

SOLVE FOR X.

Global Seismic Awareness Across the Supply Chain

Presented by:

**Ryan Peck, Regional Sales Director,
Hannibal Industries, Inc.**

Andrew Kirby, Inventor of TubeRack

**Skip Eastman, CEO and President,
Twinlode Corporation**



Agenda

- Speaker introductions
- Hannibal and Twinlode's partnership
- Data on global seismic activity
- How to effectively navigate seismic permitting requirements
- Guidelines for planning projects in seismically active areas
- Innovations in engineering solutions for seismic activity and benefits of dual-moment frames
- Examples of installations in warehouses/DCs

Introduction – Skip Eastman, Twinlode Corp.

Skip Eastman is the CEO of Twinlode Corporation.

With more than 40 years in the material handling industry, Eastman has vast experience managing projects that encompass rack, ASRS, push back and flow-through storage systems. Twinlode Corporation is a leading supplier of high-density storage rack systems, specializing in the beverage, produce and food processing industries. Under Eastman's leadership, the company has completed multiple implementations across the globe for the leading food and beverage companies in the world.

Introduction – Ryan Peck, Hannibal Industries

Ryan Peck is Regional Sales Director for Hannibal Industries. Ryan started his career in the material handling industry at the young age of 15 years old under the tutelage of his father at Liftrucks, Etc., where he accumulated a record of consistent growth for the company. In 2006, he founded a material handling installation company named WIZE Solutions, which became recognized in the industry as one of the largest material handling solutions installers in the country. After selling WIZE Solutions, Ryan was hired by Hannibal as product manager for its Metalsistem Shelving Division in 2012. His success prompted management to his recent promotion to Sales Director for Hannibal South to include Texas, the Southeastern states and internationally in Latin America.

Introduction – Andrew Kirby, Kirby & Associates

Andrew Kirby, PE, Principal at Kirby & Associates, Copartner of the TubeRack patent with Hannibal Industries, has over twenty-five years of experience in structural design and investigation of building and non-building structures, and leads structural engineering designs for TubeRack. Andrew has designed and been engineer of record for major non-building projects throughout North and South America, Europe and Asia. Andrew specializes in developing creative and innovative solutions to complex engineering related problems and believes and delivers in "doing more with less."

