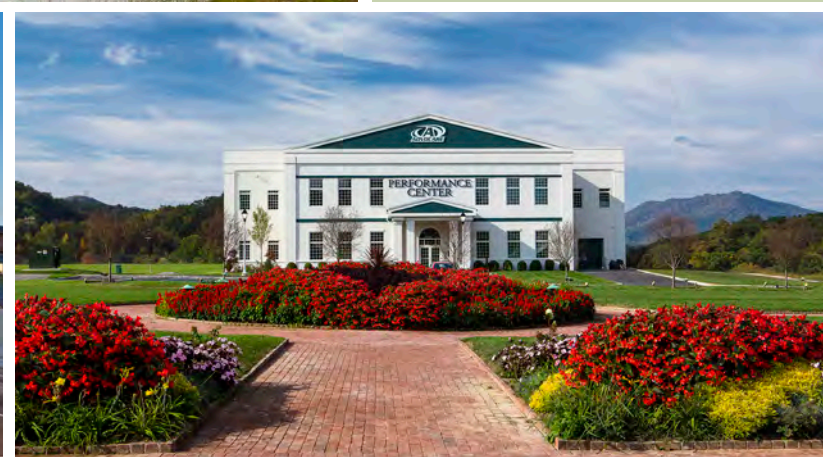


The logo for the Metal Building Manufacturers Association (MBMA), featuring the letters "MBMA" in a large, bold, white font with a stylized roofline above it.

METAL BUILDING MANUFACTURERS ASSOCIATION®
Research | Leadership | Education

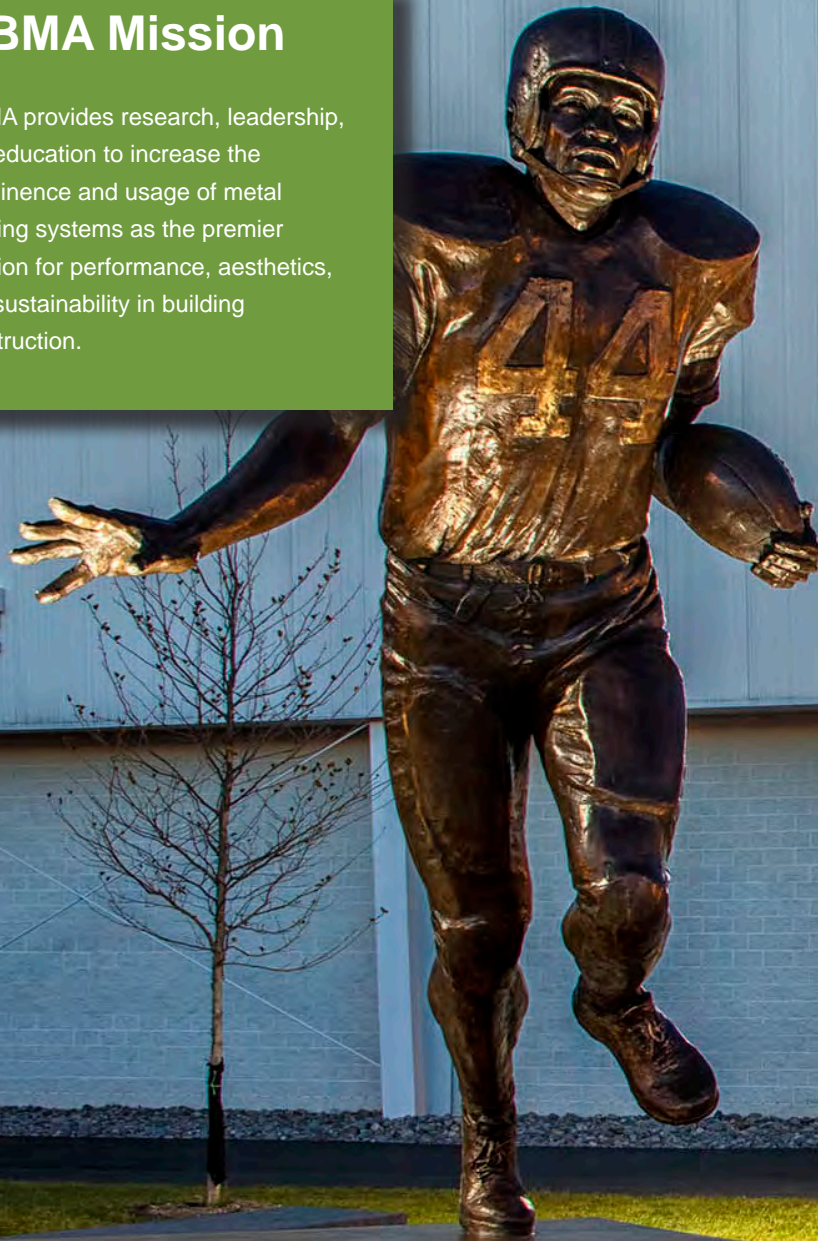
2016 Annual Report and Look Ahead

Celebrating 60 Years



MBMA Mission

MBMA provides research, leadership, and education to increase the prominence and usage of metal building systems as the premier solution for performance, aesthetics, and sustainability in building construction.



ERNIE DAVIS

ERNIE DAVIS
CLEVELAND BROWNS



ERNIE DAVIS
#44
SYRACUSE UNIVERSITY
1958-62



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About MBMA

MBMA has served metal building systems manufacturers and suppliers for 60 years. Its membership represents more than \$2 billion in annual shipments and accounts for nearly half of the total non-residential, low-rise construction market in the United States. MBMA provides engineering leadership through the many research programs it sponsors annually, often in coordination with major universities and engineering schools throughout North America. This research is used to improve the performance, efficiency, and quality of metal building systems and to elevate the technology used to produce them.



Chairman's Message, Brad Curtis

Chairman's Message, Brad Curtis

A Year of Growth...and a Plan for More



2016 brought great new opportunities to the Metal Building Manufacturers Association. As you read through this report, you'll see that those opportunities were generated by the work performed by our committees. Code changes, YouTube videos, podcasts, new technical manuals, and exciting new college courses highlighting metal building design – these are just a few of the accomplishments.

A tremendous amount of work has been completed. Throughout this report, you'll see hundreds of names scrolled across the pages. These are the people from member companies who gave their time and talents this year to make all our programs and achievements possible. We need to thank them for their contributions toward our success.

2017 promises to be equally fruitful for MBMA. We will serve the industry through new initiatives that engage, inform, educate and transform our businesses. We will complete new research and

update standards. We will help decision makers understand that metal buildings are an investment-grade building solution. In short, we will make this industry stronger.

