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**The TubeRack –
A Revolution in Steel Pallet
Storage Rack Systems**

A White Paper
By Hannibal Industries, Inc.

The Problem

When iconic pop singer Carole King wrote and sang the lyrics “I feel the earth move under my feet” she was crooning a love song. Little did she know how those words would shake up business and industry leaders worldwide, especially in earthquake prone areas like California and the Pacific Rim, South America, Japan and Southeast Asia, for instance.

According to seismic engineers at the Jet Propulsion Laboratory in Pasadena, “recent earthquakes (Northridge, Calif. 1994, 6.7 on the Richter Scale and the Kobe, Japan quake of 6.9) demonstrated the risks to modern industrial societies facing the real possibilities for massive loss of life, infrastructure damage and financial instability.”

While major efforts have been made to improve safety procedures, develop new technologies and implement stricter building codes in the U.S., there still remains a strong need to shore up earthquake resistance of a building’s contents which can be displaced if not securely designed, installed, maintained and loaded.

For low-profile objects that slide, shake damage can be minimal, but loss can increase when equipment must be realigned or interconnections repaired. Some suspended items may swing without consequences, while others may sustain substantial damage from broken connections, impact with other objects or loss of vertical support. Objects with relatively high centers of gravity can collapse or overturn.

This danger is most evident in consumer warehouse or “big box” stores, such as Home Depot, Costco and others, and in industrial buildings that store products and parts for manufacturing and shipping. These facilities currently use tall metal storage racks to hold standard forklift-ready pallets loaded with objects typically weighing thousands of pounds, ie: vehicle engines, heavy machinery, appliances. With the advent of large forklifts capable of raising pallets to heights of 24-feet and higher, the racks are vulnerable to swaying, collapsing or toppling during an earthquake -- a scenario for disaster.

For 35 years, the technology for manufacturing storage racks has not changed. Steve Rogers, vice president of sales for Hannibal Industries in Los Angeles, one of the country’s leading rack manufacturers, explained that not only is seismic activity a cause for concern among his customers, the costs and logistics of shipping, assembling and reassembling the rack configurations also play an important role in the purchasing decisions.

He added that, depending on the height and configuration of the racks, combined with the expected weight of the stored items, his customers may need to increase the thickness and strength of the concrete slab they are anchored to, a major expense that can cost millions of dollars.

Hannibal and other storage rack manufacturers adhere to structural code guidelines established in the last decade by a special Rack Project Task Group formed at the request of the Federal Emergency Management Agency (FEMA) by the Building Seismic Safety Council (BSSC).

The group is comprised of engineers, storage rack designers, researchers, members of the Rack Manufacturers Institute (RMI) and the Retail Industry Leaders Association, and other experts.

Until now, said Rogers, there have been two major types of racking:

One is the traditional “roll-formed” rack, which typically utilizes an open C-section column of varying shapes depending on the manufacturer. Traditionally in the U.S., with this particular product a brace is welded into the section, becoming a welded truss, horizontally and diagonally. Some companies in both Europe and America bolt the brace into the column instead of welding it for two main advantages – to save manufacturing costs and reduce shipping costs by compacting the load. The disadvantage of manual assembly is that the welding costs are transferred to the costs of installation, which involves labor and sorting the many boxes of nuts and bolts at the jobsite.

The other type of rack is “structural”. The manufacturing starts with hot- formed structural angle and channel steel which is then cut, hole-punched, welded and painted to the customer’s specifications. Some companies make either the C-section or the structural racks. Hannibal makes both types to satisfy any need their customers might have, said Rogers.

However, as the customers require higher and stronger rack configurations to bear the weight of heavier pallets (the average pallet handles 2500 pounds and is expected to reach 3500 pounds in the immediate future), Rogers also recognized their fears of possible dire consequences from earthquakes, seismic movement and industrial accidents.

