Standards for Expanded Metal

Selection, Manufacture & Application

Course Sponsor

Expanded Metal Manufacturers Association, a division of NAAMM (National Association of Architectural Metal Manufacturers)

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An AIA Continuing Education Program

Credit for this course is 1 AIA HSW CE Hour

COURSE NUMBER

EMM05B

An American Institute of Architects (AIA) Continuing Education Program

Credit(s) earned upon completion of this course will be reported to AIA CES for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

This course is registered with AIA CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

You must pass the quiz upon completion of this course with a score of 80% or higher to receive credit.

AIA Continuing Education Provider

Course Description

- In this one-hour course, design professionals will learn about expanded metal, focusing on its manufacture, installation, and application. It will give in-depth knowledge of existing standards and manufacture tolerances as suggested by the Expanded Metal Manufacturers Association.

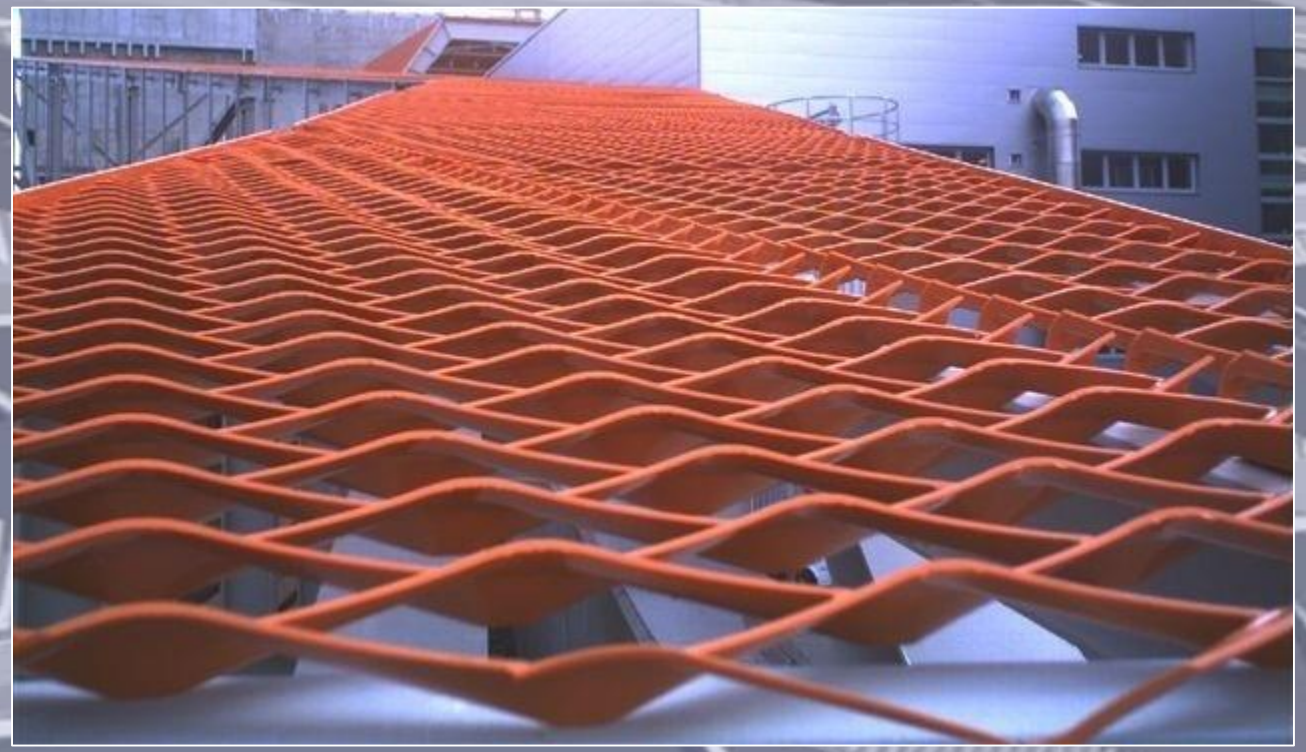
- By the end of this course, design professionals will be able to specify expanded metal using industry standards to create sustainable and stylish metal applications.

Learning Objectives

By the end of this course, you will be able to:

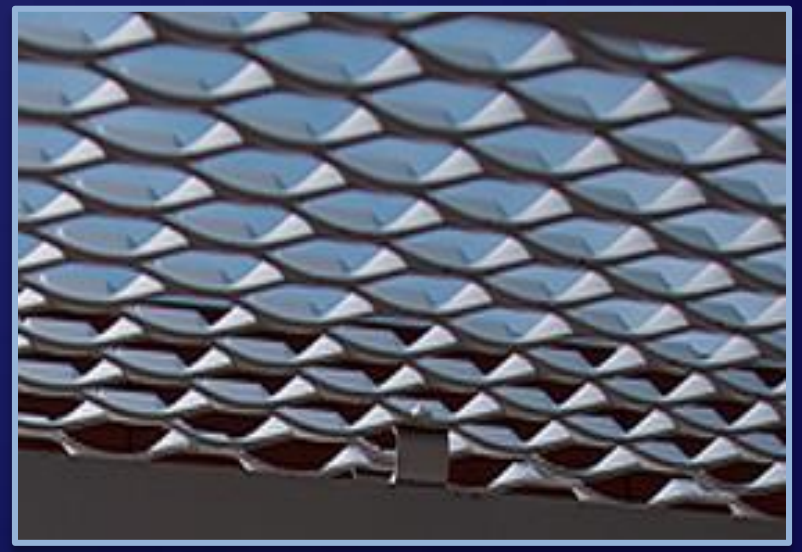
- **Explain** what expanded metal is and how it is manufactured, including various materials, designs, and applications
- **Recall** standards put forth by the Expanded Metal Manufacturers Association regarding specifications and manufacturing tolerances so that expanded metal is installed properly and safely
- **Illustrate** how expanded metal is a sustainable material that can be used to apply for LEED credits for recyclable material and local resources
- **Apply** new knowledge to specify and install expanded metal according to EMMA standards so that new expanded metal applications are safe and accessible for future occupants

Introduction to Expanded Metal and Applications



What is Expanded Metal?

- Expanded metal is a highly versatile open mesh material that allows light and air to flow freely through it while providing more rigidity than the sheet from which it was produced.
- It is formed in an expanded metal press and produced from any malleable metal product. Raw plate, sheet, or coil is simultaneously slit and stretched into diamond-shaped openings. These openings are of uniform size and spacing.