If you're not involved, get involved. You'll be amazed by what you learn, who you meet and how much can be accomplished. Let's work together and get behind the projects and initiatives that help more and more building owners make metal buildings their first-choice solution.

Not many people have the privilege of serving as the chairman of our association. It is only through this experience that I have been able to see the breadth and depth of what can be accomplished. I now have such a deep respect and admiration for all that MBMA accomplishes, and the behind-the-scenes work that makes it all happen. If your company is not a member, you need to join. If you are a member, then join a committee. You don't know what you're missing unless you get involved. Like me, you'll be glad you did!

MBMA Management

General Managers

John H. Addington

Daniel J. Walker, PE

W. Lee Shoemaker, PhD, PE

Director of Research and Engineering

Jay D. Johnson, LEED AP

Director of Architectural Services

Vincent E. Sagan, PE

Senior Staff Engineer

Jennifer M. Oblock

Client Services Administrator

Eva M. Brunk

Engineering Administrative Assistant

MBMA has been managed by Thomas Associates, Inc. since 1956. Thomas is one of the longest-running success stories among association management firms in the United States. It has an extensive and diverse technical team that can support the codes, standards, and research goals of its various client associations. Such synergy allows it to expand research capabilities and bring in human resources that enhance the technical strength of MBMA.



Management Perspective, Dan Walker

Management Perspective, Dan Walker

60 Years of Cooperation & Innovation



2016 was a productive year for MBMA and one that marked the 60th anniversary of the association. Major milestones included the completion of MBMA's industry-wide Environmental Product Declarations (EPDs), the completion of the first-ever architecture and engineering student capstone course on metal buildings, and a much broader focus on public relations. Even with these new initiatives we haven't taken our eye off of our core competency, which has been the continued development and pursuit of technical research, and the development of design guides.

MBMA's YouTube channel and Twitter account were also launched this year, and we gained followers from within the industry—as well as outside—who learned about metal buildings and how MBMA helps the industry prosper.

We also paid homage to our industry founders by helping to institute a new Founders category in the Metal Construction Hall of Fame. Three industry pioneers were recognized to start the program: Wilbur Larkin, Jack Hatcher and Johnnie Schulte.

We are proud of our heritage, and by honoring the contributions of our founders, we can help that legacy live on for the next generation of leaders to learn from.

MBMA's committees have been hard at work carrying out the strategic plan initiatives adopted by the MBMA Board. The members will benefit from these efforts as we develop new tools, research, publications and educational opportunities for our target audiences: students, builders, developers, investors, owners, engineers and architects.

We are very proud of the progress made during 2016 and we are especially excited about the good things in store for 2017! Please call or email me anytime with questions or suggestions on how MBMA can serve you better. We're happy to provide this insight into our organization and the countless activities underway to make our industry stronger, and to continue to service the commercial construction market.

Metal Building
Capstone
College Classes
Successfully
Implemented

Architects Introduced to
Metal Buildings Through
Online AIA Continuing
Education Course

*New Guide for
Inspecting Metal
Building Systems*
Released

MBMA Creates Sustainability
Video and Environmental
Product Declarations for Metal
Building Systems

MBMA Educates
Contractors on Energy
and Fire Protection with
YouTube Webinars

Committee Accomplishments in 2016

MBMA
Adds New
Membership
Category
to Include
Architects and
Engineers

MBMA
Announces
New UL Design
W447 and ULC
U421 Interior
Fire-Rated
Wall Assembly
Listings

MBMA Unveils the Substantially Updated *Energy
Design Guide for Metal Building Systems -
Second Edition*

How It's Made Video
Released: *Metal
Building Innovations are
Revolutionizing Low-Rise
Commercial Construction*

MBMA THANKS OVER 400 VOLUNTEERS WHO GIVE TIRELESSLY TO THE WORK OF MBMA COMMITTEES: JEFF ADAMS
JERROD ADAMS - JERAMY ALBERT - DAVID ALEXANDER - JEFF ALEXANDER - EDDIE ALLEN - RANDY ALLEN - SHERRY
ALLEN - JON AMANN - MORRIE ANDERSON - CURTIS ARCHIBALD - ED ARMER - ROLAND AUGSPURGER - MICHAEL BAILEY



Chuck Haslebacher, Committee Chair

Building Credibility through Accountability

The AC472 accreditation program is a high-impact quality assurance initiative that sets the pace for the industry. It is this commitment to quality and excellence that helps make metal building systems the best choice for low-rise commercial buildings. Administered through the International Accreditation Service (IAS), the program requires regular inspections of manufacturing facilities. The program includes:

- Establishment of quality assurance standards for metal building systems manufacturers
- Evaluation of vendors, their capabilities and products
- Initiation of processes and procedures that proactively assess quality and eliminate errors
- Audits of each accredited company's quality assurance procedures and product quality standards
- Greater quality awareness among employees within each accredited company

The program is based on the requirements of Chapter 17 of the International Building Code and provides code officials with a means to approve the inspection program of manufacturers involved in the fabrication of metal building systems. MBMA's Accreditation Committee works directly with IAS to monitor and assess the program and its value. AC472 benefits building owners, contractors and developers, and lends a high level of credibility to all accredited building system manufacturers.

A Step Beyond

In 2016, the Metal Building Contractors & Erectors Association (MBCEA) worked directly with IAS and MBMA to encourage accreditation of metal building contractors through the introduction of AC478: "IAS Accreditation Criteria for Inspection Practices for Metal Building Assemblers." We also got more active in MBCEA to help support their new accreditation initiative.

AC478 requires that metal building assemblers have management and inspection systems in place to assure quality, safety and code compliance. The assemblers are evaluated across multiple areas, including erection/construction practices, training, management systems, personnel qualifications,

and compliance with project specifications. The program allows developers to have great confidence that metal buildings will be assembled according to strict specifications and performance standards. In addition, accreditation makes a strong statement to the general contractor community regarding an erector's desire to provide exceptional professional services.

Together, AC472 and AC478 are a winning combination to assure the highest quality in building design and construction.

Accreditation Committee

The transportation facility market has a large need for metal buildings because they are durable, flexible and have column-free design.