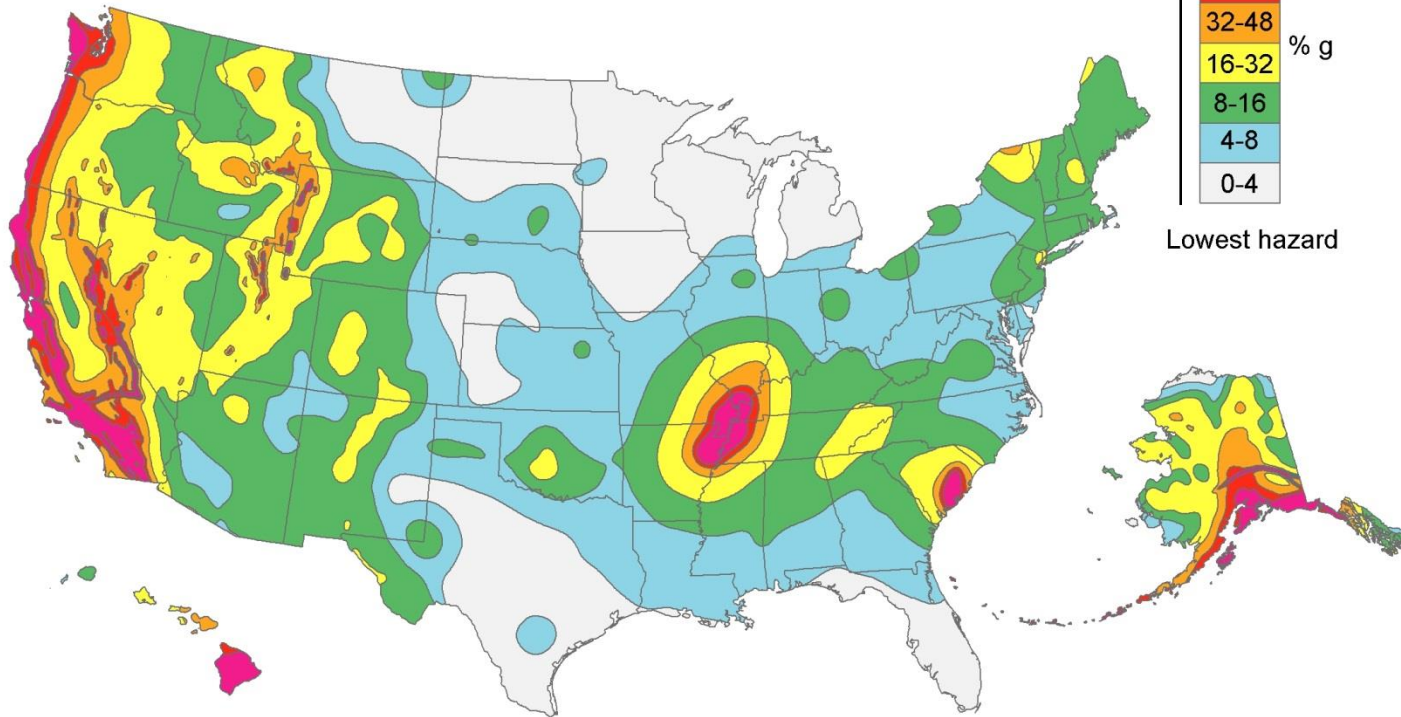
Hannibal and Twinlode's Partnership

Hannibal Industries, with its expertise in engineering solutions to protect against seismic activity, and Twinlode Corporation, with an extensive background in providing complete storage solutions for warehouse management, have teamed to present applicable guiding principles to consider when building warehouses and distribution centers in this modern era. Attendees will learn how to approach projects armed with the most stringent guidelines for optimum safety.

Global Seismic Activity

- According to the U.S. Geological Survey, there were 14,588 earthquakes of magnitude 4.0 or greater in 2015 globally.
- This is a staggering reality for many companies trying to navigate the engineering feat of building a streamlined warehouse environment.
- As the global economy grows, it is equally important for companies working within the supply chain with international reach to be aware of laws and ordinances that require infrastructure to handle weather patterns that vary.

Earthquake Hazard Map



Implementing the necessary preliminary research and evaluation in the beginning stages of the building process will set you up for success when navigating permitting requirements associated with the project.

Tips for Navigating Seismic Permitting Requirements

How to effectively navigate permitting requirements when building a distribution center in a geographic area that is susceptible to natural disasters:

1. Determine the longitude and latitude of the physical address (<http://earthquake.usgs.gov>, <http://stevemorse.org/jcal/latlon.php>)
2. Review the building construction with the Engineer of Record, including the slab details
3. Select a Rack Manufacture Institute (RMI) supplier that has experience in the geographical area of your building
4. Determine the applicable code for the area that you will be installing your racking
5. Contact the city for applicable requirements

Guidelines for Planning Projects in Seismically Active Areas

How to approach projects armed with the most stringent guidelines for optimum safety and protect your supply chain facilities from the imminent threat of natural disasters:

1. Understand the time required
2. Understand the fees
3. Understand the inspection requirements
4. Acquire and review permit applications
5. Gather copies of the documents and drawings required for the permitting

Innovations in Engineering Solutions for Seismic Activity

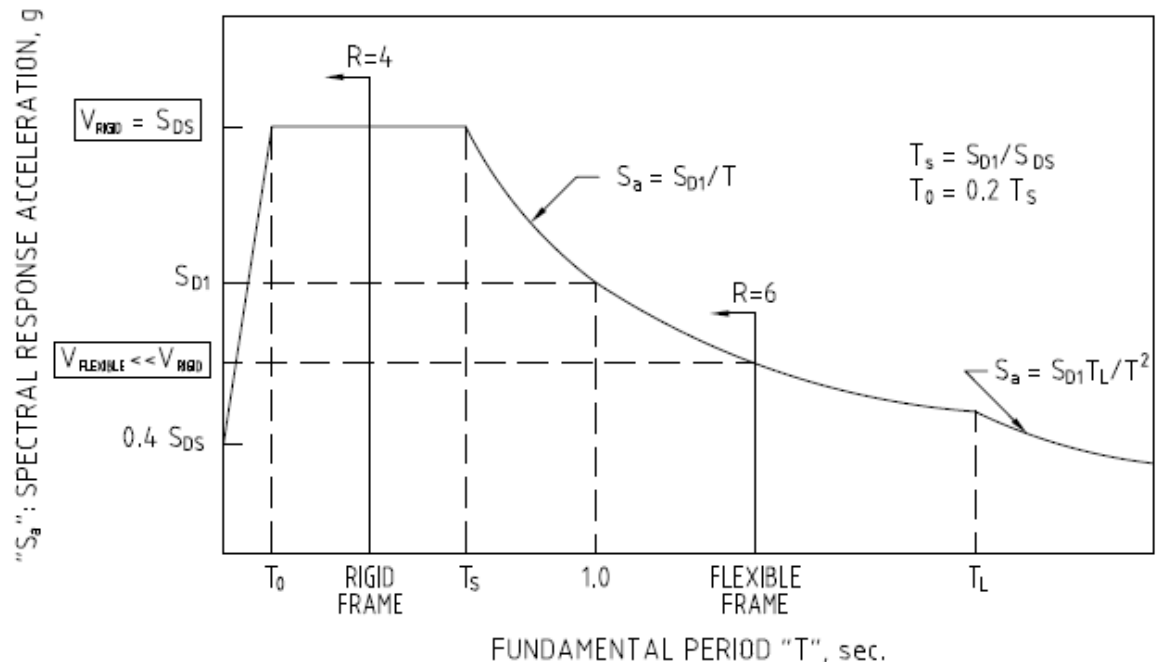
Incorporating dual-moment frame structural systems into storage system designs have resulted in material handling solutions that are **stronger, smarter and exceed new seismic regulations globally**, while providing substantial cost savings in warehouses.

