

The Case for an Engineer of Record for a Metal Building System

By W. Lee Shoemaker, P.E., Ph.D.

Metal building systems may not be popular with some structural engineers because this construction alternative competes with traditional engineering opportunities for “conventionally” designed and constructed facilities. Structural engineers who realize that the metal building segment of the low-rise construction market offers an opportunity, not a threat, will ultimately benefit as metal building systems continue to build solid market share in every low-rise marketplace — from strip centers to car dealerships to office complexes and call centers.

“...involvement of an EOR in a project that involves a metal building system.”

It is not uncommon for a building owner to forego the services of an engineer of record (EOR) on a metal building project. However, the Metal Building Manufacturers Association (MBMA) encourages the involvement of an EOR in a project that involves a metal building system. This article provides information about the metal building industry, identifies some problem areas, and discusses why the involvement of an EOR is a key component to a project’s success.

What is a Metal Building System?

Many engineers (or design professionals) believe that a metal building is selected from a catalog of standard designs, based on the required size of the building. Unfortunately, national ad campaigns by “brokers” of metal building systems contribute to this misconception, and are not representative of the common industry practice that involves a transaction between a metal building manufacturer and a builder.

Most metal building manufacturers custom design a building after the order is placed, based on the applicable building code, loading conditions and serviceability requirements. Metal buildings are governed by the same building codes and material standards as other forms of construction. MBMA member companies have registered professional engineers on staff who are highly skilled and apply sound engineering principles toward the optimal design of metal building systems. In fact, MBMA members are required to be certified, as discussed later in this article, which includes a very thorough independent audit of their engineering design practices. Advanced computer methods are used to help fa-

cilitate this design customization and optimization. This is also why the industry is moving away from the outdated terminology, “pre-engineered metal buildings”, in lieu of the more accurate identification of “metal building systems.”

Metal building systems have evolved over the years into assemblages of structural elements that work together as a very efficient structural system. The basic elements of the metal building system are: primary rigid frames, secondary members composed of wall girts and roof purlins, cladding, and bracing (Figure 1). Metal building system design may seem trivial at first, but experience shows that the complex interaction of these elements into a stable system is a challenging engineering task. MBMA member companies have demonstrated this expertise and are on the leading edge of systems design.



Typical metal building framing, but with a clerestory.

Roles and Responsibilities – What is the EOR Role?

When a project calls for a metal building system, design responsibilities are usually divided between the manufacturer and the design professional or EOR. Therefore, a clear understanding of their respective roles, as well as coordination and communication are crucial for success.

The manufacturer is responsible only for the structural design of the metal building system it sells to the builder. The manufacturer is not the design professional or the EOR for the construction project. The manufacturer is not responsible for the design of any components or materials not sold by them. Nor are they responsible for the interface and connection of other components with the metal building system, unless such design responsibility is specifically required by the order documents.

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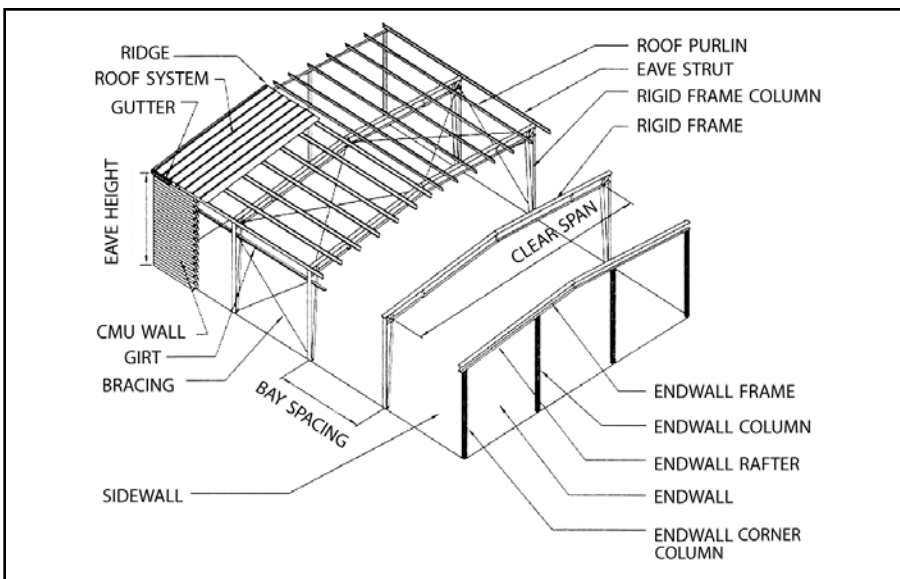


Figure 1 Anatomy of a Metal Building – Showing the primary framing, secondary framing, roof/wall cladding, and bracing.

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It is the responsibility of the metal building manufacturer to design a metal building system to conform to the specifications, including the design criteria and design loads incorporated by the builder into the order documents. The manufacturer is not responsible for making an independent determination of any local codes or any other requirements not mandated within the order documents. When specified by the order documents, the manufacturer is responsible for supplying adequate evidence of compliance with the specifications, design criteria, design loads, and other specified information necessary for the EOR to incorporate the metal building system into the construction project.

"An EOR is in a better position to evaluate the owner's needs and recommend appropriate serviceability limits..."

MBMA highly recommends that the end customer hire an EOR to be responsible for specifying the design criteria for the metal building system. These design criteria, to be used by the builder and manufacturer, should include the geometric requirements, all applicable codes and/or design loads, site and construction conditions that affect design criteria, and serviceability criteria. As with any building, clear and accurate specifications ensure the builders/manufacturers bidding on the project understand and interpret the requirements in a similar and accurate manner. Just as importantly, a proper specification ensures the building performs satisfactorily and meets the owner's requirements.

