WHITE PAPER

Visual Acceptance for Single-Skin Architectural Metal Wall Panels

Overview:

While the building and fire codes are primarily concerned with structural and fire performance of single-skin architectural metal wall panels, there are often other performance indicators used within the construction industry to define an acceptable application. Single-skin architectural metal wall panels are most often defined as those metal sheets and coils that are natural metals (copper, zinc, etc.), stainless steel, or coated-metals that have a surface layer added (painted, dipped, plated, etc.) to a metal substrate. Visual appearance is often defined in architectural specifications that are based on code requirements, architectural requirements, and appearance goals that are beyond the scope of the code. This document states the unified position of the Metal Construction Association and its members with regards to visual acceptance parameters.

Background:

This document serves as a guideline reflecting industry wide standards which evolve and change over time. This guideline should be considered a living document that will be periodically updated as technology changes and more knowledge is shared. It is also possible that a unique project or architect may have a specific set of performance requirements that exceed those highlighted within this guideline. The intent of this document is to serve as an objective reference for determining metal wall panel and installation quality based on accepted industry standards.

Discussion:

Building codes help ensure public safety enforcing a level of construction quality that ensures structural integrity. Sound structural design, a well-built frame, sub-framing system, and exterior sheathing are all key components that contribute to an acceptable single-skin architectural metal wall panel installation. Perceived visual problems with single-skin metal wall panels can often be traced back to structural or sub-assembly issues.

The following parameters are often considered to be the source of aesthetic issues:

- Panel Deflection
- Face Distortion (Oil Canning)
- Surface Imperfections
- Metal & Finish Type

Panel Deflection – Metal wall panel deflection can be caused by high wind loads, panel face dimensions, attachment requirements, and installation tolerances of the structural steel and sub-frame and supporting frame movement. The mechanical and physical properties of a metal, as well as gauge, are also factors. Although a lighter gauge may meet structural requirements it could push the panel deflection to the material's limit causing an unacceptable appearance.

Allowable deflection resulting from wind load for single-skin metal wall cladding is defined within the International Building Code (IBC) as L/60. (Table 1604.3 Footnote a) This allowable deflection recognizes the ability of metal wall cladding to deflect and still return to its original position without permanent deformation of the material. Non-ferrous metals may require additional support due to lower yield strength. Additional deflection criteria includes limiting perimeter sub-frame deflection to L/175. The perimeter deflection limits must be verified as it may change the wall panel support system.

Wall panel deflection may also be caused by movement within the supporting structure. This is often beyond the scope of panel system design and installation. Structural movement may directly affect the wall panel sub-frame and impact panel flatness. The load deflection criteria of the wall panel system and connection methods should be coordinated with the loading criteria of the primary support system in order to control movement.

Face Distortion ("Oil Canning") – Distortion can be caused by an out-of-tolerance support system (which is commonly limited by specification to 1/4":20'); however it is typically due to restraints in a panel when subjected to a change in temperature causing the surface to become "out of plane". This thermal movement causes the panel to grow as the temperature rises and to shrink as the temperature declines. These dimensional changes are relative to the temperature of the panels during installation. For single skin architectural wall panels, this change in material temperature can exceed 100^0F in the course of a day. Wall panel movement may cause significant distortion if it is not considered in the design, fabrication, and installation of the panel.

To reduce the effects of this thermal movement, wall panel fabrication typically will include slotted holes, clips, or other methods that accommodate this change in dimension (length and width). In certain instances, breaks may be used to relieve this change in dimension. Wall panels are typically installed with a fixed point in the center of the panel. This allows expansion and contraction of the wall panel in all directions from the fixed point. This technique can become difficult around openings and at building corners, but proper planning will provide a solution to this construction situation. It is also important that panel installation be completed in temperatures, consistent with the local regional average of the area. Wall panels should be allowed to reach ambient temperature prior to installation.

Finally, fasteners should not be torqued tight against the connecting sub frame, effectively locking the wall panels in place. Thin plastic shims and a torque or depth sensitive screw gun may assist with correct installation allowing for expansion and contraction.

If there is significant or chronic face distortion, an investigation into the installation techniques should be completed. Heavier gauge and larger format panels may require additional support and attachment to resist face distortion due to gravity.