BINGHAM - SHARON BIRD - AUSTIN BLACK - ALAN BLAIR - ERIC BLANSCETT - SARAH BLOWER - TOM BOAL - MEL BOOKER
BRUCE BORTREE - LAWRENCE BOWER - PAT BRADSHAW - WES BROOKER - DAVID BROWN - LELAND BROWN - STEVE
BROWNING - MATT BRUESHABER - KEN BUCHINGER - CHRISTOPHER BUFKIN - STEVE BURLEY - MIKE BURTT - STEVE



BUTLER - STEVE CAMPBELL - JEFF CARMEAN - ANDREW CARPENTER - GERALD CARR - GIL CASEY - JEFF CHASTAIN - BERT CHOP - LESLIE CLARK - TODD COBURN - DON CONRAD - ARNOLD CORBIN - ROGER COX - RYAN CRIST - GARY CUMMINGS - BRAD CURTIS - CHRIS CURTIS - EMELIE DASH - SIMON DE BRITO - NAN DEAN - BERT DECLERCK - PAUL DEFFENBAUGH



Leslie Clark, Committee Chair

Elevating Perceptions

Since its formation, the MBMA Communications Committee has developed two active groups: the PR Subcommittee and the Website and Social Media Subcommittee. Through the participation of these groups, the Communications Committee continues to achieve the goals of the 2014-2017 Strategic Plan. The communications committee was formed to address the following:

Enhance and elevate the perception of metal building systems as a high-quality, adaptable, durable building construction approach that produces economy, speed to market and single-source control.

Communicating the Vision

Through targeted communications, we have reached a broader base of building decision makers, architects and influencers. We made them aware of the benefits of metal buildings and of the level of innovation and research coming out of MBMA. Frequency and consistency in our messages was key.

Communications Committee

Educating the Design Community

The Communications Committee also advocated for a strong educational component within MBMA's strategic plan. The development of an AIA Continuing Education course introduced metal buildings to 1,200 architects, which helped us to continue a dialogue with designers through CEU and LU/HSW webinars.

We were also instrumental in helping the Education Committee launch a first-ever capstone course focused on metal building design at six universities across the nation. This forward-looking approach exposes design students to metal buildings before they enter the workforce and has the potential to shape their impressions and preferences regarding metal building systems.

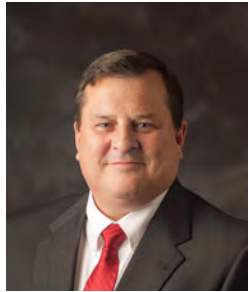
Targeted Messaging

Through the integrated use of social media, public relations and the internet, the committee also demonstrated that metal buildings are the first and best choice for owners, engineers, architects and various other influencers in the construction industry.

Whether it was through a weekly post on LinkedIn, an article placement, a tweet or a YouTube video, the perception of metal building systems was changed by telling our story to the right audience using the right media tools. We continue to refine our message and expand our reach to tens of thousands of decision makers; but more importantly, we are achieving engagement and starting a dialogue with designers, owners and industry players on why metal is the better solution for their building projects.

Moving to the Next Level

Having led the communications team for several years now, it is time to welcome a new committee chair for 2017, Craig Edwards. I have known Craig for a long time and am very excited to see where his leadership takes this committee. Welcome, Craig!



Jerry Hatch, PE, Committee Chair

MBMA Educational Programs on the Rise

The second year of the Education Committee has been productive. Our efforts have been directed at:

1. Expanding the university capstone course for engineers and architecture students to other universities
2. Changing perceptions by providing webinars and seminars for design professionals
3. Recording and making available continuing education courses for practicing engineers and architects

The first year of the university capstone courses was very well received. Industry engineers partnered with professors to provide guidance and recognition of metal building capabilities. The students sponged up the education and added metal building knowledge to their tool kit of talents. The committee continues to work with Professor Marci Uihlein at the School of Architecture at the University of Illinois at

Urbana-Champaign to develop curriculum resources and share them with other architecture faculty, encouraging them to introduce metal building concepts to undergraduate students.

MBMA's Dr. Lee Shoemaker has been reaching out to universities across the country that are in the vicinity of our member companies, making them ideal partners. Several have indicated they are interested and ready to engage in the capstone course curricula. Some will teach a course in the spring of 2017. The committee sees this as a continuing opportunity to introduce architecture and engineering students to the many benefits that metal building solutions provide. Imparting this knowledge may well change the perception and preference of metal building solutions in the decades to come.

A Successful Webinar Series

Continuing education credits are required to maintain professional licenses. MBMA has responded to the need by providing webinars and courses suitable for continuing education credits across the country. Recent courses include:

1. "The Benefits of Metal Building Systems from a Whole Building Perspective"
2. "Metal Buildings 101"

Education Committee

3. "Sustainability Part 1: Sustainability for Metal Buildings"
4. "Sustainability Part 2: Metal Building Systems and Life Cycle Assessment"
5. "Sustainability Part 3: Using EPDs to Drive Value for Metal Buildings"
6. "Skycalc – Daylighting Design for Metal Building Systems"
7. "Being the Engineer of Record for Metal Building Projects"
8. "Energy Code Compliance for Metal Buildings"
9. "Fire Code Compliance for Metal Buildings"

MBMA has partnered with the American Iron and Steel Institute (AISI) to provide a path for MBMA webinars to be eligible for AIA LU/HSW registration. We have also been recording MBMA webinars and presentations that can be made available on the web for those who could not attend the sessions. A small fraction of metal building engineers can attend the Technical Committee meetings. Making these presentations available to all metal building engineers helps to further disseminate the information and reduces individual continuing education costs.



CLAUDIA GOMEZ - MICHAEL GONG - FERNANDO GONZALEZ - SCOTT GOSSELIN - JOEL GRACE - TOM GRANITZ - THERESA GRAPE - DON GREEN - WAYNE GREGORY - LARRY GUMPERT - DUSTIN HADDOCK - ROB HADDOCK - TOM HAIC - RAHIM HAKIMI - CORY HANN - TODD HARBOUR - KIM HARRELL - ALLEN HARROLD - WILLIAM HART - PAULA HARVEY - CHUCK

The retail market depends on metal building systems because this segment demands aesthetics with lower up-front and operational costs, energy efficiency, fast construction and adaptable interior spaces.



HASLEBACHER - JERRY HATCH - ERIC HAUGEN - RICK HAWS - BRAD HEFFELMIRE - MIKE HEIDARY - STEVE HEIL - MARK HENDRIXSON - MARK HENRY - TREY HERREN - MIKE HERRIN - BEN HICKS - JOHN HINSHAW - DONNA HISE - BOB HODGES - PAUL HOWELL - MIKE HOWSER - JIM HRUBY - RICH HUBER - ANNE HUNSICKER - ALLEN HURTZ - SCOTT HUTCHINGS - SKIP



Ron Kuenkler, Committee Chair

Influencing Codes and Educating Designers

Code Monitoring

Throughout 2016, the MBMA Energy Committee continued to monitor and participate in the energy codes and standards process. This year, code proposals were addressed to update the 2015 IECC to the 2018 version. In addition, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) published the 2016 edition of ASHRAE Standard 90.1.

