

# HOW TO MAXIMIZE WAREHOUSE EFFICIENCY WITH SMARTER DESIGN



**KORTE**

build smart.<sup>TM</sup>

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## OVERVIEW

As logistics has developed into a science of efficiency, distribution centers have evolved. Today, they're far more complex than ever before, requiring a smarter design and construction approach. At The Korte Company, we believe architectural design should provide tangible value to owners investing in distribution centers. Design should support your facility's many functions and promote all avenues of efficiency, including:

- Logistical efficiency, by promoting maximum efficiency in the facility's distribution functions
- Project efficiency, by minimizing up-front costs and construction schedule
- Long-term cost efficiencies, by specifying materials, building systems and designs that provide energy savings and lasting operational efficiencies

In this white paper, we cover the goals your design should support, key considerations as you begin your project and a design approach that enhances your facility's efficiencies. Last, we'll show you specific design and material solutions that improve efficiencies in distribution centers.





# PART 1: **DESIGN GOALS FOR EVERY DISTRIBUTION CENTER**



# DESIGN GOALS FOR EVERY DISTRIBUTION CENTER

Every facility and project is different. But many of the same goals apply to every modern distribution center project. In addition to meeting the specific goals of your project, you'll want your design to:

- Maximize your storage capacity
- Support the workflow, or productive flow, of workers and machinery navigating your facility
- Promote worker happiness and efficiency
- Facilitate and support business growth and personnel using warehouse and office space
- Ensure that your space is adaptable
- Integrate all the key areas of your distribution center, such as loading docks, truck space, parking areas and on-site development
- Accommodate your future growth by incorporating future expansion plans
- Enable and support innovative material handling, such as Just In Time (JIT) storage



## PART II: KEY CONSIDERATIONS WHEN IT'S TIME TO DESIGN



# KEY CONSIDERATIONS WHEN IT'S TIME TO DESIGN

Building codes, seismic standards, safety regulations and other regulatory requirements set the baseline standards for any given distribution facility. But a range of other considerations drive decision-making in the design and construction process, including:

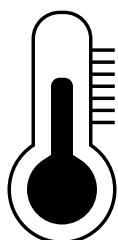
- The type of facility you need
- The level of automation in your workflow
- Your facility's unique structural requirements
- And more

In this section, we show you the key questions to answer before beginning the design process. And we show how these key considerations impact your project and facility.

## WHAT TYPE OF WAREHOUSE FACILITY DO YOU NEED?

The product(s) you store and distribute dictate the type of facility you'll require. And every decision, from energy systems to space layout, is affected by your type of warehouse facility. While each individual distribution center has some unique requirements, most facilities fall into three general categories — each with a broad set of design guidelines.

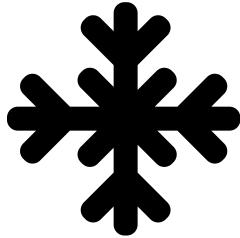
### HEATED AND UNHEATED GENERAL WAREHOUSES



These warehouses provide space for bulk, rack and bin storage, aisle space, receiving and shipping space, packing and crating space, and office and bathroom areas. The vast majority of products, particularly non-perishable goods, use these facilities.



## REFRIGERATED WAREHOUSES



In addition to serving the functions of a general warehouse, these facilities preserve the quality of perishable goods and general supply materials that require refrigeration. They often use freeze and chill space, processing facilities and mechanical areas. Many food items or chemicals require refrigerated warehouses.

## CONTROLLED HUMIDITY WAREHOUSES



Similar to general warehouses in other regards, these facilities are constructed with vapor barriers and contain humidity control equipment to maintain humidity at desired levels.



# WHAT KIND OF WORKFLOW WILL YOUR FACILITY USE?

In order to promote efficiencies in your operation, your design must support your workflow — how you receive, store and ship items throughout your facility. Your design must provide properly sized dock space and organization for trucks and rail. And it must support the movement of goods into the facility. Depending on your workflow, you may need a design that accounts for ultra heavy point loads and incorporates specialty features.

