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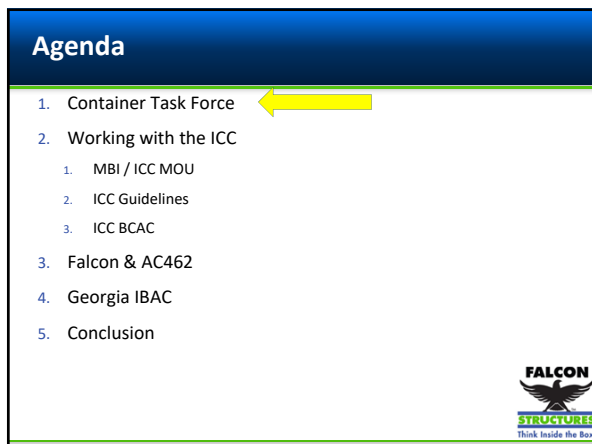
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### Industry Stats

**Today**

- ❑ \$500 million in GLOs (Ground Level Offices)
- ❑ 650,000 storage containers
- ❑ Industry economics
- ❑ Public safety

**Tomorrow**

- ❑ Acceleration of container adoption
- ❑ Increasing the size of the industry

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### ICC-ES AC462 – Feb 2016

- ❑ What is an Acceptance Criteria?
- ❑ Some Positives
- ❑ Confusion
  - ❑ Industry surprised
  - ❑ Purpose built container?
  - ❑ Go forward or retroactive?

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### Container Task Force

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.  
Stephen Howard, Container Services International  
Guy Roger, Caru West Gulf Containers  
Roland Brown, Ramtech Building Solutions  
Tom Hardiman, Modular Building Institute  
Guy Sextro, Pac Von 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



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### Industry Whitepaper

- Published Jun 2017
  - Overview
  - Current Code Environment
  - Industry Segments
  - Structural Integrity
  - Toxicity
  - Industry Positions of Segments
  - Summary of Industry Positions
- Calling card with code officials



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

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### Agenda

- Container Task Force
- Working with the ICC ←
  - MBI / ICC MOU
  - ICC Guidelines
  - ICC BCAC
- Falcon & AC462
- Georgia IBAC
- Conclusion



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### How code feels



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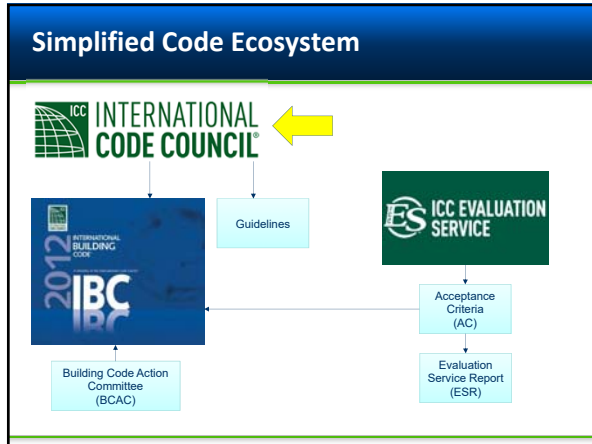
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### Key Take-Away #1

**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 governments trust the ICC's suggested codes and adopt the IBC into law.

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### MOU between ICC & MBI

- Executed April 2017
- Laid the groundwork for relationship
- Streamline use of Offsite Construction

MOU: Memorandum of Understanding

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### Key Take-Away #2

**ICC and MBI are working together to create safe and sensible shipping container building code**



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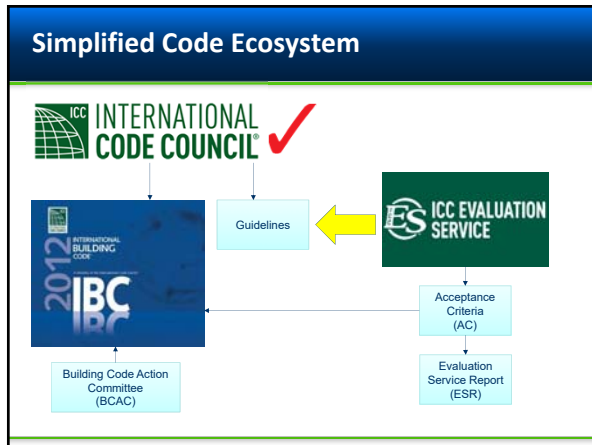
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### ICC Guidelines

