

SAFE USE AND COMPLIANCE OF **MODIFIED ISO SHIPPING** **CONTAINERS FOR USE AS BUILDINGS** AND BUILDING COMPONENTS



National Portable
Storage Association

WWW.NPSA.ORG



MODULAR
BUILDING INSTITUTE

WWW.MODULAR.ORG

ACKNOWLEDGEMENTS

THANK YOU, CONTRIBUTORS

Stephen Shang, Falcon Structures – Co-Chair
Mike Wilmot, Wilmot Modular Structures – Co-Chair
Ralph Tavares, P.E. R&S Tavares Associates
Andrew Carlson, CBO, MCO, Pyramid 1 Inc.
Stephan Howard, Container Services International
Guy Rogers, Caru West Gulf Containers
Roland Brown, Ramtech Building Systems
Tom Hardiman, Modular Building Institute
Guy Sextro, Pav Van Inc.
Rodney Schrader, Acton Mobile
Daniel Arevalo, Mobile Modular Management Corporation
Victor Zamora, Mobile Mini
David Campbell, Boxman Studios
Hala Jawad and Mohsen Anis, PE, RADCO, a Twining Company
Randy Soper, Sea Box, Inc.
Gary Bockrath, Equipe Container Service

DISCLAIMER

The content provided in this white paper is intended solely for general information purposes, and with the understanding that the publishers are not engaged in engineering or other professional advice or services.

While we make every effort to ensure that material in this paper is accurate and up to date, such material does in no way constitute professional advice or imply compliance with all provisions of all applicable building codes.

COPYRIGHT © 2017

No portion of this document may be reproduced or altered without the written permission of the Modular Building Institute and the National Portable Storage Association.



CONTENTS

OVERVIEW	7
CURRENT CODE ENVIRONMENT	8
INDUSTRY SEGMENTS	9
STRUCTURAL INTEGRITY	13
TOXICITY	17
INDUSTRY POSITIONS OF SEGMENTS	19
SUMMARY OF INDUSTRY POSITIONS	22
DEFINITIONS	23



TODAY, THE REPURPOSED SHIPPING CONTAINER INDUSTRY IS A MULTI-BILLION-DOLLAR MARKET.

There are currently over 37,000,000 ISO shipping containers in use around the world today. All of these units were built to ISO standards and maintained to standards defined by the International Maritime Organization's (IMO) "Convention for Safe Containers." They are capable of carrying in excess of 55,000 lbs. of goods on sea, road, or rail and being stacked 9-times high and fully loaded.

For industry participants, the main drivers of this segment are: safety and security (extremely hard to break into a steel box); durability (25+ year life with 75% sales price to original cost ratio); designed for mobility and to be stackable; and speed.

Well-intentioned people attracted by the idea of repurposing these steel boxes to minimize waste and by a certain "coolness" factor, have greatly publicized their use. The positive aspects of container conversion and the greater public awareness for recycling and everything eco-friendly has generated a lot of attention.

These drivers and factors have led to a broad array of applications and therefore different industry segments. The two primary segments relate to the use of the structure (whether it is a temporary or permanent structure) and the complexity of the structure (whether it is a single unit or a multi-unit structure).

These containers are now regularly being repurposed and converted into International Residential Code (IRC) and International Building Code (IBC) occupancy uses. The applications are widely diverse as are the extent to which the container is used as a structural building element. The IRC, IBC, and virtually every state administrative program are now reacting to the growing trend and are well behind in terms of regulations and compliance.

A patchwork of regulations has emerged, creating potentially conflicting and duplicative requirements. Despite the inconsistent regulations at the state level, this activity is in fact occurring through the approval of local building code officials and in some cases with the support of third-party engineers. Additionally, the International Code Council, through its Evaluation Services, published ICC-ES AC462 in February 2016 to provide the first formal guidance published by the ICC.

The industry, through this effort, will set the floor for all companies engaged in providing modularized IBC occupancy products. By leading this effort, the Modular Building Institute (MBI) and the National Portable Storage Association (NPSA) will also help shape the regulations and potentially the building codes, in a manner that:

- Minimizes the impact on existing industry-owned product
- Provides a clear path to compliance (which may vary from state-to-state)
- Provides guidelines for future productions of modified containers

So, are ISO containers safe to use as buildings and building components?