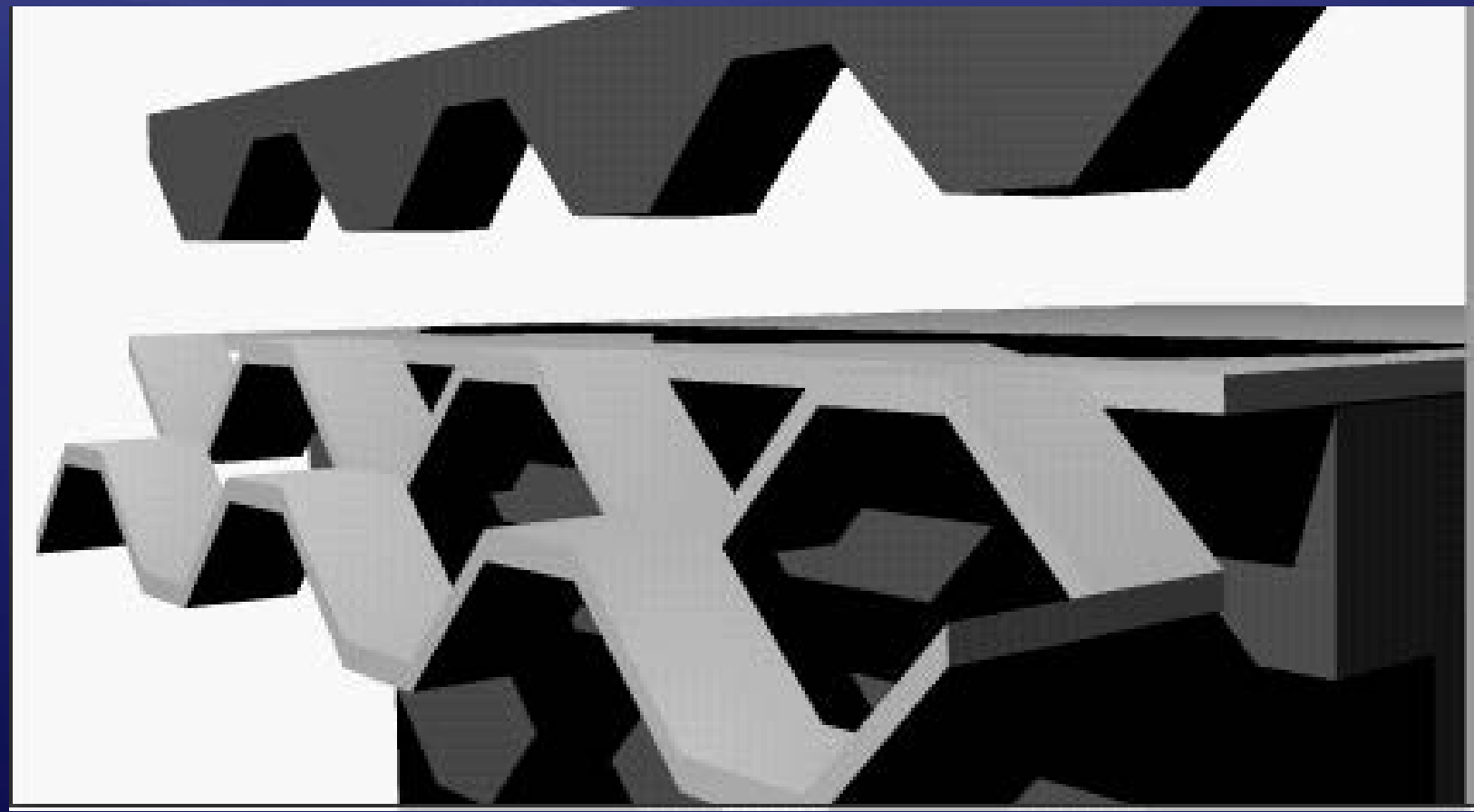


Manufacturing Process

1. The plate, sheet, or coil material is mechanically advanced over the fixed bottom die in an amount that is known as the strand width.
2. The top cutting die then descends and simultaneously slits and cold forms an entire row of half diamonds.
3. The top die then ascends and moves one half diamond right as the base metal simultaneously advances or feeds one strand width.
4. The top die then descends, slits, and forms another row of half diamonds, completing a row of full diamonds in two strokes.
5. The die then ascends, returning to its original position and repeats the process until the full sheet or coil of expanded metal is completed.

In any die pattern, the strand width and the depth of cut can be adjusted to increase or decrease the percent of open area of the expanded material.

Manufacturing Process



1 Metal advances one strand width.

2 Die forms one-half of design.

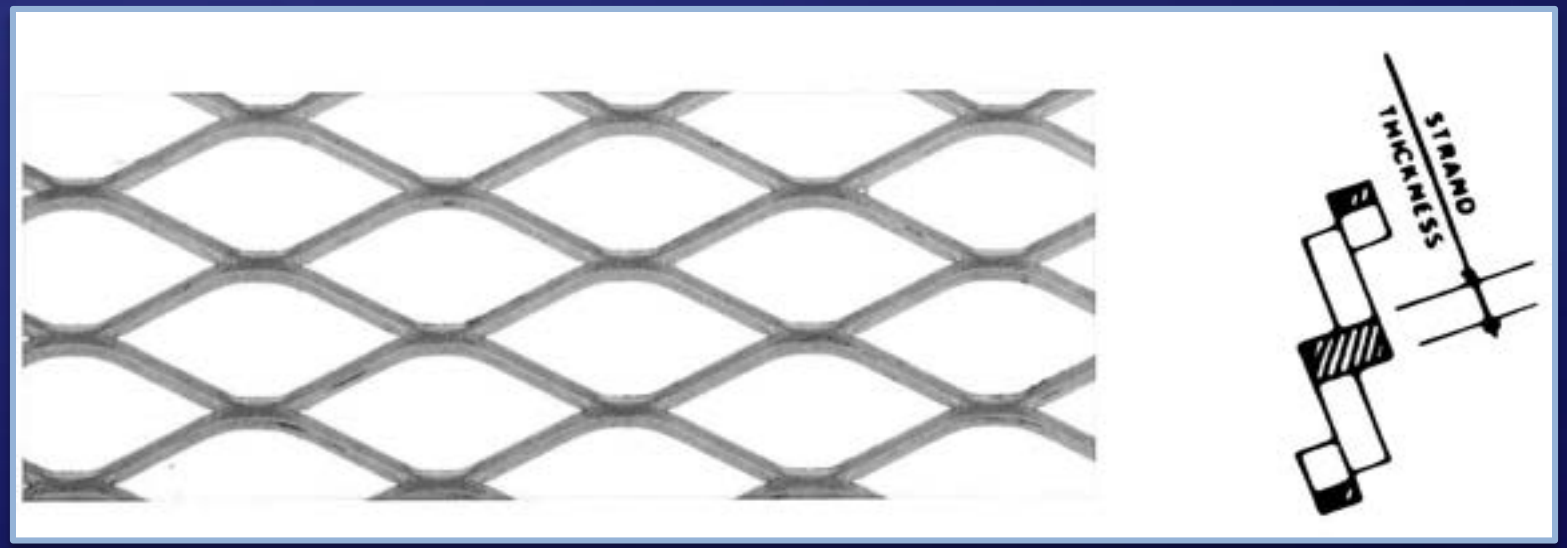
3 Press opens, indexes and . . .