## TRADITIONAL BULK STORAGE



In facilities that use a more traditional bulk storage approach, workers on pallet jacks break pallets down into smaller packages as products move into the facility. Or, depending on the shipment, some pallets may not have to be broken down if they contain only one type of item, such as water bottles. Workers then reorganize the packages and move them (or the pallets) to another part of the facility, often using forklifts. Next, workers inventory the items and manually place them on a racking system to ready them for shipping. When it's time to ship the items, workers remove them from racks, bring them to docks and load them for shipment in trucks, rail cars or other means of transportation.

Some facilities, such as the [Hershey Midwest Distribution Center](#), require innovative space allocation and structural solutions to accommodate particularly heavy forklift traffic.



## AUTOMATED WORKFLOWS



Modern distribution facilities feature automation of many tasks. One of the most common elements is the use of automated storage and retrieval systems (AS/RS) in combination with conveyors and pick pods. In these systems, racks efficiently maximize storage space, stretching vertically up to the roof, actually helping to support it. Much like a giant vending machine, a mechanical arm reaches onto these massive racks to physically place or retrieve items. The arm also sets goods on a conveyor, which moves them to workers, who process and organize them on specialized platforms, called pick pods. These systems can reduce forklift traffic and the amount of lifting done by workers.

Another way distributors automate elements of their workflow is by incorporating robotic systems, such as KIVA systems, to pick up and move goods where workers can sort them – reducing or even eliminating forklift traffic. Robotic systems can be used in combination with AS/RS systems and conveyors.



# STRUCTURAL REQUIREMENTS

Your building must stand up to the weather and other seismic load demands set by building codes or required to support mechanized equipment. In fact, your facility may face extreme structural requirements, as dictated by:

- The product(s) you're storing and distributing
- The type of facility you need
- The size of your structure
- Your workflow
- And other elements

AS/RS systems place ultra heavy point loads on walls, roofs or floors, depending on the specific setup in any given facility. Due to the constant vertical and horizontal movement of conveyors, AS/RS systems with conveyors place tricky seismic loads on a facility, requiring specific design solutions. And they demand extremely flat floors with strict Floor Flatness (FF) and Floor Levelness (FL) requirements, which greatly impacts the construction process. Robotic systems also require extremely flat floors.

## OTHER CONSIDERATIONS

By nature, distribution centers must balance space maximization (storage and functions) with workflows and circulation paths for workers and trucks or robotic equipment. This takes dedicated planning and a thorough understanding of how you need to prioritize and allocate space in your facility.

Depending on the size of your facility, the nature of your products and requirements set by your insurer, you may also need fire loss walls, which section off elements of your building. In the event of a fire or other disaster, only part of your operation will be affected.





## PART III: **5 WAYS TO CAPTURE EFFICIENCY AND SAVINGS THROUGH DESIGN**



# 5 WAYS TO CAPTURE EFFICIENCY AND SAVINGS THROUGH DESIGN

You can take several key steps, in partnership with your project team, to promote maximum efficiency — both in your project and in your completed facility.

## 1. START WITH DESIGN-BUILD AND DESIGN WITH ALL SYSTEMS IN MIND

Today's distribution centers feature more complexity than ever before, with increasingly numerous building systems competing for limited facility space. And all building systems must seamlessly work together to support your operation. It only makes sense to coordinate the design of each major building system to create a holistic design that delivers an efficient facility — one that uses best-value solutions that provide bang for your buck.

For this reason, and a number of others, [we highly recommend using the Design-Build method](#). In this construction delivery method, one entity forms a complete project team, including architect and constructors, and holds single-source responsibility for delivering your project. Construction professionals and trade contractors advise on cost, schedule and constructability during the design process, and the strongest solutions are identified.

The team approach of Design-Build pays real dividends for distributors. For example, if you plan to use an AS/RS system with conveyors, you'll likely employ a trade contractor who specializes in those systems. But your facility must be properly equipped to handle the ultra heavy point loads associated with AS/RS systems.

If you use the traditional general contracting method, your architect will complete the design, then you'll bid work to a general contractor, who hires the specialty contractors in charge of your AS/RS system. In other words, the design is made with no input from specialty contractors, and your architect won't know the critical load requirements of your AS/RS system. In the end,



the specialty contractor will have to design your AS/RS system around a building design. And you're left designing your workflow last.