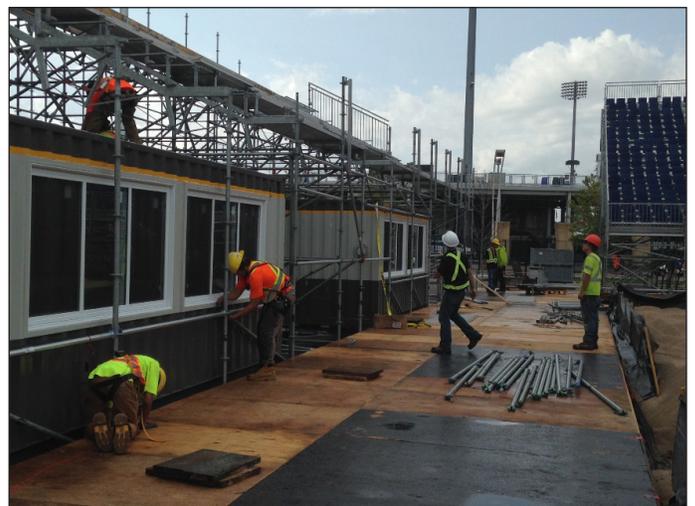
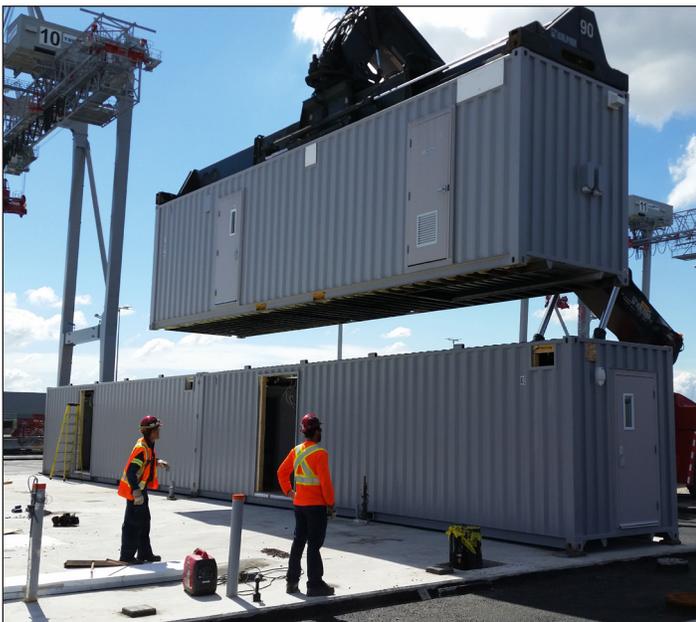
Ultimately, that is the most important and pressing question being raised. As a single unit, the shipping container undergoes a stringent design, testing process, manufacturing and quality process. Further, containers are "field tested", traversing the ocean in harsh environments before being repurposed into building components. This paper will help code officials and end users to distinguish between the various applications for modified shipping containers and to utilize these structures in a safe and efficient manner.

CURRENT CODE ENVIRONMENT

In an email survey to several state administrators, MBI concluded that only Nevada currently allows the use of modified containers within its state-wide modular administrative program. Virginia does allow it, but only if the container has also received approval via the new ICC-ES AC462 process recently announced by the International Code Council (ICC). Maryland, New Jersey, Rhode Island, Minnesota, and North Dakota do not currently allow this type of structure to be labeled. Georgia is considering how to incorporate this type of facilities into their state-wide program.

Absent any additional guidance, these types of structures and buildings will continue to gain acceptance and a patchwork of regulations will continue to emerge, creating potentially conflicting or duplicative requirements.

distinguish between larger permanent structures made from multiple containers and smaller ground level offices (GLO). Additionally, it is unclear if this acceptance criterion applies “going forward” or is to be applied to the tens of thousands of existing GLOs. A strict application of the AC 462 would result in the exclusion of a majority of existing containers from any type of use, whether as GLO or part of a larger modular building. This dramatically reduces the “green” factor of reusing existing containers for secondary purposes, as only brand new container units going forward, would be able to meet all the criteria. The industry as a whole, be it general contractors or modular lessors, would be faced with increased costs that would not enable them to serve their customers.



With the February 2016 publication of the ICC-EC AC 462, a path for an approval process for the use of containers in buildings is now available for code officials. However, at a recent joint meeting of MBI and NPSA members (representing a vast majority of the major container office owners) it was agreed that AC 462, if used as a “one-size-fits-all solution” is potentially detrimental to the industry primarily because it does not

INDUSTRY SEGMENTS

As mentioned in the overview, there are multiple uses and applications for modified shipping containers, each with its own need for segmentation and discussion. For example, there are distinctions between smaller, ground level offices that are not part of the permanent facility vs. ISO containers used as building components for larger permanent structures. There also needs to be distinctions on the permanent containerized projects incorporating closed construction elements (electrical, plumbing installed offsite) vs. containers used primarily as structural elements of a building.

Based on these distinctions, we propose creating four industry segments, which will help guide the codes and regulations going forward (See Exhibit A).