4 . . . die descends, completing.

5 Press opens, and above steps are repeated continuously.

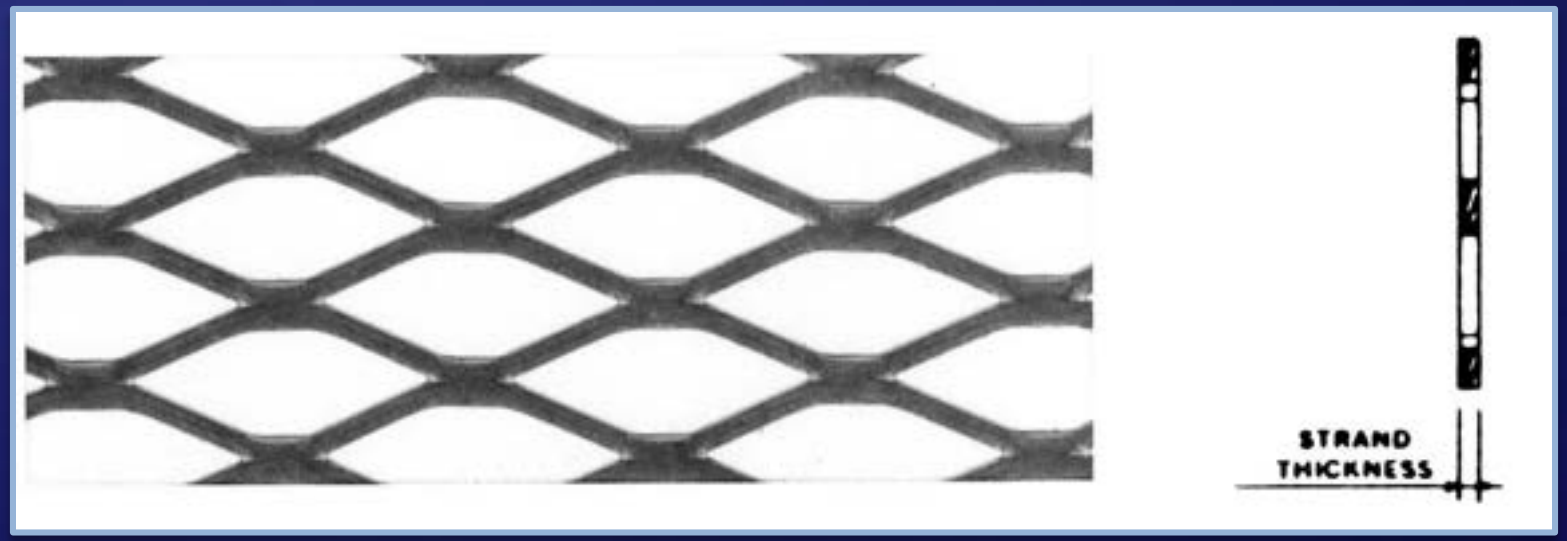
Styles of Expanded Metal

Standard or Raised – All expanded metal is produced in a raised form off the expanded metal press. The strands and bonds are set at a uniform angle to the plane of the sheet. This results in a three-dimensional surface that provides added strength and rigidity, enables angled deflection of light or air, and offers a slip resistant surface.



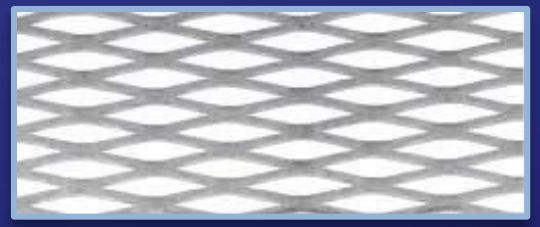
Styles of Expanded Metal

Flattened – Is manufactured by processing standard (raised) expanded metal in a rolling mill. The rolling process flattens the raised product removing the three-dimensional characteristics and reduces the thickness of the original base metal. This process also increases the strand width.



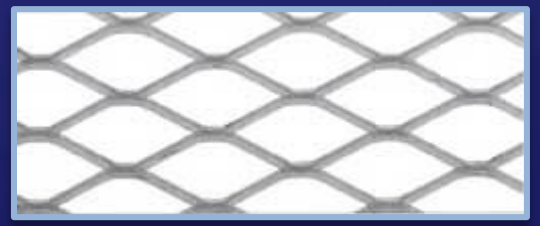
Basic Types of Expanded Metal

Conventional Expanded Metal Patterns – Openings are measured by the short way of the diamond (SWD) and generally range from 1/4” to 2” SWD and are produced in base metals from 20 GA up to 6 GA. These are standard products which are covered by EMMA 557 and ASTM 1267 specifications.



1/4 inch

3/4 inch

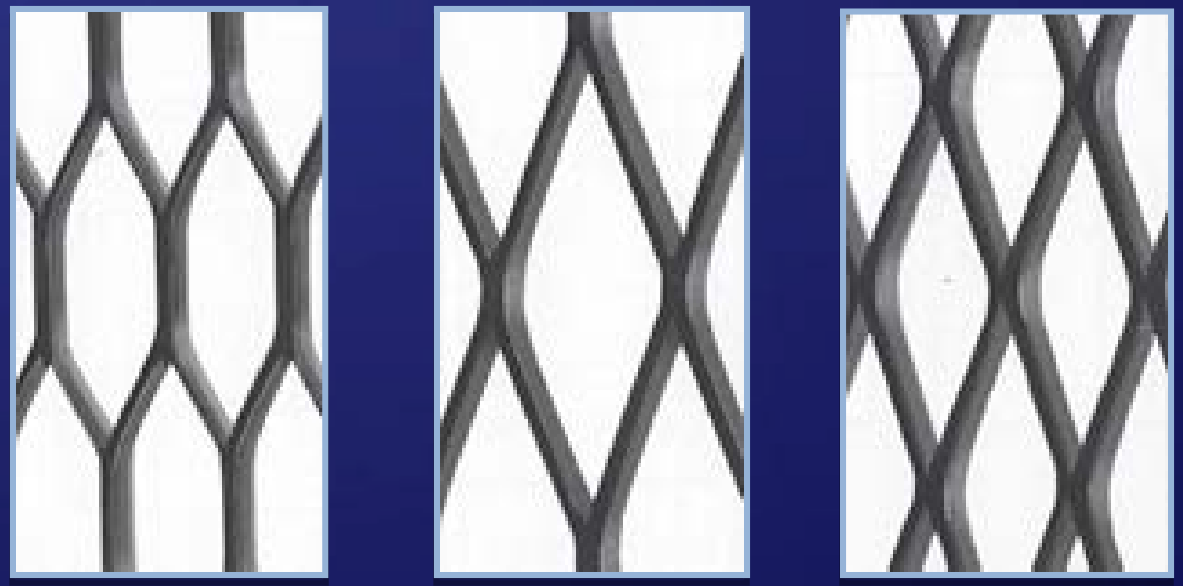


1/2 inch

1-1/2 inch

Basic Types of Expanded Metal

Grating – Expanded metal that is produced from heavier plate (10GA up to .312”); usually low carbon steel or aluminum with larger diamonds. It is typically used for walkways and platforms. Grating is not supplied as flattened product, only raised.