“What is happening with existing rack systems,” said Rogers, “is the footprints are getting bigger, often forcing the customer to build thicker slabs. Ten years ago the standard concrete floor was 5-6 inches thick. Today, the customers want to go 35 feet high and store 3000-pound pallets. Under most building codes, the facilities must have 10-inch thick slabs to withstand that kind of seismic stress. As the codes become more stringent, getting that high with that kind of load is not an option – even with a 10-inch slab.”

How could customers meet their demands without the tremendous expense of retrofitting their expansive slabs or face code violations?

The Solution

In 2005, the Federal Emergency Management Agency (FEMA), acting under the National Earthquake Hazards Reduction Program (NEHRP), issued a 160-page report specifying recommendations for improvements to buildings and their contents, including steel pallet storage racks located in areas accessible to the public and to employees. The report is designated as a “voluntary resource document” for use by practicing design professionals and building officials, and serves as the basis for the seismic requirements of the nation’s model building codes and standards.

In developing the report a FEMA task force focused primarily on steel single selective pallet storage racks. It reviewed available information on storage rack performance during earthquakes and the background on the development of standards and code requirements for storage racks. It also assessed seismic requirements for storage racks and current practices

with respect to rack design, maintenance and operations, quality assurance and post-earthquake inspections, and it examined available research and testing data.

As a result, the task force recommended specific design principals and cyclic connection testing that would enhance already existing methods of collapse prevention. It found that the rigid behavior of rack structural system members and connections are “significantly different from those of building structural systems (although the systems appear physically similar) and storage racks do not have the added benefit of diaphragms or secondary structural elements found in building structures.”

Because the detailed behavior of rack connections can be so fundamentally different from those used in buildings, the report states, “it is recommended that typical building system type detailing approaches not be applied to racks. Instead, the approaches should consider the nonlinear behavior of the racks and the necessary detailing that will ensure that the seismic response will be acceptable.”

Enter the TubeRack from Hannibal Industries

Fortunately, Hannibal’s long-time engineering consultant, Andrew Kirby, had the seismic danger problem on his mind for several years. He was familiar with the FEMA report as well as state and municipal code requirements as they applied to steel pallet storage racks, and had developed a new patent-pending rack design that would satisfy and surpass federal recommendations and meet all existing standards.

Kirby saw Hannibal as a perfect fit for his new design because it is a leading rack manufacturer with the capability to produce the tubular steel frames required. After working with Hannibal’s designers and submitting a pending joint-ownership patent, Kirby’s idea is now reality under the brand name TubeRack.

“TubeRack is simplistic in design,” said Kirby, “with unique structural engineering features and advantages not found in previous large and tall metal storage racks used inside or outside buildings. Each rack’s flexible moment frame can flex or drift laterally during an earthquake, reducing the potential of the frame collapsing and damage to stored goods and greatly improving safety to persons in the area next to the frame.”

TubeRack advantages:

- Field assembly can be accomplished without welding through the use of hand-ratcheted “snug tight” nuts and bolts. According to Kirby, “...all bolts are tightened sufficiently to prevent removal of the nuts without the use of a wrench. With TubeRack installations all connection bolts are visible, however for “hot-rolled” racks the bolt nuts are hidden behind the flanges of the posts and any loose nuts are more likely to go unnoticed.”
- TubeRacks are modular and scalable -- all frame components are interchangeable and can be built to various heights. The length and width of the racks can be easily increased when additional storage is required.

- The TubeRack’s simplistic design uses HSS structural tubing posts, providing more stringent straightness tolerances, far superior impact resistance , increased flexibility and decreased costs of ownership.
- TubeRack provides a “flexible moment frame” that allows access for loaded pallets and flexes or “floats” in a lateral motion during seismic activity in all directions.
- Due to their unique design and construction, TubeRacks can be mounted on existing slabs and provide greater storage capacity than conventional racks.
- Using TubeRack higher capacity pallet loads – up to 3,500 pounds – are easily and safely accommodated in Hannibal’s various storage solutions – Selective, Double Deep, Push Back, Pallet Flow, Drive-in, Pallet Shuttle, GlideRack, Archive, Retail and AS/RS systems.

