The Building Official’s Role in a Metal Building System Project

From Plan Review to Special Inspection and IAS AC472

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Learning Objectives

After this presentation, attendees will be able to:

• Understand the roles and responsibilities of the individuals in a project utilizing a metal building system.

• Describe the building official's role and identify any differences with a metal building project.

• Utilize the IAS Accreditation Program for metal building manufacturers to your advantage.

• Identify the inspection requirements and what inspections are important for a metal building project.
Presentation Outline

- Organizations Serving the Metal Building Industry
- Metal Building Systems Market
- Defining a Metal Building System
- Professional Design Responsibilities
- IAS AC472 Accreditation Program
- Inspection Requirements and Guidance
- Case Study
- Resources
Organizations Serving the Metal Building Industry
• A subsidiary of the International Code Council (ICC)
• A non-profit accreditation body
• Providing accreditation services since 1975
• Headquartered in Brea, California
• Accredits product certification agencies, testing laboratories and inspection agencies and fabricator inspection programs, among others
Accreditation vs. Certification

Accreditation
Focus is on an Organization’s Management System

Certification
Focus is on products, individuals, or systems

AC472 is the IAS criteria to accredit the MBS Inspection Program
IAS Accreditation Programs

Supporting Building Industry – IBC Chapter 17

Two Accreditation Criteria to Support AC472
Not Currently Referenced in ICC IBC
International Accreditation Forum & International Laboratory Accreditation Cooperation (IAF & ILAC)

- An association of accreditation bodies around the world
- Evaluations based on ISO/IEC 17021 to ensure accreditation bodies are competent and have no conflict of interest
- ILAC and IAF conduct periodic peer evaluations
- Provides mutual recognition of approved accreditation bodies

Regulators – Federal, State, County, City
Accreditation Community

• **IAF** and **ILAC** are global networks of accreditation bodies and organizations involved in **conformity assessment activities**
• Development and harmonization of accreditation practices across the globe
• Provides for recognition of competent conformity assessment bodies through **Multi-Lateral Mutual Recognition Arrangements**
• Promotion of accreditation as an effective mechanism for providing confidence in goods and services, essential for global trade facilitation and socio-economic issues
Accreditation & Conformity Assessment Structure

ACCREDITATION BODIES (ISO/IEC 17011)
International Accreditation Service, Inc. (IAS)

INSPECTION BODIES
ISO/IEC 17020
- Products, Materials, Processes inspected to Standards/Specifications

LABORATORIES
ISO/IEC 17025
- Products, Systems and Materials tested / calibrated to Standards/Specifications

CERTIFICATION BODIES
ISO/IEC 17065
- Products, Process and Services certified to Specification/Safety Requirement

GOVERNMENT, REGULATORS, USERS AND CONSUMERS - Have Assurance of Quality
Accreditation & Certification
Working Together

Accreditation

CONFORMITY ASSESSMENT BODIES

Certification of Product & Certified Service Providers

Confidence • Trust • Assurance

Government • Consumers • Purchasers

International Standards

Peer Evaluation

Standards / Regulatory requirements / Scheme criteria
IAS Accreditation Infrastructure

• IAS BOARD OF DIRECTORS (BOD) appoints all AC, TAC and staff members sitting on these committees
• Accreditation Committee (AC) is supported by TAC and IAS staff
• TAC is supported by IAS staff and management team
• IAS Staff / Assessors / Experts
IAS Board of Directors

Purpose and Function:
• 8 members
• Composed of
  – Code Regulators
  – Institutional/Academic
  – Industry Group
  – Regulatory Officials
  – Accredited Organizations
• Handle all nominations and strategic planning
8 Technical Advisory Councils
• Testing Laboratory TAC
• Calibration Laboratory
• Inspection and Special Inspection Agencies TAC
• Product Certification TAC
• Management System Certification TAC
• Personnel Certification TAC
• Regulatory Code TAC
• Food Safety TAC
IAS Accreditation Committee

Appointed by Board of Directors
Monitors Accreditation Programs
Public Hearing Process Provides Transparency
IAS Accreditation Programs

➢ Building Department Accreditation
➢ Building Department Service Providers
➢ Calibration Laboratories
➢ Commissioning Training and Certification Agencies
➢ Curriculum Development
➢ Fabricator Inspection Programs
➢ Field Evaluation Bodies
➢ Fire Prevention and Life Safety Departments
➢ Inspection Agencies

➢ Management System Certification Bodies
➢ Manufacturers of Cold-Formed Steel Components
➢ Metal Building Inspection Programs
➢ Metal Building Assemblers Inspection Program
➢ Personnel Certification Bodies
➢ Product Certification Agencies
➢ Special Inspection Agencies
➢ Testing Laboratories
➢ Training Agencies
Sample of Recognitions

- Air Force Civil Engineer Support Agency
- Consumer Product Safety Commission
- General Services Administration
- U.S. Army Core of Engineers
- U.S. Coast Guard
- U.S. Environmental Protection Agency
- U.S. Federal Emergency Management Agency
- U.S. Federal Highway Administration (FHWA)
- U.S. Food & Drug Administration
- U.S. Marines
- U.S. Navy
- Metal Building Manufacturers Association
- National Aeronautics and Space Administration
- Nuclear Regulatory Commission
- Fire Stop Manufacturers Association
Finding IAS Accredited Organizations – www.iasonline.org
Who is MBMA?

- Founded in 1956 – Cleveland Based
- Building Systems Manufacturers + Associate Members
- Roughly 9,000 contractors affiliated with member companies
- ≈30,000 buildings each year
- IAS 472 Accreditation is required for membership!
MBMA’s Mission

MBMA provides research, leadership and education that increases the prominence and use of metal building systems as a premier solution for performance, aesthetics and sustainability in non-residential building construction.
MBMA Members

43 Building Systems Members

- A&S Building Systems
- ACI Building Systems
- All American Systems
- Alliance Steel, Inc.
- American Buildings Company
- Associated Steel Group, LLC
- BC Steel Buildings, Inc.
- Behlen Building Systems
- Bigbee Steel Buildings, Inc.
- BlueScope Buildings N.A.
- Butler Manufacturing
- CBC Steel Buildings
- Ceco Building Systems
- Chief Buildings
- CO Building Systems
- Dean Steel Buildings, Inc.
- Garco Building Systems, Inc.
- Golden Giant, Inc.
- Heritage Building Systems
- Inland Buildings
- Kirby Building Systems, Inc.
- Ludwig Buildings Enterprises
- Mesco Building Solutions
- Metallic Building Company
- Mid-West Steel Buildings
- NCI Building Systems, Inc.
- Nucor Building Systems
- Oakland Metal Buildings, Inc
- Package Steel Systems
- Pinnacle Structures, Inc
- Red Dot Buildings
- Robertson Building Systems
- Schulte Building Systems
- Spirco Manufacturing
- Star Building Systems
- Sukup Manufacturing Co.
- Sukup Steel Structures, LLC
- Trident Building Systems, Inc.
- Tyler Building Systems, L.P.
- United Structures of America
- Varco Pruden Buildings
- Vulcan Steel Structures, Inc.
- Whirlwind Steel Buildings, Inc.