Face distortion is generally an aesthetic issue. Structural integrity is typically not affected. In the absence of specific contract requirements, face distortion (oil canning) should not be the sole grounds for panel rejection. For more information on face distortion (oil canning) reference the MCA Technical Bulletin titled "Oil Canning in Metal Roof and Metal Wall Systems".

Surface Imperfections – Surface imperfections are difficult to define and can be a result of numerous influences. Dents, dimples and defects from manufacturing such as coil breaks, fluting and camber are possible. Identifying imperfections should be pointed out by the installer as they occur for investigation and possible remediation or replacement.

Construction Industry performance requirements and test procedures describe an inspection made when standing 10 feet from the façade viewing perpendicular to the plane of the building. The inspection of the project is typically made under natural exterior lighting conditions. The Metal Construction Association (MCA) and the American Architectural Manufacturers Association (AAMA) (2605 Section 5.2) have adopted use of this standard as an acceptable guideline for evaluating metal wall cladding.

Metal & Finish Performance – Yield strength varies with metal type and is a consideration when specifying metal thickness. Regardless of metal type, all rolled metals show degrees of oil canning as a fact of rolled metal production. Tension-leveling mitigates this to a degree. Specifications can require all metal coil processing to provide tension leveling as one means to reduce oil canning.

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While not specifically covered in the building codes, metal finish criteria are often defined in the project specifications. Finish performance characteristics include, but are not limited to; hardness, impact resistance, wear resistance, humidity, and corrosion resistance as defined by ASTM and CCCA standards as well as AAMA 2603, 2604, and 2605 for coated aluminum products. Coil-coated metals strive for color fastness which can be measured under laboratory conditions. Finish performance analysis compares a sample of the project panel to a production control sample using one of several standard test methods. The Hunter Lab Scale is a typical standard to measure the color (red/yellow blue/green) and the lightness/darkness of the finish. The control sample is defined as the origin of a 3-dimensional grid and the panel measurement defines the relative position of the panel. The distance between these points is measured in units called "Delta E" (dE).

Grain directionality (flake orientation) within metallic or Mica based coatings is often the source for unappealing visual appearance. While the nature of the metallic elements suspended within organic coatings is not 100% controllable, current application technology has vastly improved consistency. With this in mind, proper documentation and control throughout the design, fabrication and installation of the single-skin metal panel system is paramount. Grain directionality is also evident in natural metals and mechanically finished metals.

Typical finish warranties for painted metals allow as much as 5 dE units of color change or fade over the life of the warranty. Many factors go into the scope and term of the warranty including color choice, application type, geography and the type of project finish. Further information on color fastness and finish performance should be obtained from the specific project panel supplier as there is a wide range of finishes and performances. Natural metals often come with a warranty on the substrate since the surface is a patina as opposed to a coating.

Other areas of concern that could adversely affect visual acceptance include:

- Field installation issues (fingerprints and perspiration or other stains)
- Post installation damage (often from other trades)
- Improper use of sealant, adhesives, and tapes
- Staining from upstream materials (copper run-off, cleaning solutions, mortar, etc.)
- Improper storage and handling (wet storage, greasy or residue transfer, etc.)
- Improper cleaning & maintenance (consult metal supplier)
- Coating scratches (often made worse by touch-up paint)

MCA Comments:

The Metal Construction Association has adopted the aforementioned standards and definitions of evaluation as acceptable industry-wide guidelines for "Visual Acceptance Parameters" specifically for single-skin metal wall cladding. Following the industry standards identified within this bulletin, the architect can be reasonably assured of a level of panel quality and the expected level of panel performance. Variations in such areas as workmanship, field modifications to address unplanned variation, and site specific requirements cannot be addressed in a single document. The experience, installation practices, and quality control program of a specific fabricator and installer must be considered as a primary influence on installation quality.

With proper design, engineering, fabrication, installation, training, and information sharing, all project stakeholders can have the same visual expectations. Effective communications of visual expectations are difficult to convey. Previous project photo references, dimensioned shop drawings (noting all expected face dimensions, and metal gauges), and mock-ups are all important tools that can be used to communicate visual intent.

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- Technical guidance
- Product certification
- Educational and awareness programs
- Advocating for the interests of our industry
- Recognition of industry-achievement awards
- Monitoring of industry issues, such as codes and standards
- Research to develop improved metal construction products
- Promotional and marketing support for the metal construction industry
- Publications to promote use of metal wall and roof products in construction

For more information, please visit the MCA Web site at www.metalconstruction.org.

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