You want just the opposite.

## SPECIALTY SYSTEMS DESIGN IN TRADITIONAL METHOD

Architectural design

Construction

Specialty system  
design

For the best results, you'll want to have your architect working in coordination with your specialty contractors early on to fully accommodate complex elements, such as KIVA systems, conveyers, pick pods and AS/RS rack systems. Partnering with specialty contractors early ensures they're not competing with each other or with other elements of design for limited space. All loads are accounted for. And your ideal workflow dictates all aspects of the facility design. This is exactly the process in Design-Build — your project team works in partnership from start to finish to deliver a better build around your needs.

## SPECIALTY SYSTEMS DESIGN IN DESIGN-BUILD

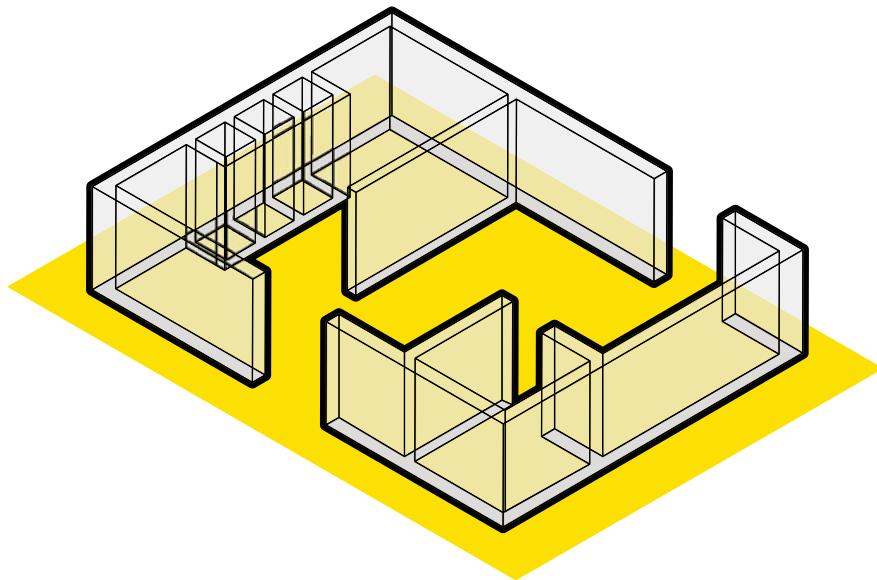
Evaluation of optimal  
workflow

Holistic design incorporating  
all specialty building  
systems

Construction

## 2. SELECT A DESIGN TEAM THAT USES A BETTER MODEL

Early pre-construction designs have traditionally been little more than napkin sketches; now they're far more scientific and complete. The Korte Company and a growing subset of design firms have adopted cutting-edge [5D Macro BIM technology](#). These models show you, at the earliest design stages, how different design concepts affect cost, schedule and constructability, allowing you to evaluate large-scale options and make informed decisions.



As your project progresses further into design, you'll want your team to use 3D BIM technology to show detailed models of your design. But computer modeling for architectural design is no longer limited to basic architectural models. Now, models of specific building systems are available and should be part of any project. Subcontractors' design consultants can use BIM to model structural engineering, mechanical, electrical and plumbing systems, ductwork, steel work and more. Combined with clash detection programs, designers can ensure no systems interfere with each other, preventing field coordination problems before they arise on the job site.

At The Korte Company, we provide a building scientist who evaluates options using Revit to help owners make the most informed decisions.



### 3. MAKE DECISIONS WITH AN LCCA

A [life cycle cost analysis](#) (LCCA) is the formal process of calculating the ROI you can expect from building investments. The LCCA provides long-term cost projections for a particular building investment over its useful life cycle, accounting for the time value of money and all other factors of cost and payoff.

In the LCCA, the costs of two or more alternative investments are calculated and compared to determine which has the lowest long-term cost and better long-term value — e.g. which is most economical over the life of your facility.