+ 74 Associate Members
Metal Building Systems Market
Domestic Shipments

MBMA Members Annual Shipments

- Tons
- Dollars

2007: Tons $3,500,000, Dollars $1,000,000
2008: Tons $3,000,000, Dollars $1,500,000
2009: Tons $2,500,000, Dollars $2,000,000
2010: Tons $2,000,000, Dollars $2,500,000
2011: Tons $1,500,000, Dollars $3,000,000
2012: Tons $1,000,000, Dollars $3,500,000
2013: Tons $500,000, Dollars $4,000,000
2014: Tons $0, Dollars $4,500,000
2015: Tons $500,000, Dollars $5,000,000
2016: Tons $1,000,000, Dollars $5,500,000
2017: Tons $1,500,000, Dollars $6,000,000
2018: Tons $2,000,000, Dollars $6,500,000
Metal Building Applications

- Offices
- Retail Stores
- Shopping Centers
- Auto Show Rooms
- Churches

- Schools
- Recreation Facilities
- Agricultural
- Aircraft Hangars
- Factories

- Distribution Centers
- Auto Repair Shops
- Warehouses
- Military
- Manufacturing
Metal Building Applications

MBMA MEMBER MARKET SHARE BY BUILDING TYPE

- **Commercial**: 37%
  - Includes: Retail, Office, Warehouses, Auto Dealerships

- **Community/Institutional**: 13%
  - Includes: Recreation, Education, Healthcare, Government, Worship

- **Agricultural**: 6%

- **Manufacturing**: 32%
  - Includes: Production, Warehouses

- **Miscellaneous**: 12%
  - Includes: Exports, Retrofits & Other
Examples of Metal Buildings
Examples of Metal Buildings
Examples of Metal Buildings
Examples of Metal Buildings
Examples of Metal Buildings
Examples of Metal Buildings
Defining a Metal Building System
What is Not a Metal Building?
Attributes of a Metal Building System

- Custom engineered, Site-specific
- One- and two-story non-residential buildings
- Metal roof: standing seam or through-fastened
- Wall materials: steel cladding, glass, aluminum, masonry, or concrete
- Fast Construction
- Energy Efficient
- Sustainable
- Flexible
- Economical
- Durable
Pre-engineered?

- Metal Building Systems are NOT Pre-Fabricated Modular Buildings, nor are they Pre-Engineered.

- Metal Building Systems are designed using the systems approach, in which standard components are used to fit customized applications. Each building system is custom engineered to meet customer needs and for the particular application.
Design – Standards & Codes

- IBC
  - Adopted Legal Document
- ASCE 7
  - Minimum Loads
- AISC 360
  - Design of Primary Frames
- AISI S100
  - Design of Secondary Members
Metal Building Components

- Main Frames
- Secondary Framing
  - Purlins
  - Girts
- Cladding
  - Metal Roof Sheeting
  - Wall Sheeting or Finish
- End Wall Beams and Columns

- Bracing
  - Lateral Bracing
  - Stability Bracing
- Connections
- Screws and Bolts
- Non-Structural Parts
Primary Frames

- Tapered
- Built-Up
- Bolted End-Plates

- Prismatic
- Rolled Shapes
- Field Welded or Bolted
Secondary Members

- Wall
  - Z girts

- Roof
  - Z purlins
  - Bar Joists
Longitudinal Lateral Bracing

- Rods
- Cables
- Portal Frames
Member Bracing

- Stability Bracing
  - Flange Braces
- Critical to Unbraced Length Assumption
Z-Purlin Behavior

Shear Center Axes

Principal Axes

Shearing Attached
Metal Roof Systems

Standing Seam Roof (SSR)

Fixed Clip

Sliding Clips
Metal Roof Systems

Through Fastened Roof (TFR)
Professional Design Responsibilities
Professionals and Their Roles

- **Owner** - End Customer of the project
- **Design Professional** - an architect or engineer retained by the owner or builder, to assist with preparation of specifications, foundation design, and design and interface of components not provided by manufacturer
- **Builder** - serves as contractor (many are design-build firms), orders and purchases the metal building system from manufacturer
- **Manufacturer** - designs and fabricates the metal building system
Shared Design Responsibility

Design Professional (EOR or Architect)

• Prepare complete specifications
• Provide builder with the following:
  – Geometric requirements
  – Applicable codes and/or design loads
  – Site and construction conditions that affect design criteria
  – Serviceability criteria, especially for compatibility of materials not supplied by building manufacturer
  – Foundation Design
  – Design of Components not Supplied by Metal Building Manufacturer
Metal Building Manufacturer

• Design of Metal Building System
• Not Engineer of Record
• Provide Evidence of Compliance/Deliverables
• (As Specified in the Order Documents)
  – Approval Documents
  – Engineering Data
  – Plans
Metal Building Manufacturer

– Party that designs and fabricates the materials included in the metal building system

– All MBMA members are IAS AC472 accredited.

The manufacturer is responsible for the quality control of the work they produce. Enforcement of a quality control program, which is verified by an outside inspection agency, similar to the IAS AC 472 accreditation program described in the MBSM Section VI, is one primary indication of the manufacturer’s due care in satisfying this responsibility.

It is essential that the components of a metal building system are fabricated and assembled (erected) as required by the approved construction documents. To achieve this goal, the manufacturer and erector provide their own quality control inspections and the owner employs third party special inspectors to perform quality assurance inspections, when required by the authority having jurisdiction. These third party special inspections, when required, are performed in the shop to review the manufacturer's work and in the field to focus on the erector’s work.
Shared Design Responsibility

- Design Professional
- Manufacturer’s Engineer
- Engineer/Architect of Record

One of the roles of the registered design professional in responsible charge is set forth in the IBC, Section 107.1. This individual prepares the documents that are submitted with the building permit application, including the statement of special inspections, and he or she receives reports of special inspections. According to IBC Section 107.3.4, the registered design professional in responsible charge must review and coordinate any submittal documents prepared by others for compatibility with the design of the building.

The registered design professional in responsible charge is almost never the manufacturer's engineer of the metal building system. If on a particular project, the manufacturer's engineer of the metal building is to function as the registered design professional in responsible charge for the project, this should be clearly set forth in the contract with the manufacturer.
Professionals and Their Roles

- **Owners 3rd Party (Special) Inspector** – Examines work, provides reports to Building Official and Design Professional in Charge.

- **Building Official or AHJ** – Enforces the building code and receives inspection reports by others, etc.
Administers and enforces the building code, issues permits, receives inspection reports and other certifications required by the building code, and issues certificates of occupancy.

Additionally, as noted in the definition in IBC Section 202 and as required in Section 1704.2.5.2, the building official approves a fabricator, "based on a review of the fabricator's written procedures and quality control manuals and periodic auditing of fabrication practices by an approved special inspection agency." For a metal building manufacturer, a building official typically utilizes the International Accreditation Services' (IAS) Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems (AC 472) criteria as a means of approving a metal building fabricator. For more information on the AC 472 program, refer to Section 3.3.
CLARK COUNTY DEPARTMENT OF BUILDING & FIRE PREVENTION
Technical Guidelines

- **TG-1-06a** - PREPARATION OF A QUALITY SYSTEMS MANUAL FOR STRUCTURAL STEEL FABRICATORS

- **TG-2-09** REQUIREMENTS FOR APPROVAL AS A CLARK COUNTY BUILDING DIVISION STRUCTURAL STEEL FABRICATOR/MANUFACTURER

- **TG-3-09** REQUIREMENTS FOR PERFORMING CLARK COUNTY BUILDING DIVISION REQUIRED FABRICATION FACILITY AUDITS, INSPECTIONS AND NONDESTRUCTIVE TESTING OF STRUCTURAL STEEL
• Review fabricator’s/manufacturer’s submitted application package for Initial Listing Approval, Annual Renewal Listing Approval, or Project Specific Listing Approval application documentation. (All fabricator/manufacturer listing approval types)

• Determine if the fabricators/manufacturer’s submitted application package for Initial Listing Approval, Annual Renewal Listing Approval, or Project Specific Listing Approval application documentation complies with CCDB TG requirements.

