MBMA

METAL BUILDING MANUFACTURERS ASSOCIATION®

We changed an industry

We made a difference

We created a new future

JULY 2016

METAL BUILDING MANUFACTURERS ASSOCIATION

60TH ANNIVERSARY

RESEARCH | LEADERSHIP | EDUCATION

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CELEBRATING 60 YEARS OF PROGRESS WITH MBMA

Research. Leadership. Education. These words encapsulate the primary mission of the Metal Building Manufacturers Association (MBMA). Thirteen metal building systems companies originally founded our organization in 1956. They did so with a strong desire to provide unique, high-quality building solutions to the construction industry. Today, MBMA's membership has grown to 43 building manufacturers and approximately 60 of their suppliers.

Over the last six decades, MBMA research and programs have worked to document the industry's superior structural performance, energy efficiency, sustainability and aesthetics. Decades of research, leadership and education have led to the widespread acceptance of metal buildings as the best choice for low-rise commercial construction around the world.

In recognition of our 60th year of service to the metal building systems industry, the following pages reflect on the importance of our members and their accomplishments through the association over the years. In addition to reflecting on our successful past, we will also provide insight into what we believe the future holds for our growing industry. Enjoy!

Dan Walker, P.E.
Associate General Manager

MBMA
METAL BUILDING MANUFACTURERS ASSOCIATION®
Research | Leadership | Education

MBMA MISSION

To enhance the collective interests of the metal building systems industry.

MBMA PLEDGE

To represent and promote the common interests of the member companies and wisely invest their resources to benefit the group.

MBMA ONLINE
WWW.MBMA.COM

MBMA CONTACT

Did this 60th anniversary insert give you new insights, raise new questions or capture your interest in the industry? If so, we encourage you to get involved in MBMA.

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WILL YOU LEAVE A LEGACY LIKE THIS?

BY BRAD CURTIS, CHAIRMAN, MBMA

While my involvement in MBMA has occurred in just the last decade, I wanted to share with you some wisdom from those who've come before me. In looking through MBMA's archives, I learned some very important things from leaders who worked so hard to make MBMA great so many years ago. I hope you will enjoy reading a little bit about a few of these leaders and how they influenced—and were influenced by—the MBMA.

VOICES OF THE PAST

Lon Shealy served as MBMA chairman in 1979 and was on the executive committee from 1975 to 1979. He began his career in the metal building industry in 1947. After retiring from the workforce in 1987, he wrote a book, "Destiny by Design," on strategic planning. He was also appointed Assistant Director of Commerce by the governor of Oklahoma. In 2006, at age 82, he had this to say about the influence of MBMA on the metal building industry:

"When I was on MBMA's executive committee, we had a mission to do better by the construction industry, offering attractive and functional structures at lower costs. The net value is that our efforts saved the American economy billions and billions of dollars. Much of the retail and commercial construction could not have happened without systems construction.

As an association, those of us who led competing companies learned to work together. Just as when Butler shared their research on wind damage in Canada, we learned to trust and help one another. We became loyal to our industry. MBMA made this possible. They saw the potential of teaming together and lived up to it. In my opinion, no association has done it better."

Don Pratt served as chairman of MBMA in 1983 and was on the association's executive committee for several years prior to his chairmanship. An industry leader throughout his career, he exuded vision within the industry and respect for MBMA's contributions. About a decade ago, he expressed this opinion of MBMA's place in history:

"Our industry has a unique history and MBMA is a unique organization. It has created a place where competitors can work in cooperation to solve industry issues. Such cooperation has allowed the technology to evolve and adapt to offer high-performance solutions for commercial and industrial buildings. MBMA encourages the exchange of ideas. This has led to a steady stream of new construction and system building technologies that have changed individual member companies and the industry as a whole."

George King was integral to MBMA's executive committee from 1987 to 1990, and again from around 1992 to 1995. He also served as chairman twice in 1990 and 1995. George felt his call to duty was rewarding because of the significant achievements of that era. He provided the following assessment of MBMA's contributions through investment in research:

"Throughout its history, MBMA's solid commitment to research has had a major influence on the industry. This research has enabled the industry to broaden its horizons in terms of end use of metal systems. Metal became more than 'tin sheds' and 'shades and shelters.' Metal systems became widely used and attractive—because of the research effort. And, the research enabled the technical committee to work with model and city code authorities to gain wider acceptance of metal building systems in the marketplace.

Research, development and engineering … along with certification … changed our industry and led to tremendous growth. And it was all accomplished by a group of highly competitive companies who chose to unite and come together for a common cause. I've seen this happen to some extent in other associations, but none have been as successful at this as the MBMA."

Harry R. (Bob) Lowe, P.E., was chairman of MBMA in 1999 and 2005. Throughout his career, he spent a total of 16 years on MBMA's board of directors and worked on many committees and special initiatives as well. "I have witnessed the evolution of the MBMA," he says, "from an exclusive 'Good ol' Boys' club to a flexible organization that responds proactively to inevitable change." Here's what he said in 2005 as he pondered the impact of MBMA:

"Sometimes I wonder just where our industry would be today if the MBMA did not exist. Our market share would have shriveled by just the lack of influence in codes alone. And the credibility of the industry would be in question without a stringent certification process. We will never know the extent of the impact this one association has had—and will have—on our industry, our country, our world. It may be a 'quiet' association, but its influence is powerful and lasting."

Wisdom is made of words that stand the test of time. These statements, from leaders through the years, affirm the importance of MBMA and its contributions of the past. Thanks to what MBMA has done, future generations will benefit; and the next generation of metal building systems professionals will take us to new heights that we can't currently envision.

Here's to an exciting—and amazing—future!

A Retrospective Overview

1700s

Ditherington Flax Mill in Shrewsbury, England, was the world's first iron-framed building. Construction ran from 1796 to 1797 at a cost (including equipment) of £17000, which equates to about $25,500.

PHOTO CREDIT: TALIESIN EDWARDS

1800s

During the California Gold Rush, Peter Naylor, a metal roofer from New York, advertised "portable iron houses for California." Between 500 and 600 of the houses were shipped out in 1849. According to the ad, 20-foot-by-15-foot homes could be built "in less than a day [and] were cheaper than wood, fireproof and more comfortable than a tent."

EARLY 1900s

Metal structural members and panels were used for garages. Small structures were advertised in the *Saturday Evening Post* in 1916, selling for about $66.

Metal building systems were next used in oil fields. Four or five companies made buildings that had metal structures with walls and roofs of corrugated steel panels.

In the early 1920s, an advertisement placed by Chicago-based Liberty Steel Products Co. pictured a fabricated steel building, shipped from the factory and ready to erect in a matter of hours.

Introduction of a "pre-engineered" standing seam metal roof at the 1934 Century of Progress Exposition in Chicago.

PHOTO CREDIT: SATURDAY EVENING POST

A LONG HISTORY OF SERVING THE BUILDING COMMUNITY

In the 1700s and 1800s, during the first and second Industrial Revolutions, iron and steel became more commonly used as practical building materials. Early in the 20th century, steel building companies started sprouting up in the United States. Since then, the metal building systems industry has continued to grow and evolve.

In the early 1950s, the industry encountered a variety of challenges. Metal buildings offered unique solutions, not always considered in the development of local and national building codes and insurance requirements. MBMA was formed because the founding members knew the industry needed help to overcome obstacles so metal building systems could achieve recognition as a viable construction option. Those founders were also passionate to provide a network to promote sound engineering and quality fabrication.

MBMA helped develop relationships between manufacturers and local builders, with both sides benefitting from these constructive relationships. Today, networking provides manufacturers with a reliable source of projects; and in return, manufacturers provide training, marketing support and guidance to builders. By having a single source from which to obtain the complete building envelope, builders develop relationships with manufacturers that lead to lasting partnerships, which benefit individual companies and the industry itself.

In early applications, metal buildings were not as aesthetically pleasing as they are today, causing architects and engineers to shy away from such a useful, but seemingly inflexible, building approach. This negative impression was one of the industry's toughest hurdles. Manufacturers responded by fashioning steel and other materials in ways that were more attractive, functional and eco-friendly. Revamped architectural aesthetics, such as sweeping expanses of glass and dramatic overhangs, have helped transform public perception. Softer, more neutral paint colors allowed for a stylish integration of metal panels with brick, stone, concrete and wood.