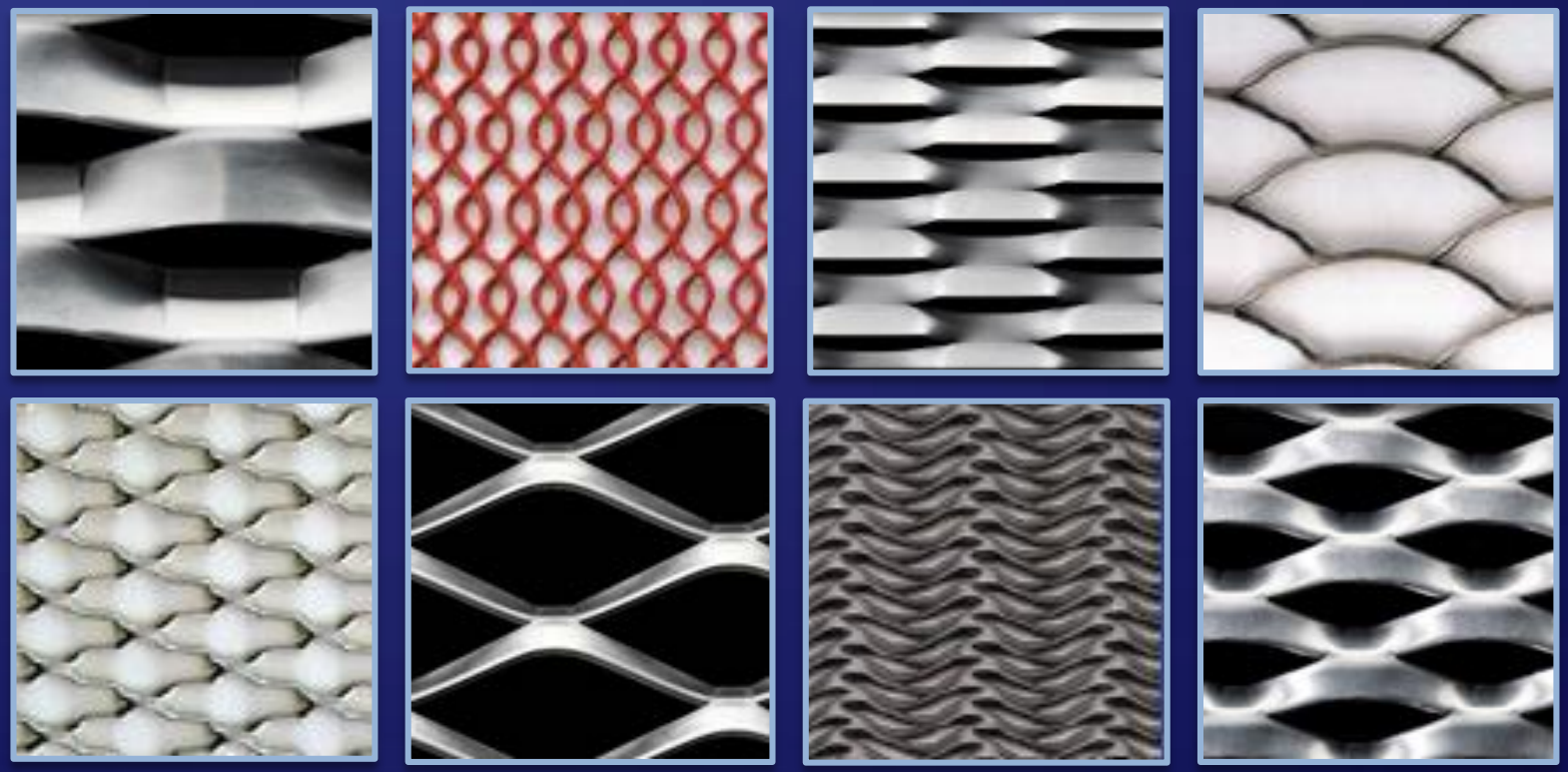


Basic Types of Expanded Metal

Decorative Meshes – Expanded metal manufactured with smaller diamond sizes or unique shaped openings. See manufacturers for many other styles and custom designs.