• Determine if the fabricators/manufacturers submitted QSM complies with CCDB TG-1. (Initial Listing Approval or *Project Specific listing Approval only) (*When Required by CCDB PM)

• Notify fabricator/manufacturer in writing of any QSM items that do not comply with CCDB TG-1.

• Perform CCDB Initial Audit of fabricator’s/manufacturer’s Quality System. (Initial Listing Approval only)

• Notify fabricator/manufacturer in writing of Initial Audit results noting any Quality System items that do not comply with the fabricator/manufacturer’s QSM and/or CCDB TG requirements.

• Review CCDB approved quality assurance agency submitted fabricator/manufacturer annual in-plant audit.

• Notify fabricator/manufacturer in writing of annual in-plant audit results noting any Quality System items that do not comply with the fabricator/manufacturer’s QSM and/or CCDB approval requirements.

• Notify fabricator/manufacturer in writing of approval status.

• Maintain an Approved Fabricator/Manufacturer listing.

• Maintain an Approved Quality Assurance Agency listing.
IAS Accreditation Program
Inspection of MB Fabricators

• What does AC 472 cover?
  – Structural Welding (modeled after AC172)
  – Cold Formed Steel Fabrication
  – Engineering

• What are the benefits of AC 472?
  – Compliance with inspection requirements in Chapter 17
  – Assurance that MBS manufacturer has qualified staff and well managed quality system
  – Fabricators are knowledgeable about code requirements
  – Confidence in dealing with trusted source
  – May be specified by an owner/EOR as project requirement
IAS AC472 Accreditation

• Mandatory for MBMA Members!
• Why is this important?
  – AC 472 focuses on
    • Order documents – clear and concise
    • Design & Detailing – code compliant engineering
    • Raw material usage – high-quality traceable materials
    • Quality assurance and qualified staff – licensed engineers, certified welders and inspectors
  – AC 472 requires
    • Two annual on-site plant inspections
• Engineer in Responsible Charge
  – PE w/Experience Designing Metal Buildings
  – Have full authority and control
  – Conduct annual management review

• Written Procedures
  – Contract document evaluation
  – Preparation and checking of design calculations that are in conformance with specified codes/standards
  – Detail drawing preparation
  – Approval of revisions/change orders
  – Letter of Certification
1704.2.5.1 Fabricator approval. Special inspections during fabrication are not required where the work is done on the premises of a fabricator registered and approved to perform such work without special inspection. Approval shall be based upon review of the fabricator’s written procedural and quality control manuals and periodic auditing of fabrication practices by an approved agency. At completion of fabrication, the approved fabricator shall submit a certificate of compliance to the owner or the owner’s authorized agent for submittal to the building official as specified in Section 1704.5 stating that the work was performed in accordance with the approved construction documents.
Building Codes require Code Officials to approve fabricators as well as agencies engaged in conducting tests or furnishing inspection services

✓ Many departments may lack the resources to review and approve fabricators, inspection agencies, etc.
✓ Specialized accreditation agencies like IAS provide specific accreditation programs based on code requirements
✓ Regulators can turn to accreditation listings which are freely available for reference
Enforcement of IBC Chapter 17 Through Conformity Assessment

Good Conformity Assessment Practices, including Product Evaluation and Fabricator Accreditation support effective enforcement of building codes and standards by providing regulators with:

- Independent confirmation that building products are safe and compliant with codes and standards
- Independent assurance of an organization’s competence to perform certain activities
- Unique solutions to particular regulatory concerns
- Lists of accredited organizations to assist regulators in the approval process
- Lists of metal building systems manufacturer’s for easy referral by architects, engineers, and code officials
Chapter 2 Definitions

• **Approved Agency.** An established and recognized agency that is regularly engaged in conducting test, furnishing *inspection services* or furnishing *product certification* where such agency has been *approved* by the building official.

• **Approved Source.** An independent person, firm or corporation, *approved by the building official*, who is competent and experienced in the application principles to materials, methods or systems analyses.
Inspection Requirements and Guidance
Based on MBMA Guide for Inspecting Metal Building Systems
Table of Contents

• Chapter 1  Introduction
• Chapter 2  Foundations
• Chapter 3  Primary Rigid Frames
• Chapter 4  Bracing
• Chapter 5  Secondary Structural Members
• Chapter 6  Metal Roof and Wall Systems
• Chapter 7  Inspections Related to Maintenance
• Appendix A  Fabrication Tolerances
• Appendix B  Crane Runway Beams
• Appendix C  Inspection Reports
• Appendix D  Inspection Checklists
Intended Audience

• Individuals who are responsible for contracting, performing, and reporting inspection tasks
  – Representatives of the Owner
  – Design Professionals
  – General Contractor
  – Erector
  – Building Official

• Inspections
  – Building code requirement
  – Contract requirement
  – Optional (owner acceptance, insurance, etc.)

• Useful resource when inspecting a metal building
Scope

- Primarily focus on inspecting newly constructed metal building systems
  - Primary Framing
  - Secondary Framing
  - Metal roof and wall cladding
- Additional materials briefly discussed
  - Windows
  - Doors
  - Skylights
  - Insulation
- Not discussed
  - Erection
  - Lighting and Mechanical Systems
  - Soil conditions, veneers
  - Existing buildings
Chapter 1 Introduction

• 1.1 What is a Metal Building System?
• 1.2 Overview of Inspection Requirements and Responsibilities
  – 1.2.1 IBC Inspection Requirements
  – 1.2.2 Inspection Requirements per Contract and Order Documents
  – 1.2.3 Involved Parties
1.2.3.2 Owner/End Customer
• Party who will be the initial owner of the construction project

1.2.3.3 Third Party Inspector
• Employed by the owner to perform the special inspections and tests identified in and required by the statement of special inspections prepared by the registered design professional in responsible charge.
Introduction

• 1.2.3.5 Building Official

• Building Official

– Administers and enforces the building code, issues permits, receives inspection reports and other certifications required by the building code, and issues certificates of occupancy.

Additionally, as noted in the definition in IBC Section 202 and as required in Section 1704.2.5.2, the building official approves a fabricator, "based on a review of the fabricator's written procedures and quality control manuals and periodic auditing of fabrication practices by an approved special inspection agency." For a metal building manufacturer, a building official typically utilizes the International Accreditation Services' (IAS) Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems (AC 472) criteria as a means of approving a metal building fabricator. For more information on the AC 472 program, refer to Section 3.3.
1.2.3.6 Metal Building Manufacturer
- Party that designs and fabricates the materials included in the metal building system
- All MBMA members are IAS AC472 accredited.

The manufacturer is responsible for the quality control of the work they produce. Enforcement of a quality control program, which is verified by an outside inspection agency, similar to the IAS AC 472 accreditation program described in the MBSM Section VI, is one primary indication of the manufacturer’s due care in satisfying this responsibility.