Throughout six decades of changes, the MBMA has continued to serve as the industry's leading metal building systems advocate. The association promotes the efficiency, resilience, flexibility and aesthetics of metal through education, advertising, speaking engagements, brochures, outreach and other promotional investments. It also sponsors the industry's most advanced and forward-thinking technical research initiatives. MBMA provides a united front to a continually advancing industry. MBMA members are dedicated to serving the ever-changing needs of a progressive and diverse marketplace.

MBMA ADVANCES THE AEC INDUSTRY

The Metal Building Manufacturers Association is helping to raise up the entire architecture, engineering and construction (AEC) industry. Thanks to the efforts of MBMA and its members, metal building systems sales have risen dramatically since annual sales were first recorded some 45 years ago. In 1960, sales were estimated below $1 million. In 2015, the industry shipped over 1,070,000 tons of steel exceeding $2.5 billion and growth is expected to continue over the next decade. MBMA members provide over 25,000 buildings each year. That number is on the rise with continued growth in relatively new market segments such as retail and office space. These figures reflect how building owners, engineers, architects and others in the construction community have embraced the durability, flexibility and life cycle advantages associated with metal building systems.

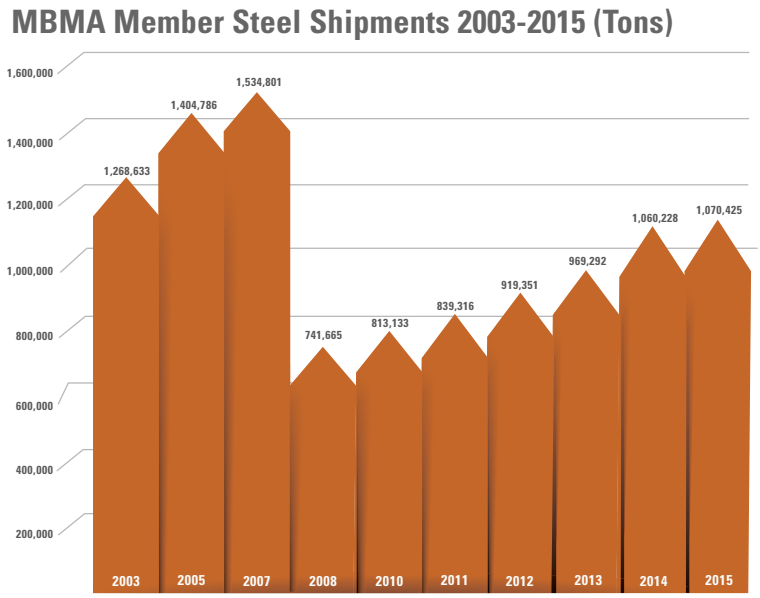
In 2014, MBMA members were responsible for constructing over 265 million square feet of low-rise construction. MBMA member sales today constitute the largest portion of buildings in the non-residential, low-rise construction market in the United States.

> ***"The need for metal building systems continues to grow and the marketplace continues to embrace these systems because of their versatility, reliability and sustainability."***
>
> - Brad Curtis, MBMA Chair

A breakdown of MBMA member's 2015 sales by end-use categories include: 35 percent commercial buildings; 31 percent manufacturing buildings; 10 percent community facilities, 7 percent agriculture and 17 percent miscellaneous end-uses.

Commercial end-users include retail stores, office and bank buildings, aircraft hangars and automobile dealerships. Community buildings include schools, recreation centers, churches and health care buildings.

The national economic recovery is now seven years old and total non-residential construction spending has started making a comeback. Metal building shipments over the past six years have held steady compared to total non-residential construction. Metal buildings remain the frontrunner in the low-rise, non-residential construction sector.



The pre-engineered building business prospered during World War II with the introduction of the Quonset Hut, which was portable, inexpensive and easy to erect.

1950s AND 1960s

Wilbur Larkin of Butler Manufacturing first conceived the idea and MBMA was founded on October 1, 1956. Initial membership included 13 metal building manufacturing companies.

A straight, sidewall panel for commercial/industrial buildings and color-coated panels were introduced.

COURTESY OF VARCO PRUDEN

Manufacturers began to do business through builder and dealer networks.

MBMA formed its first Technical Committee and published the inaugural "Metal Building Systems Manual." Providing consistent updates as the market changes, this remains the industry standard.

MBMA established its first Insurance Committee to address the effects of insurance rates on construction.

COURTESY OF VARCO PRUDEN

The typical end product at this time was less than 10,000 square feet. In 1960, agricultural users accounted for 34 percent of total MBMA shipments. The remaining 66 percent went into commercial, industrial and other uses.

MBMA member sales grew from $69.6 million in 1956 to $98.9 million in 1960, with market share comprising 20 percent of low-rise, nonresidential construction.

By 1960, MBMA grew to 16 members with 23 plants, representing the interests of 1,000 dealers.

In the early 1960s, the first factory-insulated wall panels were introduced together with the first UL-approved roof, subsequently lowering insurance costs.

1970s

MBMA grew to 25 members with 40 plants. The number of builders and dealers tripled to 3,000.

End use of products grew to: commercial and industrial, 36 percent each; agricultural, 10 percent; community, 8 percent; and miscellaneous, 10 percent.

Manufacturer sales in 1970 were $363 million. Market penetration in the low-rise, nonresidential segment of construction increased from 20 to 30 percent. By the end of the decade, the industry had captured over 40 percent of the market.

During the decade, manufacturers and MBMA invested millions of dollars to develop product features, increase capacity, and reduce the final product cost to the marketplace.

A flat-profile metal roof was introduced in the early '70s, increasing architects' interest in metal. Standing seam roof systems also gained prominence due to energy efficiency and watertightness, elevating the roof seam above the water plane and virtually eliminating fasteners through the panel.

New design and manufacturing techniques increased strength-to-weight ratios, using structural members with lighter cross sections and higher strength steel. Energy savings were added with the factory-insulated sandwich wall panel, providing for high insulation R-values and further attracting building designers and owners.

MBMA'S DISTINGUISHED TECHNICAL LEADERSHIP

W. LEE SHOEMAKER

For the last 22 years, W. Lee Shoemaker, Ph.D., P.E., has served as MBMA's Director of Research and Engineering. In 2015, Dr. Shoemaker was elected to the Metal Construction Hall of Fame, sponsored by *Metal Construction News* magazine. Judges assess nominees based on five criteria: longevity in the industry; unique contributions to the industry; body of work throughout a career; legacy; and integrity.

Dr. Shoemaker follows in the footsteps of two previous MBMA Directors of Research and Engineering, Dr. Duane Ellifritt and Gil Harris, also members of the Metal Construction Hall of Fame. Dr. Shoemaker has helped guide some the most innovative metal building research programs in the history of the industry. He is also a strong voice to represent metal buildings

"The Hall of Fame showcases the best talent in the metal construction industry. When you look at the work Dr. Shoemaker has done over the years, it is clear that he belongs with this elite group of industry veterans and pioneers."

- Dan Walker, Associate General Manager

MBMA'S TECHNICAL COMMITTEE CHAIRS

Robert Blickensderfer	Armco	1957–1962
Norman Rimmer	Butler Manufacturing	1962–1971
Lyle Wilson	American Buildings Co.	1972–1974
Gilliam S. Harris	Mitchell Engineering	1975–1977
William Sontag	Pascoe Steel	1978–1980
John Rave	Inryco	1981–1983
Donald Johnson	Butler Manufacturing	1984–1986
Joe Nunnery	AMCA Buildings	1987–1989
J. Walter Lewis	Kirby Building Systems Inc.	1990–1991
Donald Johnson	Butler Manufacturing	1992–1993
Maury Golovin	Ceco Building Systems	1994–1995
Joe Nunnery	Varco Pruden Buildings	1996
J. Walter Lewis	Kirby Building Systems	1997–1998

in technical and trade groups, such as the American Society of Civil Engineers (ASCE), the American Institute of Steel Construction (AISC) and the American Iron and Steel Institute (AISI).

Since he accepted his role with MBMA in 1994, Dr. Shoemaker has led the development of numerous technical publications, including the industry flagship, "Metal Building Systems Manual." He has supervised over $4 million in research contracts with universities and testing agencies on behalf of MBMA. Currently, he is heading an MBMA-driven initiative to integrate metal building design and construction practices into architecture and engineering collegiate curricula, an effort to foster a nationwide industry/academic partnership that provides real-world experience for undergraduates and elevates the perception of metal buildings within the next generation of design-build professionals.