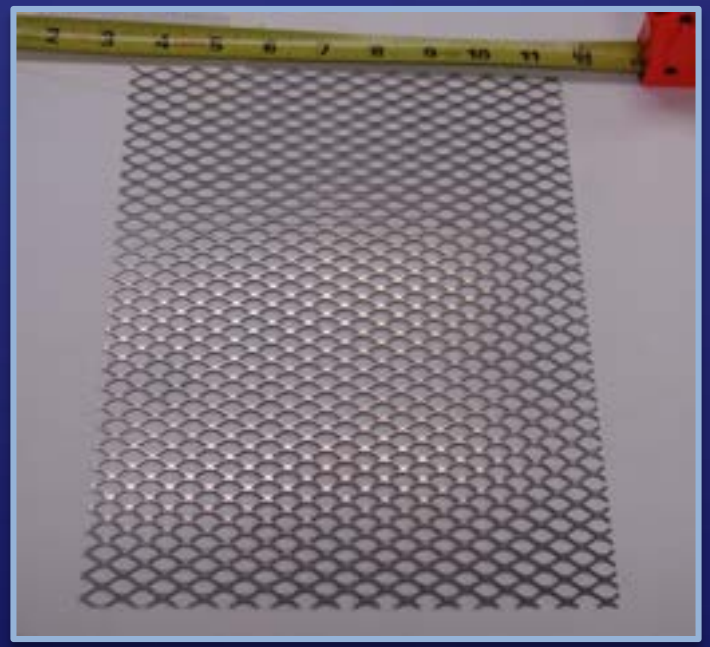
Basic Types of Expanded Metal

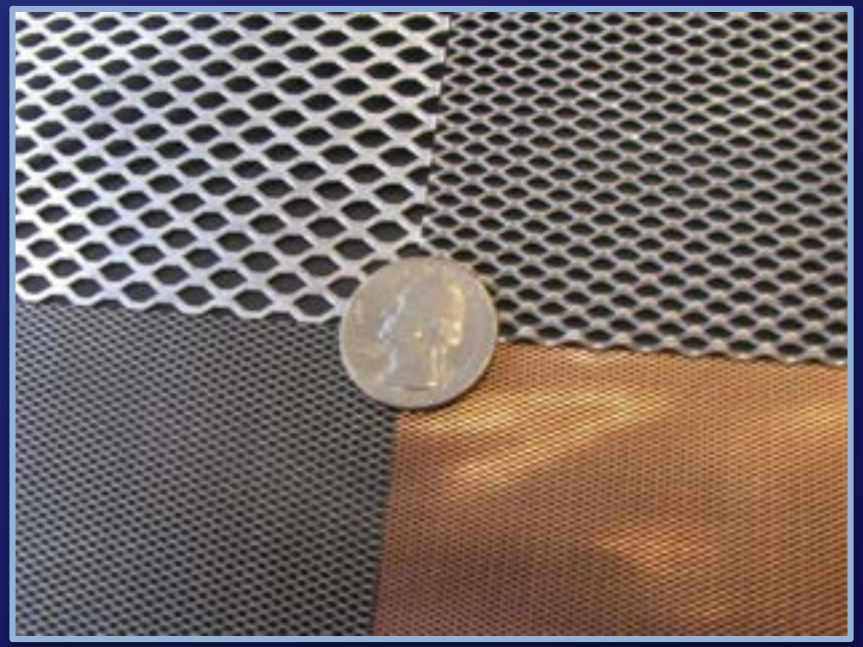
Architectural Meshes – Manufactured with unique shaped openings which possess great appeal for architects and designers.



Basic Types of Expanded Metal

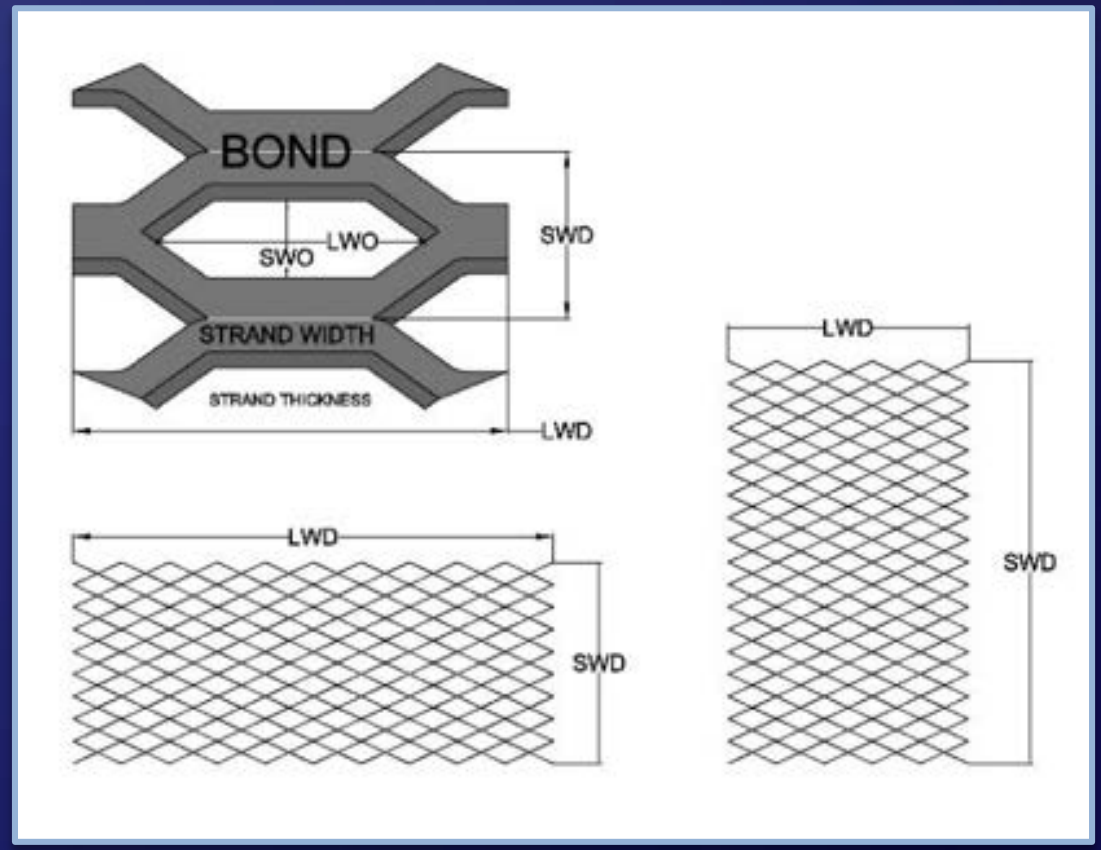
Fine Mesh – A precise, miniature version of conventional expanded metal that can be manufactured from a wide range of metals. These can be produced flattened and raised and can be supplied as both coils or sheets.