- Task Force formed in June 2017
- Not regulatory doc
- Open for public comments

**Scope**  
Many code officials, when presented with a request for a shipping container to be used in their jurisdiction, are **challenged** in terms of what is in the best interest of their jurisdiction. This is primarily due to the **lack of regulatory information** in today's codes.

This guideline is intended to **provide direction** to all those involved in the use and application of shipping containers in terms of the health, safety, or welfare of the built environment.



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### Current Regulatory Environment

- Until 2016, container structures were risky to develop
  - Developers were at the mercy of local AHJ's
  - "Alternative Means & Methods"
  - NOCO
- Code community starts to pay attention
  - Patchwork of inconsistent regulations
  - ICC-ES AC462 Published



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### Industry Segments

	TEMPORARY	PERMANENT
<b>SINGLE UNIT</b>	<b>I</b> GROUND LEVEL OFFICE CONSTRUCTION OFFICE STORAGE UNITS	<b>III</b> INDUSTRIAL WORKSPACE EQUIPMENT ENCLOSURES SECURITY ACCESS POINTS
<b>MULT-UNIT</b>	<b>II</b> POP-UP RETAIL TRADE SHOW STRUCTURES SPECIAL EVENTS	<b>IV</b> INDUSTRIAL HOUSING HOTELS MULTI-FAMILY

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### Industry Segments 1 & 3



Example of Type 1: Single unit Temporary - Mobile Ground Level Office



Example of Type 3: Single unit Permanent - Poolside cabana

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### Industry Segments 2 & 4



Example of Segment 2:  
Temporary multi-unit tailgate



Example of Segment 4:  
Permanent multi-unit Stadium

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### Key Take-Away #3

It doesn't make sense to regulate a single-unit ground level office the same way we'd regulate a multi-story apartment complex.

**Shipping container building code should not be one-size fits all.**



**FALCON**  
STRUCTURES  
Think Inside the Box

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### Referenced Standards

- CSC – Convention for Safe Containers
  - International Agreement in 1972
  - Allows containers to operate worldwide
- ISO 1496
  - International Standards Organization
  - World-class specifications
  - 164 standards bodies



International Organization for Standardization

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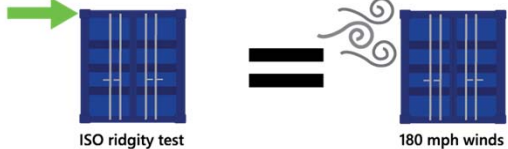
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### ISO Standards



The ISO rigidity test demonstrates that anchored shipping containers can withstand 180 mph winds without warping.



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### Testing & Certification

- Classification Society
  - American Bureau of Shipping
  - Lloyds Register
  - Bureau Veritas
- Testing & Certification
  - Review container design
  - Load tests
  - Dimension check
  - Regular Inspection

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### CSC Safety Approval Placard



Worldwide safety regulations & standards

- ISO 1496
- Convention for Safe Containers (CSC)
- Classification Societies



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Guideline

### Key Take-Away #4

**Shipping industry already tests the structural integrity of each container.**

We should be able to use container industry standards to inform the performance of containers that will be used as building elements.



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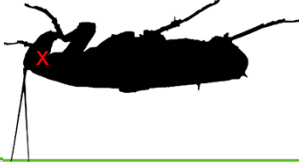
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Guideline

### Interior and Wood Floor Treatment

- Published Sep 2017
- Evaluate toxicity of four commonly used wood treatments:
  - Basileum
  - Meganium
  - Radaleum
  - Tailileum
- Review of the peer-reviewed toxicological literature
  - World Health Organization (WHO)
  - Food and Agricultural Organization of the United Nations (FAO)
  - Environmental Protection Agency (EPA).