Dr. Shoemaker graduated from Duke University with a B.S. in Civil Engineering, earned his masters degree in Civil Engineering from Tulane University and then returned to Duke for his doctorate in Civil Engineering. Prior to joining MBMA, he served as an assistant professor at Auburn University, was the chief engineer and vice president of engineering at Cornell Crane Manufacturing, and worked for Avondale Shipyards in New Orleans as a structural engineer.

"Dr. Shoemaker is an invaluable resource for MBMA and the industry."
- Tom Gilligan, Past Chair


TOM GILLIGAN

Barney Ruble	**Steelox Systems**	**1999**
Mark Radmaker	**Garco Building Systems Inc.**	**2000–2002**
Eric Masterson	**NCI Building Systems Inc.**	**2003–2004**
Scott Russell	**Nucor Building Systems**	**2005–2008**
Jerry Hatch	**NCI Building Systems Inc.**	**2009–2013**
Scott Russell	**Nucor Buildings Systems**	**2014–Present**


NORMAN RIMMER


GILLIAM S. HARRIS


DONALD JOHNSON

Steel coil coaters applied new wall panel coatings in polyurethane and polyvinyl fluorides. These long-life colors offered greater resistance to corrosion.

1980s

MBMA member sales topped $1 billion in 1980, compared to $323 million just a decade earlier.

In 1981, MBMA had 35 members operating 74 plants in the United States, and 10 overseas. There were 8,800 independent builders.

In 1980, the industry published its first tabloid-size trade publication, *Metal Building News*. In the mid-'80s its name was changed to *Metal Construction News*.

In 1985, a second industry magazine *Metal Architecture* (devoted to educating architects and building designers about the benefits of metal building systems, products, and roofing for new and retrofit construction) was introduced.

1990s

The 1990s saw a period of major growth for the metal building industry. In 1990, MBMA member sales exceeded $1.5 billion and steel shipped was over 1.2 million tons. By 2000, MBMA member sales were over $2.5 billion and steel shipments approached 2 million tons.

MBMA led the effort to sponsor research at Rensselaer Polytechnic Institute to determine if changes in building codes were warranted. The research resulted in changes to ASCE 7.

At MBMA's urging, the American Iron and Steel Institute (AISI) coordinated the formation of a coalition of steel industry groups to contend with controversial new OSHA standards impacting the industry. Ultimately, OSHA entered into a voluntary agreement with the steel industry coalition to implement specific recommendations to manufacturers of metal decking and roofing. This was a significant achievement, creating a win-win solution.

2000s

In response to the devastating Northridge earthquake in 1994, MBMA directed an initiative that led to the development of a seismic design guide to assist engineers and plan checkers in applying new seismic requirements to metal buildings.

In 2004, MBMA established an Energy Committee to research codes and test products to ensure they are fairly rated, develop product solutions to better meet energy codes and standards, and to keep MBMA members apprised of significant ongoing changes in energy codes.

In 2005, MBMA published the "Tapered Member Design Guide" incorporating weight-savings criteria based on proven design approaches to benefit the entire industry.

MBMA and AISI sponsored research conducted at Virginia Tech to provide a more rational approach to determining

MBMA'S LEGACY OF LEADERSHIP

1956–1957—Wilbur B. Larkin, Butler Manufacturing Co.

1958—Donald Malcom, Armco Inc.

1959—George Cobb, Soule Steel Co.

1960—Charles Homer, National Steel Products Co.

1961—Howard Carew, Carew Corp.

1962—Harry Williams, Braden Steel Corp.

1963—C. L. Mitchell, Mitchell Engineering Co.

1964—Donald Malcom, Armco Inc.

1965—William T. Slaton Sr., Delta Steel Building Co.

1966—James Dennis, Atlantic Building Systems Inc.

1967—C. V. Blackburn, Pascoe Steel Corp.

1968—Jack Hatcher, Varco Pruden Buildings

1969—John Von Blon, A&S Building Systems Inc.

1970—R. J. Atkinson, Butler Manufacturing Co.

1971—Lon Shealy, Star Manufacturing Co.

1972—Gilbert Leach, Marathon Metallic Building Co.

1973—James D. Murphy Jr., American Buildings Co.

1974—John Reigle, National Steel Products Co.

1975—Lou Barrenechea, National Steel Products Co.

1976—Hugh F. McCarley, Atlantic Building Systems Inc.

1977—Scott C. Lewis, Braden Steel Corp.

1978—R. J. Atkinson, Butler Manufacturing Co.

1979—Robert C. Kelley, Varco Pruden Buildings

1980—Charles H. Waldron, Mitchell Engineering Co.

1981—James L. Sullivan, Inryco Inc.

1982—Herman J. Oellerich, Armco Building Systems Inc.

1983—Donald H. Pratt, Butler Manufacturing Co.

1984—Talmage G. Rogers Jr., Ceco Building Systems and Mitchell Building Systems

1985—Gary Heithecker, Mesco Metal Buildings Corp.

1986—James D. Murphy Jr., American Buildings Co.

1987—Norman Yerke, Summit Buildings

ROBERT T. AMMERMAN

BILL SAVITZ

BOB LOWE

KEITH FISCHER

"Strong leadership has been vital to the association throughout its first 60 years. Vision, leadership and a passion for the industry are the common attributes of our chairmen throughout the last six decades."

- Dan Walker, MBMA Associate General Manager

1988—Robert C. Kelley, AMCA Buildings Division

1989—Clayton H. Richardson Jr., Gulf States Manufacturers Inc.

1990—George F. King, Kirby Building Systems Inc., a division of ABS

1991–1992—Richard S. Jarman, Butler Manufacturing Co.

1993—Dan Zabcik, NCI Building Systems Inc.

1994—Duane Stockburger, Varco Pruden Buildings

1995—Robert T. Ammerman, American Buildings Co.

1996—Tony F. Raimondo, Behlen Manufacturing Co.

1997—George F. King, Kirby Building Systems Inc., a division of ABS

1998—J. Terrell Landrum, Ceco Building Systems

1999—Harry R. Lowe, Nucor Building Systems

2000—Leonard F. George, NCI Building Systems LP

2001—John M. Underwood, Inland Southern Corp.

2002—Joel Voelkert, MAGNATRAX Buildings Group

2003—Will Feland, Pinnacle Structures Inc.

2004—John Price, Chief Buildings

2005—Harry R. Lowe, Nucor Building Systems

2006—Robert T. Ammerman, MAGNATRAX Buildings Group

2007—C. William Savitz, Garco Building Systems

2008—Keith Fischer, Robertson Ceco Corp.

2009—Phil Raimondo, Behlen Building Systems

2010-2011—Chuck Haslebacher, Varco Pruden Buildings

2012—Fred Koetting, Schulte Building Systems LP

2013—Jeff Carmean, Nucor Building Systems

2014—Brad Robeson, NCI Building Systems Inc.

2015—Tom Gilligan, Butler Manufacturing

2016— Brad Curtis, Tyler Building Systems

CHUCK HASLEBACHER

FRED KOETTING

JEFF CARMEAN

bracing anchorage forces in a metal roof, so that designers would have more flexibility in providing a bracing system. As a result, new provisions were adopted into the 2007 AISI specification, and a new AISI Design Guide was developed to help explain the requirements.

In 2007, metal building sales reached $2.9 billion and MBMA members shipped approximately 1.5 million tons of steel.

In 2008, the International Accreditation Service approved accreditation criteria for its guide, "Inspection Programs for Manufacturers of Metal Building Systems–AC472." It provides code officials with a means to approve the inspection programs of manufacturers that fabricate metal building systems.

2010s

In 2010, MBMA published the "Energy Design Guide for Metal Building Systems." The handbook is the industry's comprehensive resource for information on energy-efficient design and construction for metal buildings.

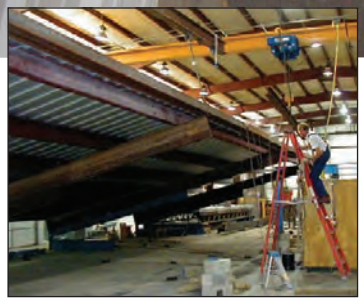
Also, in 2010, MBMA published the "Fire Resistance Design Guide for Metal Building Systems," defining and describing how to effectively meet fire resistance requirements for a metal building system.

In 2011, MBMA began an energy webinar/seminar series to educate audiences on the energy performance of metal building systems. The programs continued successfully for five years and will be featured as on-demand YouTube videos to provide free education for end users, contractors and designers.

