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Expanding Education Environments

Education and Training Centers Expand Through Modular Construction

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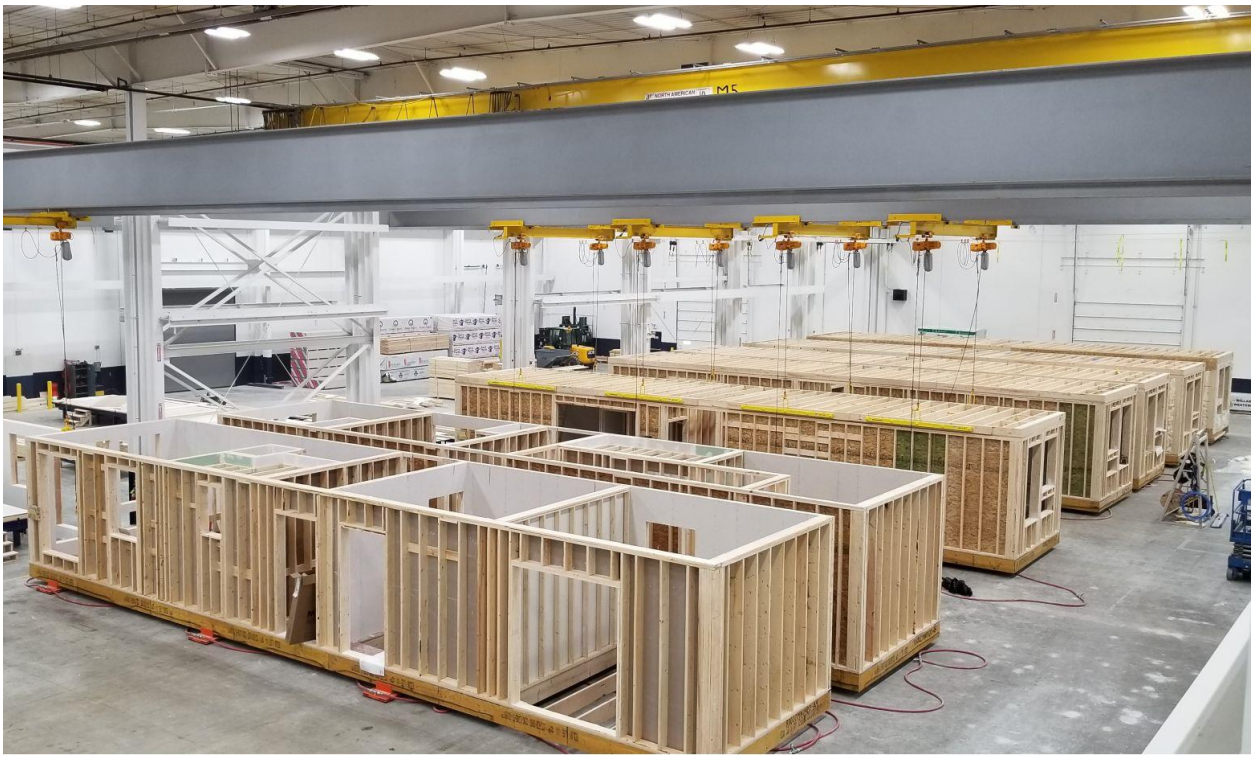

The demand for additional classrooms and training facilities in the education sector has skyrocketed. The COVID-19 pandemic has pushed academia to establish healthier and safer learning environments. These new spaces often need a bigger footprint to accommodate the same number of people, plus specific safety features like enhanced air flow and ventilation. Modular or prefabricated structures have emerged as a viable answer to the demand for expanding campus education and training centers quickly and cost-effectively.

Unfortunately, modular manufacturers are not always optimized for producing these factory-built learning environments. Traditional material handling systems that move massive 12-meter assemblies through the facility can create as many problems as they solve. To economically produce boxes at speed,

manufacturing facilities have turned to a tool that capitalizes on the strengths of the prefab process: the air caster.

The science of air-prefabricated modular structures fill the gap between long-term building projects and short-term space requirements. Built in controlled factory environments where weather is not a mitigating factor, the structure can be produced faster, safer, and more economically than with traditional on-site construction. In fact, a report from industry advisory group McKinsey & Co. found that "modular construction can cut schedule by 20–50 percent and costs by 20 percent," positioning it as an ideal method to meet the immediate demand for versatile training and education spaces.