It is essential that the components of a metal building system are fabricated and assembled (erected) as required by the approved construction documents. To achieve this goal, the manufacturer and erector provide their own quality control inspections and the owner employs third party special inspectors to perform quality assurance inspections, when required by the authority having jurisdiction. These third party special inspections, when required, are performed in the shop to review the manufacturer’s work and in the field to focus on the erector’s work.
Chapter 2 Foundations

• 2.1 Foundation Checking
  – 2.1.1 Base Plates
  – 2.1.2 Grouting
  – 2.1.3 Anchor Rod Connection to Base Plate

Figure 4.1-3: Hillside Washer
2.1.1 Base Plates

- Holes do not align with anchor rod locations

2.1.1 Base Plates

Base plates are included with the columns that have been included with the proper sized holes at the metal building manufacturer's plant to allow the anchor rods to pass through and be secured to the framing system. Typically, holes in the base plates are slightly oversized to accommodate variations in the field locations of the anchor rods. If it is necessary to enlarge or slot a hole in the base plate to accommodate poorly located anchor rods, the registered design professional or the manufacturer's engineer must approve such action and provide any necessary remediation. Column base plates should come in full contact with the concrete slab or pedestal, otherwise grouting may be necessary.
Base plates for metal building columns most often simply rest on the slab or concrete pedestal. The use of grout pads between the slab (or pedestal) is not a common practice in the metal building industry. However, if the base plate cannot sit flush on top of the concrete, then grouting is warranted, as shown in Figure 2.1-1. Prior to grouting, column bases may be elevated by utilizing nuts on the anchor rods on the underside of the column base, or using shims to hold the base at the proper elevation. In either case the column base must be fully grouted utilizing non-shrink grout. Grout must be forced completely under the base plate to eliminate any voids so the column has uniform bearing on the entire grout bed. Grouting is not the responsibility of the metal building manufacturer or the erector, unless called out on the approved construction documents.
Chapter 3 Primary Rigid Frames

- 3.1 Rigid Frames
- 3.2 Tolerances
- 3.3 IBC Special Inspection Requirements for Fabricated Steel
- 3.4 Inspection of Welding
- 3.5 Inspection of High Strength Bolted Connections
- 3.6 Inspection of Erection Drawing Details
- 3.7 Mezzanine Structures
- 3.8 Crane Runway Beams
3.2 Tolerances

Variations are to be expected in the finished overall dimensions of structural steel rigid frames. Such variations are deemed to be within the limits of good practice if they **do not exceed the cumulative effect of rolling, fabricating, and erection tolerances**.

Inspection for conformity to fabrication and erection tolerances is performed by visual observations and measurements using tools such as rulers, tape measures, squares, calipers, string lines, and in the case of erection tolerances, surveying instruments. See Appendix A for the fabrication tolerances associated with built-up structural members. The construction documents will specify the tolerances permitted for a given project, which may differ from those referenced in this Guide.

Erection tolerances are those set forth in the AISC Code of Standard Practice (AISC 303) Section 7. Individual structural members are considered plumb, level, and aligned if the deviation from **plumb does not exceed 1:500** (See Figure 3.2-1). Additional tolerances are recommended for crane support systems in metal building system projects. Erection tolerances for crane runway
3.5 Inspection of High Strength Bolted Connections

3.5.1 Snug-Tightened Joints
Snug-tightened joints are one of the most common connection methods used in a metal building system, as illustrated in Figure 3.5-3. The approved construction documents will specify when this type of joint is to be used. 1As defined in RCSC Specification Section 8.1, "the snug tightened condition is the tightness that is attained with a few impacts of an impact wrench or the full effort of an ironworker using an ordinary spud wrench to bring the plies into firm contact." The inspection of snug-tightened joints, thus, involves the visual examination of the work to ensure that the proper fastener components have been used, including washers where required, the connected plies are clean, the bolt holes meet the diameter and quality requirements, and the plies of the connected elements have been brought into firm contact.
Connection plates that are bolted together, such as those in a bolted end-plate connection (see Figure 3.5-1), should have no spaces between them within a circle three times the nominal diameter of the bolt \(d_b\) as illustrated in Figure 3.5-2. Gaps in excess of \(\frac{3}{16}\) inch in these areas should be shimmed. Gaps outside of these areas need no corrective action. Although Figure 3.5-2 was derived from the RCSC Specification Bolted Parts (Section 3) that illustrates the minimum unpainted area of the plane of contact between two plies of a joint (a.k.a. faying surface), it has been interpreted by the RCSC Committee to be an appropriate zone for considering gaps between the two plates. Gaps at the outer extremities of the plates due to plate warpage caused by welding do not generally have to be filled to achieve appropriate performance of that joint.
3.5 Inspection of High Strength Bolted Connections

3.5.2 Pre-Tensioned Joints and Slip-Critical Joints

The joints that are designated as pre-tensioned joints and slip-critical joints in the approved construction documents need to be addressed by the erector and the inspector as it relates to the installation and inspection technique. The selection of an installation method is not made by the metal building manufacturer. RCSC Specification Section 8.2 identifies four techniques for installation and pre-tensioning for these types of joints, while Section 9 provides inspection requirements.

The pre-installation test in RCSC Specification Section 7 is required for all four pre-tensioning techniques. For all methods other than calibrated wrench tensioning, the test must be run against each lot of bolts. For calibrated wrench tensioning, in addition to the above requirement, the test is required at the start of each work shift. The test is used to prove the installation procedure, i.e., amount of turn required, torque required, etc. The inspector should observe the test to verify conformance to the specification.
Primary Rigid Frames

3.5 Inspection of High Strength Bolted Connections

3.5.2.1 Turn-of-Nut Pre-Tensioning

There are two approaches to turn-of-nut pre-tensioning: match-marked and non-matched-marked. When the bolt and nut are properly match-marked, the offset between the marks is evidence of the required installation rotation of the turned element. The offset between the marks can be observed by the inspector after installation. When the bolts are not match-marked, the inspector must confirm by "routine observation" during installation that the installation is in conformity with specified requirements.
Primary Rigid Frames

• 3.5 Inspection of High Strength Bolted Connections

3.5.2.2 Calibrated Wrench Pre-Tensioning

When calibrated wrench pre-tensioning is used, the inspector confirms by "routine observation" that the calibrated wrench is properly applied to the turned element, and that the work conforms to the specified requirements. Wrenches are calibrated daily using a hydraulic load cell. One device that is commonly used in the industry is manufactured by the Skidmore-Wilhelm Manufacturing Company.

Note: This technique is used during installation. Use of “torque” wrench after installation is not appropriate.
3.5 Inspection of High Strength Bolted Connections

3.5.2.3 Twist-Off-Type Tension-Control Bolt Pre-tensioning

Twist-off-type tension-control bolt pre-tensioning involves the use of bolts that are manufactured with splined ends that are engaged by the chuck of the installation wrench. These splined ends are twisted off from the bolt shank at pre-determined levels of force that indicate that the required pretension has been achieved. The inspector observes by "routine observation" that the splined ends have been severed from the bolts at the appropriate time to establish that the installation conforms to the specified requirements.
• 3.5 Inspection of High Strength Bolted Connections

3.5.2.4 Direct-Tension-Indicator Pre-Tensioning

Direct-tension-indicator pre-tensioning uses washer-like elements that are placed under the nut or bolt head. These washer-like elements have projections that are compressed in the pre-tensioning process. The success of the pre-tensioning is indicated by refusal when the inspector attempts to insert an appropriately sized feeler gage. The inspector also visually checks that the tension indicator washer is installed in the correct orientation with the protrusions away from the work. In RCSC Specification Section 9.2.4, after the snug tight operation and prior to the pre-tensioning operation, the inspector must confirm by routine observation during installation that the appropriate feeler gage is accepted in at least half of the spaces between the protrusions of the DTI assembly.
### 3.5 Inspection of High Strength Bolted Connections

- Inspection of bolting depends on the type of joint and the installation technique.