Benefits of Dual-Moment Frame Structural Systems

Reduce the design base shear requirements by changing the lateral force resistance system from rigid to flexible

Transverse moment frames have a longer fundamental period “T” combined with a greater response modification factor “R” (6 for flexible compared to 4 for rigid).

Using such systems can reduce the seismic design demands by as much as 70-80%.



DESIGN RESPONSE SPECTRUM

Benefits of Dual-Moment Frame Structural Systems

Stronger

- Closed tube upright frames provide resistance to earthquake and impact forces in all directions from head-to-toe, including torsion or twisting.
- Dual-moment frames behave as horizontal springs under impact and are much more resistant to damage.

Smarter

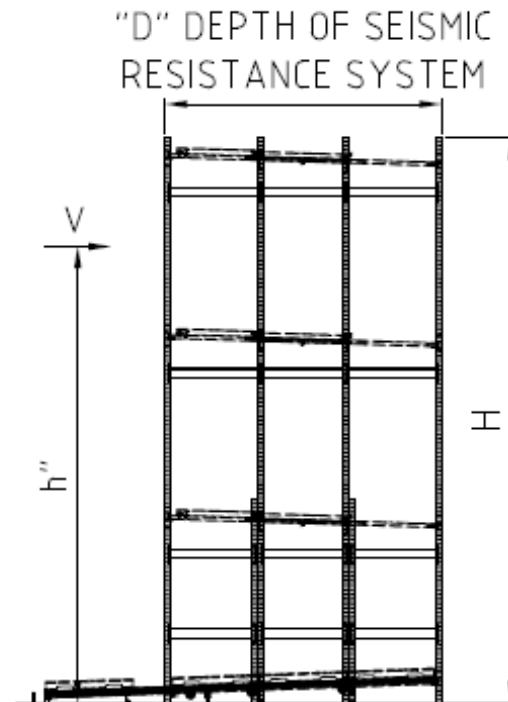
- Dual-moment frame structural systems have transverse seismic design demands 70-80% lower than those of conventional rack uprights.
- Lower design force demands permit greater storage height to upright depth ratios without compromising operator safety.

Safer

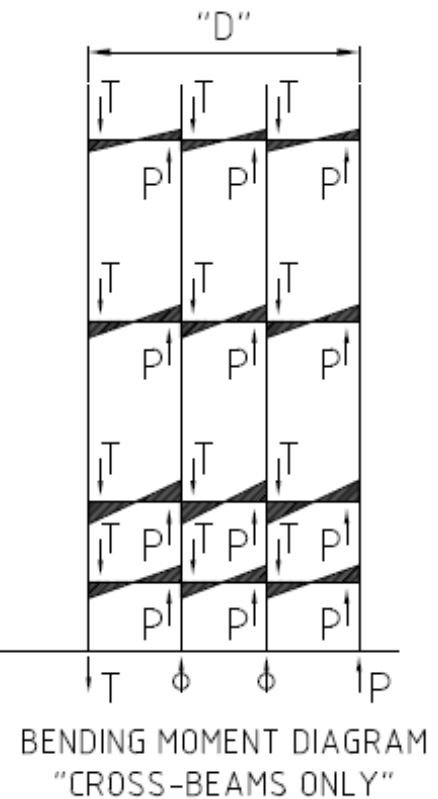
- Dual-moment frame uprights behave as horizontal springs and flex "slowly" under earthquake and impact loads. This results in less product shedding and a safer working environment.
- The loss of any cross-beam connection or member does not result in a mechanism such that the system is prone to catastrophic collapse. With dual-moment frames the system remains in a stable condition and is easier to repair. These frames have built-in redundancy.

Dual-Moment Frame Structural System Example

- No added axial load on interior posts due to seismic lateral loads
- Earthquake demands on slab greatly reduced
- Anchor bolts have little or no net tension forces



GREATLY REDUCED UPRIGHT HEIGHT
TO DEPTH RATIO, $[H/D]$



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Examples of Installations in Warehouses/DCs



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TWINLODE DRIVE-IN RACK SYSTEM:



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HANNIBAL STRUCTURAL PALLET RACK SYSTEM:



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