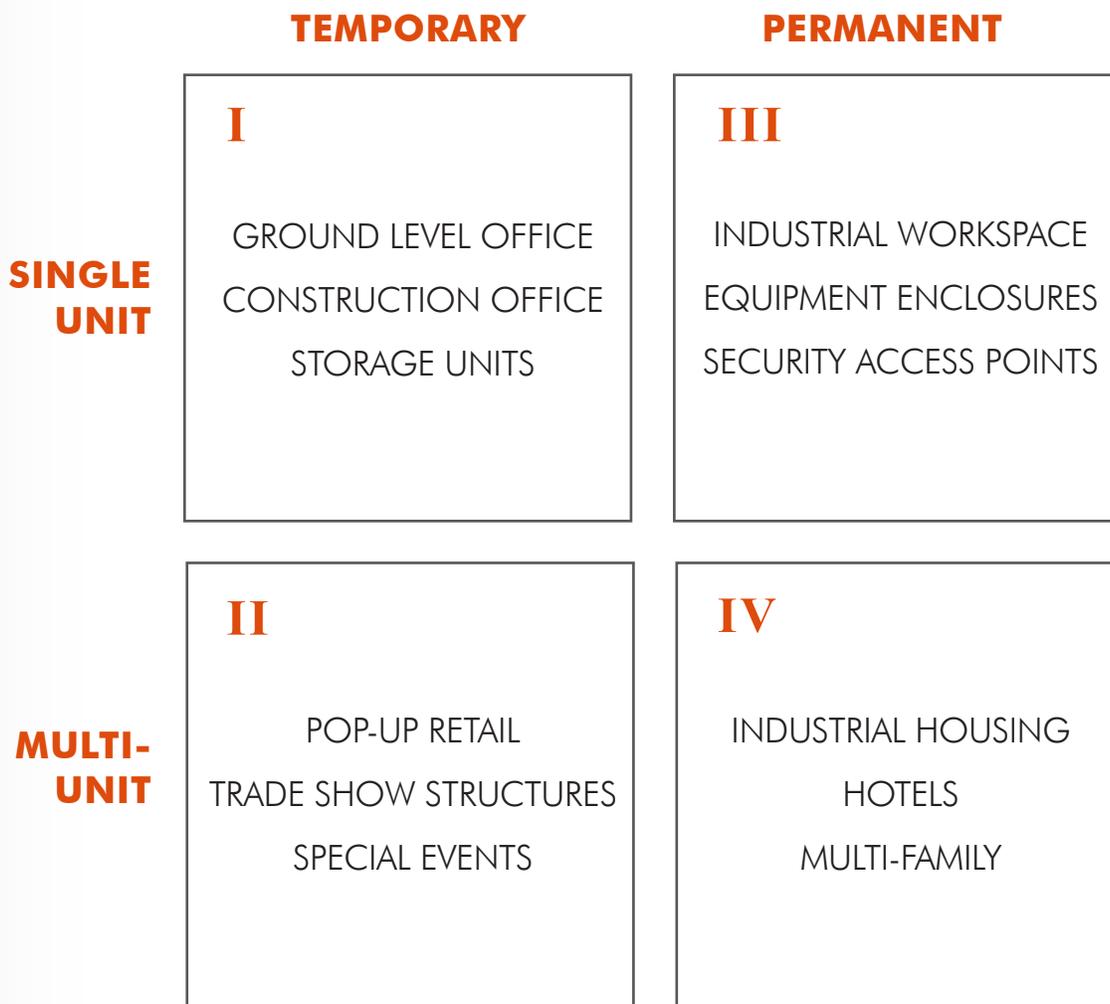


EXHIBIT A

Clearly, a one-size-fits-all policy makes little practical sense when comparing these containerized structure segments.

As represented by the matrix in Exhibit A, the main lines for container segmentation are:

- Temporary vs permanent applications.
- Single vs multi-unit applications.

Other factors come into consideration as well, such as access by the general public and the degree of construction that occurs at an offsite location (open vs closed construction). Additionally, ANY new codes or regulations should only apply going forward. There are countless examples that set the precedent for prohibiting the retroactive application of new requirements. Lastly, in addition to structural integrity, questions have emerged about the potential toxicity of the containers. All of these factors are taken into consideration in this paper.

TEMPORARY VS. PERMANENT

In section 108.1 of the International Building Code, the building official is authorized to issue a permit for temporary structures up to 180 days with a provision allowing for extensions for demonstrated cause.

108.2 requires temporary structures to conform to requirements of the code as necessary to ensure public health, safety, and general welfare, while not requiring compliance with all of the provisions of the building code.

The City of San Diego currently provides for an exemption of these type of ISO units when “used temporarily on a site for and during construction of a building having a valid building permit...” as well as an exception for units when “used for equipment/storage/props during a permitted special event.”

Additionally, some states provide an outright exemption based on occupancy classification and use. Construction site offices not open to the general public are often exempted for the requirements in the building code and many state modular administrative programs.

SINGLE UNIT VS MULTI-UNIT COMPLEXES

Regarding size, there needs to be a distinction between a single container that is modified and used as a temporary security office compared to a container that is modified and used as a building component in a larger structure. Some states have amended the code and/or their administrative programs to provide for an outright exemption based on size, including Maryland (under 320 square feet).

EXISTING PORTABLE STORAGE AND OFFICE UNITS

The main concern from the industry is a retroactive application of any code provision or acceptance criteria on existing units. Companies operating in the portable storage and office market have a substantial capital investment of \$2 to \$3 billion in their collective rental fleets.

The ICC specifically provides code requirements for existing buildings in its International Existing Building Code (IEBC). Within the IEBC, an existing building is defined as “a building erected prior to the date of adoption of the appropriate code or one for which a legal building permit has been issued.” While this definition provides a great deal of protection for a majority of the modular industry’s relocatable product, it does not sufficiently protect the ISO container units, primarily because these types of units have historically been exempted, or not otherwise required to follow the permit process.

**SEGMENT I:
TEMPORARY, SINGLE UNIT**

A common 8 ft. x 20 ft. ISO container “Ground Level Office (or GLO).” These units are intended to remain on the building site for not more than 360 days per the IBC.



**SEGMENT II:
TEMPORARY, MULTI UNIT**

Despite its temporary nature, these facilities are often open to the general public and should not be exempt based on the provisions for temporary permits.