The LCCA puts solid numbers behind decision-making and allows you to evaluate where you can best spend project dollars. To reap maximum benefits from an LCCA, make it part of your project from the earliest stages of design and continuously update it throughout your project as you evaluate solutions for various project elements.

### 4. GIVE YOUR TEAM COMPLETE INFORMATION TO SUPPORT YOUR WORKFLOW

Supporting your workflow should be a primary goal of your design. To achieve this end, provide your project team information on:

- The means of transportation used to bring goods to your facility
- Where transportation will be staged to offload new shipments
- How products move through your distribution center
- What, if any, elements of your workflow you plan to automate
- How products leave your distribution center

Your design can and should support your workflow, beyond simply supporting heavy loads. For example, when full pallets of one item are received, your crews can bypass the process of sorting goods and breaking them down into individual boxes. In this instance, an efficient facility will incorporate strategic rack placement next to the docks that receive these specific pallets. The end result is better traffic flow throughout the facility and savings in both time and dollars. With the right information, your design team can and will identify a range of solutions that improve your workflow and storage.



## 5. PLAN FOR FUTURE EXPANSION FROM THE START

If you know that your operations are expanding and you'll likely outgrow even your new facility, planning for expansion can provide significant savings. For one, it can allow you to phase your project and minimize current expenses. Second, it allows your facility to grow with you.

But planning for expansion isn't just about adding more space. You'll need a facility that's designed from the onset to withstand future structural and seismic loads, particularly if you plan to add more conveyors or AS/RS systems.

Some other considerations for future expansion include:

- Extending wiring, piping and utilities where the building expansion would be located
- Using temporary, lower-cost materials for the parts of the facility that will be torn down or replaced

At The Korte Company, we've completed many expansions for a wide range of facilities, including distribution centers for some of the nation's biggest producers and distributors.



# PART IV: DESIGN, MATERIAL AND ENERGY-EFFICIENCY SOLUTIONS THAT MOVE THE NEEDLE

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# DESIGN, MATERIAL AND ENERGY-EFFICIENCY SOLUTIONS THAT MOVE THE NEEDLE

Now that you've got a solid idea of what you can do to achieve efficiencies through design, we'll show you a range of specific solutions that have provided our clients with great efficiency and bang for the buck.

## EFFICIENT, DURABLE WALLS

Your walls are one of the most critical elements of your facility. The two most commonly used wall construction methods in distribution centers are Tilt-Up concrete wall construction and pre-engineered metal buildings (PEMBs). Both afford a number of advantages and can be customized to provide a great look.

In Tilt-Up construction, your project team pours concrete panels on-site then uses a crane to tilt them up into place with the roof and foundation. When implementing pre-engineered wall systems, your project team procures a metal building that comes in pieces, customizes it for your needs then assembles it on-site.



It takes a highly skilled, organized contractor with proven experience in Tilt-Up to complete a Tilt-Up job. But the method provides a range of advantages, including:

- Up-front cost reduction
- Rapid project schedule — your contractor can pour and tilt up multiple sections of the wall in overlapping, concurrent fashion
- Airtight seals and continuous insulation, which provide long-term energy savings and are great for food storage facilities
- Highly durable walls that stand up to ultra heavy loads and provide strong fire resistance
- Sound reduction
- And project safety — Tilt-Up can eliminate the need for scaffolding and vertical formwork, or molds, to assemble your building

Pre-engineered metal buildings afford many of the same advantages with less up-front cost, as they require fewer people and less time to construct. But over the long haul, they usually require more maintenance than Tilt-Up walls and aren't quite as effective from an energy-efficiency standpoint, as they provide less insulation. Taking into account the unique qualities of your facility and using an LCCA, you can determine which is the most cost-efficient option. If you don't need a highly controlled environment, don't mind changing temperatures or aren't going to achieve a great energy savings from Tilt-Up, then PEMBs might be right for you.

## BEST-VALUE ROOFING SYSTEMS

In our experience on more than 4,000 projects, two roof systems stand above others for distribution centers: Standing Seam Metal Roofs and ethylene propylene diene terpolymer (EPDM) roofs. Over the long haul, both are far more durable and energy efficient than traditional roofing options, such as asphalt shingle roofs.



