employees to develop a personal relationship to one particular truck couldn't run efficiently. Thus, instead of having names, every vehicle at McLean Trucking was starkly numbered. Whenever Malcom McLean launched into something, sensitivities had to yield to profitability.

In 1965, McLean had enough money to make his dream of a universal freight container for ships, trucks and trains come true. Since he still couldn't expect any support from the various transport branches, he decided to become a shipping company owner himself. He bought the Pan-Atlantic Steamship Corporation after fighting stubbornly, and eventually successfully, for a loan that actually exceeded the bank's limit. His competitors were incensed: they sued him, citing the then valid anti-monopoly law, which prohibited companies from operating sea and land transport at the same time. McLean had to choose between his new shipping company and his very successful trucking business, which he had established in tedious work over so many years. Without hesitation, he gave up trucking because he was so obsessed with his new business plan and convinced of its success. When the first container ship, the "Ideal X", with on-board loading bridges, left the harbor of Newark, New Jersey that same year, experts were certain that this was nothing but some very expensive pipe dream that was not going to survive the reality check. His own crew had difficulties with the innovations in their traditional métier, too. When their boss suggested abolishing the ships' names and giving them numbers just as he had done with the trucks, there was almost mutiny. But it was this very novel approach that made him the revolutionary he was. What distinguished him from other ship owners, who mainly thought about shipping, or the truck business owners, who only thought about trucking, was that he was concerned about nothing but the freight. When he opted for the shipping branch and against trucking, he didn't switch to a different industry; he only changed the means of transportation for his freight.

In 1960, the Pan-Atlantic Steamship Corporation was renamed Sealand Services. The new, simple and more direct name mirrored McLean's philosophy that had no room for maritime nostalgia; this company was all about efficiency and success. McLean didn't bother to build new ships—similarly to his former trucking business, he used cargo ships and converted them to hold containers because it saved time and money. The beginnings of Sealand Services were rough: the enterprise had to circumnavigate bankruptcy several times, but all the young employees that McLean had wisely selected with the help of his siblings were highly motivated and worked hard and enthusiastically for the new idea. Within the following years, more and more container ships landed in US American harbors. While followers commuted between the West Coast and Hawaii, Sealand Services covered the routes along the East Coast. Nevertheless, the old established shipping companies still did not believe in his long-term success, especially in international overseas traffic. When McLean announced that soon he was going to send extremely fast container ships across the Atlantic at intervals of only two days, nobody took him seriously.

Many people are still not quite aware of the great extent to which the freight container influences our life today, even though it has changed consumer behavior dramatically in most parts of the world. Sand shrimp from the North Sea is only available at discount prices in German supermarkets because McLean's containers ship them from Bremen to Mexico and back at a very low cost so that Mexican workers who have probably never tasted sand shrimp in their lives can shell them for a fraction of the wage that a German worker would cost. Today, hardly any final product is assembled in one place anymore; every single component of a thermos flask is produced and added at a different manufacturing plant somewhere in the world. Nations in the most remote corners of the globe now have the opportunity to participate in the world market because no route of transport is as cheap as the one by sea. The introduction of the shipping container has turned oceans into maritime highways.

Back then, the world wasn't waiting for McLean's invention He had to make himself and his ideas known, and the clever businessman sniffed out his great chance during the Vietnam War. Shortly after its outbreak, the US Army experienced difficulty in getting supplies to its soldiers; freight ships loaded with food and military equipment were jammed up outside the harbor of Hanoi because it took so long to unload. With his container system, McLean had the perfect solution for the problem but when he wanted to present it, he wasn't even given an appointment at the Pentagon. Without further ado, he traveled to Arlington, Virginia himself and waited in front of the supply officer's door in order to intercept him on the way to work at seven o'clock in the morning. One last time, his revolutionary idea was greeted with nothing but skepticism. How could this man claim to unload his ships within only 24 hours when everyone else needed at least several days? A free tour arranged right on the spot finally convinced the US government, and a few years later, the rest of the world followed suit. Since the government paid for both ways, back and forth, and McLean didn't want to waste a single traveled sea mile, he soon started organizing the transport of goods from Japan, Hong Kong and Taiwan for the return trip, thereby causing not only an invasion of Asian foods, toys and electronic devices to the US, but also laying the foundation for globalization.

Finally, the farm boy from North Carolina had won the long battle against the shipping industry and at the same time, eliminated almost all manpower from the process of bringing goods to the people. The few dockworkers left in the harbors have no idea what commodities they are loading and unloading every day at their computer-operated terminals, with the help of driverless vehicles. There is almost nothing that cannot be shipped in a standardized metal box.