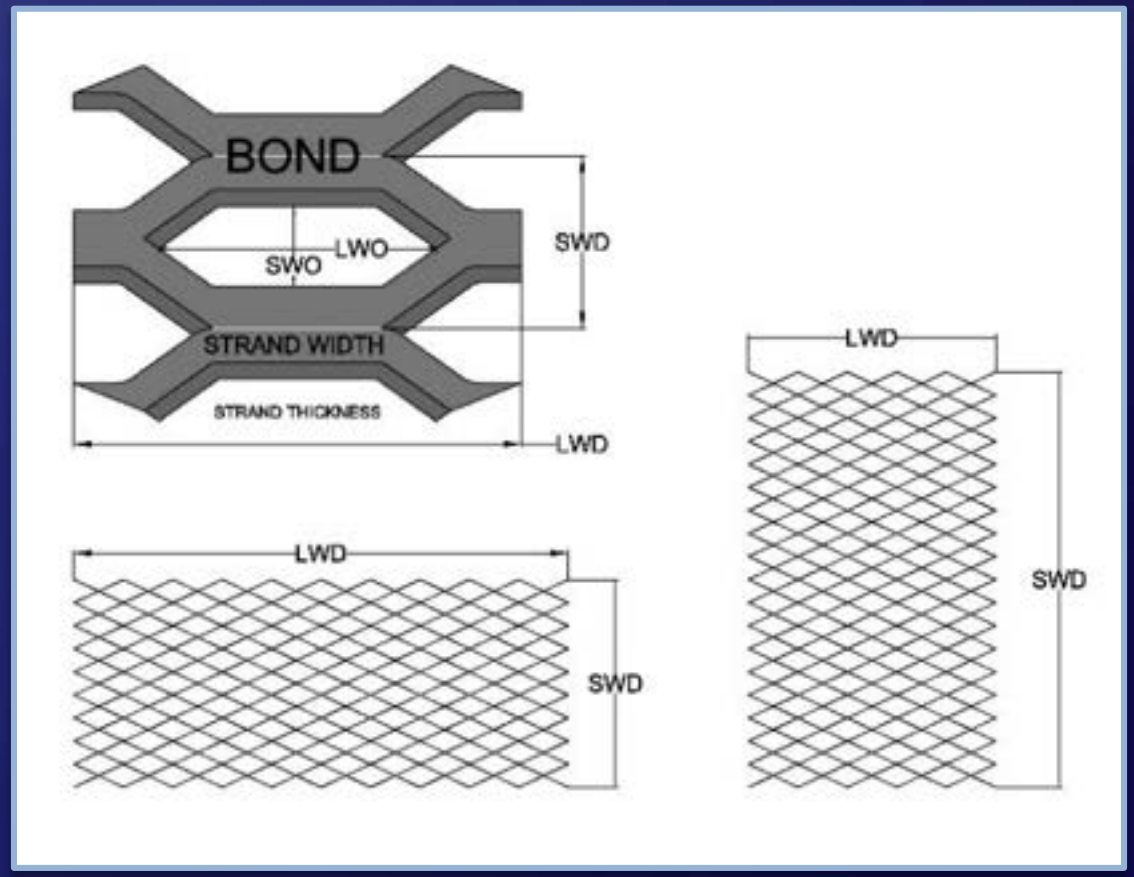
Design Designations

- **Strands** – The sides of the expanded metal openings.
- **Strand Thickness** – Thickness of the base material from which the sheet was produced.
- **Strand Width** – Amount of metal fed under dies to produce one strand.
- **Strand Thickness and Width** – Can be varied to create different openings and to increase or decrease open area. The width of the strand should be equal to or greater than the thickness of the base metal.



Design Designations

- **SWD** – Nominal dimension, Short Way of Diamond.
- **LWD** – Nominal dimension, Long Way of Diamond.
- **Design Size** – Actual dimension SWD and LWD. Measured from a point to a corresponding point on the adjacent diamond.
- **SWO** – Short Way of Opening.
- **LWO** – Long Way of Opening.
- **Bond** – Where two strands intersect; equal to 2 X the strand width.



Pattern Designations

- A combination of numbers, letters, and abbreviations used to designate pattern specifications:
  - The first number indicates nominal pattern dimension, short way of the diamond (SWD).
  - The second number completes the designation and refers to the thickness of the base metal.
  - Finally, the abbreviations S (Standard) or F (Flattened) are required to indicate whether the material is Standard (Raised) or Flattened.
    - e.g. 1/2“ #16 S; 3/4“ #9 S; 3/4“ #13 F.
- Aluminum and most other non-ferrous metals are specified similarly except the decimal thickness and alloy are specified:
    - e.g. 1/2”.080 AL3003 H14 F; 3/4“ .125 AL3003 H14 S.
- Stainless Steel should be specified showing the alloy:
    - e.g. 1/2” #16 304 S, 304L S, 316 S, etc.

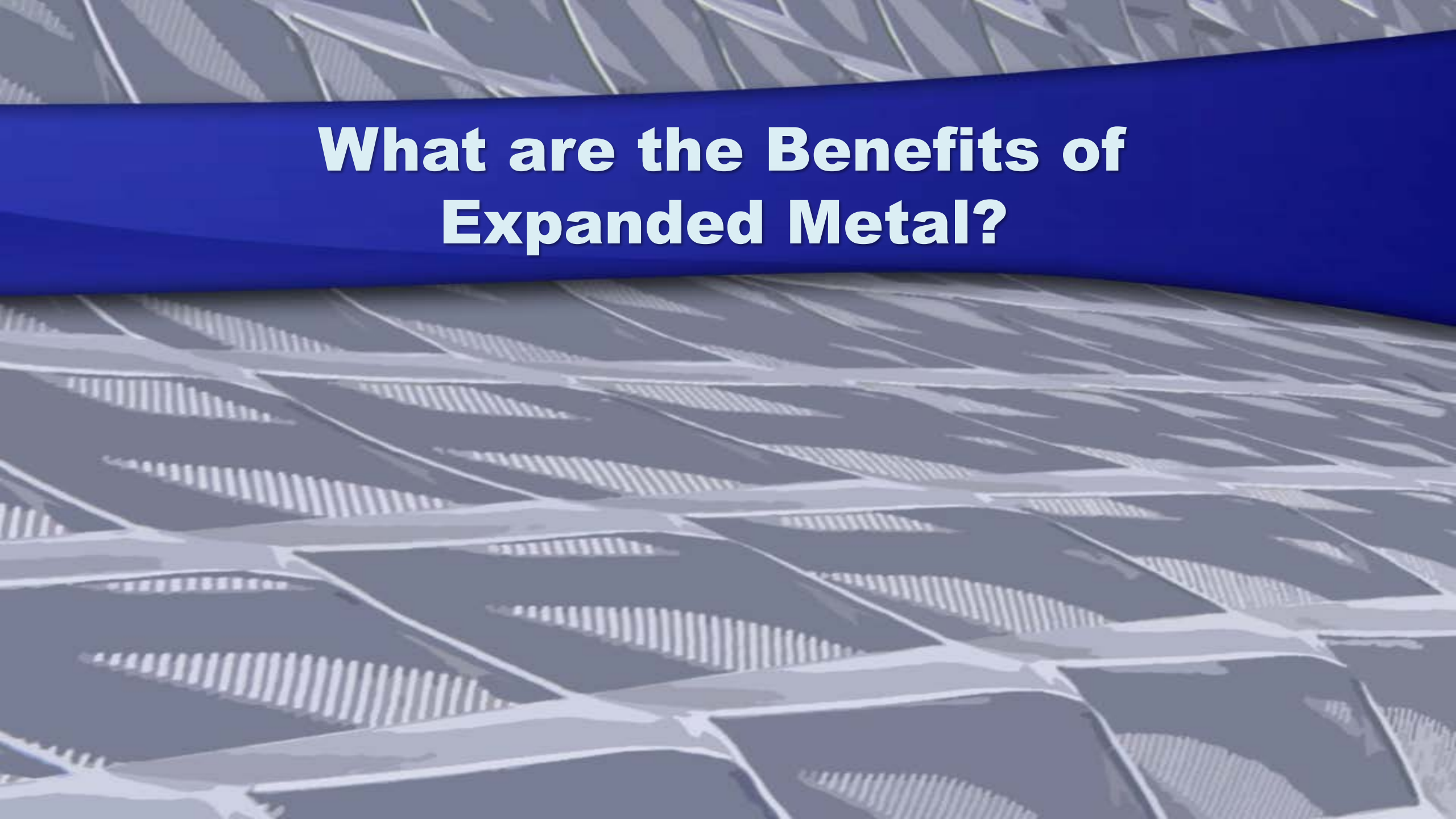
Material Suitable for Expanding

- Carbon Steel
- Aluminum
- Stainless Steel
- Galvanized
- Copper
- Brass
- Titanium
- Weathering Steel
- Platinum
- Zinc
- Nickel
- Silver
- Gold

Finishes

A variety of finishes can be specified for expanded metal, similar to other architectural metal surfaces. Some finishes can be accomplished at producing plants and others can be arranged with outside resources. These include hot-dip galvanizing, pre-galvanizing, anodizing, enameling, powder coating, painting, plastic coating, etc.