The science of air

Air casters help to fast-track more modular structures through the production line and onto the campus by reducing friction. Air casters are donut-shaped bags that fill with standard compressed air. Once fully inflated, the air leaks between the bag and the floor until the structure is lifted on an ultrathin film of air no thicker than a business card. The friction coefficient is reduced to less than one percent, allowing the structure to glide like a puck on an air hockey table, with almost no resistance from the floor surface. Once floating, even a structure 13 meters long weighing 30 metric tons can be moved from one station to another without need of a crane, forklift, chain – or even very many people. "Just grab a few more casters, put some air into them, and boom, move," says John McElroy, process engineering manager at Plant Prefab. This U.S.-based manufacturer designs and builds bespoke, high-end modular buildings and uses air casters in its own production processes. A single operator exerting no more than 2 to 11 kg of force can move and position a load weighing as much as 2 metric tons. Moving heavier loads requires only a modest increase in the number of additional air caster modules and operators.

The economics of air

Air casters power a degree of plant design flexibility that is impossible with other material handling systems. This flexibility, in turn, can power operational, labor, and cost efficiencies that wouldn't otherwise be possible. "Perhaps the fundamental benefit of air casters is the ability to design creative plants," says Jason Carter, president of advisory firm The Mod Coach, which works with modular manufacturers to improve factory design.

Air casters benefit production processes in five specific ways:

1. Air casters make it easier to move heavy and lengthy structures. "One of the most difficult and costly challenges in prefab is moving large volumetric pieces," says McElroy. Because modular assemblies are so cumbersome to move, they require larger and more expensive material handling systems like cranes, forklifts or chain systems. Worse, the cost of the material handling system increases at a disproportionate rate as the size and weight of the assembly grows. "As a crane needs to become bigger to pick up heavier boxes, the cost increase for the crane to handle more weight is not a linear scale relative to the weight," McElroy explains. "The cost increases almost on an exponential scale." An air caster system, by contrast, is based on a single principle: compressed air motion. Operators can move heavier items just by adding more air caster modules. Here, the cost progression is linear relative to weight increases. Once floating, a structure as much as 13 meters long weighing 30 metric tons can be moved from one station to another without need of a crane, forklift, chain, or even very many people. Air casters are so small, lightweight, and easy to manage, they require no operator certification and minimal training.

2. Air casters require less space, so facilities can fit more structures into the same footprint. Because air casters fit within the footprint of the structure being moved, little additional space is required for maneuvering. Other solutions must be included in planning the floor layout. Forklifts require space to maneuver. Cranes and chain systems have to be built into the facility itself and, once installed, are usually permanent and unchangeable. With less production space, production throughput falls. Air casters have no such impact. With air casters, manufacturers can maximize production capacity and reduce production waste and excess travel – key objectives when implementing lean manufacturing methodologies.

3. Air casters enable plant reconfiguration. With cranes or chains, manufacturing facilities are limited to a straight-line production layout for moving assemblies from station to station. The facility cannot introduce changes that improve efficiency or productivity. By contrast, air casters are mobile, so a facility can easily change, grow and adapt, switching to a more efficient U-shaped production line, for example. Adaptability is especially critical when manufacturing modular structures are intended for education because they often have unique structural or electrical requirements and can vary tremendously in form, function, and features.

4. Air casters reduce risk of injury. Cranes, forklifts, and chains all impose specific safety hazards. Chains in particular present a significant tripping hazard, as a massive chain may cross a number of workstations along a length stretching hundreds of feet. Due to their light weight and compact size, positioning air casters underneath the modular structure creates less risk of strain-related injuries. Since air casters raise loads no more than a few centimeters, the risk of injury due to falling loads is eliminated.

5. Air casters optimize labor and supplies. Efficiency gains can yield secondary benefits. For example, the flexibility of air casters can also be helpful in dealing with pandemic-induced supply shortages. A manufacturer who is unable to finish a structure due to supply chain issues can temporarily move an assembly out and then back to the line without line stoppage.

Outcome for educational environments

Ultimately, rising demand for additional training and education space is prompting the construction industry to rely on prefabricated structures. Manufacturers are under pressure to produce these structures swiftly, safely, and reliably. “The speed, safety, and reliability of the material handling system have to match the overall goal,” says McElroy. With air casters, modular manufacturers increase production speed and cost savings, making it possible to meet the demand for much-needed training and education facilities. “That's why we're incorporating an air caster methodology into our process. It's extremely versatile. It's extremely safe. And it's fast.”

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