Education Planning Material Development

The *Energy Design Guide for Metal Building Systems - Second Edition* is complete, with substantial updates throughout the publication. The revised guide also includes the latest high-performance roof and wall insulation systems that will be referenced in ASHRAE 90.1-2016, and will be an indispensable asset for contractors wishing to expand their customer options. In addition, "Energy Code Compliance for Metal

Building Systems" is a free, on-demand webinar series being developed to educate MBMA members and designers. The video will complement the newly updated guide mentioned above, which is referenced throughout the program.

Our committee also completed the "Contractors Energy Guide for Metal Building Systems" report. Written in layman's terms, it contains pertinent energy code information and describes how to design a metal building to meet energy codes and to service customer demands for lower operational costs.

Project Updates

The committee is also undertaking a comprehensive study to determine the acoustical performance of the now-common, highly-insulated metal building assemblies. This information is important for designers who wish to use metal buildings for schools, churches, offices, and to meet the LEED v4 and other high-performance specifications. Members of the Energy Committee defined three roof assemblies and five wall assemblies to be considered for acoustical testing that will provide third-party test results the whole industry can use.

Energy Committee

The development of the acoustical data completes the design trifecta by allowing MBMA to promote fire, energy and acoustical data that is highly sought out by designers and will allow metal buildings to remain competitive with other building types.

MBMA is also helping to fund the Oak Ridge National Lab (ORNL) Roof Savings Calculator update. This multi-year project is expected to be complete in 2017. Fourteen other industry associations and the Department of Energy (DOE) are involved. The focus is to update the calculation methods used by the DOE through their Cool Roof Calculator, which can be used to show the long-term cost savings for specifying a cool roof.



Andy Jaworksi, Committee Chair

Fire Protection and Insurance Committee

Focused on Performance

Our committee's mission is to encourage fair and equitable treatment of metal building systems by regulators, fire and building codes, insurance and insurance regulating and rating organizations, underwriters, and re-insurance firms. In 2016, our committee focused on:

- Providing technical assistance for metal building fire protection and building insurance to MBMA members and other decision makers.
- Reviewing the MBMA *Fire Resistance Design Guide for Metal Building Systems* to determine if it is still state-of-the-art and recommending updates.
- Addressing photovoltaic systems on metal building system roofs. In coordination with the UL Non-Combustible Roof Group (whose members include MBMA, testing laboratories, solar panel manufacturers and panel mounting system manufacturers) we continue to work toward adding testing exemptions in UL Standards and the International Building Code (IBC).

- Working with MBMA Fire Protection Counsel, Dr. Nestor Iwankiw of Jensen Hughes, the committee completed a roof-ceiling study documenting the demand for roof-ceiling fire-rated assemblies based on end use occupancies and geographic location. The study utilized MBMA market statistics and recommended improvements to MBMA's existing UL-rated designs.
- Obtaining interior fire-rated wall listings UL Design W447 and ULC Design No. U421 for use in the United States and Canada. In both cases, the new interior wall utilizes Z-shaped girts and furring channels supporting gypsum wallboard on both sides. These assemblies were suggested by a contractor focus group that reviewed the industry's fire protection needs.

In addition to the above items, representatives of the committee met with UL and USG to discuss current MBMA head-of-wall/continuity joint and roof-ceiling fire-rated assemblies.

Another significant achievement was the conversion of the successful MBMA fire protection webinars, which have been converted into a series of free, online video segments. By educating the marketplace on the availability of fire ratings for metal building systems, these informative sessions provide the tools

to assist designers in choosing metal buildings. This education will help open new markets and defend existing ones.

Moving Forward in 2017

The committee will continue to maintain and update our existing MBMA fire-rated assemblies. We will also be working to incorporate additional roof insulation systems, such as filled cavity and liner systems, through engineering studies, testing, and collaboration with industry partners. This will include initiating engineering studies with UL to add ceiling-support hanger wire options to the roof-ceiling assemblies requiring additional insulation, and fire and air leakage testing of a new head-of-wall detail. The committee will also consolidate and update the existing MBMA Fire and Insurance bulletins to make them more user-friendly, concise and specific.

With the review of the MBMA *Fire Resistance Design Guide for Metal Building Systems* completed, the committee will update it to the 2018 IBC and include new MBMA-rated assemblies. Further, the UL Non-Combustible Roof Group will continue working to change testing standards to recognize non-combustible roofs and to add testing exemptions in the UL Standards and the IBC.

One of the most familiar and recognizable uses for metal buildings is in the construction of manufacturing and warehousing facilities.



JOHN LAWRENCE - JOHN PAUL LAWRENCE - ANDY LEE - RICHARD LEY - BILL LI - KEITH LINDEMULDER - RUSS LIVERMORE
TIM LOGUE - PAM LOWRY - E.B. LUDWIG, III - ROBERT LYTLE - STEVE MABEE - KENT MAKISHI - KIM MANSON - LORI
MARINO - IGOR MARINOVIC - JIM MARKS - BRIAN MARSHALL - VERN MARSHALL - MARTY MARTIN - PAUL MARTIN



SCOTT MARTIN - ERIC MASTERSON - JIM MATHIS - DAVID MAZAK - RICHARD MCCLURE - ART MCCULLOUGH - DENNY MCDEAVITT - DARREN MCGONIGLE - JIM MCINDOO - MIKE MCLAIN - CANDY MCNAMEE - RACHEL MERCADO - SANTIAGO MILLAN - CRAIG MILLER - DUANE MILLER - RON MILLER - CHARLES MILLS - NATHAN MIMMS - JIM MIRANDA - JAMES

Safety Committee

Safety Committee



Curtis Archibald, Committee Chair

Raising the Bar on Safety

The Safety Committee continues to work to establish the metal building industry as a leader in safe work practices. Participation on the committee is open to all members, so don't be afraid to get involved and start sharing what works in safety with your peers. By focusing on safety and best practices, member companies benefit from tangible things such as:

- Protecting employees by creating a safe working environment
- Fewer lost work days and restricted-duty assignments
- Less exposure in OSHA audits
- Reduced insurance premiums at renewal
- Improved morale and productivity

The Safety Committee also continues to produce quality training and idea-sharing opportunities by holding a popular and engaging annual safety

workshop that focuses on building leadership skills and sharing best practices among MBMA member companies. In addition to the workshop, the committee holds safety training webinars every other month that are free and open to all MBMA members, including Associate members. The webinars range from issues such as fall prevention, training new hires/temporary workers, hand and eye protection and mobile equipment training.