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INTRODUCTION

FROM THE CONTAINER TO AN ARCHITECTURE

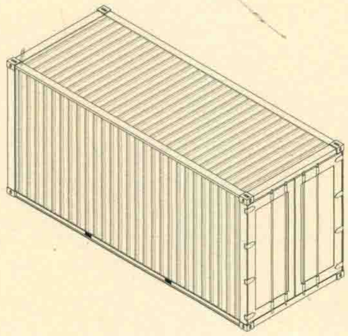
The freight container as a storage and transport vessel for goods revolutionized the transport sector in the last century. Instead of loading and unloading using port cranes or ship cranes, modern global transport is now based on container ships and container terminals. Freight containers can be found all over the world—from the Antarctic to the tropical rain forest.

The "container revolution" began in the 20th century. Malcolm McLean, a former trucking entrepreneur, was one of the first to implement the idea of standardized containers and developed these in 1956 for his trucking empire in the USA in the form of 35-foot-long boxes that could be loaded onto ships. At around the same time, the military was also instrumental in promoting the spread of containers. Back as early as the Second World War, the US Army had already employed rectangular containers as a solution to major logistical problems in crisis areas. The US Army also developed 20-foot boxes that could be transported by water and by land. These developments were then adopted worldwide in the 1960s. Standardization of freight containers in the 1970s, in line with the ISO (International Standards Organization) standard, helped put in place the prerequisites for the worldwide dominance of containers.

The main technical details regarding containers were specified in this ISO standard. The maximum dimensions of containers are mainly determined by the transport conditions, as the locally applicable road traffic regulations prescribe the maximum size of container trailer chassis. 20-foot (6 meters nominal size) and 40-foot (12 meters nominal size) freight containers have become established today from among the various different lengths of container types available. They have a standard width of 8 feet (≈2.4 meters) and various heights: standard cube with 8.5 feet (≈2.6 meters), low cube (rare) with 8 feet (≈2.4 meters) and (increasingly) high cube with 9.5 feet (≈2.9 meters). Transportation and lifting equipment the world over, is tailored to match these dimensions. One 40-foot container or two 20-foot containers can be transported on a single chassis. Alongside the standard containers with lengths of 20 feet and 40 feet, there are also variants and special designs for various purposes: ventilated, cooling, open-top, open-side, bulk, tank, and platform/flat containers.

A standard container consists of a steel construction with standardized special profiles and load-bearing walls. Today these steel containers are generally made of slow-rusting COR-TEN steel. However, there are also other variants—for example: containers with non-load-bearing wooden wall fillings (plywood containers), those made of aluminum (half the weight, double the price), or more recently, containers made of plastics that have a supporting steel frame.

The load-bearing capacity of containers is also specified in the standard. The containers must be able to withstand deformations in line with specified standard values, and must be fully sealed. Because they are sealed, containers do not sink initially at sea: shipping accidents have resulted in around 30,000 containers currently floating aimlessly on the world's seas—they often lie just under the surface of the water, a potential nightmare for anyone hoping to sail around the world.



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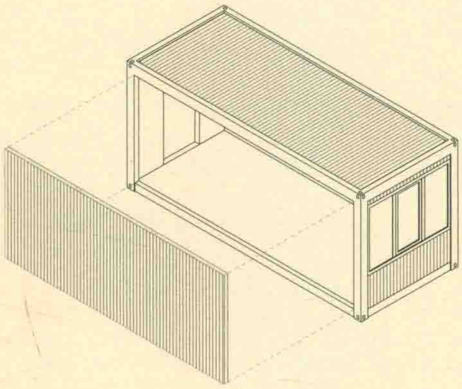

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Freight containers are extremely stable: a 20-foot container weighs 2.4 metric tons, can take a load of 24 tons, and can be stacked eightfold. A 40-foot container weighs 4.5 metric tons, but can only take a load of 30 tons as the load is still only supported by four corners, thus limiting the load-bearing capacity.

Freight containers are also very inexpensive: a new 20-foot container costs around €2,500 and a used one around €1,300. Most containers are produced in Asia and have generally been used once for freight already.

The supporting structure and weather-protective shell is thus available for a price of approximately €200 per square meter or around €60 per cubed meter, a price that is unbeatable when compared to the costs of erecting a conventional building.