**SEGMENT III:
PERMANENT SINGLE UNIT**

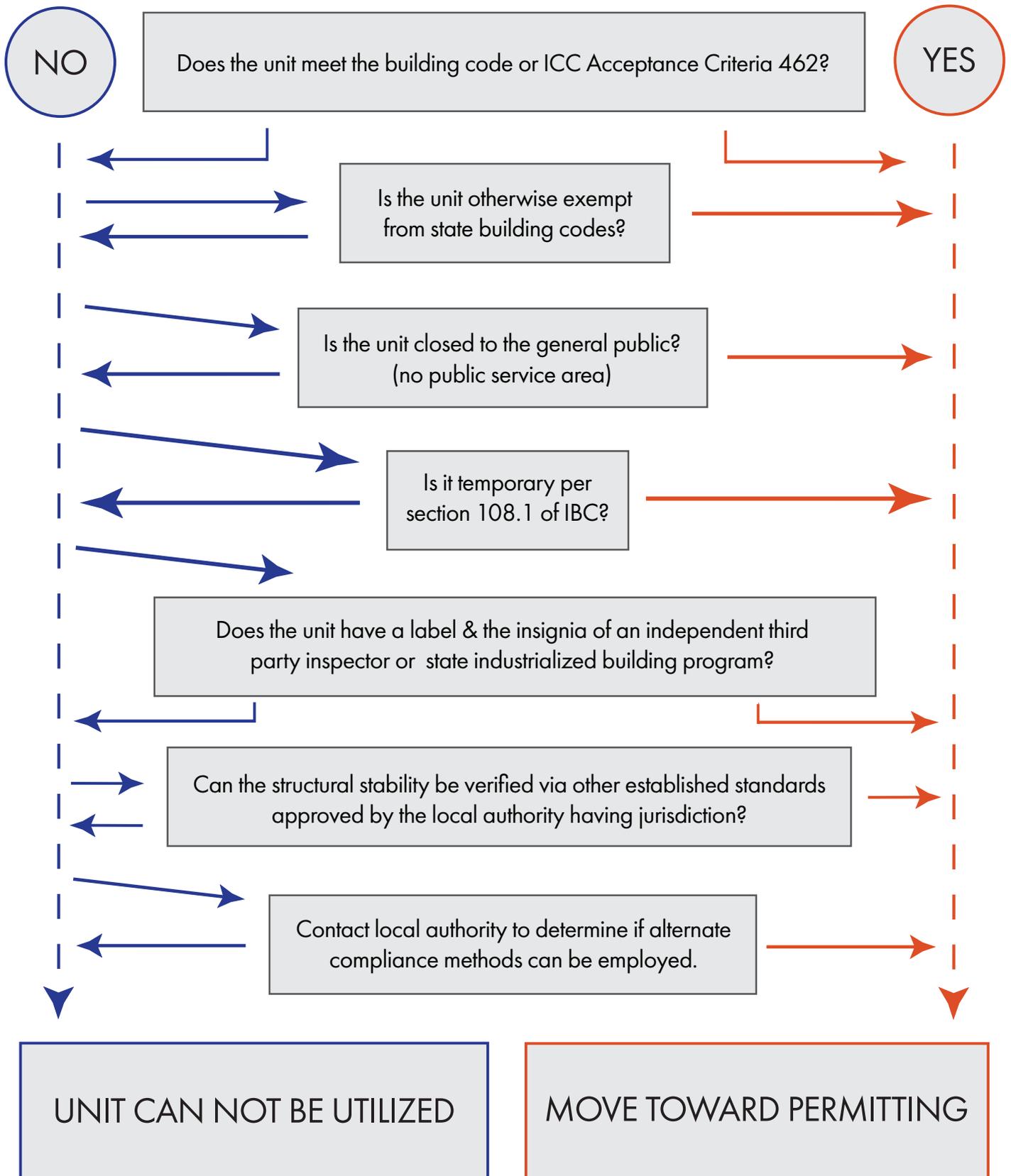
Because the envelope of the structure is a container, certain codes are not possible, such as the 2% roof slope. However, other codes related to life safety, should be followed.



**SEGMENT IV:
PERMANENT, MULTI UNIT**

A new hotel in Canada. The \$6-million structure is almost entirely built out of containers — making it the largest structure of its kind in North America.





STRUCTURAL INTEGRITY

The ISO containers themselves are tested and inspected to internationally accepted standards including ISO 1496 International Standards Organization and the Convention for Safe Containers (CSC) International Agreement in 1972, which allows containers to operate worldwide.

ISO containers are built in accordance to ISO 1496 (incorporated in the CFR under 49 CFR 173.411 (b)(6) (iii)). ISO specifies both static and dynamic tests which every container has to meet to receive a classification society approval. Designs meeting all CSC and ISO requirements are assigned a CSC number, which appears on the safety approval plate of every container built to that design.

CSC is an international agreement resulting from the 1972 International Convention for Safe Containers. The countries adopting CSC are known as Contracting Parties, for example, the USA is a contracting party. CSC is administered by the governments of the Contracting Parties or by organizations designated by the governments (such as classification societies; for example, ABS (American Bureau of Shipping) in the USA). Approvals under the authority of a Contracting Party are accepted by other contracting parties. As a result, containers can operate worldwide under a single set of safety regulations.

CSC SETS INTERNATIONAL STANDARDS IN TWO AREAS:

- Design type approval to ensure that new containers are designed and built to meet ISO (International Standardization Organization) dimensional and strength requirements.
- Safety inspections to ensure that containers are maintained in safe condition during their operating lives.

ISO codes -

Each container that has been certified is given:

- An ISO type (22G1 for 20' General Purpose, 42G1 for 40' General Purpose) which identifies the structural standard used to build the unit.
- A CSC number that confirms units were inspected and meet the quality criteria to qualify for ISO certification.

ISO codes therefore allows us to identify what standards a unit was built to, even in the case of used containers.



Inspection companies (not classification societies) are capable of verifying the condition of containers and confirming whether they still meet their original ISO standards both for static and dynamic use.