What are the Benefits of Expanded Metal?

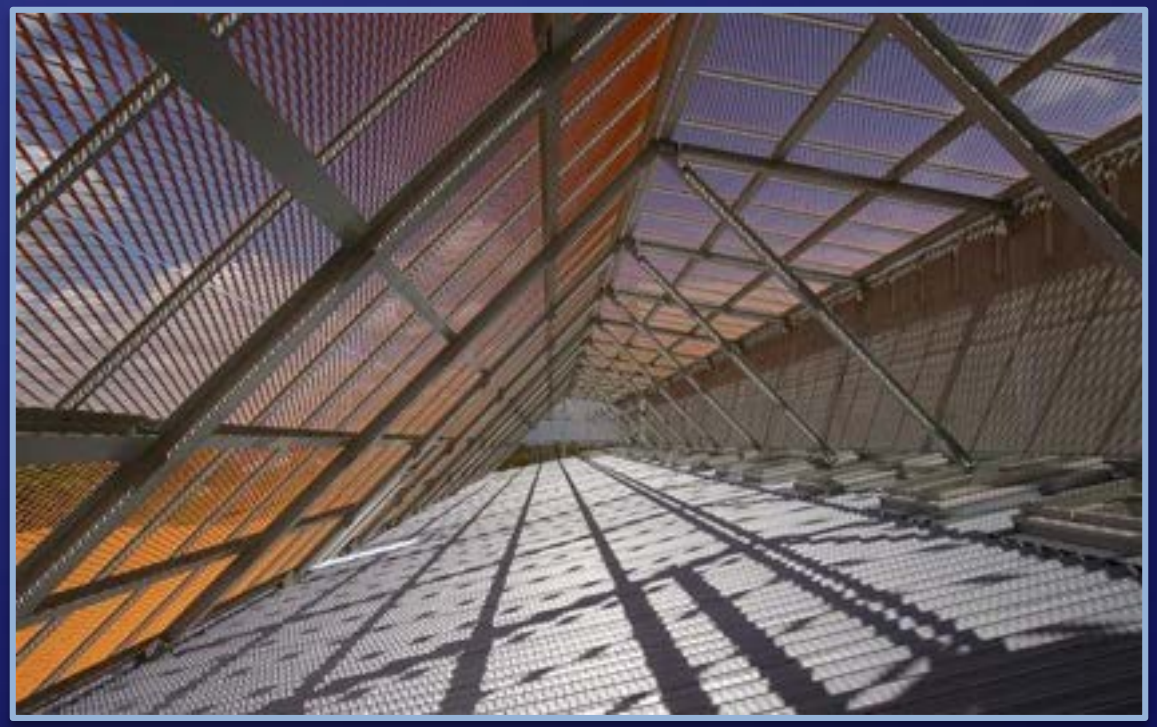


The “Flow” of Light and Air

- By its very nature, expanded metal has a percentage of “open area.” This amount or percentage can be modified to accommodate the architect or designer’s specific needs.
- By changing the pattern sizes or strand width, you can control the percent of open area thereby increasing or decreasing the flow of air or light to you project’s exact needs.
- Additionally, the flow of natural light can be further controlled by the orientation or pitch of the pattern (diamond opening).

The “Flow” of Light and Air

With a raised (standard) pattern, the uniform angles of the strands and bonds act as facets, which reflect or enhance lighting. Expanded metal has become popular among lighting designers particularly as of late because of this unique characteristic.



Design Customization

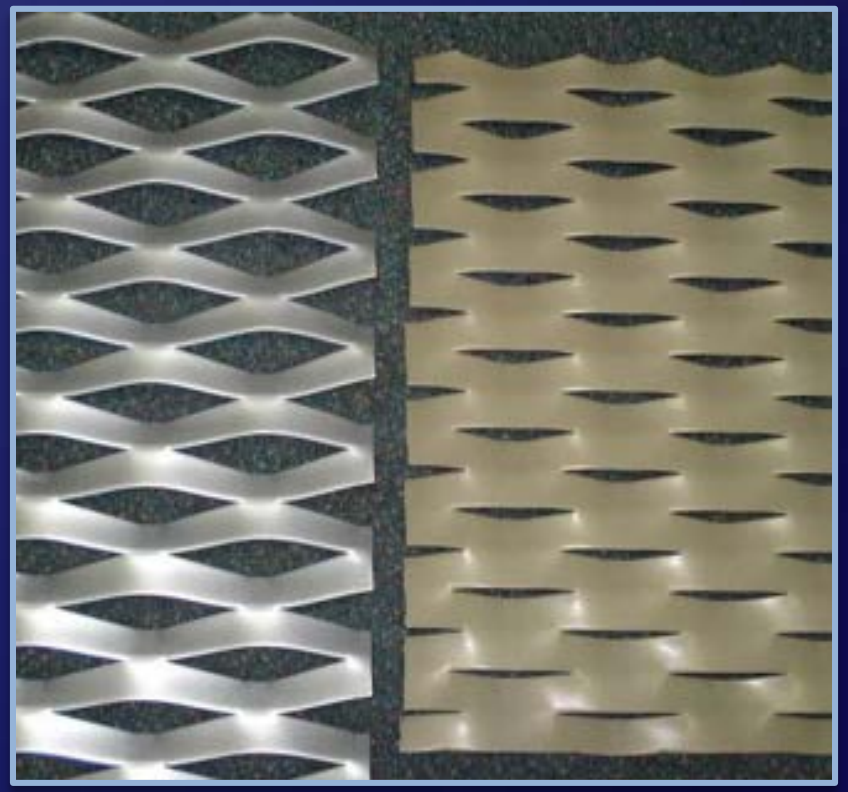
Expanded metal may be designed according to a particular style or design. The degree of angles and different types of slits, stretches, placement, indentions, etc. may vary project to project according to a designer's preference.

EMMA Sunshade Study Results

- EMMA commissioned a study in April 2015 to test the effectiveness of mounting expanded metal on the exterior of a building as a sunshade.
- The results indicated that not only is expanded metal an effective sunshade it helps reduce solar heat gain as well.
- The test reports are available for further review on the NAAMM website.