Annual Safety Awards

Safety awards were presented in May 2016 at the MBMA spring meeting. Forty-five manufacturing facilities again submitted data for the OSHA Injury Statistics Safety Award program. The process was changed in 2013 to make the program more stringent, with two levels of recognition: 1) Superior Safety Award for those companies with zero recordable injuries throughout the calendar year, and 2) Safety Performance Award for companies with an incident rate less than 50% of the industry average as reported by OSHA. One MBMA member plant received a Superior Safety Award, and 10 MBMA member plants were recognized with the Safety Performance Awards.

Another Great Annual Safety Workshop

This year, the MBMA Annual Safety Workshop was held in Dallas, Texas, with 27 attendees. The workshop consisted of an interactive series of roundtable discussions where members shared a best practice from their facility with the group. Their ideas for implementation included assigning mentors to new hires, using photos as a teaching tool for unsafe situations, creating job knowledge books, and installing netting to protect tow motors on loading docks, in addition to dozens of other great new ideas. Attendees also reviewed the top 10 OSHA citations for 2015 and how to prevent them, which helps companies to be prepared in their own plants and to prevent citations during an OSHA audit.

The Safety Committee will continue to hold an annual workshop and we are busy planning a new series of webinars for 2017 to share best practices to continue to foster a culture of safety for the industry.



John Underwood, Committee Chair

Educating the Design Community on MBMA's Industry-Wide Sustainable Resources

The MBMA Sustainability Committee was formed to ensure fair and equitable treatment for metal buildings by the many groups that publish standards relating to sustainability in the construction arena. Additionally, this committee prepares industry-wide resources to assist MBMA members in substantiating green building claims.

The following resources are now available on MBMA's website to assist the design community as they choose metal building systems for their sustainable building projects:

- Industry-Wide Life Cycle Inventory (LCI) data, available for practitioners to use in their Life Cycle Assessment (LCA) software programs

- Industry-wide LCA report
- Three Environmental Product Declarations (EPDs)
- Walter P. Moore case studies comparing metal building systems and other forms of construction
- Metal Building Systems Solution within the Athena Impact Estimator LCA software
- Promotional flyers highlighting the sustainable benefits of metal buildings versus wood in low-rise building construction
- USGBC LEED v4 summary of credits applicable to metal building systems

Environmental Product Declarations

In early 2016, the MBMA industry-wide EPDs for primary framing, secondary framing and wall and roof panels were completed and posted on UL Environment's website and featured on MBMA's website.

Environmental Product Declarations disclose the environmental impacts of a product based on the results of an LCA, in addition to providing other useful information. The MBMA EPDs are third-party validated, are ISO compliant, and can be used by the design community when specifying structural steel and metal panel products.

Sustainability Committee

Sustainability Education and Webinars

This year, the Sustainability Committee focused on educating the design community using the resources mentioned above, by posting information on the Athena Sustainable Materials Institute website, and by conducting three webinars. The webinars were recorded for distribution through MBMA's YouTube channel.

Codes, Standards and Rating Systems Monitored

The Sustainability Committee monitors the development of the ICC International Green Construction Code (IgCC), ASHRAE 189.1 Standard for the Design of High-Performance Green Buildings, and the USGBC LEED Rating System.

We anticipate that upcoming trends in the sustainability-related provisions will center on acoustics, resiliency and chemical concerns. There will be increased stringency in developing EPDs and a goal to develop standards to allow EPDs to be readily comparable.



PIRTLE - MARK PLATZ - COY PORET - JAMES PUNZEL - IRVING PYLATE - PHIL RAIMONDO - RANDY RAMSKUGLE - ROCKY RAU - RONALD REED - HERB REFFERT - STANLEY REID - STEPHEN J. REINERS - KEVIN REINHEIMER - MIKE REPP - BRIAN RIBIC - CHRIS RICHARDS - RANDY RIDENOUR - JONATHAN RIDER - DENNIS RIEMER - DON RILEY - CHUCK RIMSKY - TIM

Auto dealers were among the first to recognize the advantages of modern metal building system design due to distinctive exterior options and flexible, open interiors.



RITCHIE - CHRIS ROBBINS - HAL ROBBINS - MICHAEL ROEDER - BOB ROLLASON - FRANK ROSALES - JOHN ROSCOE - DAVE ROSENBERG - MICHAEL A. ROSENBERRY - ROY F. RUDOLPH - RODGER A. RUSS - SCOTT RUSSELL - DAVID RUTHERFORD JOHN SAMARO - MAX SARGENT - ANNE SAVAGE - GABE SAVELY - TIM SCHROCK - GARY SCHUMACHER - TIM SCHWARTZ



Scott Russell, Committee Chair

Building the Future: Research and Guides to Improve Metal Building Systems

MBMA's Technical Committee continues to achieve significant progress on key initiatives in 2016. Below are the highlights.

Research Projects

Seismic Behavior of Metal Buildings

This multi-year project primarily addresses the height restrictions and potential for member compactness limitations that impact metal buildings in high-seismic areas. This project is helping us understand and quantify inelastic behavior of tapered member frames. In addition to assisting in the development of appropriate seismic design procedures, this knowledge may propel us into a new era of performance-based design and advanced analysis.

In 2016, researchers from Johns Hopkins and Virginia Tech universities completed validation of a sophisticated computer model to reproduce the seismic behavior of every structural component within metal building frames observed during full-scale shake-table tests. As an indication of the complexity of these computer models, it takes approximately eight hours on a supercomputer to reproduce 10 seconds of shake-table testing.

Much work has also been done this year to define how the system analysis will be completed, including extensive meetings with the researchers, steering group, and academic peers. The modeling and analysis will commence in 2017, with completion in early 2018, leaving plenty of time to make the 2022 ASCE 7 code cycle.