When compared to the structural and seismic requirements set for in the International Building Code the shipping container's structural integrity far exceeds the requirements as evidenced by the data charts on page 15.

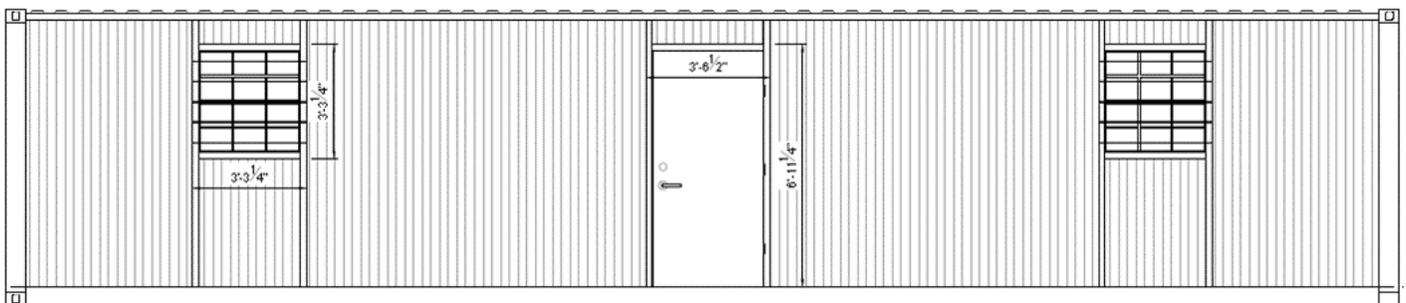
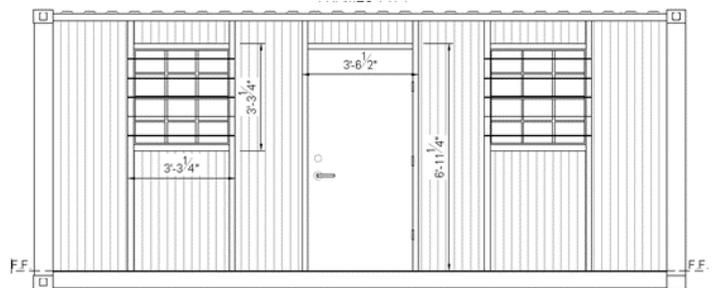
STRUCTURAL CALCULATIONS FOR COMMONLY USED GROUND LEVEL OFFICES

(Source: R&S Tavares Associates)

The purpose of this analysis is to provide a comparison between the structural design requirements of the current IBC with testing done by the ISO for containers.

Several tests are conducted by the ISO for containers. One test consists of a 150kN (33.7k) lateral point load applied to the end wall of the container. Another test consists of a 75kN (16.85k) lateral point load applied to the side wall of the container. Typically for a single-wide container, lateral design in the transverse direction (8ft end wall) is governed by wind design. In the longitudinal direction (20ft or 40ft side wall), the lateral design is typically governed by Seismic Design.

Using a wind design load of 180 miles per hour with Exp. "D", common to high-wind zones located on the coasts of Florida, the unit would be subjected to a lateral point load to the end wall of 5.97k for the 40ft length container and a 2.98k lateral point load for the 20ft container. Using a safety factor of 5, the ISO container testing still exceeds with a 6.74k lateral point load to the end wall for both the 40ft and 20ft containers.



LATERAL COMPARISON WITH AND WITHOUT OPENINGS

			Lateral ISO Test			Container Loading Without Openings		Container Loading With Openings		Comparison
			Unfactored	Factored*		Wind	Seismic	Wind	Seismic	
20' Module	Sidewall	[psf]	843	169	>	60	60	120	101	OK!
40' Module	Sidewall	[psf]	421	84	>	30	45	40	60	OK!

* Note that the safety factor (SF) has been taken as 5.0

LATERAL COMPARISON OF MODULE LOADING AND ISO TESTING

		Lateral ISO Test			Container Loading		Comparison	
		Unfactored	Factored*		Wind	Seismic		
20' Module	Endwall	[kip]	33.70	6.74	>	2.98	1.00	OK!
	Sidewall	[kip]	16.85	3.37	>	1.19	1.00	OK!
40' Module	Endwall	[kip]	33.70	6.74	>	5.97	1.81	OK!
	Sidewall	[kip]	16.85	3.37	>	1.19	1.81	OK!

* Note that the safety factor (SF) has been taken as 5.0

With seismic design, using seismic coefficients for a high seismic area like Eureka, CA and utilizing a stringent response modification coefficient (R) of 2, the unit would be subjected to a lateral point load to the side wall of 1.81k for the 40ft length container and a 1.0k lateral point load for the 20ft container. Using a safety factor of 5, the ISO container testing still exceeds with a 3.37k lateral point load to the side wall for both the 40ft and 20ft containers.

For the exception, it is recommended to state that the CSC original tab must be kept on the container, protected from paint and damages during retrofit. Also, doors and windows could be added on the longitudinal walls if the openings are reinforced at perimeter in a manner to keep the original container boundary condition.