Freight containers were first put to new uses in unconverted form. For example, they were used as tool sheds or storage space. The next step was to use freight containers for other purposes, such as for living in, and to convert them accordingly. The load-bearing capacity of shipping containers is very high, but comprehensive conversion work on the basic structure can impair their static properties. As conversion work can be very cost-intensive, the amount of work carried out is often limited by the amount of finance available. Freight containers are almost always used in architecture for temporary construction purposes. Minimum building physics requirements, mainly relating to heat insulation, can be difficult to achieve with unmodified freight containers, however. Containers are favored in event architecture because of their image.

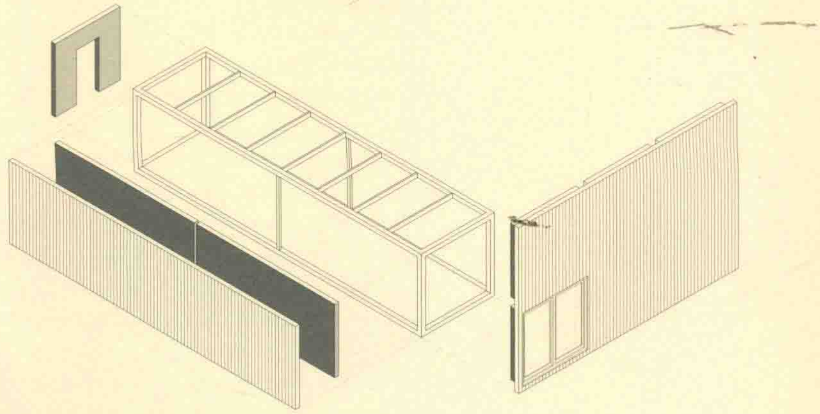
001 | Freight container system

Building containers have become very widespread in the construction industry and are used mainly in Europe. These are containers with a significantly lighter construction that are used as offices or for commercial or housing purposes. They were originally also produced in ISO dimensions, but later on developed their own sizing systems and were fitted with specific transport features. These containers are familiar as construction-site offices, emergency housing for asylum seekers, accommodation in disaster areas, etc. From a statics point of view, it is possible to stack these containers to create up to three stories. They can be stacked up to four stories in exceptional cases, but reinforced constructions must then be used. More stringent building physics requirements, such as those necessary for permanent constructions, can only be fulfilled with increased labor and costs, meaning that building containers are generally only equipped to a minimum standard. They are placed in rows and stacked, and this is generally done without any regard for architectural form. Some manufacturers do make an effort to give their products a certain quality level by providing more generous facade solutions and by carefully selecting and processing their surface materials—with a commendable degree of success, too. Since these systems are not compatible with similar products from other manufacturers, we refer to these systems as *closed systems.*

002 | Building container system

With all of the systems described so far, the building containers must be custom-manufactured if they are to be joined to produce larger combined spaces. Since fittings components always contribute to load-bearing too, the limits of what is statically permissible can be quickly exceeded if wall, ceiling or floor fillings are omitted. When a number of modules are arranged in rows or stacked, these components double up and are redundant, as there are always two walls, ceilings or floors beside or on top of each other. In principle, the building containers can be reused after being disassembled, but excessive costs may be involved in adapting them to meet new requirements. The sustainability of this building system is thus limited, as the components may need to be processed and treated before being reused.

The principles behind building containers have been transferred to module frames, which can be manufactured in any size, independently of the ISO dimensions system. The fillings also perform a load-bearing function in this building system. This provided the impetus for Professor Han Slawik to develop his own building module, the container frame, and to propose a systematic separation between the load-bearing frame and non-load-bearing fillings. The container frame was the first system to strictly adhere to the idea of adding non-load-bearing fillings to the supporting frame, thus separating the supporting structure and the fittings. There are similar systems available from various manufacturers, but they rely on the shell construction making a contribution to structural strength. This container frame building module has been further developed over the course of various studies, competitions and patent applications. The non-load-bearing fillings are interchangeable in this system, thus guaranteeing maximum flexibility and variability for these modules. With the thermally separated frames and fittings on the frame level and outer premounted shells as an alternative, the building physics requirements could be optimized to a significant extent. The implementation of this type of "pure" system certainly involves more labor and is more costly, but also has the significant advantage that all components created according to a standard, universal system of dimensions are interchangeable and can be reused. Ideally, the components should