Column-Base Rotational Testing

The purpose of the testing is to understand column base stiffness behavior and use that information in frame modeling to reduce frame weight while maintaining lateral drift limits. We believe that a better understanding of baseplate behavior—and how to quantify it as part of rigid-frame analysis—will generate significant benefits and economies when included in our everyday design practices. This data will also be useful input into the seismic modeling effort. Full-scale cyclic testing to determine the behavior of 11 different specimens has been

Technical Committee

carried out at the University of Houston. The results have been compiled in a report and provided to MBMA with the intention of answering the following questions:

- What factors affect whether the anchor rod will yield or pull out of the concrete?
- What influences whether the base plate will yield or the concrete will crack beneath the baseplate?
- How much rotational stiffness is present for different column-base configurations?
- Can this be a mechanism used to dissipate some of the energy from a seismic event?

This report will initially serve two primary purposes. First, it will allow the researcher who developed MBMA's Baseplate Wizard to update and expand its abilities. Second, it will help us to better define the fixity situation at the base in the 3D finite-element full-building models being generated for our seismic behavior project.

Bolted End-Plate Connections

As a result of this project, performed by Dr. Matthew Eatherton of Virginia Tech, three new bolted end-plate connection configurations have been developed and validated and one previously-tested option has expanded limitations. These new configurations will allow metal building manufacturers to optimize design and provide a more competitive product. They

Technical Committee

will be incorporated into the next edition of *AISC Design Guide 16*.

“The new bolted end-plate configurations will allow metal building manufacturers to optimize design and provide a more competitive product.”

Due to some efficiencies in the first phase of testing, some project funds remained unspent. These funds are being used to expand our research on seismic connections. A new configuration has been identified and cyclic testing will be complete by the end of 2016.

In 2017, we expect this project to result in a new version of *AISC Design Guide 16* with many enhancements and new information for the *Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications* specification (AISC 358). This will be a great benefit for differentiating metal buildings as a superior low-rise solution in high-seismic regions.

Limit-State Design of Girts/Purlins Research

A series of research projects, performed by Dr. Cris Moen of Virginia Tech, resulted in a design approach for metal building wall and roof systems that has been adopted in the AISI S100 cold-formed steel specification. These provisions will improve industry competitiveness by reducing the need for costly

testing, such as the base test, which currently defines capacity limits in AISI S100. The new approach can accommodate new products as they become available and will encourage a fresh look at the efficiency of existing wall and roof systems. This project is complete and the results were used to generate new provisions that are now included in the 2016 edition of AISI S100.

Rod-Brace-to-Web Connection Anchorage

Rod-bracing anchorage is critical to overall building stability. This project will provide a better understanding of the behavior of the connection of rod-bracing to rigid-frame webs using hillside washers and oversized long slots. Product tests indicate the presence of greater capacities than our current design methodology typically predicts. Also, the existing methodology should be updated for current limit states. This project is scheduled to be completed in late 2017.

Jamb Design for Overhead Vehicle Doors

New design guidance will be incorporated into the next edition of the *Metal Building Systems Manual* based on this study. It will provide a rational approach for how to design the jamb for an overhead vehicular roll-up sheet door. The challenge was to develop a proper door jamb interface utilizing typical steel C-section jambs. These jambs will rotate and affect the magnitude of the catenary forces imparted to the

jambs as well as the deflection of the doors. Dr. Cris Moen led the effort to develop a design tool that was validated to the tested door and jamb assemblies in the study.

Combined Lateral/Torsional Bracing

This project, performed by Dr. Don White of Georgia Tech, evaluated how to take advantage of combining lateral and torsional bracing. He developed new design procedures that have been adopted into the commentary for Appendix 6 of AISC 360-16. These provisions enable a more sophisticated evaluation of primary frame design that should lead to a more efficient use of flange braces. The next phase will be the development of a design guide that will aid in applying the new provisions and a design seminar.

Florida Building Code Panel Testing

Since the 1990s, building codes in south Florida have limited the allowable deflection for structural metal roof and wall panels to L/240, which is significantly more restrictive than the L/60 limit in the International Building Code (IBC). After meeting with the Miami-Dade County building officials, the MBMA, in conjunction with the Metal Construction Association and Force Engineering & Testing, developed a test program to demonstrate the performance of roof panels at deflections greater than the Florida Building Code High Velocity Hurricane Zone (HVHZ) deflection limits.

(continued on page 27)



Metal buildings are frequently chosen for office facilities because they are attractive, energy-efficient and durable. Maintenance costs are kept low due to the long-life building system and the weather-tight performance of a metal roof.

TRAVER - RICH TRICE - CHARLOTTE TYNER - MARK UBL - JOHN UNDERWOOD - SMOKEY UNDERWOOD - JIM USALIS
PRAMOD VADREUVU - RANDY VARBLE - KEVIN VERING - CRAIG WAGNER - ZACHARY I. WALKER - JEFF WALSH - DENNIS
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WEBBER - MARY WEBER - STEVE WEBER - AMANDA WELCH - KEN WELCH - JON WENSMAN - DENA WHITAKER - CHAD WIEBERG - JASON WILLIAMS - RICK WILLIAMSON - JIM WILSON - DANIEL WISE - JIMMY WORLEY - STEVE WRIGHT - TOM WRIGLEY - TRAVIS YETTER - WES YOUNG - BOB ZABCIK - ERIN ZASKE - MING ZHU

Technical Committee

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Results from the testing were shared with Florida building code officials and there is now strong support for relaxing the allowable deflection limit for roof panels. This change is progressing through the code change process and should be included in the next version of the Florida Building Code.

Exploration Study on 3D Metal Building Analysis

As an offshoot of our seismic analysis efforts, Dr. Ben Schafer at Johns Hopkins University suggested that we explore the potential benefits of analyzing an entire structure, including frames, bracing, wall and roof secondary framing, flange bracing and sheeting, as one 3D system. This is only possible because of the technologies developed in conjunction with the aforementioned seismic analysis project.

We will compare the current 2D designs of two typical metal buildings against 3D models using the same methods and technologies used in the seismic study. We hope to better understand the design, manufacturing and construction efficiencies this approach may bring, and any challenges to implement a 3D design approach.

Associate Member Innovation Award Project Update

The 2014 MBMA Innovation Award winner was submitted by Dale Nelson of Roof Hugger, Inc. The scope of the project is to review information on metal and non-metal roofing systems, as well as building code requirements. The goal will be to

summarize advantages and disadvantages of these systems in a report that can be used by the MBMA Communication Committee to educate owners, specifiers, contractors and building officials about re-roofing systems.