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Guideline

### Key Take-Away #5

*"[It is] not expected that any potential exposure to these pesticides present in the flooring of the storage containers would pose an immediate or long-term health concern."*

– Toxicological Evaluation of Four Wood Treating Products, TRC



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Guideline

### Don't scrap AC462. Just clarify it.

- Not meant for overall building code compliance
- But establishes the physical & chemical properties of a shipping container.
- AC462 is not retroactive on existing buildings and GLO's
- Differences in single vs multi container
- AC462 is not the only path forward for shipping container
- Clarifies CSC & ISO and the role of Classification Societies such as ABS



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Guideline

### FAQ #1

What is the process to determine the presence of other possible chemicals or toxins such as those used in the packing material contained in the shipped cargo or used in the construction of the container?

Several national & international protocols and procedures in place by the shipping container industry that minimize chance that a contaminated could not be properly cleaned

- International Maritime Dangerous Goods (IMDG) Code
- US Customs & Border Patrol / EPA



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Guideline

### FAQ #2

- Can a container-based structure have any use or occupancy?
- There are no restriction on the type of use or occupancy provided all applicable code requirements for that specific use or occupancy are satisfied



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**FAQ #3**

- ❑ What is the fire-resistance rating for shipping container walls?
- ❑ There has been no conclusive study or testing performed to determine what the minimum fire-resistance rating.



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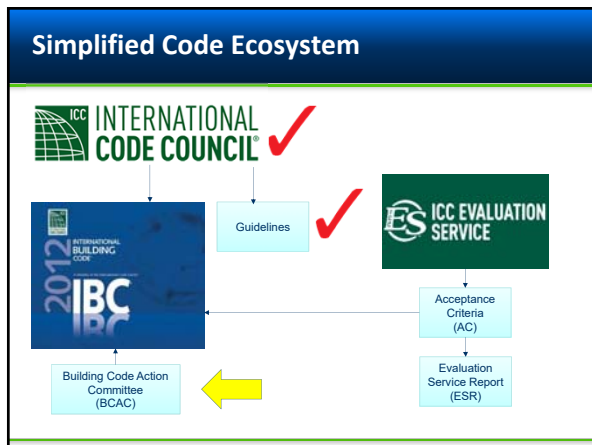
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**ICC Building Code Action Committee (BCAC)**

- ❑ Initiated in Oct 2016 by ICC
- ❑ Launched in June 2017
- ❑ Code Hearings April 15-25, 2018 – **Approved 14-0**
- ❑ Incorporate into chapter 31 into IBC 2021

**Reason:**  
This code change purpose is to introduce intermodal shipping containers into the International Building Code based on requests by code officials in the U.S. Prior to this proposal, several jurisdictions had created their own individual regulations or ordinances, or had administered additional requirements beyond the code (e.g. Section 104.11 "Alternative materials, design and methods of construction and equipment") so as to be comfortable to ensure a safe structure. This code change proposal is in response to those requests to develop a set of consistent code provisions which cover the minimum safety requirements, but which do not duplicate existing code provisions.

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**ICC Annual Conference 2018**



**G151-18**  
MOTION  
**AMPC**  
ENDED

NOTES  
1 & 2

97.42% (261)  
Support

2.58% (7)  
Oppose

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**Sample – Ch 31**

- Scope
- Simplified structural design of single-unit containers
- Guidance on multi-unit container structures



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**Scope**

- Intermodal shipping containers that are repurposed for use as buildings or structures or part of buildings or structures
- Exceptions:
  1. Previously approved with Ch 14 of IEBC
  2. Stationary storage battery arrays complying with Ch 12 of IFC
  3. Listed as equipment