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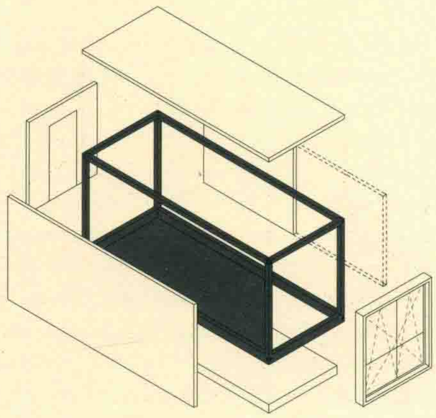
be industrially manufactured. In the case of mounting, disassembly and remounting where the components are reused directly without any modifications, this type of building system that is *open to the market* can be regarded as highly sustainable. Recycling of material or of products—for example in the case of the construction of a skeleton that has to be removed, prepared, or disposed of—is not necessary here. In addition, a supporting frame system can also accommodate do-it-yourself fittings, as the fittings do not have a load-bearing function, thus giving the project team complete design freedom in this regard.



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003 | Module frame system

004 | Container frame system (with thermally separated frame profiles)

Building using containers has by now acquired something of a "cult status". The specific image of containers is often important when they are used in architecture, particularly in the event sector. The globalized container box evokes certain associations: the image of a well-traveled item is automatically linked with the raw atmosphere of a busy port, for example. The more striking the building solutions using (freight) containers, the stronger the associative effect of these buildings appears to be.

Despite their strict layout patterns, modular systems based on containers still offer a wide range of spatial solutions. The prerequisite for this is the positioning of the container—an originally very mobile and extremely unaesthetic box that is available everywhere and is always on the move; a quiet life at a fixed location is not something generally granted to a container. However, this does indeed happen when containers are used in architecture, but the container nonetheless remains mobile and transportable to a limited extent because it can be disassembled.

Building using containers thus often involves more than simply stacking and arranging containers in rows. An architectural structure can only be said to exist if:

- The mobile containers have a fixed location.
- Rooms and spatial connections/openings are created by architectural means, resulting in indoor rooms, intermediate areas, and outdoor spaces.

Only when containers are placed in a spatial context with spatial and architectural qualities do container boxes actually become *container architecture.*

03

USE OF CONTAINERS

Containers are always suitable for use where spatial solutions have to be found for a limited period of time. Container architecture is thus generally found in temporary buildings, where the advantages of a flexible, mobile building system come to the fore. The quick, short-term availability of containers make them effective as building modules. Unfortunately, minimal importance is often attached to architectural quality in the case of temporary building solutions. The frequent repetition of the same building blocks leads to the risk of architectural monotony and anonymity and urban-planning aspects are often ignored too. Construction based on containers used to have a negative image in the past, as a temporary requirement for space is often associated with circumstances where provisional interim solutions are required for people in emergency situations. This effect was often compounded by poor maintenance. However, current examples of container architecture show that solutions that fulfill high architectural standards are indeed possible using containers.

The use of containers in architecture is strongly influenced by the planned usage and the desired effect/impression. The usage strongly affects the type of solution implemented and thus the architectural design too, and low costs also play an important role. The planned service life, which is of course closely related to the usage, is another critical factor. The container is then no longer a mass product when used as a building module, but instead appears as something individual, unique and unmistakable.

The examples of container architecture allow for a categorization according to usage that emphasizes the profile and range of uses for containers in architecture. One can classify projects into public buildings, office buildings, and temporary housing and extensions to housing. Usage as permanent living space is financially most viable in locations where a mild, dry climate is present and protection against heat losses and moisture is not so important. For buildings that meet short-term spatial requirements in a functional manner, architectural design plays a less important role in the selection of the building module. The associated effect, that is attached to freight containers in particular, is used to help generate an image in the commercial sector, for events, for installations in public space, and for art projects involving containers: the image of the container then becomes associated with the product or event too, a process referred to as corporate architecture. Social projects also take advantage of the low acquisition costs of containers (low-budget or no-budget architecture).

A special form of container architecture involves recreated containers that are built using conventional construction techniques, but have the esthetic and structural characteristics of a building container or building container system—the so-called container-look. These are architectural quotes from a construction style that merely suggests a temporary character. In fact, this form of "imitation container" is less efficient from an economic and civil engineering point of view as the advantages associated with prefabrication are lost.

Public buildings

flyport is a passenger terminal that can be implemented anywhere in the world. It has a very short construction time, allows for flexible usage and design, and can be adapted to meet individual needs.