GRAVITY COMPARISON OF MODULE LOADING AND ISO TESTING

		Allowable Loads		Container Loading	Comparison	
ROOF	Dead + Live	[psf]	61	>	26	OK!
	Dead + Snow	[psf]	61	>	56	OK!
	Uplift	[psf]	61	>	61	OK!
FLOOR (TYPE A)	Dead + Live (50)	[psf]	137	>	60	OK!
	Dead + Live (100)	[psf]	137	>	110	OK!
	Dead + Live (125)	[psf]	137	>	135	OK!
FLOOR (TYPE C)	Dead + Live (50)	[psf]	216	>	60	OK!
	Dead + Live (100)	[psf]	216	>	110	OK!
	Dead + Live (125)	[psf]	216	>	135	OK!
	Dead + Live (150)	[psf]	216	>	160	OK!
	Dead + Live (200)	[psf]	216	>	210	OK!



HJCU 2151 17 D 2261
HJCU 2066 14 4 2261
HJC 216 14 4 2261
HANSON SHIPPING CO. LTD.

HJCU 8155 70 D 2261
BSIU 224533 2261
HANSON SHIPPING CO. LTD.

HJCU 8202 71 5 2261
HJCU 8142 37 0 2261
HJC 814 3 0 2261
HANSON SHIPPING CO. LTD.

HJCU 2099 74 4 2261
CLHU 250390 2261
HANSON SHIPPING CO. LTD.

FCIU 225207 2261
HJCU 2063 01 6 2261
HJC 260 16 2261
HANSON SHIPPING CO. LTD.

HJCU 2097 54 6 2261
HJC 295 46 2261
HANSON SHIPPING CO. LTD.

TRLU 360822 2261
GESU 202219 15 2261
HANSON SHIPPING CO. LTD.

TRLU 938470 2261
TRLU 387730 2261
HANSON SHIPPING CO. LTD.

TRLU 358509 2261
HJCU 2062 87 4 2261
HANSON SHIPPING CO. LTD.

HJCU 8482 19 6 2261
HANSON SHIPPING CO. LTD.

HJCU 8478 38 6 2261
HANSON SHIPPING CO. LTD.

HJCU 2072 67 7 2261
HANSON SHIPPING CO. LTD.

60U 500 41 6 2261

HJCU 2066 26 6 2261

TRLU 363039 2261
HANSON SHIPPING CO. LTD.

FSC 36339 2261

TOXICITY OF CONTAINER FLOORS

A common misconception with containers is that the wood floors are impregnated with pesticides and are harmful to humans. Industry research suggests otherwise and demonstrates that container floors are safe to humans.

In April 2017, the industry conducted preliminary tests on toxicity of ISO containers. The testing was conducted by the Center for Toxicology and Environmental Health, LLC based in Arkansas.

Based on preliminary research conducted to date on the compound names provided (Basileum, Tailileum 400, and Radaleum), it appears that these compounds have a fairly selective toxicity to insects. Furthermore, the active ingredient in both Tailileum 400 and Radaleum is essentially non-volatile and would not be expected to partition into the air within the container. The main exposure route for these two compounds would be dermal contact and ingestion of dusts from an unsealed floor. At this time, the following additional information can be provided:

BASILEUM

The active ingredient in this treatment appears to be Phoxim, an organophosphate insecticide that has an appreciably low toxicity to mammals. As stated by the World Health Organization, "Phoxim is an insecticide with selective properties: it is toxic to insects but virtually non-toxic to mammals." This is because mammals are able to metabolize the compound quickly. In this past, the compound has been used as a topical treatment for many farm animals. If present, it appears this compound may volatilize into the air.

TAILILEUM 400

The active ingredient appears to be imidacloprid. This is a commonly used insecticide that was made to mimic nicotine. As stated by the National Pesticide Information Center (NPIC), "imidacloprid is much more toxic to insects and other invertebrates than it is to mammals and birds." There are more than 400 products for sale in the U.S. that contain imidacloprid. This compound has a low vapor pressure and as such would not readily partition into the air (it is non-volatile) under ambient conditions. According to one reference from the State of California, the chemical properties of this compound "makes it unlikely that imidacloprid will be present in the air in detectable amounts following application by any method."

RADALEUM

The active ingredient appears to be cypermethrin, a synthetic pyrethroid insecticide. Because of the low vapor pressure, this compound does not readily volatilize into air. As stated by the State of California Department of Pesticide Regulation, "in mammals and birds, cypermethrin is relatively non-toxic."

The information provided in this section is preliminary in nature and is based off a brief search of the scientific literature. A more thorough analysis would need to be conducted prior to drawing any health-based conclusions.



INDUSTRY POSITIONS BY SEGMENT

SEGMENT I: TEMPORARY, SINGLE UNIT

Companies operating in the portable storage and office market operate a combined fleet of approximately 650,000 units. Eight companies are national players and own about half of these units and another 1,100 smaller companies operate locally running one or two sites. According to KeyBanc Capital markets (independent financial analysts) the portable storage market, represented roughly \$1 billion in annual sales in the U.S. in 2011.

Of this amount, it is difficult to determine exactly where the line is drawn between portable storage units and units converted for other business purposes such as construction site offices. In almost all cases, these existing containerized structures have not been through a standardized state administrative approval process nor do they bear the insignia of any state modular or industrialized program.

The most common modified container applications are ground level offices (GLOs), typically used on construction sites. Because they are used on construction sites, they are typically considered temporary structures. While the commonly used designs adhere to the life safety elements of the IBC, other factors such as roof slope, are less practical because of the design of a standard container. As an industry, these container offices have had an impeccable safety record.

The commonly used design of the GLO could be standardized, especially when considering reinforcement of the openings, and adherence to electrical standards. From a structural standpoint, the commonly used standard designs exceed the requirements of the IBC. (See chart on page 15- Calculations by R&S Tavares and Associates).