In 2015, MBMA initiated a groundbreaking educational initiative by providing faculty fellowships in partnership with AISI. The awards expedite the development of a model program that partners the metal building industry with undergraduate engineering and architectural faculty and students.

MBMA's Contributions to the Metal Building Industry

W. LEE SHOEMAKER, PH.D., P.E., DIRECTOR OF RESEARCH AND ENGINEERING, MBMA



Testing at Virginia Tech to determine purlin roll forces at different roof slopes. MBMA Graduate Fellowship winner Michael Seek is pictured.

Metal buildings have evolved to become highly attractive, multiuse structures that are often not even recognizable as metal buildings. Many factors have contributed to the wider application and market growth of metal buildings. One significant reason that metal buildings have rapidly evolved is MBMA's focus on technical issues that impact the metal building industry. This includes sponsoring research to learn more about the structural behavior of metal buildings with an eye on optimizing material utilization and the appropriate loads that should be specified in the building codes. In fact, all low-rise construction has experienced improvements that directly result from research and building code changes sponsored and promoted by MBMA.

RESEARCH IN THE '60S: COLD-FORMED STEEL AND TAPERED MEMBER BEHAVIOR

Cold-Formed Steel Research

Since the mid-1960s, MBMA has been involved in improving the performance and efficiency of cold-formed steel, primarily metal roofing systems, through advances in AISI's Specification for the Design of Cold-Formed Steel Structural Members. Early research was conducted

Dr. Shoemaker follows in the footsteps of two previous MBMA Directors of Research and Engineering, Dr. Duane Ellifritt and Gil Harris, also members of the Metal Construction Hall of Fame. They are pictured here with Dr. George Lee from the State University of New York at Buffalo. MBMA first co-sponsored a major research project in 1966 in which Dr. Lee conducted a study on tapered structural members.

at Cornell University, under the direction of Dr. George Winter, and was sponsored by the American Iron and Steel Institute (AISI), with MBMA serving in an advisory role.

The Cornell tests were performed on simple span C and Z-beams, with and without diaphragm bracing, for both uplift and gravity loads. Good correlation was achieved between the test results and their computer model predictions, except for the case of diaphragm-braced beams for gravity loads. In this case, the actual tested capacity was considerably higher than the predicted values. Unfortunately, specific design recommendations were not finalized before the work by AISI came to an end. MBMA then stepped forward and sponsored additional work by Dr. Teoman Pekoz at Cornell to complete this important component of the research.

Tapered Member Research

MBMA first co-sponsored a major research project in 1966. This project was a study on tapered structural members conducted at the State University of New York at Buffalo by Dr. George Lee. Other sponsors included the U.S. Naval Facilities Engineering Command, American Institute of Steel Construction (AISC), and AISI. A joint task committee consisting of the Column Research Council (now the Structural Stability Research Council) and the Welding Research Council was established to facilitate the study. This began MBMA's 15-year association with Dr. Lee and his tapered member research that led to the notable book, "Design of Single-Story Rigid Frames," published by MBMA in late 1980.

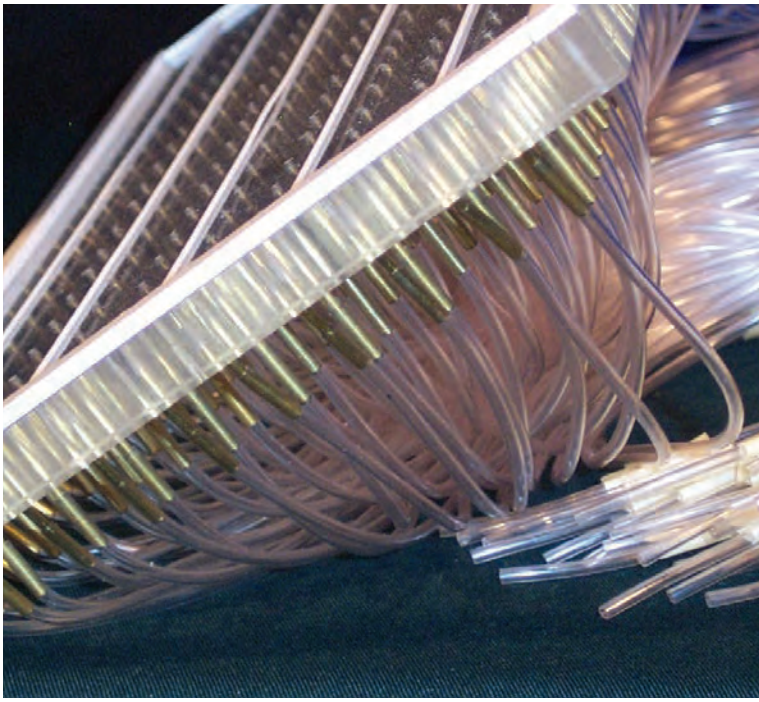
Don Johnson, now a consultant who retired from Butler Manufacturing in 1996, and who was a two-term MBMA Technical Committee chairman, headed the MBMA subcommittee that helped guide this research. Johnson recalls that, "it was a very complex problem, requiring Dr. Lee to come up with a very complex solution; but this helped advance our knowledge of the behavior of tapered members, particularly with regard to geometric limits on the taper."

The ultimate goal with any research is to positively influence the building codes or material specifications. Supplement No. 3 was released in 1974 for the AISC Specification that added Appendix D on Tapered Members, which was based on Dr. Lee's research. This validated the work and provided an optional method to the designer when tapered members are used. This method served the industry well for 25 years, but advanced computer methods eventually enabled direct modeling of tapered members. An AISC/MBMA sponsored "Design Guide on Frame Design Using Web-Tapered Members" provided recommendations consistent with the 2005 AISC Specification.

RESEARCH IN THE '70S: WIND LOADS AND BOLTED-END PLATE CONNECTIONS

Wind Load Research

In 1974, when the model building codes indicated interest in adopting the wind loads from the American National Standards Institute (ANSI) A58.1 Minimum Design Loads for Building and Other Structures (which became ASCE 7 in 1988), MBMA decided it was time to sponsor wind load research aimed at settling the differences in the various standards.

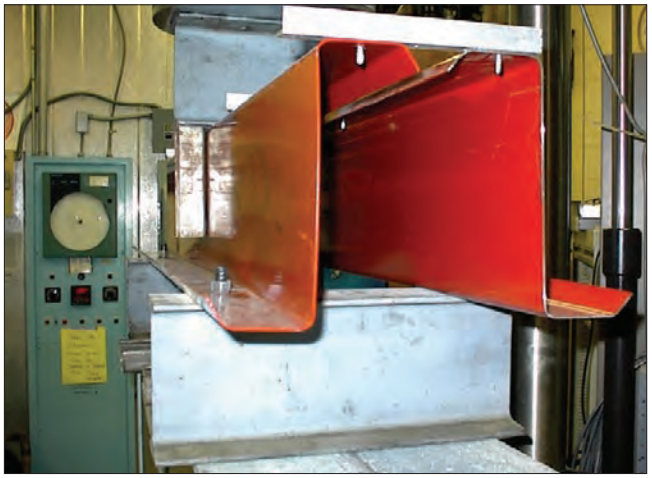


Hundreds of pressure taps used in a wind tunnel model at the University of Western Ontario.

Especially since the ANSI standard was completely based on testing of high-rise buildings and was inappropriate for low-rise applications. Until MBMA became involved, there was little concern about this from others. It is important to note that this was not just a metal building issue, it was a low-rise building issue, and the research had far-reaching impact.

Dick Gewain, former consultant to MBMA on fire test and insurance, gives the thumbs up after a roof assembly achieves the desired fire rating.

Dr. Shoemaker presents an MBMA Graduate Fellowship to Emmett Sumner of Virginia Tech.



Web crippling tests run by Dr. Roger LaBoube at the University of Missouri-Rolla.

"The wind load research was undoubtedly the most successful technical endeavor undertaken by MBMA."

This MBMA involvement launched research at the University of Western Ontario (UWO) under the leadership of Dr. Alan Davenport that was the first comprehensive investigation of wind action on low-rise buildings, which recognized both the importance of boundary layer flow and the action of turbulence. In 1976, additional sponsors joined the effort at UWO-AISI, and the Canadian Steel Industry Construction Council. The task of trying to codify the extensive database of wind tunnel results for low-rise buildings was a very difficult one. But this is where Dr. Davenport's UWO team and MBMA may have made their greatest contribution.