Manuals and Guides

Updated Seismic Design Guide

An update to MBMA's *Seismic Design Guide for Metal Building Systems* will be completed in 2017 and result in a state-of-the-art document based on the latest code provisions, 2015 IBC and ASCE 7-10 (which will also include commentary on the provisions of ASCE 7-16). It will be expanded with information related to recent MBMA-sponsored research and address metal building-specific issues in seismic design with supplemental information and rational explanations not found in other U.S. standards. It will also include expanded coverage of buildings with mezzanines.

New Field Inspection Handbook

In 2016, MBMA published the *Guide for Inspecting Metal Building Systems*. This resource for building officials, engineers-of-record, contractors, erectors, owners, the insurance industry and MBMA members will help eliminate misunderstandings and lead to shorter punch lists, faster project completion, and better-constructed metal buildings. The Metal Building Contractors & Erectors Association (MBCEA) provided valued input and the publication is now available at www.techstreet.com/mbma.

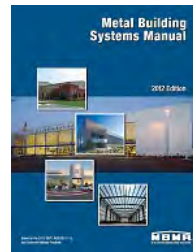
AISI D111 Design Guide Revision

This project will update and consolidate two purlin design guides (AISI CF97-1 and AISI D111) into one comprehensive resource. Material on gravity loading and through-fastened roof systems will be added. The revised guide will cover all aspects of cold-formed steel purlin roof-framing system design, in accordance with the 2016 *Specification for the Design of Cold-Formed Steel Structural Members* (AISI S100).

The Technical Committee appreciates the continuing support of the MBMA members as we focus on proactively developing information and technologies that differentiate us from competing forms of construction in our market.

MBMA Educational and Technical Resources Provide Valuable Information for the Industry

MBMA continues to lead the metal building systems industry and fulfill its mission by providing educational, research and technical resources. These include an increasing number of design guides and manuals that are invaluable for anyone who works with metal buildings anywhere in the world. MBMA publications are sold as print-on-demand or downloadable PDF files at www.techstreet.com/mbma. Users who purchase manuals this way are automatically notified of updates and errata. MBMA also provides an array of free resources that can be found at www.mbma.com.



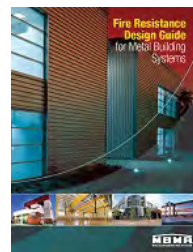
2012 Metal Building Systems Manual

- Nationally recognized reference manual for the metal building industry
- Used by building owners, manufacturers, general contractors, erectors, engineers, architects, specifiers, inspectors, and other building professionals
- Covers the 2012 International Building Code and the American Society of Civil Engineers/ASCE 7-10



Metal Roofing Systems Design Manual - Second Edition

- An important industry guide written around the most commonly adopted standards and codes
- Incorporates the results of research undertaken by MBMA, its members, and other industry groups
- Includes access to industry-wide roof details in AutoCAD format



Fire Resistance Design Guide for Metal Building Systems

- Addresses fire protection solutions specific for metal building systems
- Includes prescriptive fire protection practices related to occupancy and construction options
- Offers extensive background information on fire-resistant provisions of the building codes relative to metal buildings



Energy Design Guide for Metal Building Systems - Second Edition

- A complete update of this essential guide
- Contains details on a variety of state energy codes, standards, and compliance tools
- Includes commentary on the latest editions of green building codes, standards and rating systems
- Provides information on cool roofs, a daylighting design guide, and useful information about photovoltaic panels on metal buildings
- Incorporates both the 2012 and 2015 International Energy Conservation Codes, as well as 2010 and 2013 editions of ASHRAE Standard 90.1 provisions pertaining to metal building systems



Seismic Design Guide for Metal Building Systems

- It's out of print currently, but MBMA committees are working on a new version to be released in 2017
- Includes practical design examples to illustrate acceptable approaches for dealing with common seismic design issues, and provides insight into the impact of recent code developments



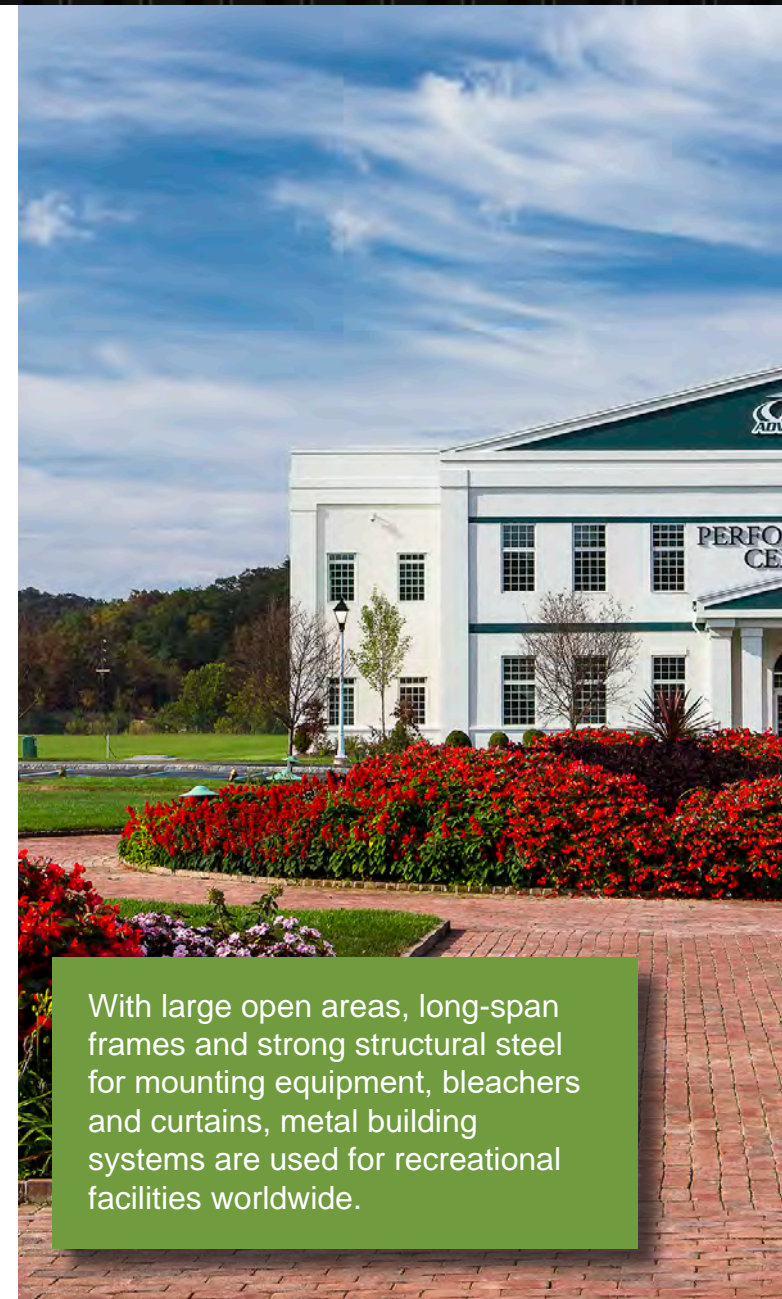
Concrete Masonry Walls for Metal Building Systems