INDUSTRY POSITION FOR SEGMENT I: TEMPORARY, SINGLE UNIT

1. Application of any new codes related to container units in Segment I (if any) should be on a go-forward basis, using IEBC's treatment of existing buildings as precedent – "a building erected prior to the date of adoption of the appropriate code or one for which a legal building permit has been issued."

2. Whether a unit is temporary should be based on the transfer of ownership and public accessibility of the unit. If the title of the unit is not transferring hands to the owner of the site, the building should be deemed "temporary" as it will not be permanently on that property. Additionally, these types of units are most often used on closed construction or industrial sites not accessible nor made available to the general public (2012 IBC definition of "public use areas").

3. For consistency, states should consider any industrialized/modular/containerized building unit 720 sf or less to be exempt from the codes and regulations provided the building is not part of the permanent site plan and not open to the general public. Any utility hookups, set-backs, or accessibility issues should continue to be the responsibility of the local authority having jurisdiction.

4. For GLOs, develop a standard process for openings, reinforcement of openings, and adherence to electrical standards.

To require these temporary existing units to comply with the ICC's Acceptance Criteria 462 is overly cumbersome and difficult (if not impossible) to achieve.

SEGMENT II: TEMPORARY, MULTI-UNIT STRUCTURES

Because of the transportability and deployment speed of container structures, an increasing number of temporary applications are emerging for multi-unit structures. Special events and trade shows are seeing numerous containers assembled on-site. Retailers are experimenting more and more with pop-up retail stores that can easily be disassembled, moved, and reassembled, allowing for flexibility in following the market.

INDUSTRY POSITION FOR SEGMENT II: TEMPORARY, MULTI-UNIT

Unlike units categorized in Segment I exempted as temporary units, Segment II units should NOT be exempted based on the temporary permit application, but rather follow a process that is in alignment with Segment III and Segment IV.

SEGMENT III: PERMANENT, SINGLE UNIT

While similar in nature to Segment I, Segment III has a broader array of products and applications for container structures because of the more permanent nature of the product. Because the business model in this segment is more capital expenditure, rather than rental, the market can demand a more customized product.

Some applications in this segment are workspaces in industrial complexes, breakrooms, equipment enclosures, and security access points.

Currently, standards do not exist for the extent to which products can be customized. In cases where too much of a container wall is cut out and not properly reinforced, these can present safety hazards to the general public.

Similar to Segment I, because the envelope of the structure is a container, certain codes are not possible, such as the 2% roof slope. However, other codes related to life safety, should be followed.

INDUSTRY POSITION FOR SEGMENT III: PERMANENT, SINGLE UNIT

1. States should consider any industrialized/modular/containerized building unit 720 sf or less to be exempt from the codes and regulations provided the building is not open to the general public. Any utility hookups, setbacks, or accessibility issues should continue to be the responsibility of the local authority having jurisdiction.

2. Standards should be created and adopted regarding when to get an engineer involved to ensure the structural integrity of the container structure. The charts on pag 15 could be good starting point to provide guidance on which containers can be used as building elements, how many openings are acceptable, how to reinforce the openings, and when to get an engineer involved. Example: A structural engineer needs to review and certify the plans if more the 25% of the linear feet of the wall is cut out.

3. Codes relating to life safety should be highlighted, as well as interior climate systems, while other codes that do not apply well to a smaller container structure, should be exempted.

- Examples of life safety related codes – structural requirements (gravity and seismic), electrical standards, fire safety, and means egress.
- Examples of codes that should not apply due to physical container constraints – room size, ceiling heights, roof slope, and accessibility.

SEGMENT IV: PERMANENT, MULTI-UNIT

Are ISO containers safe to use for buildings and building components? Ultimately, that is the most important and pressing question being raised. As a single unit, the shipping container undergoes a stringent design, testing process, manufacturing, and quality process. Furthermore, containers are “field tested,” traversing the ocean in harsh environments before being repurposed into building components.

For Segment IV units, the degree of completion of the unit becomes a factor. For example, if the container is modified at an offsite location to the extent that the electric or plumbing of each unit is concealed when it arrives on site, the unit is considered “closed construction.” Units modified in this manner should follow the existing protocols in states with modular or industrialized building programs (see next section).

Alternatively, the local Authority Having Jurisdiction (AHJ) can require this evaluation to be carried out by an independent third-party inspection agency or engineer, with each unit “labeled” as meeting the local code requirements. The IBC defines a labeled unit as: Equipment, materials, or products to which has been affixed a label, seal, symbol, or other identifying mark of a nationally-recognized testing laboratory, inspection agency, or other organization concerned with product evaluation, that maintains periodic inspection of the production of above-labeled items and whose labelling indicates either that the equipment, material or product meets the identified standards or has been tested and found suitable for a specific purpose.

However, if the modified container is simply being used as a structural element in a larger building (no concealed elements), the building as a whole should be evaluated rather than each module individually. In this scenario, the construction design, engineering, permitting, inspection, and code compliance process should fall under the AHJ.

This process is currently being used in many places across the country with third-party engineers who have already developed procedures for evaluation and safe use of modified containers. These engineers are considering factors such as the structural integrity of the container before and after alterations, the quality control/quality assurance programs, whether the steel elements meet or exceed applicable ASTM or equivalent standards, gravity loads, lateral loads, wind, snow, and seismic factors. These factors obviously will vary by region, which is why it is important for the local AHJ to work with an engineer licensed to do work in their state.