The hard work finally paid off, when the Standard Building Code (SBC) first adopted the wind loads developed by Dr. Davenport's team. This was included as an alternate procedure in the 1982 SBC, which was notable since this code governs the design of buildings along most of the hurricane coastline in the United States. Then, in the 1986 SBC, these provisions became mandatory for low-rise buildings because of the improved performance of buildings designed to these provisions. The American Society of Civil Engineers Standard, Minimum Design Loads for Buildings and Other Structures (ASCE 7), finally made revisions in its 1995 edition, introducing the UWO primary framing loads for low-rise buildings. The wind load research was undoubtedly the most successful technical endeavor undertaken by MBMA.

MBMA continues to be active in wind research. Recent UWO projects have evaluated wind load on longitudinal bracing in open buildings that will be included in ASCE 7-16. Another UWO project looked at the impact of various parapet heights and shapes on wind uplift to see if this might lead to ways to more economically design roofs.

BOLTED END-PLATE CONNECTIONS

The metal building industry, with MBMA's leadership, pioneered the use of bolted end-plate connections in the United States. This was in large part due to the research program that established the design procedures that have been adopted for this type of connection. MBMA began sponsoring research in 1971, when Dr. Krishnamurthy of Auburn University was selected to conduct the study on bolted end-plate moment connections that was co-sponsored by AISC. Dr. Krishnamurthy later moved on to Vanderbilt University and to the University of Alabama–Birmingham, but the MBMA research continued under his direction at those institutions as well.

Dr. Thomas Murray of the University of Oklahoma and Virginia Tech followed Dr. Krisnamurthy's work for MBMA in 1982 to develop a new method aimed at unifying the design approach for the most common end-plate connections utilized in the industry. Comparisons of test data to his design theory proved that this method produced accurate results, yet economical designs. The culmination of this work was realized in 2002 with the publication of the "AISC/MBMA Design Guide No. 16." This is now the recognized standard for bolted end-plate design and serves the industry well.

Recent MBMA-sponsored research at Virginia Tech, under the guidance of Dr. Matthew Eatherton, has added several new bolted end-plate designs to those already in "Design Guide 16." Drs. Eatherton and Murray are in the process of updating this guide that will include these new end-plate configurations.

MBMA sponsored wind load research aimed at settling the differences in the various standards of low-rise construction.

RESEARCH IN THE '80S: METAL ROOFING SYSTEMS AND WIND UPLIFT TESTS

METAL ROOFING SYSTEMS

In 1980, MBMA recognized that it was increasingly necessary to look at the roof as a system with regard to purlin design for gravity and uplift loads, expansion and contraction behavior, and the impact of insulation. In fact, for purlin design, 22 separate roof system parameters were listed by the Technical Committee that could affect the behavior. Since it was expected that the work of Dr. Pekoz would lead to a design procedure for uplift, the new focus was to do more research for gravity loading.

MBMA selected Dr. Murray to begin the research on the behavior of roof systems under gravity loads in 1981. The objective was to determine the quantitative effects on roof systems of such devices as sag members (intermediate braces), anti-roll clips, roof diaphragm, end anchorage of panels, and the effect of various insulation schemes on the ultimate load capacity under gravity loads.

"All low-rise construction has experienced improvements that are a direct result of research and building code changes that have been sponsored and promoted by MBMA."

Dr. Murray's work finally yielded a solution, whereby a simple span test could be used to predict purlin capacity in a continuous span system. This test came to be known as the Base Test and was adopted into the 1996 AISI Specification. This has been hailed as a breakthrough which finally solved the purlin capacity impasse.

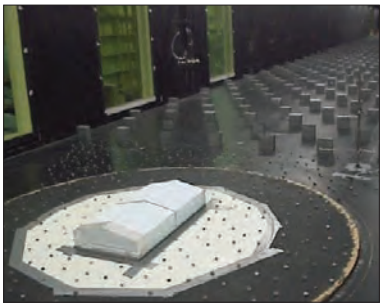
WIND UPLIFT TESTS (STATIC VERSUS DYNAMIC)

The UL 580 test that had been introduced in 1973 was a success in improving the performance of roofing assemblies by evaluating them in a simulated wind event. But this test was not designed to predict the actual uplift resistance. In 1988, ASTM began the development of the E1592 wind uplift resistance test. One advantage of this test was that it used a larger roof specimen, which is now recognized as a better test for standing seam roof systems. However, both of these tests utilized a uniform static air pressure over the roof specimen which does not represent true wind behavior. The real interaction of wind and structure produces wind loads that vary dramatically from one instant to the next, and over very short distances, on the roof's surface.

MBMA initiated an effort in the late 1980s to try to better predict the actual performance of metal roofing against high wind uplift forces. A full-scale assembly of a metal roof corner was constructed and tested at Mississippi State University using the standard ASTM E1592 protocol to obtain the static uplift resistance. Then, a dynamic test using a grid of 34 electromagnets was used to simulate the actual non-uniform wind behavior. The electromagnets were programmed to reproduce independent time-history traces obtained from the detailed UWO wind tunnel analysis. The simulated wind event was based on Hurricane Andrew. Load cells were placed at selected standing seam clip locations for both the static ASTM E1592 test and the dynamic electromagnetic wind simulation. The clip loads in both tests were evaluated to determine the true load that was being imparted to the roof system.

Dr. Ralph Sinno and Gill Harris look on at the electromagnetic test set-up at Mississippi State University.

Dr. Alan Davenport of the University of Western Ontario discusses wind engineering research with Gill Harris.



A model in the wind tunnel at the University of Western Ontario.

MBMA focuses on technical issues to promote an evolving metal building systems industry.

It was found that the E1592 uniform pressure test was a conservative estimate of the actual capacity under real wind uplift. This finding was incorporated into the 2007 AISI Specification by increasing the E1592 static capacity by 50 percent in the corners and edges of a standing seam roof.

MBMA is currently working with the Insurance Institute for Business and Home Safety (IBHS) to measure the uplift forces on a standing seam roof on a full-scale building in their test facility. Additional tests are planned at UWO to better understand the complex dynamic behavior that not only includes the gustiness of the wind, but also the structural response of the roof. This project should provide more guidance on actual loading and proper testing to ensure economic roofing designs that perform as intended.

RESEARCH IN THE '90S: SNOW LOAD RESEARCH AND OSHA/SENRAC

MBMA-sponsored research at Rensselaer Polytechnic University has improved our knowledge of how snow drifts across low-slope gable roofs as shown in this photo.

SNOW LOAD RESEARCH

Heavy snowfalls in the 1990s focused attention on snow loads. Roof failures and observations of accumulated snow drifts at the time of these collapses led investigators to believe that the building codes may not have been sufficiently capturing the observed loads. Gable roofs with slopes less than 15 degrees were not thought to provide the necessary conditions for snow to drift over the ridge. MBMA led the effort to sponsor research at Rensselaer Polytechnic Institute (RPI) to determine if changes were warranted.

The research resulted in changes to ASCE 7 that required new unbalanced snow loads that were higher at the eaves of the building and tapered off toward the ridge. Buildings designed to the latest codes where snow governs may exhibit heavier or deeper purlins at the eaves to resist this heavy snow load. Further research at RPI sponsored by MBMA refined the drifting snow condition based on water flume tests that simulate drifting snow on scale models.

OSHA/SENRAC

In 1995, the Occupational Safety and Health Administration (OSHA) began work on a new safety standard for steel erection that focused on controversial fall protection requirements. OSHA utilized a new consensus building process called a negotiated rule-making process. The Steel Erection Negotiated Rulemaking Advisory Committee (SENRAC) was formed for this purpose. One of the issues raised during the deliberations of the OSHA/SENRAC effort to update the steel erection safety standards was the presence of rollforming lubricant residues on decking products and their potential to contribute to the slipperiness of deck during the erection operation.

At MBMA's urging, AISI coordinated the formation of a coalition of steel industry groups that would be affected by the proposed OSHA rule on slippery surfaces. A research effort was undertaken to evaluate methods to test slippery surfaces as well as to reduce or eliminate the presence of lubricant residues and the impact on corrosion and formability if these lubricants were eliminated or altered.

After years of study and evaluation, OSHA entered into a voluntary agreement with the steel industry coalition to implement specific recommendations to manufacturers of metal decking and roofing. This was a significant achievement in coming up with a solution to the issues raised without the imposition of controversial regulations on testing the slipperiness of these products.

RESEARCH IN THE 2000S: PURLIN ANCHORAGE

PURLIN ANCHORAGE

One topic that has received considerable attention is the capacity of purlins that are laterally braced by a standing seam roof. Z-purlins try to twist and roll over when subjected to loads in the plane of their webs. How these purlins are braced has a significant effect on their overall load-carrying capacity.