<table>
<thead>
<tr>
<th>Type of Joints</th>
<th>Installation Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specified on erection drawings</td>
<td></td>
</tr>
<tr>
<td>Snug-Tightened Joints</td>
<td>Snug Tight</td>
</tr>
<tr>
<td>Pre-tensioned Joints and Slip Critical Joints</td>
<td>Turn of the Nut</td>
</tr>
<tr>
<td></td>
<td>Calibrated Wrench</td>
</tr>
<tr>
<td></td>
<td>Twist Off Type</td>
</tr>
<tr>
<td></td>
<td>Direct Tension Indicator</td>
</tr>
<tr>
<td></td>
<td>Addressed by erector and inspector</td>
</tr>
</tbody>
</table>
### 3.5 Inspection of High Strength Bolted Connections

- Inspector presence/interaction

<table>
<thead>
<tr>
<th>Pre-installation</th>
<th>Installation Technique</th>
<th>Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snug Tight</td>
<td>After installation</td>
<td></td>
</tr>
<tr>
<td>Turn of the Nut – match marked</td>
<td>After installation</td>
<td></td>
</tr>
<tr>
<td>Turn of the Nut – non match marked</td>
<td>Routine observation</td>
<td></td>
</tr>
<tr>
<td>Calibrated Wrench</td>
<td>Routine observation</td>
<td></td>
</tr>
<tr>
<td>Twist Off Type</td>
<td>Routine observation</td>
<td></td>
</tr>
<tr>
<td>Direct Tension Indicator</td>
<td>Routine observation</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 4 Bracing

• 4.1 Roof and Wall X-Bracing
• 4.2 Flange Braces
4.1.1 Installation of Roof and Wall Bracing

Rods and wire strand of the X-bracing terminates with threaded ends or eyebolts. These ends typically pass through slots in the web of the column or rafter and utilize a hillside washer, standard wrought washer, and nut (see Figure 4.1-3). The hillside washer is essential to provide proper bearing and load transfer from the rod to the primary structural member. Larger rods may utilize a clevis/pin arrangement attached to a gusset in the primary structural member.
The nut(s) on the end and/or turnbuckles are used to tension the rod or cable. The bracing members should be tightened as snugly as possible without creating distress in the connections to the framing members, or distorting purlins or girts that are acting as compression struts.

Matching members should always be equally tensioned in each bay. Although there are no specific tension requirements when tightening the member, the rule of thumb is to remove the sag, as shown in Figure 4.1-4. However, some sag may still be present, but not to the extent shown in Figure 4.1-5.
Bracing

• 4.1.1 Installation of Roof and Wall Bracing

Wall X-bracing is occasionally installed in the plane of the girts. When this occurs, it is typical for the erector to **field cut slots in the webs of the girts for the bracing member to pass through** (see Figure 4.1-6). However, this example illustrates an improper slot through the web of the girt, causing the rod not to tension properly. These slots should be of the minimal size necessary to allow the passage of the member – typically no more than 1.5 to 2 times the member diameter. It is **not acceptable for the flange of the girt to be notched** for bracing installation.
• 4.2 Flange, Purlin, Girt Bracing
  – Flange bracing – angles attaching purlins/girts to rafters/columns

Flange braces are typically angles that attach the purlins, girts, and eave struts to the columns and rafters, as shown in Figure 4.2-1. When visually inspecting a metal building there will be a pattern of where the braces are installed, as provided in Figure 4.2-2. If the pattern is broken up, such as shown in Figure 4.2-3, then the manufacturer should be consulted to ensure that no braces are missing. The primary purpose of flange bracing is to prevent the inside flange of columns and rafters from buckling or twisting. All flange braces must be installed in accordance with the erection drawings and are not removed or modified without prior written approval of the metal building manufacturer, because they are essential for the structural stability of the metal building system. They may be located on one side or both sides of the column or rafter.
4.2 Flange, Purlin, Girt Bracing

- Flange bracing – angles attaching purlins/girts to rafters/columns

- Manufacturer’s Erection Drawings will specify if:
  - Flange braces are to be installed one side or both sides
  - Holes/tabs may be present on both sides of rafter/column though brace is only required on one side.
  - If one side, same side or alternating side
  - Attachment to purlin/girt
  - Optional attachment when liner or insulation vapor barrier is present
Chapter 5 Secondary Structural Members

- 5.1 Girts
- 5.2 Purlins
- 5.3 Eave Struts
- 5.4 Adding Framed Openings
- 5.5 Endwall Framing
Secondary Structural Members

- Number of Holes
- Holes or Slots
- Washers
- Vary by Manufacturer and Location

The zee-shaped members are designed to lap over the rafter/column to develop continuity resulting in more strength and stiffness. The lap length may vary from 12 to 60 inches. Bolts are provided at the ends of the laps. Depending upon the manufacturer, the number of holes in the web of the secondary members could be the exact number of bolt holes needed for the specific connection. Alternatively, the manufacturer may provide standard holes to address the many possibilities of where bolts could be used, which could result in some holes not needing bolts. Oversized holes or slots may be provided in the lap areas. Washers are not needed at these locations as the slots are provided as an erection aid and evidence shows that washers are not needed for the members to behave as expected.
Secondary Structural Members

- **5.1 Girts**
  - Sag rods or discrete bracing

- **Type of Bracing**
  - Channel, Strap, Knock-in
  - Varies by manufacturer
  - Not always required

- **5.2 Purlins**
  - Sag angles or discrete bracing
  - Prevent “roll”
• 5.2.1 Hanging Loads on Purlins
  – Loads of “any significance” – vary by manufacturer

It is common to hang or suspend loads from purlins. These loads may be due to a suspended ceiling, lights, fire sprinkler system, heaters, or other equipment. While very light loads may be attached to the bottom flange, **loads of any significance must be attached to the purlin web**, as shown in Figure 5.2-2. **In no case should loads be attached to the purlin "lip"**, as shown in Figure 5.2-3. If the purlins have been designed to support hanging loads, the magnitude of a specific load or a collateral load in pounds per square foot must be noted on the drawings. The capacity of the purlins to support roof live and snow loading will decrease if the hanging loads exceed these values or when no collateral load was included in the design.
• 5.2.1 Hanging Loads on Purlins
Chapter 6 Metal Roof and Wall Systems

• 6.1 Standing Seam and Through Fastened Metal Roofs
• 6.2 Metal Wall Panels
• 6.3 Fasteners for Metal Roofs and Walls
• 6.4 Oil Canning
• 6.5 Metal Decking
• 6.6 Other Wall Materials
• 6.7 Roof and Wall Insulation
• 6.8 Inspection of Surface Preparation and Application of Coatings
The inspector must be aware of the following safety precautions when walking or handling metal panels:

- Metal panels may contain a manufacturing lubricant that can be extremely slippery. A Voluntary Lubricant Compliance Program for Steel Deck and Roofing provides guidelines with manufacturing metal panels to reduce the level of lubricant. For more information, refer to the MBMA Metal Building Systems MBSM, Appendix A13.
- Never step or walk on the major rib of a panel. Always walk in the panel flat.
- Never step, stand, sit, or place material/equipment on skylights.
- Never walk, stand, or sit on an unsecured roof panel. Panel may buckle or collapse causing serious or critical injury.
- Appropriate fall protection procedures must be followed.
Be sure that the clamps are of non-corrosive metals that are compatible with the roof. Aluminum clamps with stainless hardware are preferred and compatible with Galvalume® coated steel.

Any setscrews that secure the clamp to the seam should have a rounded point (not a cup point) so that gouging, or breaching of the metallic coating is avoided.

Be sure that the holding strength of the clamp is third-party lab tested for the specific gauge and panel seam profile and gauge being used. Holding strength is seam profile- and gauge-specific.

Loads introduced into the clamp will be transferred to the panels. Panels must be adequately secured to the structure and have sufficient flexural strength to resist these loads.