## STANDING SEAM METAL ROOFS

Standing Seam Metal Roofs have continuous metal panels that run from your roof's ridge to the eaves. Seams are one of the major vulnerabilities in shingle roofs. But Standing Seam Metal Roofs reduce the number of seams, and because the seams between the panels are raised — or standing — water doesn't get in through them. Since these roofs are made of metal, they're durable. Your contractor can also paint them any color, allowing you to have a cool roof that reflects light and prevents solar heat gain. Metal is moderately expensive up-front but low-cost over time.



## EPDM

EPDM roofing is essentially highly durable, hard rubber. Like Standing Seam Metal Roofs, EPDM provides high resistance to the elements. — it can resist hail, extreme temperatures and strong winds. It's fire-resistant, Ultraviolet-radiation-resistant and even lasts through powerful thermal shocks. EPDM is time-tested, and studies have shown it to last for 30 or more years. Over time, it will reduce maintenance costs and leaks. EPDM is more expensive up-front than a shingle roof, but its durability and long-term cost reduction often make it the more cost-efficient option.



Both EPDM and Standing Seam Metal Roofs are highly durable, stand up to weather and reduce the risk of water damage. They work well in conjunction with Tilt-Up walls or PEMBs. And, if implemented with a strong design, can accommodate ultra heavy point loads.



## CAPTURING ENERGY-EFFICIENCY SAVINGS

Through the years, we've delivered more than 85 LEED-Certified projects. In the process, we've identified many sustainable building solutions that not only reduce energy usage but also provide excellent cost savings.

One solution that delivers ROI is efficient zone lighting. And it's not just about specifying the right bulbs. In modern distribution centers, you can set up automated lighting controls that work in conjunction with warehouse activity. Lighting can be programmed to turn on when there's activity in specified zones and turn off during downtimes. The lighting zones can be as big or small as owners need, and the savings are significant. Other lighting solutions include daylighting and passive solar design. By orienting your facility in an optimal way and designing the right windows and skylights, architectural designers can use the sun to both light and heat much of your facility. In addition to energy savings, research has shown these solutions improve worker morale and productivity.

To further improve worker comfort and productivity, your facility can use indoor docks for unloading during cold weather. Distribution centers are largely "skin load" facilities, where energy loss and consumption is most affected by open areas that let heat in and out. Indoor docks help save energy and costs during winter. It's also good to use no-slip floor coatings near docks for worker safety.



Other great ways to achieve energy savings include:

- Solutions that reduce rooftop HVAC systems, which can reduce rooftop space and significantly impacts cost savings
- PV solar panels, which can achieve relatively fast payback and ROI not only through energy savings but also in the form of grants, rebates and utility credits
- Ceiling mounted fans, which reduce heat stratification and promote both air flow and worker comfort
- Additional insulation, which has a highly predictable ROI that makes it easy to invest in the optimal amount of insulation
- Using smart planning and design to [eliminate thermal bridges](#), a major source of heat loss, energy waste and unnecessary costs

Perhaps the most important element of achieving energy-efficiency savings is providing your project team an accurate picture of how you'll use your facility. With this information in mind, your team can accurately model how much energy you use and identify the best solutions to capture savings.



# MORE ABOUT THE KORTE COMPANY

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At The Korte Company, we've designed and built distribution centers for some of the nation's biggest producers and distributors. And we've delivered each one on-time and on-budget.

Ours is an innovative, [Design-Build approach](#) in which we build the best team for the job — an all-star cast hand selected for the task at hand. Working in total team collaboration, our multi-disciplined project teams identify and implement best-value solutions. Through this process, we provide a seamless project from start to finish, with innovative design, fast-track delivery and a smooth customer experience. The end results are not only highly efficient distribution centers, but also rapid delivery, risk minimization, energy savings and cost reduction. We deliver to the highest quality standards, completing every job on-budget and on-time.

But don't take our word for it. See [our best work](#) or [read client testimonials](#). If you're preparing to build or update your distribution center, let's talk. Give us a call at 618-654-8611 or [contact us about your project here](#).

