

Built for an aggregate company, this Batch Plant Office includes a bathroom and kitchenette on the lower level and an upstairs office to oversee the quarry operations below.



Fortress Obetz near Columbus, Ohio, is a three-story community gathering space built using 122 shipping containers. It currently stands as the largest container-based building in the United States.



These Military Operations in Urban Terrain (MOUT) training structures were made for Cannon Air Force Base in New Mexico using over 700 shipping containers stacked up to four stories tall.

SAFE BUILDING with SHIPPING CONTAINERS By Stephen Shang

Repurposed shipping containers have taken root within the construction industry. What were once utilitarian boxes full of cargo out at sea are now seen across the United States and around the world as offices, living spaces, retail spaces, and multi-unit structures. The use of these steel cargo boxes as building materials continues to grow rapidly and, to keep up, structural engineers and the construction industry at large must learn to build these container-based structures with safety in mind.

This is the present challenge. A patchwork of regulations for shipping container structures has emerged, producing confusing and potentially conflicting information as local Authorities Having Jurisdiction (AHJs) have sought to develop specific standards. In some cases, the lack of definitive regulations has led industry participants to ignore building codes altogether, creating potentially unsafe structures. Imagine a construction worker getting trapped inside a container office due to poor structural welds. What if a cantilevered container structure were to collapse due to a lack of structural engineering approval? Tragedies like these would put lives in danger and bring permanent damage to the industry.

Fortunately, the International Code Council (ICC) is taking the necessary steps to create a safer future for container-based buildings. The ICC is dedicated to developing model codes and standards used in the design, build, and compliance process to construct safe, sustainable, affordable, and resilient structures. Most local governments trust the ICC's suggested codes and adopt the *International Building Code* (IBC) into law. Working alongside the Modular Building Institute's Container Task Force, which is comprised of various shipping container manufacturers and structural engineers, the ICC took steps to incorporate shipping container structures into the building code.

To that end, the ICC has published a new ICC Guideline, ICC G5 – 2019, which is intended "to help state and local jurisdictions – as well as owners, architects, builders, and engineers – in their assessment as to how to design, review, and approve such shipping containers as a building element." All quotes herein are from this Guideline unless otherwise noted.

The ICC Guidelines break the container-based structures industry into four segments: temporary single units (e.g., construction offices), permanent single units (e.g., equipment enclosures), temporary multi-units (e.g., pop-up retail structures), and permanent multi-units (e.g., multi-family buildings). Because these four segments are distinctive, shipping container building codes should not be one-size-fits-all solutions. For example, a single unit ground level office should not be regulated as a multi-story apartment. The ICC Guidelines make it clear that permanent structures built from containers, "like any other building structure, are required to comply with the codes," both non-structural and structural. However, for temporary structures, the ICC Guidelines state that they "may not be requiring full compliance with the provisions of the building code."

Specific to structural code compliance, one of the critical problems is the lack of information on material properties and specifications for the steel elements of the container. The ICC Guidelines solve this problem by providing a section on Referenced Standards and demonstrate how the shipping container industry tests the structural integrity of each container. A Convention for Safe Containers (CSC) Safety Approval Plate, fastened to the exterior of the structure, distinguishes containers that are built, tested, and inspected against the ISO standards, providing the necessary data and information on the construction of the specific container. "A code official can reasonably rely on a data plate to confirm that a container was built and inspected to the appropriate ISO standard." A container without a CSC Safety Approval Plate can and should be rejected by code officials.

The ICC Guidelines also address the interior of the containers and their wood flooring. What has caused concern for some is rooted in misunderstanding. The ICC Guidelines provide evidence supporting that it is highly unlikely that a contaminated container would make it into the marketplace, and they cite evidence proving that the chemicals used to treat the wood floors are harmful only to insects as a repellent, and not to humans.

The current Acceptance Criteria pertaining to shipping containers, ICC-ES AC462, is not meant for overall building code compliance but instead establishes the physical and chemical properties of the container. This regulation is not retroactive and, although it is the most utilized regulation, it is not the only path forward.

As the ICC Guidelines evolve into more definitive requirements, the ICC will provide a ratified amendment to Chapter 31 of the 2021 IBC. This new building code will incorporate shipping containers for the first time, and provide data for code officials and the industry to ensure these container-based buildings are structurally safe even when modified. Additionally, the code provides a roof exemption and a simplified structural design methodology for single unit containers.

Considering all the previously discussed guidelines, a future of a well-defined shipping container building code is becoming a reality. The adoption of these guidelines will allow the shipping container construction industry to evolve safely. It will ensure that each container structure is safe and that there is a starting framework to engage in proactive dialog. Now, one can imagine a future where container-based structures help in solving problems instead of creating them, possibly by providing affordable housing in major urban areas or extra space in overcrowded schools. A different picture results from well-regulated shipping container structures, one that comes with an abundance of benefits for the businesses and communities that use them.

To learn more about shipping container building code, read the ICC G5-2019 Guideline for Safe Use of ISO Intermodal Shipping Containers Repurposed as Buildings and Building Components (https://bit.ly/31ZD7o0) and the Modular Building Institute's Safe Use and Compliance of Modified ISO Shipping Containers For Use as Buildings and Building Components white paper (https://bit.ly/36ikrit).

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