MBMA- and AISI-sponsored research was conducted at Virginia Tech to provide a more rational approach to determining bracing anchorage forces that need to be accounted for in a metal roof so designers have more flexibility in providing a bracing system. The test setup being used is innovative in that a full-scale roof system can be inclined at different angles and the bracing forces measured. New provisions were adopted into the 2007 AISI Specification, and a new AISI design guide was developed to help explain the requirements.

"The ultimate goal with any research is to positively influence the building codes or material specifications."

RESEARCH IN THE 2010S: SEISMIC RESEARCH

SEISMIC RESEARCH

After the Northridge, Calif., earthquake in 1994, significant changes began to take place affecting the seismic design of steel moment frames. Welded moment connections typically used in mid- and high-rise buildings were found to be susceptible to cracks, and even though there were no catastrophic failures, an unprecedented federal research effort was launched to determine the cause and recommend new practices.

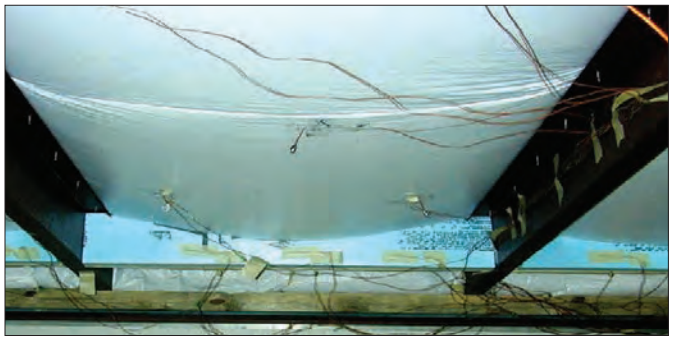
An initial MBMA effort led to the development of a seismic design guide for metal buildings which was published by the International Code Council to assist engineers and plan checkers in applying the new seismic requirements to metal buildings. However, it was clear that the seismic design provisions being used were not developed with metal building behavior in mind and research was needed to fill this void.

MBMA and industry partner AISI jumped into seismic research by evaluating the behavior of full-scale metal building frames at the University of California, San Diego (UCSD) under the leadership of Dr. Chia-Ming Uang. This effort utilized load actuators to alternately "push and pull" a frame back and forth to assess the behavior and ductility of the system. Many observations were made in this study, including how metal building moment frames behave quite differently with regard to ductile design philosophy.

The next phase of the seismic research was undertaken to learn more about metal building performance by utilizing a full-scale shake table simulation. This testing was also conducted at UCSD on the largest outdoor shake table facility in the world, as part of a government-industry partner program. Three metal buildings were tested that incorporated metal sidewalls, heavy concrete walls, and a heavily loaded mezzanine on one-half of the building width plus a heavy concrete wall on the opposite side. The shake table results were successful in demonstrating that the three metal building specimens were capable of satisfying the code performance requirement to remain standing during the required design earthquake.

Drs. Ben Schafer and Cris Moen at Johns Hopkins and Virginia Tech University, respectively, are leading an effort to develop an advanced finite element computer model that will replicate the performance of the metal buildings on the shake table. This is the final step in being able to evaluate hundreds of typical metal building designs that will then establish the appropriate design criteria that should be adopted into the codes.

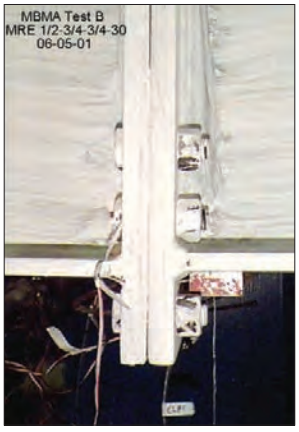
This summary of MBMA contributions focused on one or two primary research thrusts for each decade. However, this is only a sampling of the research efforts sponsored by MBMA to better understand the loads that act on low-rise buildings as well as the structural behavior of metal buildings.



A hot box test sample with thermocouples in place to measure heat flow during research at Oak Ridge National Laboratory.

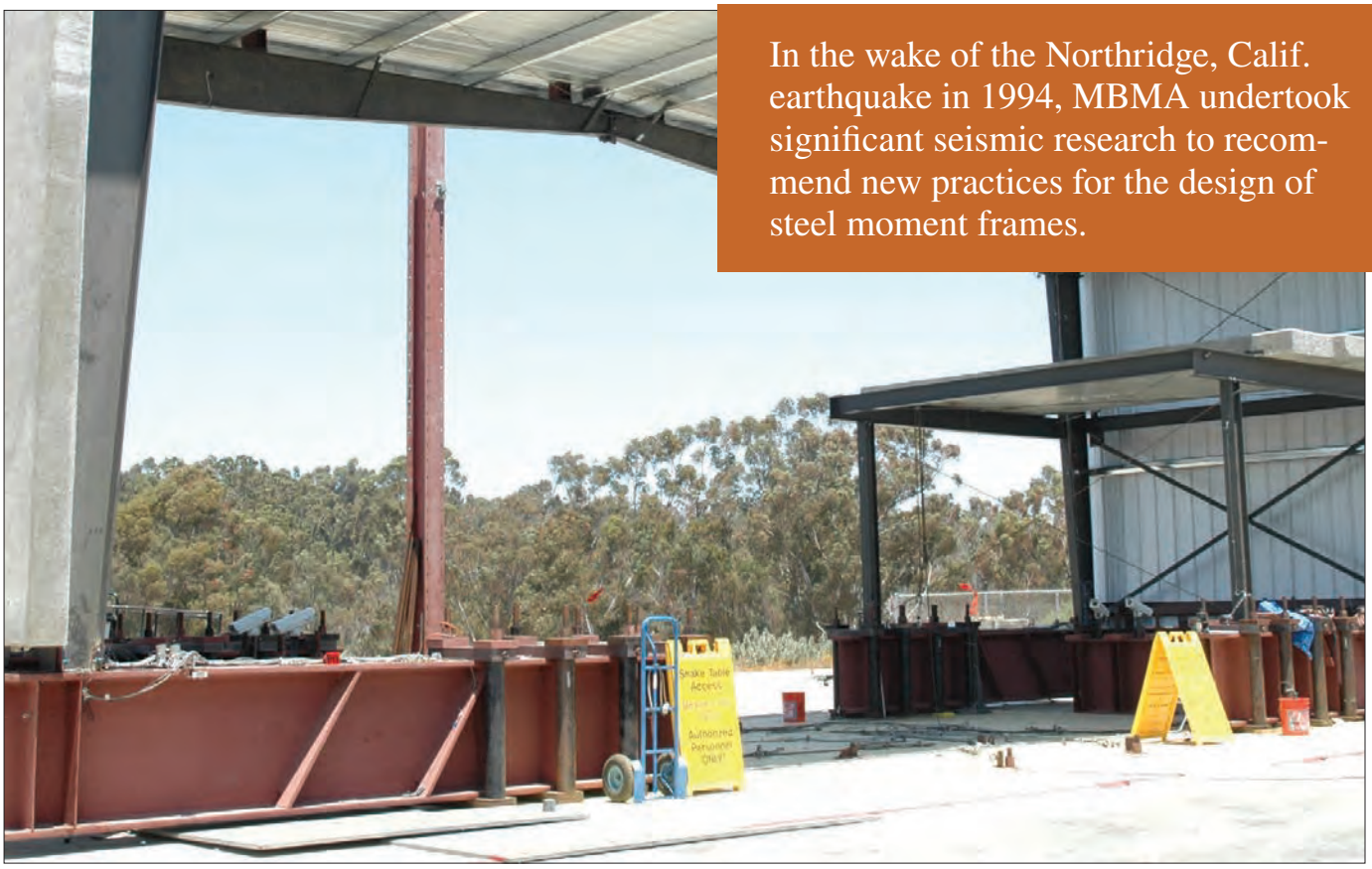
Mark Henry of Butler Manufacturing Co. Inc., helps prepare a composite roof specimen for a research test at the National Research Center in Ottawa, Canada.

Full-scale seismic loading test at the University of California–San Diego.



Bolted end-plate connection research by Dr. Tom Murray at Virginia Tech.

In the wake of the Northridge, Calif. earthquake in 1994, MBMA undertook significant seismic research to recommend new practices for the design of steel moment frames.



A metal building on a shake table for seismic testing.