Ideally, clamps should be located at the panel clip locations at a purlin, in order to minimize localized loads on the panel seam.
Critical Sealant Applications

Eave:
- Panel to eave flashing or gutter
- Panel rib closure to eave flashing or gutter
- Panel to rib closure
- Panel seam end

Diagram: Vertical rib fixed eave with flange back gutter.
Endlap:
- Panel flat to panel flat
- Panel rib area to panel rib area (and into seam)
Critical Sealant Applications

Ridge:
- Panel to closure components
- Closure components to ridge flashings
Critical Sealant Applications

Terminations:
- Panel to flashing at rakes or gables
- Panel to flashing at longitudinal expansion joints
- Panel to flashing at parapet conditions

Penetrations:
- Panel and ribs to preformed curbs
- Panel and ribs to other roof penetrations

Flashings and Trim:
- Laps of adjacent flashing segments
- Flashings to panels
The fasteners should be installed securely and installed in accordance with the locations called out on the approved construction documents. The following is a brief list of common fastener connection details for the inspector to make note of and contact the appropriate party for a repair according to manufacturer's recommendations:

- Correct fastener style, size, and finish. Note that a larger size is acceptable as discussed below.
- Verify the fasteners penetrate individual components intended to be secured.
- Missing fastener heads.
- Stripped fasteners that turn freely.
- Improper fastener spacing and edge distances not according to the construction drawings.
- Over driven, under driven, or loose fasteners.
6.4 Oil Canning

Oil canning is defined as a waviness that may occur in the flat areas of thin gauge, formed metal roof and wall panels, as shown in Figure 6.4-1. This oil canning is sometimes temporary but could be permanent depending on the situation. Structural integrity is not normally affected by this inherent characteristic. Oil canning is generally an aesthetic issue and not cause for roof or wall panel rejection. For a detailed discussion on oil canning, refer to the Metal Construction Association (MCA) Technical Bulletin, *Oil Canning in Metal Roof and Metal Wall Systems*. 
Chapter 7 Inspections Related to Maintenance

• 7.1 Ice and Snow Buildup
• 7.2 General Maintenance
• 7.3 Condensation Control
7.2 General Maintenance

The following components that are a part of a building envelope may need periodic maintenance to ensure proper working conditions and the avoidance of water penetrating into the building interior. Installation of these materials should have originally been in accordance with the approved construction documents.

**Gutters and Downspouts** - Clear all debris (leaves, dirt, etc.) from gutters and downspouts as required. Local conditions govern the frequency of these cleanings. However, it is recommended that an inspection for damage and a cleaning be made at least once a year.

**Walk Doors** - Walk doors should be checked periodically to assure tightness of locksets, closure hardware, and door hinges. Any loose bolts or fasteners should be tightened. Any moving parts that start to stick or squeak should be properly lubricated.
Windows - Caulking in windows will deteriorate over time, usually resulting in window leakage. If this happens, remove the old caulk and apply new caulk in its place. Windows that become hard to slide should have the track area thoroughly cleaned and a light coat of grease applied to the tracks. Check yearly for loose fasteners and tighten as required.

Overhead Doors - Periodically check the attachment bolts around an overhead door and tighten as required. The door manufacturer should be contacted if the door gets out of alignment or the mechanical parts within the door become hard to operate.

Loose Fasteners - Windows, doors, vents, and louvers should be checked yearly for loose fasteners and tighten as required, and lubricate any moving parts as necessary.
**Insulation** - Any holes or tears in the facing should be repaired with patch tape as supplied by the insulation supplier. Insulation tearing loose at various locations within the building (particularly at the eave or base) might not be the result of poor installation, but rather a strong negative pressure inside the building resulting from an improperly balanced HVAC system or an extra exhaust fan added after the erection of the structure. This, combined with a strong wind outside the building will often result in the insulation coming loose in these areas.

**Loose Structural Bolts and Bracing** - Structural bolts and bracing normally require no maintenance except in instances where the structure is exposed to vibration, such as a building with an overhead crane. Bolts, including those in crane building connections, should be inspected at least once a year and in accordance with OSHA requirements. Any loose connections should immediately be brought to the tightened condition specified by the building manufacturer.
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ITEM</th>
<th>CONDITION</th>
<th>ACTIONS TAKEN OR RECOMMENDED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Extreme caution used when:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Walking on or handling panels. New panels contain slippery lubricant</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Near major rib. Avoiding stepping on a major rib of a panel. Always walk on panel flat.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Near skylights. Never step, stand, sit or place material/equipment on skylight.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Near rigid board insulation. Never step, stand, or sit on. May be unsupported with liner panel.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Near unsecured roof panel. Panel may buckle/collapse.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Erection bracing properly installed to avoid collapse of rigid frames during construction.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Appendix D Inspection Checklists

**Main Frames Columns and Rafters**

<table>
<thead>
<tr>
<th>Construction</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Any modifications to shape</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check the primer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base plate sitting flush on top of concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If not, non-shrink grout installed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holes in base plate within tolerance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loose bolts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any missing or mislocated anchor rods / bolts</td>
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<td></td>
</tr>
<tr>
<td>Correct length anchor rods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bolt tightening per specifications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field welding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erection and fabrication tolerances not exceeded</td>
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<td></td>
</tr>
<tr>
<td>Flange braces - &quot;all&quot; installed per drawings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix D Inspection Checklists

### Secondary Framing

<table>
<thead>
<tr>
<th>Item</th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
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</thead>
<tbody>
<tr>
<td>Any modifications to shape</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Any additional collateral loads</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing bolts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing roof clips</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erection tolerances met</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fabrication tolerances not exceeded</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hanging loads on purlin - through web and not on purlin lip</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flange and Purlin and gir bracing - All installed per locations on drawings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bracing Rods / Cables</td>
<td>Building Evolution</td>
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<tr>
<td>-----------------------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>X-bracing - installed per locations on dwgs</td>
<td>Any openings been relocated / modified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X-bracing - rods/cables - Limited amount of sag</td>
<td>Any secondary framing been altered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Any additions to existing building</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Appendix D Inspection Checklists

## Walls & Roofs Panels
- Damaged panels
- Drill or other metal shavings removed
- Fasteners installed properly
- Any roof ponding
- Any debris/vegetation growth
- Displaced closures
- Sealants installed per drawing locations
- Other

## Roof Curbs and Hatches
- Fasteners installed
- Condensation lines draining properly
- Loose or displaced closures
- Sealants displaying signs of cracking
- Other
### Appendix D Inspection Checklists

<table>
<thead>
<tr>
<th>Other Roof Penetrations</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flashed properly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weathertight seal</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Secured and not prone to movement</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Deterioration of skylight/panels</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Sealant displaying signs of cracking</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Does not impede the flow of water</td>
<td></td>
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<tr>
<td>Other</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Flashings</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Roof to wall flashing</td>
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</tr>
<tr>
<td>Coping</td>
<td></td>
<td></td>
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<tr>
<td>Ridge and Hip caps</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Corner trim attached properly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gutters and downspouts installed properly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Windows and doors</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
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<tr>
<td>Insulation</td>
<td></td>
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<tr>
<td>------------------------------------------------</td>
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<td>---------------</td>
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<td></td>
</tr>
<tr>
<td>All seams in vapor retarder sealed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vapor retarder sealed properly around bracing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tears and rips have been sealed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proper drape of insulation between secondary framing members</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No air cavity between insulation and cladding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
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</table>

| Other                                          |               |               |               |
|                                                |               |               |               |
|                                                |               |               |               |
|                                                |               |               |               |
|                                                |               |               |               |
|                                                |               |               |               |
Case Study