- Published jointly with the National Concrete Masonry Association (NCMA)
- Highlights the advantages of metal buildings using concrete masonry hardwalls
- Includes recommendations on masonry design standards and industry practices, design aids, construction recommendations, and details for integrating masonry with metal buildings



Guide for Inspecting Metal Building Systems

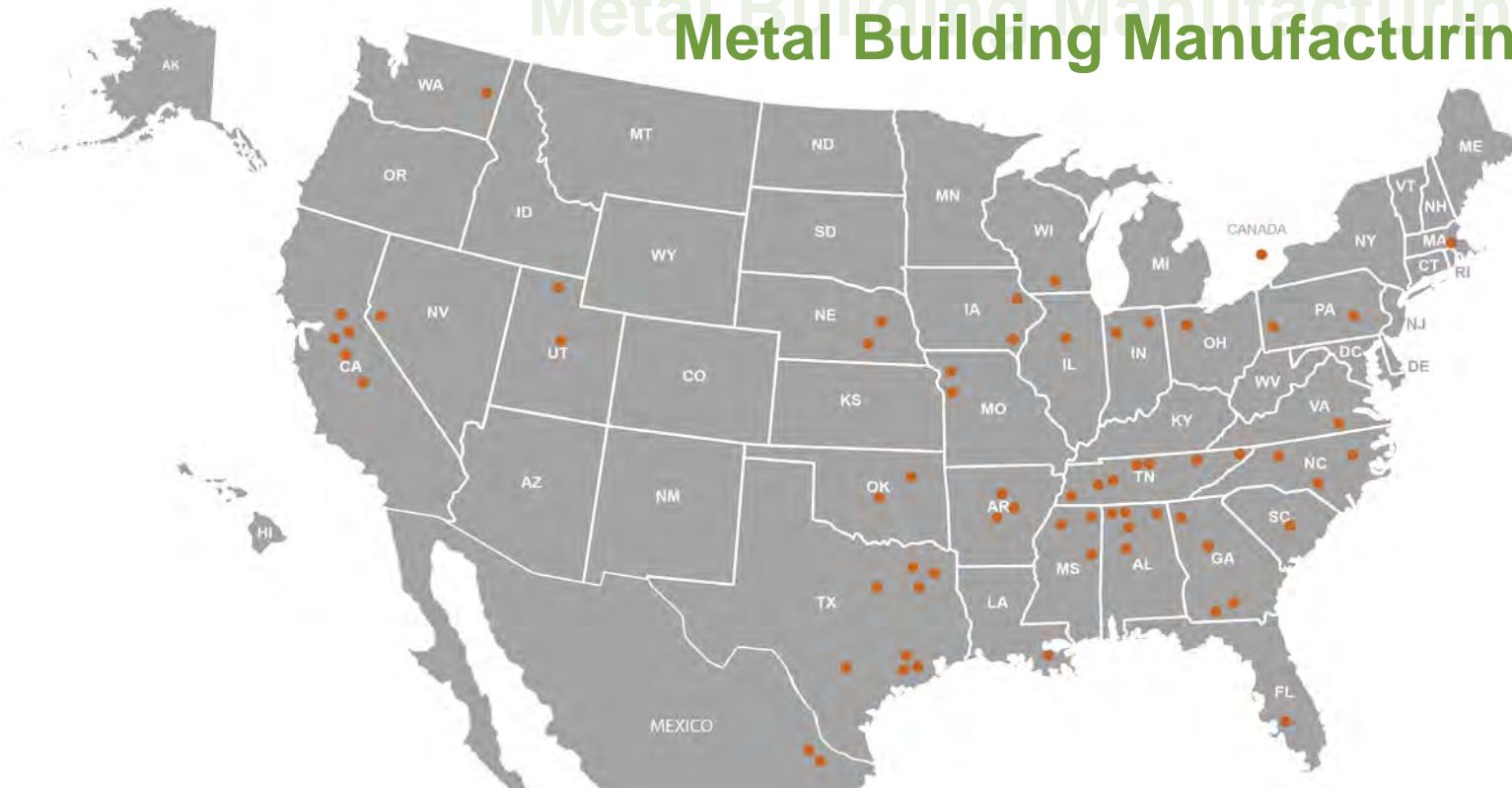
- A resource for individuals responsible for contracting, performing and reporting inspection tasks related to the construction of a metal building project
- Intended to help eliminate misunderstandings and lead to shorter punch lists, faster project delivery, and high-quality construction methods
- Focuses primarily on inspecting newly constructed metal building systems, including primary framing, secondary framing, and metal roof and wall cladding
- Provides overview of standards on materials common to the building envelope, such as windows, doors, skylights and insulation materials



With large open areas, long-span frames and strong structural steel for mounting equipment, bleachers and curtains, metal building systems are used for recreational facilities worldwide.



Metal Building Manufacturing Plants

**ALABAMA**

Cullman
Eufaula
Florence
Hueytown
Muscle Shoals
Raineville

ARKANSAS

Cabot
North Little Rock
Pine Bluff

CALIFORNIA

Atwater
Lathrop
Lockeford
Turlock
Visalia

FLORIDA

Fort Meyers

GEORGIA

Adel
Cedartown

Lithia Springs
Thomasville

ILLINOIS

El Paso

INDIANA

Rensselaer
Waterloo

IOWA

Monticello
Mount Pleasant

LOUISIANA

Harahan

MASSACHUSETTS

Sutton

MISSISSIPPI

Batesville
Columbus
Starkville

MISSOURI

Kansas City

St. Joseph

NEBRASKA

Columbus
Grand Island

NEVADA

Carson City

NORTH CAROLINA

Greensboro
Laurinburg
Rockmount

OHIO

Kenton

OKLAHOMA

Claremore
Oklahoma City

PENNSYLVANIA

Ambridge
Annville

SOUTH CAROLINA

Swansea

TENNESSEE

Caryville
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Jackson
Lexington
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Metal buildings provide government agencies with a high return on investment, and meet their needs for both function and form.





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