A test that subjects a partial frame of tapered members to a cyclic load to observe the buckling behavior.

COLLABORATION CREATES OPPORTUNITY

MBMA members provide leadership and knowledge to increase the prominence of metal building systems. As industry advocates, members work to increase the acceptance of metal building systems as the preferred building solution for low-rise, non-residential construction projects.

The association offers opportunities for participation through the following membership categories:

Building Systems Members: MBMA's building systems manufacturer members are IAS AC472 accredited companies that design, engineer, fabricate and market metal building systems in the United States. MBMA building systems member companies employ more than 10,000 employees in over 50 manufacturing plants located throughout the United States. It is also estimated that approximately 10,000 building erection companies are actively involved in the construction of metal buildings, with over 25,000 metal building projects completed each year.

Associate Members: MBMA's associate members supply products or services to the metal building systems members. They help shape MBMA's direction and activities through affiliations such as the Associate Member Advisory Council, in addition to active participation on the various MBMA project committees. New to MBMA in 2016 is the introduction of an associate membership category titled Professional A/E Firms for companies engaged in metal building project design and procurement.

MBMA building systems members will benefit from direct interaction with engaged A/E firms at association meetings to gain insight into construction industry trends and opportunities.

Professional A/E Firms will gain the advantage of direct interaction with building fabricators and suppliers to help leverage the design-build process more effectively and gain competitive advantages.

To learn more about membership, contact mbma@mbma.com.

Efforts made by MBMA's members serve to educate and inspire the commercial building community.

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All American Systems
Alliance Steel Inc.
American Buildings Co.
Associated Steel Group LLC
BC Steel Buildings Inc.
Behlen Building Systems
Bigbee Steel Buildings Inc.
BlueScope Buildings North America Inc.
Butler Manufacturing
CBC Steel Buildings
Ceco Building Systems
Chief Buildings
CO Building Systems
Dean Steel Buildings Inc.
Garco Building Systems Inc.
Golden Giant Inc.
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Inland Buildings
Kirby Building Systems Inc.
Ludwig Buildings Enterprises LLC
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Metallic Building Co.
Mid-West Steel Buildings
NCI Building Systems Inc.
Nucor Building Systems
Oakland Metal Buildings Inc.
Pinnacle Structures Inc.
Red Dot Buildings
Robertson Building Systems
Ruffin Building Systems Inc.
SBC Building Systems LLC
Schulte Building Systems Inc.
Spirco Manufacturing
Star Building Systems
Trident Building Systems Inc.
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Varco Pruden Buildings
Vulcan Steel Structures Inc.
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Steel Dynamics Inc.
Tell Manufacturing
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United States Steel Corp.
Valspar Corp.
VELUX Design and Development Co. USA Inc.

MBMA BRINGS YOU SOLUTIONS

MBMA continues its leadership of the industry with a number of new and continuing research projects in 2016. The organization has invested millions of dollars and thousands of volunteer hours in raising the industry's engineering expertise, enhancing manufacturing processes and improving building quality. MBMA research projects are generally undertaken in coordination with major universities and engineering schools throughout North America, and include such topics as seismic performance, wind loads, structural performance and connection design.

Annual Reports: The information detailed in MBMA's annual reports provides essential information for owners, builders, contractors, architects, specifiers and code officials.

Life Cycle Assessment: MBMA members worked together with other industry groups to develop Product Category Rules (PCRs) for their products, and are committed to documenting the environmental impacts of the industry's products. MBMA commissioned a Life Cycle Assessment (LCA) report and created industry-wide Environmental Product Declarations (EPDs).

Safety: MBMA invests in continuous in-plant safety training for all member companies, and offers webinars and face-to-face workshops to keep safety discussions timely and practical.

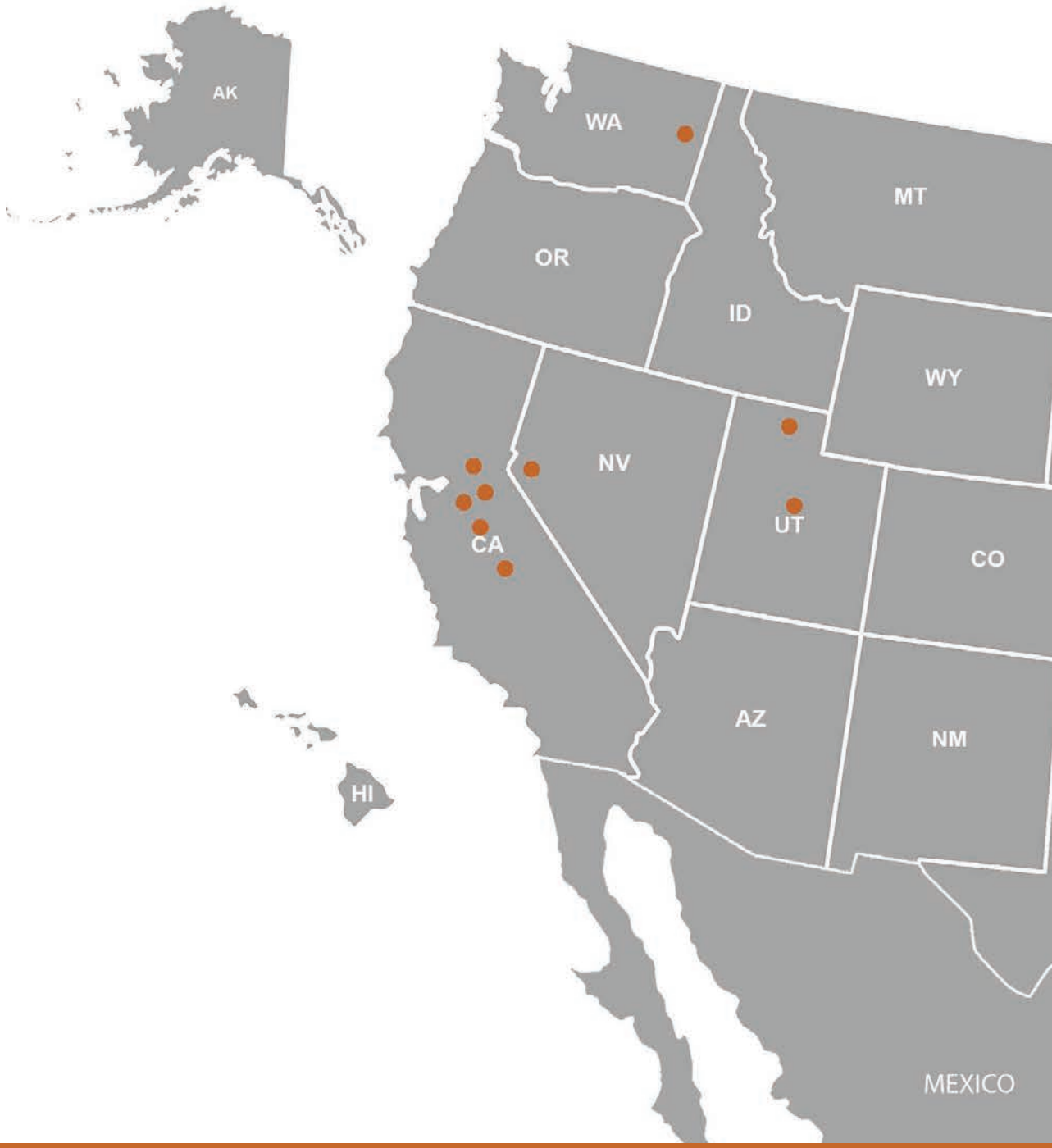
Accreditation: MBMA partnered with the International Accreditation Service (IAS) to create an independent program to audit metal building manufacturing facilities for quality assurance. The IAS AC472 program, "Inspection Programs for Manufacturers of Metal Building Systems," helps differentiate accredited metal building manufacturers from non-accredited companies, and raises the bar on both manufacturing and engineering performance. MBMA also supports the efforts of the Metal Building Contractors and Erectors Association (MBCEA) it rolls out its own IAS accreditation program, AC478, "Accreditation Criteria for Inspection Practices of Metal Building Assemblers." By specifying an AC472 accredited manufacturer's products, erected by an AC478 accredited assembler, you can get the highest quality metal building possible.

Snow Loads Database: The Applied Technology Council (ATC), with assistance from MBMA and the American Iron and Steel Institute (AISI), developed a website that provides easy access to ASCE 7 site-specific ground snow loads by simply entering GPS coordinates or a mailing address for your proposed project.