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**Data Plate**



- ❑ Containers shall bear a data plate per ISO 6346 / Verified by approved agency
- ❑ Permitted to be removed when repurposed



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**Key Sections 3114.4 to 3114.8**

- ❑ Protection again decay & termites – Section 2304.12.1.1
- ❑ Underfloor ventilation – Section 1202.4
- ❑ Roof assemblies – Ch 15
  - ❑ EXCEPTION: Single-unit intermodal shipping containers not attached to other buildings or structures
- ❑ Joints & Voids – Section 715



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**Structural design - Detailed**

- ❑ Detailed design procedure
  - ❑ Material properties – properly identify or test
  - ❑ Seismic design – ASCE 7 Table 12.2-1
  - ❑ Allowable shear value – Testing & analysis Section 104.11



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**Structural design - Simplified**

- ❑ Simplified structural design of **single-unit containers**
- ❑ Limitations
  - ❑ Not in contact with or supporting other containers or structure
  - ❑ Top & bottom rails, corner castings, columns shall not be notched, cut or removed
  - ❑ Horizontal with floor at the bottom
  - ❑ Seismic Design Cat A,B,C,D
- ❑ Assumptions for steel shear walls
  1. The appropriate detailing requirements contained in Chapters 16 through 23.
  2. Response modification coefficient,  $R=2$ .
  3. Overstrength factor,  $O_e=2.5$ .
  4. Deflection amplification factor,  $C_d=2$  and
  5. Limits on structural height,  $h_u=9.5$  feet (2900 mm).




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**Structural design - Simplified #2**

**TABLE 3114.8.5.3**  
Allowable Strength Values for Intermodal Shipping Container Corrugated Steel Shear Walls for Wind or Seismic Loading

CONTAINER DESIGNATION <sup>1</sup>	CONTAINER DIMENSION (Nominal Length)	CONTAINER DIMENSION (Nominal Height)	ALLOWABLE STRENGTHS (kips/ft <sup>2</sup> )	
			Side Wall	End Wall
1EEE	45 feet (13.7 M)	9.5 feet (2896 mm)	75	843
1EE	40 feet (12.2 M)	8.5 feet (2591 mm)	84	
1AAA		9.5 feet (2896 mm)		
1AA		8.5 feet (2591 mm)		
1A		8.0 feet (2438 mm)		
1AX	30 feet (9.1 M)	9.5 feet (2896 mm)	112	
1BBB		8.5 feet (2591 mm)		
1BB		8.5 feet (2591 mm)		
1B		8.0 feet (2438 mm)		
1CX	20 feet (6.1 M)	8.5 feet (2591 mm)	168	
1CC		8.0 feet (2438 mm)		
1C	10 feet (3.0 M)	8.5 feet (2591 mm)	337	
1CK		8.0 feet (2438 mm)		
1D		8.0 feet (2438 mm)		
1DX				

**Conditions**

1. Openings < 50% of length of side or end walls
2. Full height wall length > 4'
3. Boundary element
4. Openings are framed
5. Max penetrations per 8' length
6. End wall doors shall be welded closed




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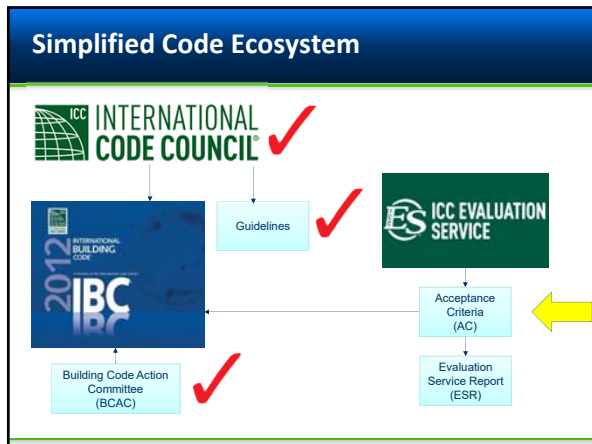
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### ICC-ES AC462 Update