In the sale of most metal building systems, there are at least two independent written agreements – the building order documents and the contract documents. The order documents are normally required to process the order for the metal building system, while the contract documents (including the drawings and specifications) define the material and work to be provided by the contractor for the total construction project. The manufac-

turer typically reviews the order documents, while the EOR often evaluates the contract documents to ensure the specifications and drawings have been properly interpreted.

The owner may retain an EOR to create



Depending on the application and architectural treatments, a metal building system can look no different than other construction.

the contract documents. The EOR may also review the shop drawings prepared by the contractor (or subcontractor or manufacturer). In some cases, construction contracts require the contractor to provide delegated design engineering to a licensed professional. The engineering is based upon the manufacturer's specific component properties and may be performed by the manufacturer or by an experienced independent structural engineer.

"The owner does not always understand the need for an engineer of record..."

The metal building system is just one element of the total construction project. For example, the metal building manufacturer rarely provides site preparation, mechanical-work, electrical design, and certain building envelope components/accessories. Similarly, he or she is not responsible for the foundation's design. The EOR is typically responsible for these important elements of the project as well as floor slabs, interior/exterior concrete masonry and/or tilt-up walls, and the connection of these walls to the metal building framing. With regard to the foundation design, the manufacturer does prepare the anchor bolt plans showing the location, diameter, and projection of the bolts required to attach the metal building system to the foundation.

Serviceability

An EOR can provide the owner with essential advice on the serviceability requirements for a project, especially with regard to the building's functional performance requirements under service loads, including lateral drift,

deflection, and vibration. This is a critical need in the project's specification phase, as serviceability decisions address an owner's needs and preferences that may not be spelled out in the building code.

Metal building systems, clad in flexible metal siding and roofing, can tolerate sizeable amounts of movement. However, masonry, concrete and other more brittle wall materials are increasingly being incorporated into metal building systems because of owner or architectural preferences. This is especially true for many retail and institutional applications.

Since drift limits are not covered in the building codes, it is important they are properly specified, depending on the flexibility of the wall materials. MBMA recommends using the American Institute of Steel Construction (AISC) *Design Guide No. 3, Serviceability Design Considerations for Low-Rise Buildings* (recently revised and renamed, *Serviceability Design Considerations for Steel Buildings*).

"...a proper specification ensures the building performs satisfactorily and meets the owner's requirements."

While it is important to specify appropriate drift limits, giving consideration to the deflection tolerances of any brittle wall elements, it should also be understood that limits that are overly restrictive influence the cost of a building. An EOR is in a better position to evaluate the owner's needs and recommend appropriate serviceability limits, such as given in the reference cited above, that do not lead to unnecessary building costs.

Inspection Services

One of the most common problems that can occur with metal building systems is quality control during the erection process. Flange braces that are left out may not show up until a major snowstorm. The metal building manufacturer is not responsible for inspection of a construction project unless this is incorporated into the order documents. Typically, a manufacturer is limited because of logistical constraints as well as not having the expertise in inspection services. Furthermore, a manufacturer is not in the best position to inspect the work of the builder who is the manufacturer's customer.

Ideally, an end customer should utilize the inspection services of the EOR for the project to provide this important function. The EOR can ensure that the project is constructed according to the manufacturer's erection drawings.



For longer spans, bar joists are used instead of cold-formed purlins.

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Certification of the Manufacturer

An EOR should also be aware of the rigorous certification program that is available to metal building manufacturers through AISC. This can be an advantageous addition to the specification of a metal building system by requiring that the manufacturer be AISC-MB certified. Manufacturer certification should be included in the specification, because it ensures the building is being provided by a manufacturer that has demonstrated a high level of competency in all aspects of engineering design and fabrication.

In fact, the metal building industry is the only industry that has a certification program incorporating design engineering. The program also examines policies and procedures at each of the manufacturer's facilities, and verifies the application of those policies and procedures within randomly selected projects. Inspection and evaluation teams from an independent engineering auditing firm annually observe and evaluate the manufacturer in almost every aspect of professional design and manufacturing.

Therefore, an EOR working on a metal building project with a certified manufac-



A metal building system with a steep roof and masonry wall cladding.

turer can have a higher level of confidence that they are working with a thoroughly qualified company. A current list of certified manufacturers is available on the AISC website (www.aisc.org).

Summary

Metal building systems are widely used in all types of building applications. The owner does not always understand the need for an engineer of record and his/her role in a project. MBMA highly recommends that the end customer hire an EOR to be responsible for specifying the design criteria for the metal building system, designing the building com-

ponents not supplied by the metal building manufacturer and their interface with the metal building, and providing inspection services as needed or required by the building code.

MBMA is trying to be more proactive in working with the engineering community to educate EOR's about the metal building industry and to find ways to improve the coordination and understanding of the shared design responsibility in metal building projects. It is hoped that this article will help in this important effort. ■

More information is available in the newly updated Metal Building Systems Manual, as well as other publications on the MBMA website (www.mbma.com).

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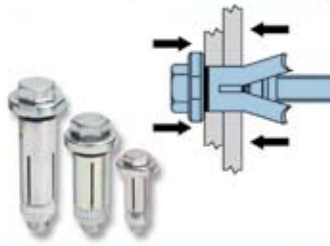
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