005 | flyport/wolfgang latzel architekten, 2004: Public buildings

Office

The headquarters of the PLATOON agency, a creative collective active in the area of communications, is located on an undeveloped site right in the middle of Berlin's lively Mitte district. The building consists of an ensemble of freight containers in military green, together with a lawn area and a pool.

006 | PLATOON headquarters/PLATOON, 2007: Office

Housing

This home in California uses freight containers as additional room modules. Used freight containers are freely available and thus also inexpensive in the USA because of the skewed balance of trade where imports exceed exports (Redondo Beach House/DeMaria Design).

007 | Redondo Beach House/ DeMaria Design, 2008: Housing

Social/low budget architecture

Containers are suitable for use in charitable organizations funded by donations such as Children's Activity Centre (Phooey Architecture) in Melbourne, a social facility for children that doesn't charge for admission and therefore has to survive on public subventions.

008 | Children's Activity Centre/Phooey Architecture, 2007: Social low-budget project

Commercial/corporate architecture

The mobile PUMA salesroom by the architects LOT-EK consists of 24 shipping containers staggered to form a three-story sculpture. The product being sold, sports and leisure footwear will of course already have traveled the globe in just such a container. The associative interplay of product and architecture results in "corporate architecture".

009 | PUMA/LOT-EK, 2006: Corporate architecture

Event/exhibition

The Nomadic Museum (Shigeru Ban) employs containers in two ways: as building blocks that form the supporting structure for this large-scale exhibition hall, and as transport containers for building elements and for the exhibition display specimens themselves. Additional containers can also be rented locally, as required.

010 | Nomadic Museum/Shigeru Ban, 2005: Exhibition

The Illy Café (Adam Kalkin) was developed for a temporary use with a predefined duration as part of the 52th Biennale in 2007 in Venice. At the push of a button, a container that appears unmodified from the outside folds out into a café platform, thus becoming an exhibition object itself.

011 | Push Button House – Illy Café/ Adam Kalkin, 2005: Event

Art

The Belgian architect and artist Luc Deleu uses freight containers in his art by stacking them to create monumental structures and landmarks that can be seen from far around. The containers used are often exaggerated in an artificial manner because of the way they are stacked without their essential forms being changed.

012 | Middelheim Construction X/ Luc Deleu, 2003: Art

Container look

The projects in the "Container look" category are built in a conventional way, but are intended to resemble containers. These buildings merely refer to the esthetic and structural features of containers or container systems, and actually have little in common with container architecture.

They are often structural elements of secondary importance, such as additions to roofs or extensions (parasite architecture). The addition of these "pseudo-containers" is often a deliberate attempt to suggest a process of subsequent, often temporary extensions to a building, even when these secondary components were actually built at the same time as the main building structure itself.

013 | Sjakket Youth Center/ PLOT = JDS + BIG, 2007: Container look

014 | Wismar Technology and Business Center/Jean Nouvel with Zibell+Partner, 2003: Container look

The use of imitation containers is somewhat odd from an architectural point of view, and this approach is also less than favorable from a civil engineering point of view since the imitation of prefabrication using conventional construction methods is actually very inefficient.

Nonetheless, an imitation container can help to liven up the architectural impression made by a building.

It is possible that container-like spatial cells are recreated for practical reasons in a certain context instead of using ready-made containers (for example: the facade openings might be too small to allow containers to be transported into the building). One possible alternative here would be to use special constructions that can be collapsed (e.g. folding containers).

Certain buildings appear similar to container architecture based on their architectural structure, but these are often simply skeleton structures that follow a strict modular layout. The appearance of a building constructed from spatial cells is created by borrowing the proportions of containers for the pattern dimensions and by repeating identical openings at regular intervals.

015 | Distributiecentrum Piet Zoomers/ Van den Belt & Partners, 1992: Container look

016 | Student housing/Mecanoo Architekten, 2009: Container look


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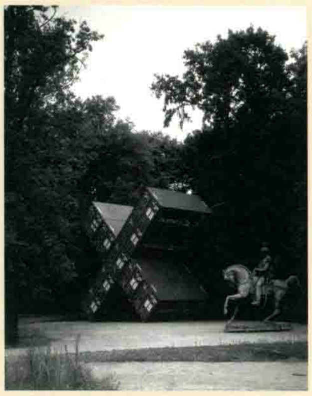
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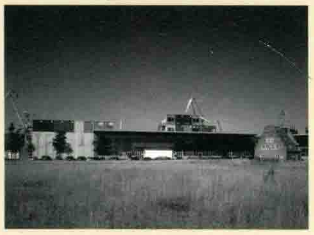
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