Note – Plan is to substitute O’Reilly Auto Parts Store as Case Study

3451 S. Decatur Blvd., Las Vegas

But, heavier on Building Official Role through the process
**Project Details**

- **Muscle Shoals High School Athletic Training Facility**
- **Size:** 135.375 ft x 186.083 ft x 26 ft Eave Ht.
- **Description:** Gable Building to House High School Athletic Training
- **Bigbee Start Date:** April 16, 2013
- **Planned Bigbee Delivery Date:** June, 3 2013
- **Actual Bigbee Delivery Date:** June 3, 2013
Customer Contacts Bigbee to Begin Metal Building Quote (1)
Customer Contacts Bigbee to Begin Metal Building Quote (2)
Customer Contacts Bigbee to Begin Metal Building Quote (3)
Customer Contacts Bigbee to Begin Metal Building Quote (4)
Customer Contacts Bigbee to Begin Metal Building Quote (5)
Customer Contacts Bigbee to Begin Metal Building Quote (6)

<table>
<thead>
<tr>
<th>Builder</th>
<th>Phone</th>
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<tbody>
<tr>
<td>Address</td>
<td>Fax</td>
</tr>
<tr>
<td>City</td>
<td></td>
</tr>
<tr>
<td>State</td>
<td>Zip</td>
</tr>
<tr>
<td>Customer</td>
<td>MUSSLE SHOWS HIGH SCHOOL</td>
</tr>
<tr>
<td>Job Location</td>
<td>MUSSLE SHOWS, AL</td>
</tr>
<tr>
<td>Building Type</td>
<td>ATHLETIC FACILITY</td>
</tr>
<tr>
<td>Requested By</td>
<td>Date Rec'd: 4-11</td>
</tr>
<tr>
<td>Date Req'd: 4-11</td>
<td>Date Req'd: 4-11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blg. Type</th>
<th>Width</th>
<th>Length</th>
<th>Eave</th>
<th>Slope</th>
<th>Bay Spacing</th>
<th>L. Ewall</th>
<th>R. Ewall</th>
</tr>
</thead>
<tbody>
<tr>
<td>LRF</td>
<td>195' 4&quot;</td>
<td>180' 1&quot;</td>
<td>24</td>
<td>1:12</td>
<td>2 1/2'-20, 20, 3'-1-1/2'</td>
<td>P.15</td>
<td>P.15</td>
</tr>
</tbody>
</table>

- **Roof**: Rib, Standing Seam VR 18"
- **Wind Load**: 90 mph Code: 15C.09
- **Mechanical Load**: 7 psf EXP.B I-1.0

- **Live Load**: 20/12 psf, Other
- **Roof Insulation**: By Bigbee, By Others
- **Wall Insulation**: By Bigbee, By Others
- **Gutters & Downspouts**: Yes, 3 Lin.Ft.
- **Roof Insulation**: None
- **Wall Insulation**: None

**Accessories**: 20 Yr. Weather Tightness Non-Present, Walls Reversed Polystyrene

**Thermal Blocks in Roof**: By Others

**Windows, Doors, Framed Openings, Vents, Canopies, Skylights, etc.**
Quote Negotiations Continue (1)
Quote Negotiations Continue (2)

Specifications From Authoritative Agency

SECTION 05120 - STRUCTURAL STEEL

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of the contract including General and Supplementary Conditions and Division 1 Specifications Sections apply to work of this section.

DESCRIPTION OF WORK:

Extent of structural steel work is shown on drawings, including schedules, notes and details to show size and location of members, typical connections, and type of steel required.

Structural steel is that work defined in AISC "Code of Standard Practice" and as otherwise shown on drawings.

QUALITY ASSURANCE:

Codes and Standards: Comply with provisions of following, except as otherwise indicated:

1. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including "Commentary" and Supplements thereto as issued.
2. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
3. AWS D1.1 "Structural Welding Code".
4. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use.

Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests.

1. If re-certification of welders is required, retesting will be Contractor's responsibility.

SECTION 15120 - PREFabricATED BUILDINGS

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specifications sections apply to work specified in this Section.

SUMMARY:

Extent of pre-engineered buildings work is shown on drawings.

Building Type: The pre-engineered building system shown is a single story, rigid frame type metal building of the nominal length, width, eave height and roof pitch indicated.

Provide standard metal building blanketed insulation with waffle facing under roof and inside walls as indicated on drawings.

1. Manufacturer's standard components may be used, providing components, accessories, and complete structure conform to architectural design appearance shown and to specified requirements.
2. Concrete floor and foundations and installation of anchor bolts are specified in a Division-6 section.
3. Anchor bolts (including size and length) and anchor bolt plans to Contractor for work by others.
4. Seals and caulking are specified in a Division-5 section.

Description:

Provide all materials, labor, equipment and services, and perform all operations in connection with the furnishing and installing of roofing, including; in accordance with the drawings and specifications, and including, but not limited to, the following:

1. A pre-formed and pre-finished metal roofing panel complete with roof and wall insulation.

Include perimeter flashing, trim, ridge and gable closures and flashing as applicable, fasteners, supplementary lathing and supports and sealants required for complete roofing system, including the following:

1. Roof and Exterior Wall Panels
2. Skirt and Fascia Panels
3. Roof and Wall Insulation
4. Gutter and Downspouts
5. Ridge Vent
6. Roof Curbs
Specifications From Authoritative Agency

**SUBMITTALS:**

**Product Data:** Submit manufacturer's product information, specifications and installation instructions for building components and accessories. Submit sample warranty.

**Shop Drawings:** Submit complete erection drawings showing anchor bolt settings, sidewall, endwall, and roof framing, transverse cross sections, covering and trim details, and accessory installation details to clearly indicate proper assembly of building components.

**Samples:** The contractor shall submit two (2) samples each of the following for Architect's review. Samples will be used to evaluate the quality of the finished roofing system:

1. 12-inch long by actual width of roofing with required finish.
2. Fasteners for application of roofing, deck, siding, and soffit panels.
3. Sealants, closures and clips.
4. 12-inch long minimum by 12-inch wide minimum of actual standing seam sidelap seams for both sides of a typical panel.
5. Length and width as required for actual standing seam roof panel and lap seam including stiffeners and fasteners and side lap seams for both sides of a typical panel.

**Manufacturer's Qualifications:** Provide pre-engineered metal buildings as produced by a manufacturer with not less than 5 years successful experience in the fabrication of pre-engineered metal buildings of the type and quality required. Manufacturer will be a member of the MBMA.

**Erector's Qualifications:** Pre-engineered building shall be erected by a firm that has not less than 5 years successful experience in the erection of pre-engineered buildings similar to those required for this project, and that has been licensed by the manufacturer of the building system.