Education: MBMA developed an online Learning Unit (LU) course for architects and others interested in learning about the capabilities of metal building systems. The course runs through the end of 2016 and is available for free. One LU is available to architects who complete the online quiz correctly. The course is called "The Benefits of Metal Building Systems from a Whole Building Perspective."

"MBMA's proactive research and technical expertise have had a tremendous contribution to the industry's accelerated growth rate over the last 60 years. We're also very excited about what MBMA members are researching right now, and what these new projects will do to support tomorrow's industry leaders."

-W. Lee Shoemaker, Ph.D., P.E., MBMA Director of Research and Engineering



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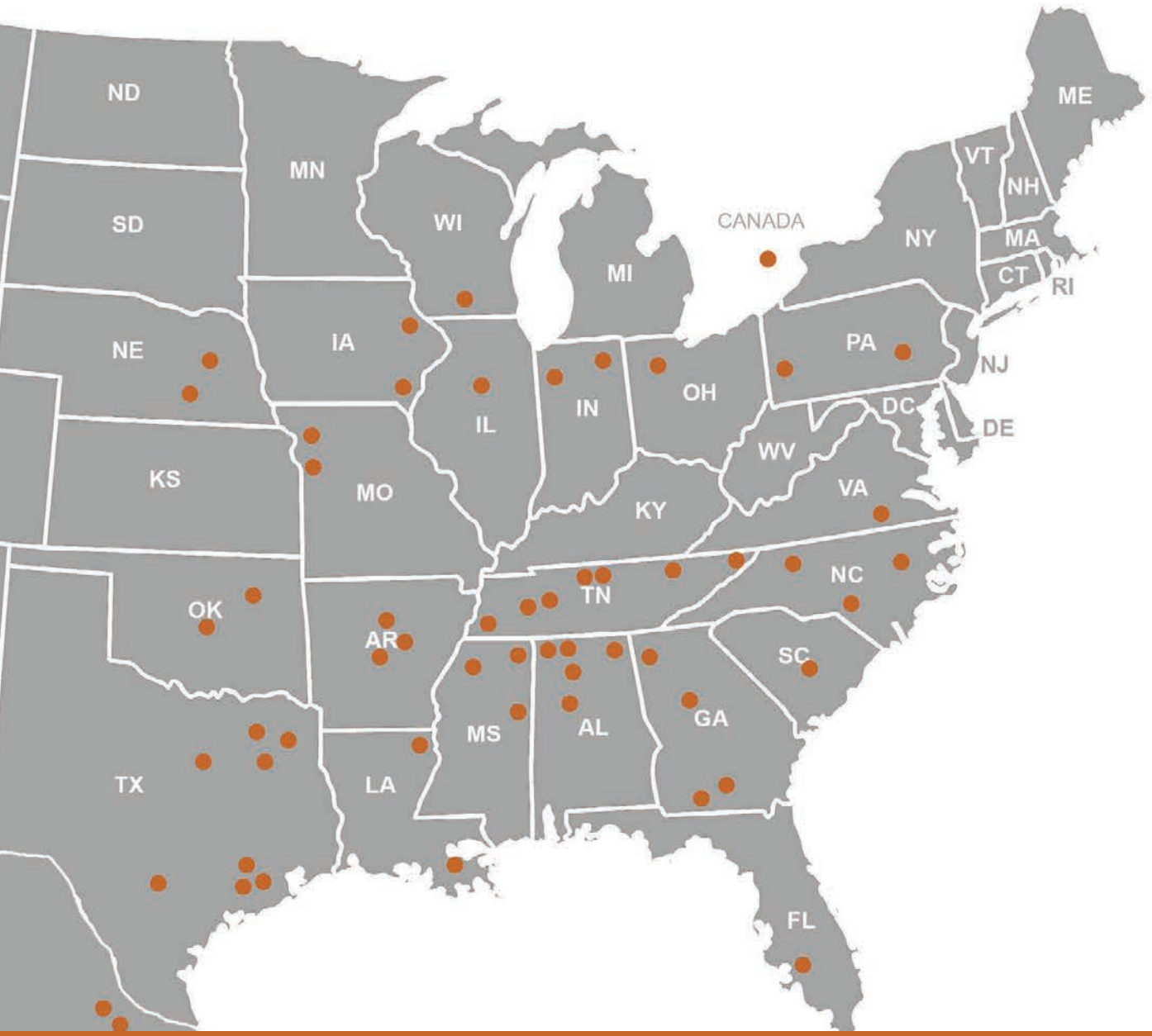
METAL BUILDING MANUFACTURING PLANTS



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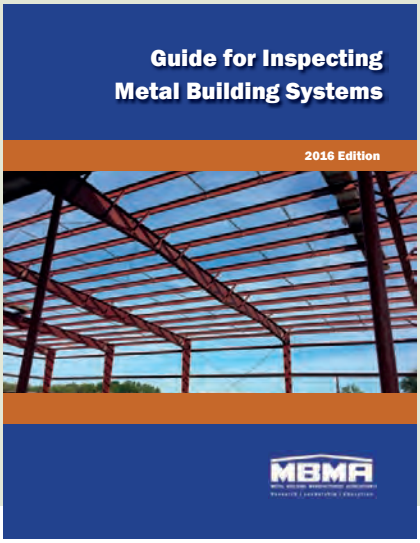


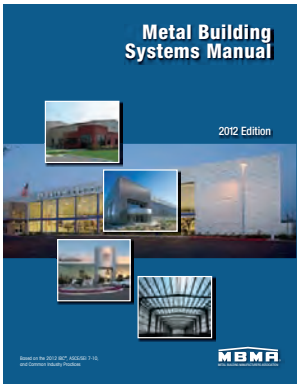
MBMA Unveils New Guide

Guide for Inspecting Metal Building Systems

This guide provides a useful resource for inspecting any metal building project. It is of value to owners' representatives, design professionals, general contractors, erectors and building officials. It assists with building code and contractually required inspections, as well as other optional inspections such as owner acceptance and insurance evaluations.

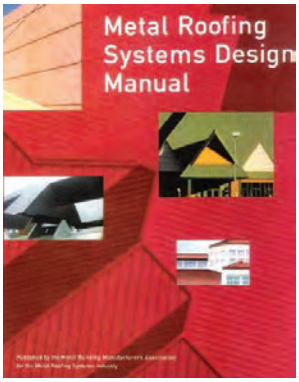
EDUCATIONAL RESOURCES THAT INFORM AND TRANSFORM THE INDUSTRY

MBMA continues to lead the metal building systems industry by fulfilling its mission to provide education, research and technical resources. These include an increasing number of design guides, manuals and webinars that will prove invaluable for anyone working with metal buildings. As new information becomes available and changes are made to all of these guides, updates are provided in MBMA's online bookstore at www.mbmamanual.com.



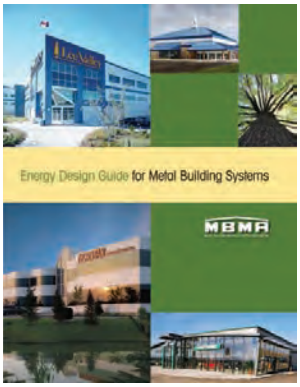
Metal Building Systems Manual

The 2012 Metal Building Systems Manual brings the publication into conformance with the 2012 International Building Code (IBC), its referenced standards e.g., {ASCE 7-10), and common industry practices. The 2012 Manual includes a CD-ROM with a searchable PDF version of the manual, along with various AutoCAD roofing details.



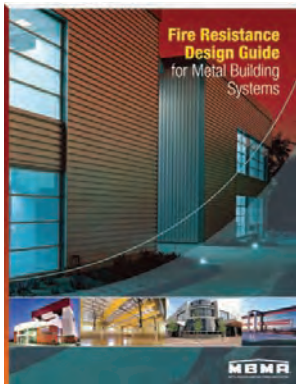
Metal Roofing Systems Design Manual

The Metal Roofing Systems Design Manual is a one-of-a-kind resource for anyone who works with metal roofs. It also includes dozens of downloadable AutoCAD roofing details for various roof configurations.



Energy Design Guide for Metal Building Systems

The Energy Design Guide for Metal Building Systems is the best and only resource available on energy-efficient design options for code-compliant metal buildings.



Fire Resistance Design Guide for Metal Building Systems

The Fire Resistance Design Guide for Metal Building Systems offers a wealth of information on how to effectively use metal buildings to meet the fire resistance requirements of a project.

MBMA also provides an array of free resources at mbma.com.