- ❑ May 2017 – 1<sup>st</sup> ESR issued
- ❑ May 2018 – 2<sup>nd</sup> ESR issued
- ❑ Multiple states incorporate AC462
- ❑ Open Issues
  - ❑ Classification Societies
  - ❑ Practicality of used containers



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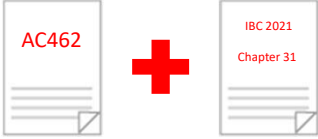
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### BCAC & AC462

- ❑ Chapter 31 will co-exist with AC462
- ❑ AC462 cannot be incorporated into IBC
- ❑ “Non-consensus developed documents”



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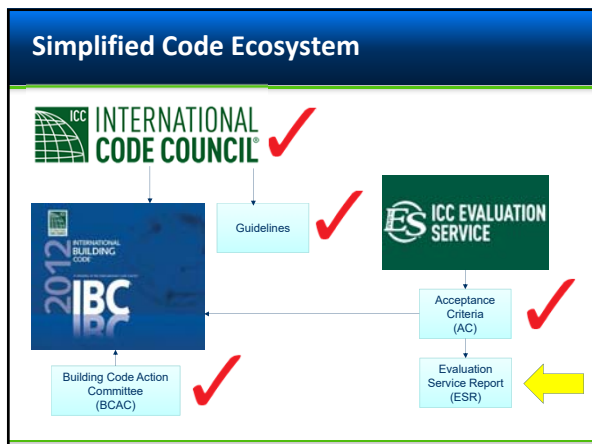
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### Agenda

1. Container Task Force
2. Working with the ICC
  1. MBI / ICC MOU
  2. ICC Guidelines
  3. ICC BCAC
3. Falcon & AC462 ←
4. Georgia IBAC
5. Conclusion



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### Falcon - AC462 Timeline

- Kicked off in Aug 2017
- Quality Manual (AC10)
- Selecting manufacturer
- Train employees
- Revamp operational process
- 3<sup>rd</sup> party inspector came out to inspect
- Receive ESR



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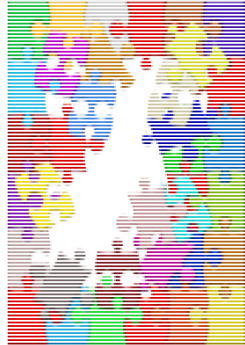
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### Key resources & challenges



- Selecting container manufacturer
- JIS - Comparable, not equivalent
- Quality system
- Design guide
- Resources - ~\$100k
- Timeline – Aug 2017 to April 2018



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**Key Take-Away #6**

**Viable paths for code compliance  
are emerging.**



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**Agenda**

1. Container Task Force
  1. Industry Whitepaper
  2. Toxicology Report
2. Working with the ICC
  1. AC462 Update
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3. Falcon & AC462
4. Georgia IBAC ←
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**Georgia's IBAC\***

- Initial presentation – Aug 2016
- IBAC Vote – Dec 2017
- Effective Date – July 2018
- Highlights
  - Accepts AC462, but also CSC & IICL
  - Up to 4 years old
  - Temporary storage use exempt
  - Open issue: Toxicity



\* IBAC – Industrialized Buildings Advisory Committee

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### Agenda

1. Container Task Force
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### Conclusions

- ❑ ICC is dedicated to developing model codes for SAFE structures
- ❑ ICC and MBI are working together to create safe and sensible shipping container building code
  1. Shipping container building code should not be one-size fits all
  2. Shipping industry already tests the structural integrity of each container.
  3. Floor treatments are safe for humans.



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### Conclusions

- ❑ Viable paths for code compliance are emerging.
  - ❑ Guidelines
  - ❑ Ch 31 IBC
  - ❑ AC462



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**Questions?**

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**Falcon Structures**

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M: 512-825-9516

[stephen@falconstructures.com](mailto:stephen@falconstructures.com)

*Think Inside the Box™*



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**Thank You For  
Attending**



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