How Fabricators Can Combat Metal Buildings

Fabricators should capitalize on the flexibility and strength of structural steel buildings to increase market share in warehouse and industrial applications

By Jeffrey S. Nawrocki, P.E.

THE GENERAL THOUGHT THAT PRE-ENGINEERED METAL BUILDINGS ARE USUALLY THE LEAST COST OPTION is a gross misunderstanding

During the past half century, the pre-engineered building has emerged as the preeminent choice for providing a building shell. Early on, the primary use for such structures were agricultural, warehouse and other storage facilities. Metal buildings are well suited for this type of application since the structure does not have very strict performance requirements with respect to flexibility and durability. These type of structures do not have any more strength than required and the collateral design loads are generally very small. From an engineer's viewpoint—who was taught structural optimization in school—this type of design is fascinating.

However, most other building types require at least some structural redundancy to account for loads that may not have been initially anticipated or that result from changes in building use. Metal building manufacturers have come a long way in developing their market and have now captured an increasing share of the low-rise market, be it for commercial, educational, industrial or institutional use. While the modern pre-engineered metal building can be designed for just about any load and performance requirement, their competitive edge disappears when requirements increase. It is up to steel fabricators and a project's Engineer-of-Record (EOR) to ensure that an owner is aware of a metal building's limitations and the additional costs that can occur later in a building's life.

Misuse Of Metal Buildings

A increasingly common problem is the use of the basic, economical, flexible metal building for structures that have stricter performance or loading requirements than can easily be accommodated by metal building design. This happens often on design/build projects where the building shell is often ordered before details of the project are fully determined—and often there is no EOR on board at that point to provide proper design parameters for the building.

This becomes a problem when final design plans evolve after the metal building is selected. For example, when the wall system later changes to block or brick, cracking can occur since the pre-engineered metal building is too flexible. The block wall must span from foundation to eave and there may not be an eave girt on a metal building that can support the lateral load from the wall. And even when there is, it typically would be designed for a live load deflection of L/240, which is inadequate for this use.

Another case emerges from lateral drift. The Metal Building Manufacturers Association (MBMA) recommends that later-

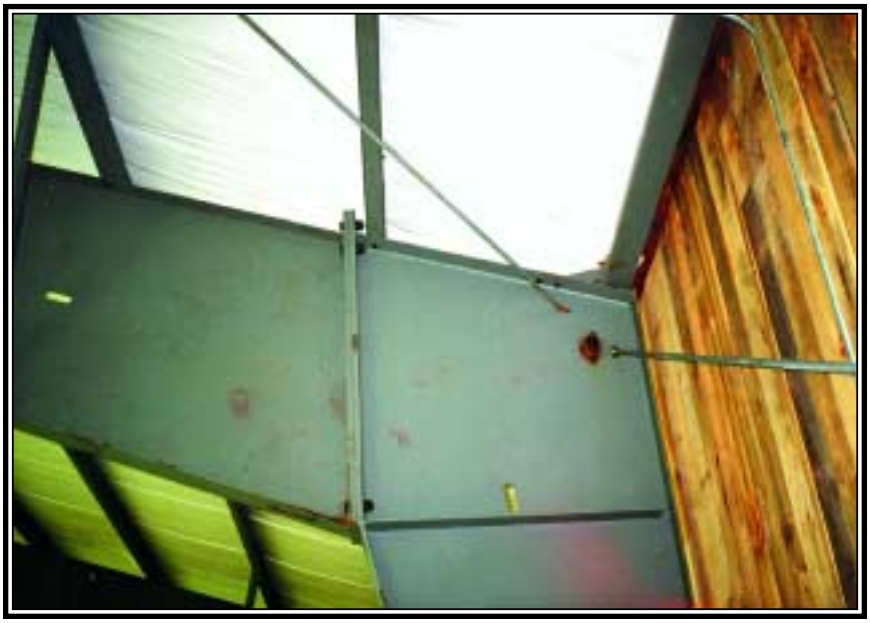
al drift be limited to h/60. For a 20' eave height, this equates to 4" of drift. The would be a problem, for example, on a 30'-high pre-engineered metal building designed for industrial use. A few years later, the owner decides to build a three-story mezzanine at one end for offices and storage. The problem is that a typical 30'-high pre-engineered metal building has a design drift at the eave of 4½", which is within their allowable criteria for a tall, open building. Since the two structures cannot be kept independent because of such large deflections, the mezzanine structure must be designed to support the metal building too at no small cost premium.

Most engineers designing steel or other types of buildings would not allow such large deflections. For a brick or block exterior, the recommended allowable drift would be more in the order of h/300, if the base is fixed. When brick or block becomes part of the wall system, it should be structurally independent from the building, which is logistically difficult, or he building should be designed with appropriate deflection parameters.

Another common problem encountered with the flexibility of metal buildings is roof deflection. If a building is originally used for open storage, large roof deflections are not easily detected. However, later, when an owner opts to build offices inside and suspends the ceiling from the roof structure, it becomes all-to-apparent. Take, for example, a 60' roof beam designed for an l/240 live load deflection (or 3 inches) and a secondary purlin spanning 25' and deflecting 1-1/4". If the new office corridor is 6' wide and under heavy snow, the ceiling tiles at the center have dropped 4". To the occupants, it looks like collapse is imminent!

A Better System

One way that steel-framed buildings can compete with pre-



Properly designed structural steel frames will not only reduce costs, but will also allow for future expansion.

engineered metal buildings is through a team approach, where a fabricator and engineer work together to market, design and fabricate a structure. For this type of arrangement to be successful, it is essential that the engineer has a good working relationship with the fabricator and that the fabricator is willing to be creative and is able to supply some up-front research and marketing time to gain projects.