“Instead of welding or bolting a solid truss, Kirby’s design allows us to create a system with only horizontal members, no diagonals and connections that use snug tightened bolts, not ratcheted,” Rogers added. “The footplates are smaller and the anchor bolts are closer to the column, not further away. This allows movement in all directions to relieve the stress during a seismic event.” Kirby calls it a “horizontal spring”, the energy goes into the structure and returns to its original position.

This combination of strength, flexibility, ease of installation and reassembly is ideal for growth, he said. “As the customer requires higher (sometimes floor to ceiling) and larger racks with heavier wall sections, TubeRack frames can be made in 3 by 3-inch, 3 by 4-inch and 3 by 5-inch configurations and up to a quarter-inch thickness to accommodate these demands.”

Since cost-efficiency is uppermost on the minds of Hannibal customers, important elements of the storage rack purchasing equation are the potential cost savings for the building (slab), the ability to use desired pallet loads (no weight reductions due to uplift issues), costs of shipping and future savings for repair as well as disassembly and reassembly when moving to a different location. Rogers said his customers save an average of 30 percent on freight costs, since up to 48,000 pounds of TubeRack components can be neatly stacked onto a single truck.

A customer’s testimonial

One of Hannibal’s first customers for TubeRack developed out of its long-time relationship with Storage Solutions, a major provider of industrial storage and material handling equipment headquartered in Indiana. The company has designed and installed more than 27 million square feet of rack systems just in the last three years across the U.S., Canada, Mexico and Puerto Rico.

For Kevin Rowles, president of Storage Solutions, the decision to purchase the TubeRack system was prompted by recent cancellations or postponements of its customers’ projects “due to the increased cost associated with increased slab thickness requirements and reworking/reinforcing of traditional products.”

He added that “with ever-changing compliance requirements necessary in seismic areas throughout the country, it was imperative to have a new product design that would reverse the trend of ‘additional’ costs associated conforming to local municipality code requirements.”

“When TubeRack was introduced to us by Hannibal, it was described as revolutionary in the industry, and would change the approach for future racking specifications,” said Rowles. “Our decision to invest in TubeRack was based on its innovation, flexibility and value. We are very pleased with the complete cooperation and project management assistance we have received from Hannibal throughout the project. So far, we are very pleased with the product and its performance.”

Consider the source

When Andrew Kirby selected Hannibal Industries in Southern California to build his revolutionary design into the patent-pending TubeRack system, he knew that the employee-owned company is the largest metal fabricator and manufacturer of steel pallet racks west of the Mississippi River, providing turnkey storage systems to the most massive operations in the world. Its customers include “big box” retailers, archive storage and food and beverage industries.

During his long relationship as an engineering consultant to Hannibal, he also knew that the company is committed to quality throughout its diverse product line, including safety and code compliance (the tubular products division is ISO 9000-2008 certified). And he was impressed with the fact that Hannibal already owned a patent for a pallet rack system adjustable safety restraint.

In its two divisions, headquartered near central Los Angeles at 3851 Santa Fe Ave., Hannibal’s high value steel products are offered in round, square, rectangular and other shapes (oval, elliptical, trapezoid) with wall thicknesses ranging from .035-inch to .250-inch, and with hot-rolled, pickled and oiled, cold rolled, galvanized and aluminized surface finishes.

With its TubeRack systems, Hannibal’s product line consists of structural and roll-formed pallet racks and a variety of rack systems, including Hybrid, Cantilever, Pushback, Pallet Shuttle™, GlideRack, Pallet Flow, Case Flow and Drive-in.

Hannibal customers also can take advantage of Hannibal’s engineering and design services which include system design, seismic engineering, permit administration, in-house installation and custom fabrication.

Contact Information

More information about Hannibal’s new TubeRack systems and its wide variety of steel storage rack systems and services is available at the company website, www.hannibalindustries.com, or by calling corporate headquarters at toll-free (866) 513-1200.