MODULAR BUILDING PROGRAMS

Any three-dimensional, volumetric modular building or component that includes concealed elements such as electrical and plumbing behind a finished wall is considered “closed construction.” While the IBC does not define closed construction, the National Institute of Building Sciences Offsite Construction Council defines it as:

Closed construction - A building, component, assembly, subassembly, or system manufactured in such a manner that all portions cannot be readily inspected at the installation site without disassembly or destruction thereof.

Therefore, if the container is modified to the degree that it includes concealed elements, not easily able to be inspected on site, it should be treated like any other modular or industrialized building component and be regulated and inspected through the state or provincial agency where the building is to be located if such an agency exists. Currently, 36 state and provincial programs have oversight on the modular industry in North America. In states or provinces where no such agency exists, the local AHJ would have oversight.

INDUSTRY POSITIONS FOR SEGMENT IV UNITS: PERMANENT, MULTI-UNIT

- If the containers are “open” with no concealed plumbing or electrical elements and used primarily as structural elements in the building, the local AHJ working with an independent third party should determine compliance of the building as a whole.
- If each container or module contains concealed elements installed at an offsite location so as to make on-site inspection by the local AHJ difficult without destructive inspections, the containers should be inspected and labeled by an independent third party in accordance with state modular programs or subject to approval by the AHJ.

SUMMARY OF INDUSTRY POSITIONS

SEGMENT I - TEMPORARY, SINGLE UNIT:

- Application of any new codes related to container units in Segment I (if any) should be on a go-forward basis, using IEBC's treatment of existing buildings as precedent – "a building erected prior to the date of adoption of the appropriate code or one for which a legal building permit has been issued."
- Whether a unit is temporary should be based on the transfer of ownership and public accessibility of the unit. If the title of the unit is not transferring hands to the owner of the site, the building should be deemed "temporary" as it will not be permanently on that property. Additionally, these types of units are most often used on closed construction or industrial sites not accessible nor made available to the general public (2012 IBC definition of "public use areas").
- For consistency, states should consider any industrialized/modular/containerized building unit 720 sf or less to be exempt from the codes and regulations provided the building is not part of the permanent site plan and not open to the general public. Any utility hookups, set-backs, or accessibility issues should continue to be the responsibility of the local authority having jurisdiction.
- For ground level offices, develop a standard process for openings, reinforcement of openings, and adherence to electrical standards.
- To require these temporary existing units to comply with the ICC's Acceptance Criteria 462 is overly cumbersome and difficult, if not impossible, to achieve.

SEGMENT II – TEMPORARY, MULTI UNIT:

- Unlike units categorized in Segment I exempted as temporary units, Segment II units should NOT be exempted based on the temporary permit application, but rather follow a process that is in alignment with Segment III.

SEGMENT III – PERMANENT, SINGLE UNIT:

- States should consider any industrialized/modular/containerized building unit 720sf or less to be exempt from the codes and regulations provided the building is not open to the general public. Any utility hookups, set-backs, or accessibility issues should continue to be the responsibility of the local authority having jurisdiction.
- Standards should be created and adopted regarding when to get an engineer involved to ensure the structural integrity of the container structure. The charts on page 15 could be a good starting point to provide guidance on which containers can be used as building elements, how many openings are acceptable, how to reinforce the openings, and when to get an engineer involved. Example: A structural engineer needs to review and certify the plans if more than 25% of the linear feet of the wall is cut out.
- Codes relating to life safety should be highlighted, as well as interior climate systems, while other codes that do not apply well to a smaller container structure, should be exempted.

Examples of life safety related codes – structural requirements (gravity and seismic), electrical standards, fire safety and means egress

Examples of codes that should not apply due to physical container constraints – room size, ceiling heights, roof slope, and accessibility

SEGMENT IV – PERMANENT, MULTI UNIT:

If the containers are “open” with no concealed plumbing or electrical elements and used primarily as structural elements in the building, the local AHJ working with an independent third party should determine compliance of the building as a whole.

If each container or module contains concealed elements installed at an offsite location so as to make on-site inspection by the local AHJ difficult without destructive inspections, the containers should be inspected and labelled by an independent third party in accordance with state modular programs or subject to approval by the AHJ.



DEFINITIONS

CLOSED CONSTRUCTION

A building, component, assembly, subassembly, or system manufactured in such a manner that all portions cannot be readily inspected at the installation site without disassembly or destruction thereof. (source: National Institute of Building Science).

LABELED

Equipment, materials, or products to which has been affixed a label, seal, symbol, or other identifying mark of a nationally-recognized testing laboratory, inspection agency, or other organization concerned with product evaluation, that maintains periodic inspection of the production of above-labeled items and whose labelling indicates either that the equipment, material or product meets the identified standards or has been tested and found suitable for a specific purpose. (source: 2012 International Building Code).

PUBLIC USE AREAS

Interior or exterior rooms or spaces that are made available to the general public. (Source: 2012 International Building Code).

TEMPORARY STRUCTURE

A structure erected for a period of less than 180 days. (Source 2012 IBC).

ISO

An independent, non-governmental international organization bringing together experts to share knowledge and develop voluntary, consensus-based, market relevant International Standards.

Modular Building Institute
944 Glenwood Station Lane, Suite 204
Charlottesville, VA 22901 USA
www.modular.org

National Portable Storage Association
3312 Broadway, Suite 105
Kansas City, MO 64111 USA
www.npsa.org