The third member of the team is a general contractor who knows the engineer and/or fabricator and is willig to work with them on negotiated or design/build projects and compare structural buildings to pre-engineered structures.

In the Northeast, at least, the contractor is the one who oftentimes has contact with the owner. The contractor knows the cost of a metal building—and knows whether a fabricator would have to match the price or has some leeway due to the increased quality and value provided with a fabricated steel frame. However, it is essential that the contractor is comparing apples to apples. For example, the foundation is generally more expensive for a metal building that has large horizontal forces at the base of its rigid frame. Unless foundation costs are included, the cost of the metal building will be much lower.

Another method that steel fabricators must learn is to push a hybrid design. For some owners, purchasing a building is like buying a car: cost is just one factor among many. Those owners can be approached and convinced of the many future benefits of a structural steel frame. For others, however, first cost is everything. For them, it is more practical to combine building systems. Selling only columns and beams is still better than selling nothing at all.

Limitations

Expansion. Growing businesses will need to one day expand. Metal buildings are generally not very easy to add onto, unless the addition is simply an extension of the building in the direction parallel to the ridge. Additions that include an upward expansion, or adjacent additions with intersecting roofs, are difficult to accomplish in a metal building. When additions cause overbuild onto an existing roof, the metal roof systems are at a disadvantage because valleys are next to impossible to properly seal. The buildings are not typically designed for any extra load so strengthening of the building is almost always required. Also, when tapered frames are used, modifications are not as straightforward for the engineer. If the addition adds lateral loads, it is generally difficult to resist them with the existing structure since sway limits are already well beyond acceptability for most engineers.

Roof top or hanging mechanical units. The roof purlin system used with most metal buildings is very light, so hanging mechanical units or adding rooftop units cannot be done without adding structural members. When units are supported from these light purlins, the result is usually damage to the light members.

Single-side welding of I shapes. Most metal building manufacturers weld their flanges to the webs on one side only, while the opposite side is tacked. AISC provisions call for flanges to be continuously connected to the webs and I believe the intent is for both sides to be attached to model the performance of a rolled shape. Although we generally cannot show that welding one side only will result in a structural deficiency, in my experience most engineers feel that this is not a good quality practice. An example of the problems welding just one side can cause occurred on a transfer station renovation project on which I worked. Adjacent to an overhead door on the metal building was a rigid frame column that apparently was an obstacle for the Cat 980 loader. Due to the single-side welding, the loader was able to peel the flange from the web of the column. Once the flange was pulled loose, it became even more of an obstacle, so the loader operator peeled the flange up another 10' or so to get it out of his way. Would this have happened to a hot rolled section?

In addition to this welding practice, the paper-thin plates generally used for columns are a bad idea in any area where columns are subject to impact. Owners should be made aware of this problem on any project where fork lift trucks will be used.

Durability. Just as a car-buyer expects his vehicle to look good for a number of years, it's not unreasonable for building owners to expect durability from a structure. While cars have a life span of seven to 10 years, most industrial and warehouse structures should last at least 30 or 40 years without looking like a wreck. Unfortunately, metal buildings quickly get faded and dented—inside and out. How many 20-year-old metal buildings still look like the day they left the showroom? Owners need to consider durability and future value.

Build-out. While a metal building shell is easy to erect, finishing the space is more difficult. Since girts are typically spaced at 5' to 7' apart in metal buildings, drywall cannot be directly installed. Instead, if a wall needs to be insulated, another wall must be built inside of the metal building shell. If an owner wants a properly insulated and finished space, that extra wall will take up to 12" of space—substantially reducing the interior volume of the building. Mezzanine additions are also difficult in metal buildings. Owners often don't realize that rigid frames take up space and cause interference. If a second floor is constructed for offices, it is not unusual to discover a 4'- or 5'-deep obstruction. Again, own-

ers need to be aware of these obstacles, even if they are not finishing the space today.

Resale value. A building should be considered an investment and an investment needs to be protected. Owners should be aware metal buildings usually do not retain their value as well as steel-framed structures.

Pro-Active Marketing

Pre-engineered buildings are gaining market share because fabricators are not taking a pro-active stance to promote the many benefits steel-framed structures and the relative disadvantages of pre-engineered metal buildings.

Obviously, if bottom line first cost in the only factor for an owner, it is a waste of time to try to compete in that market against pre-engineered structures. However, many owners are willing to take a longer range view, especially if the premium for a steel-framed building is minimal. Also, certain types of buildings clearly lend themselves to being sold as a steel-framed structure rather than a pre-engineered metal building. Likely candidates include industrial and warehouse structures subject to some level of abuse—and this includes any building with fork lift trucks, loaders, craneways or industrial processes. In addition, complex and multistory buildings are—and have always been—a natural for structural steel.

It's essential that fabricators begin to think in terms of a team approach and to pro-actively market their product. Pre-engineered metal building salesmen are master sellers. But structural steel fabricators have the advantage of selling a better product—they just need to be willing to educate the owner and sell their product.

This article was adapted froma paper delivered at the 1997 NSCC in Chicago. Jeffrey S. Nawrocki, P.E., is a principal with JSN Associates in Portsmouth, NH.

One of the problems with pre-engineered metal buildings is that they quickly show their age. The dings and dents that quickly occur in a warehouse or industrial building are with the owner for the long haul and even relatively new structures can look old.