

Cost, Performance Tradeoffs of Racks, Pallets

Most warehouse systems use racked pallets for product storage and transport. In many cases, this racked storage requirement is the critical design constraint that governs the design and cost of a pallet. Wood pallet designers add \$1-2 to the cost of a pallet for open span racking. Plastic pallet designers add much more. Fortunately, there are opportunities that pallet users can utilize to reduce costs in racked storage.

Most pallet manufacturers make rackable pallets. In reality, any pallet is rackable under some conditions. The true performance of a pallet when racked is a function of three factors: Pallet material and design, Load type and weight, Rack type and support span.

Pallet Material and Design

In the past, pallets were manufactured of solid wood components and were built with relatively large components by today's standards. The original grocery pallet specification from 1976 was much stronger than today's GMA pallets. Today about 90% of pallets are still solid wood, but we see a wide variety of materials used to make the other 10% of the pallet market. At Virginia Tech, we are approached with about 1-2 new innovative materials or designs each month. The 450 million annual new pallet market size keeps the innovators and investors thinking about new ways to capture 1% of that market. Some of the pallet materials we have tested for rackability in the last few years are:

Solid Wood, Steel, HDPE, PP, PVC, PC, Noryl, Plywood, OSB, Strawboard, Corrugated Paper, Honeycomb, Composites.

Each of these materials is fastened, molded, extruded, welded, or somehow formed into a unique pallet design. Stiffer materials such as wood, metal and manufactured wood are much easier to make rackable than less stiff materials such as plastics and paper-based pallets. Designers using less stiff materials often add costly metal or fiberglass to reinforce the pallets. Reinforcement can add \$5-\$15 to the cost of each pallet. This is expensive and may not be the best way to make pallets rackable.

Load Type and Weight

Not all loads pass the same stresses to a pallet even if they are the same weight. A 2,000 lb. load of cinder blocks transfers much less stress to a racked pallet than 2,000 lbs. of column stacked corrugated boxes. We call this Load Bridging, the ability of a load to bridge a span. Asphalt shingles, cinder blocks and steel drums exhibit high levels of load bridging. Many boxed and bagged products exhibit lower levels of load bridging. We are currently studying the load-bridging effects on wood pallets for the

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next upgrade of the Pallet Design System (PDS) program. Packaging designers can incorporate some general packaging modifications to reduce stresses on racked pallets: Interlock stacking containers, Tie sheets between box layers, Stretchwrap or shrinkwrap, Vertical or horizontal banding, Adhesives between layers of packaging.

You can compare the cost to modify loads to increase load bridging versus the cost of reinforcing the pallet.

Rack Type and Support Span

Some common type racks used to support pallets are: Single Deep, Double Deep, Drive In, Dynamic Flow, Cantilever, Push back.

Most racking concepts are designed to the inherent characteristics of wood pallets. The strong and stiff wood pallets are grandfathered into today's material

handling equipment. Also, the rack manufacturer, just like the pallet manufacturer, is bidding for the project and lower bids are more competitive bids. What helps the rack manufacturer lower their costs often forces the pallet manufacturer to increase costs and vice versa.

For example, it costs about \$1-2 to reinforce a wood pallet for rackability. It costs \$5-15 to reinforce a HDPE plastic pallet. Users should compare the cost of pallet reinforcement versus a one-time rack modification. For \$15 per pallet position, many racks can be reinforced with cross bars or wire decks, and this is a one-time cost. The one time rack upgrade may be more economical than the ongoing pallet upgrades. If designers understand both racks and pallets, they can help the user make an informed decision based on overall cost and performance of both components.

Even a chain conveyor is a type of rack. We have seen cases where pallets were designed to withstand a 50-foot section of 2-strand chain conveyor. How much does it cost to add a 3rd strand to the chain conveyor? What's the cost to install a new 50-foot conveyor that can handle less costly pallets?

When evaluating potential cost savings in rackable pallets, make sure that you test for the worst-case stresses and racking spans. Stiffer pallets can usually be tested with any load to predict performance under general use conditions. If possible, lower stiffness pallets should be tested with the actual packaged product, because minor differences in load configuration can lead to big differences in rack performance with lower stiffness pallets.

Remember, the cost of rackable pallets is determined by the load and rack system. Look for opportunities to modify the pallet and material to increase rackability. Learn about packaging. Evaluate the cost of modifying packaging versus pallet reinforcement. Learn about rack systems. Evaluate the cost of modifying the rack versus pallet reinforcement. Understanding racks, pallets and packaging will lead to the most economical and reliable rackable pallet solution. 