The Contractor will provide an approved and certified independent third party inspection firm. The inspection firm will provide a certificate of compliance in a start up, in progress and final inspection mode, certifying that the roof system will be approved to receive a 20 year manufacturers warranty. Recognized approved independent firms will consist of:
**MATERIALS:**

<table>
<thead>
<tr>
<th>Metals</th>
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<tbody>
<tr>
<td>1. Hot-Rolled Structural Shapes: Comply with requirements of ASTM A36 or A529.</td>
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<td>2. Tubing or Pipe: Comply with requirements of ASTM A500, Grade B, ASTM A501, or A83.</td>
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<tr>
<td>3. Members Fabricated from Plate or Bar Stock: Provide 42,000 psi minimum yield strength. Comply with requirements of ASTM A529, A570 or A572.</td>
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<td>4. Members Fabricated by Cold Forming: Comply with requirements of ASTM A367, Grade 50.</td>
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<tr>
<td>5. Bolts for Structural Framing: Comply with requirements of ASTM A307 or A325 as necessary for design loads and connection details.</td>
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**Insulation**

<table>
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<tr>
<th>Blanket Insulation: Provide glass fiber blanket insulation, of density and thickness required to obtain R-factors as follows:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Walls</td>
<td>R-10</td>
</tr>
<tr>
<td>2. Ceiling</td>
<td>R-19</td>
</tr>
</tbody>
</table>

**Secondary Framing:**

The spacing of all purfins as shown on the drawings is diagrammatic. The Registered Professional Engineer for the Pre-Engineered Building shall be responsible for the design of the roof structure to support the framing to meet all state, federal and local code restrictions and structural requirements set forth by the structural engineer. It shall be the responsibility of the Pre-Engineered Building manufacturer to coordinate with the Building Contractor the amount of erection required for the roof framing before bidding.

Provide not less than 16-ga. shop-punched rolled formed sections for the following secondary framing members unless shown otherwise on structural contact drawings:

1. Purfins,
2. Eave struts,
3. Endwall rafters,
4. Flange bracing,
5. Stag bracing.

Provide not less than 14-ga. cold-formed galvanized steel sections for the following secondary framing members:

1. Base channels,
2. Steel angles,
3. Endwall structural members (except columns and beams),
4. Purfin spacers.

Bolts: Provide ASTM A307 bolts, at secondary structural connections. Provide zinc-plated or cadmium-plated bolts when a structural framing component is in direct contact with roofing and siding panels. Primary structural connections to be made with ASTM A502 bolts.
Quote Negotiations Continue

Specifications From Authoritative Agency (W/Addendums and more Addendums...)

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A2.1 GENERAL

A. The following changes and/or substitutions to the plans and specifications are hereby made a part of same and are incorporated in full force as part of the contract.

B. Bidders shall acknowledge receipt of this Addendum in writing on his Proposal Form.

C. A pre-bid conference shall be held on Thursday, April 4, 2013, at 10:30 AM, at the project site (1900 E, Avalon Avenue, Muscle Shoals, AL).

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A2.2 SPECIFICATIONS

A. The following manufacturers are hereby approved subject to the plans and specifications:

- Houston (HHS) - Insulated Exterior Rolling Doors
- Concept Overhead Doors

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A3.1 GENERAL

A. The following changes and/or substitutions to the plans and specifications are hereby made a part of same and are incorporated in full force as part of the contract.

B. Bidders shall acknowledge receipt of this Addendum in writing on his Proposal Form.

A3.2 SPECIFICATIONS

A. The following manufacturers are hereby approved subject to the plans and specifications:

- Houston (HHS) - Facility Automation and Control Systems
- General Controls
- Riko (RKO) - Fire Alarm System (Addendum)
Quote Negotiations Continue

Specifications From Authoritative Agency (W/Supplemental Drawings and Sketches)
Job Coordinator Assembles Design File Including Pertinent Design Information
Engineer Designs Primary (Frames) and Secondary Steel (Purlins & Girts) for Building
Engineer Designs the Building
Engineer Completes Anchor Bolt Plan
Engineer Completes Design Package
Job Coordinator Assembles
Permit/Approval Drawing Package

Job Coordinator Sends
Permit/Approval Package to
Customer Project Coordinator
Job Coordinator Receives Approval Package Back from Customer and Makes Any Needed Changes for Resubmission
Production Engineering Detailer
Completes all Detail Drawings
Production Engineering Detailer
Completes all Detail Drawings
Production Engineering Detailer
Completes all Detail Drawings
Job Detailing Completed, Checked, and Back Checked (by Engineer)

Job Released by Production Engineering Coordinator to Production Shop for Manufacturing
Production of Metal Building

- All Production is Accomplished According to Bigbee’s Quality Program
- Bigbee’s Quality Program Includes a Quality Procedure Manual and Participation in Accreditation Programs (AC472, IAS, etc)
Components Produced for Frames
Frames Assembled (Welded)
Secondary Steel (Purlins, Girts, Struts, Zees, Columns, Channels, etc.) Produced
Panels (Roof and Wall) and Trim Produced
Additional Components Selected from Warehouse
All Components Loaded for Delivery According to the Shipper (BOM)
Metal Building Delivered on Flatbed Trailers
Contractor / Developer / Erector Unloads Metal Building at Jobsite and Stages Materials for Building Erection
Bigbee’s Part of Project Completed with Delivery of Building and Erection Plans
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Bigbee’s Part of Project Completed with Delivery of Building and Erection Plans
Building Erection
Building Erection
Building Erection
Building Erection
Completed Project
Completed Project
Completed Project
Resources
What is AC472 Accreditation Program?  
The AC472 Accreditation Program is the newest, comprehensive quality assurance program for building materials, manufacturers, and assemblers. As an example, manufacturers can be accredited by the program to ensure that their products meet or exceed the requirements set forth by the program.

What is the AC472 Accreditation Program?  
The AC472 Accreditation Program is designed to ensure that building materials, manufacturers, and assemblers meet or exceed the requirements set forth by the program. The program is administered by the Building Materials Manufacturers Association (MBMA), which is a not-for-profit organization that represents the interests of building materials manufacturers and suppliers.

Benefits to the Building Official:  
- Improved AC472 accreditation authentication process  
- More efficient, streamlined process  
- Improved quality assurance program  
- Improved communication with manufacturers  
- Improved accountability of manufacturers  
- Improved compliance with building codes

Q: What is the International Accreditation Services, Inc.?  
A: The International Accreditation Services (IAS) is a worldwide subsidiary of the International Code Council, which evaluates and accredits building departments, special inspection agencies, testing and qualification laboratories, fire-dependent inspection programs, and oversees the AC472 Accreditation Program for Metal Building Systems Manufacturers.

Q: What do they do?  
A: IAS measures a manufacturer’s ability to conform to documents and standards referenced in building codes through expert assessment and periodic monitoring by IAS-accredited third-party inspection agencies. It also oversees a manufacturer’s quality assurance program.

Q: Why was the AC472 Accreditation Program developed?  
A: To address industry and design programs statement: metal building systems became very successful in entering mainstream market by becoming more common and replacing previous systems. The manufacturer’s current building system had to be capable of meeting the AC472 Accreditation Program regulations. An AC472-accredited manufacturer is able to develop an accreditation program to improve the confidence of the design team and manufacturing processes in the building system industry and in compliance with the special inspection requirements in Chapter 17 of the International Building Code®.

Q: Are there other accreditation and certification programs like AC472?  
A: Yes, these programs only address specific manufacturing processes—no unique needs of building systems.

Q: Why are these needs unique?  
A: Since the design, detailing, and manufacturing is done by the same company, these processes are mutually dependent and need to be evaluated together.

Q: With conventional construction, I receive a set of design documents, and drawings stamps by a registered professional engineer. Why isn’t that adequate for metal building systems?  
A: A conventional design will use the same set of drawings as the steel buildings, and the design and fabrication processes are standardized and require no additional communications between the engineer and the manufacturer. The only way to be assured that these facilities are being properly integrated is to require that the manufacturer be AC472-accredited.

Q: If a building design involves only AC472-accredited companies, can they build projects in my jurisdiction, with the same strategy competition worth that construction needs safety risk?  
A: No. There is a significant number of companies that provide services to both AC472-accredited and non-AC472-accredited companies.
Other Resources Available
Thank You!
www.iccsafe.org/conference

#ICCAC19