Design Flexibility

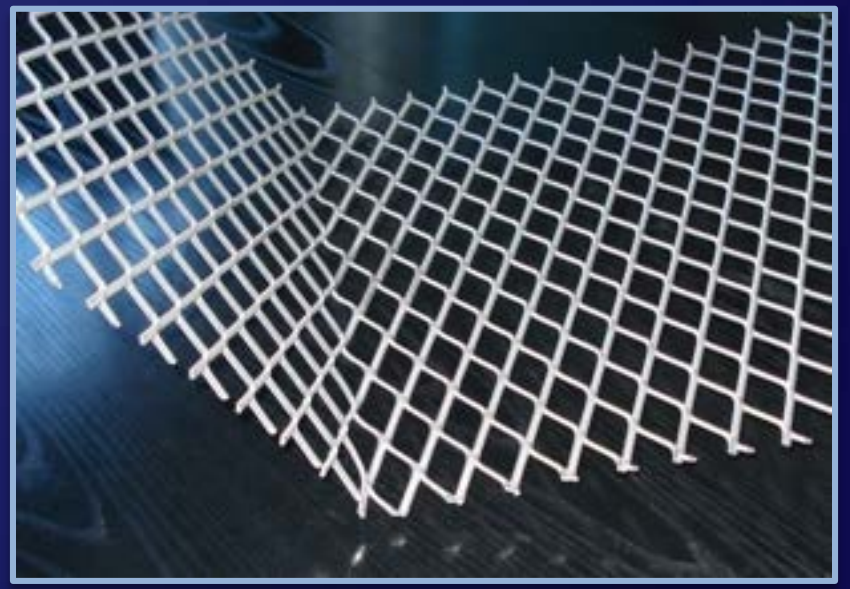
- Architects enjoy the limitless design flexibility of expanded metal to obtain their desired look.
- For example, these parts were run with the same tooling but when you change the depth of cut it completely changes the appearance of the design.



Strength and Formability

- Expanded metal sheets are slit and stretched into a rigid, non-raveling continuous sheet. The twist of the metal that occurs during the expanding process results in a higher rigidity and strength than the original sheet of raw material. This material can be utilized not just for its aesthetic appeal but also for the structural qualities inherent therein.

- Expanded metal is able to withstand a 90-degree bend with a 1/4 inch inside radius in either direction without fracture.



Durability

Durability can be created by matching suitable raw materials to the environment of the project. Because virtually any malleable metal can be expanded, one need only select the proper raw material for compatibility with the project. Additionally, if needed, proper coating selection can further improve longevity (e.g. galvanized in a coastal location).

Expanded Metal vs Perforated Metal

Expanded Metal

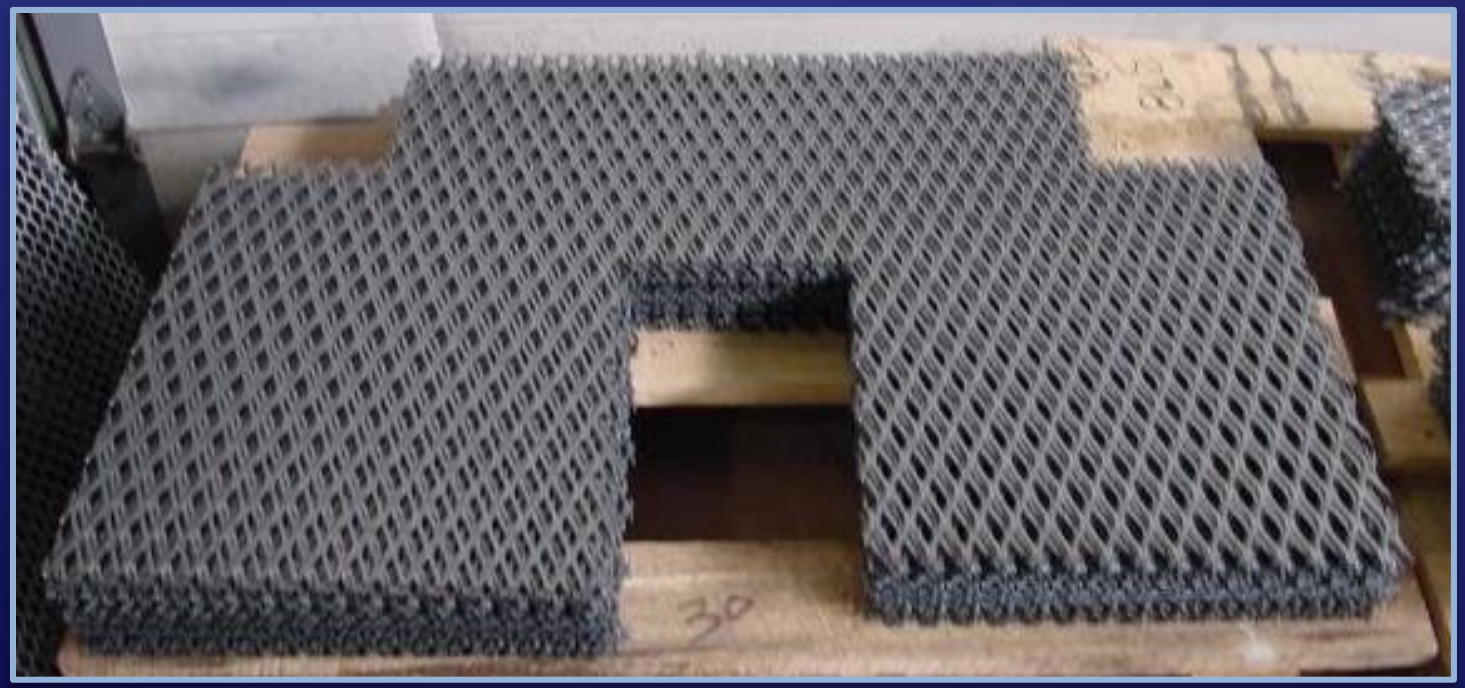
- Provides a 3-to-1 yield and sometimes more *(Example using 3/4” #9 - one 4’ x 8’ raw blank yields three finished 4’ x 8’ sheets).*
- Ease of formability.
- Ease of installation.
- Stronger than perforated metal.

Perforated Metal

- Provides a 1-to-1 yield and for every hole you generate scrap.
- Lack of yield increases your cost.

Cost Effective

- Durable product that has minimal damage in handling and shipping.
- Material can be sheared to size, notched or profile cut at the manufacturing facility just as any other product can be.



Installation & Standards

Installation Methods

- Expanded metal panels can be installed in the same manner as any other sheet metal building product including mechanical fasteners and welding.
- Design Considerations: In designing panel sizes, to assure a closed (bonded) edge, it is desirable to specify panel widths that are a function of the LWD diamond size, which changes based on pattern selection (i.e. 48” is equally divided by a 2” LWD diamond). Consult with EMMA member companies for design assistance.
- In fencing applications, panels can be installed similar to chain link or palisade fencing except that they are individual sheets.
- For ceiling tiles, typical drop ceiling panel systems can be used with expanded metal panel inserts. Custom systems can also be used for specialized spacing or sizes. Consult with EMMA member companies for design assistance and pattern selections.

Specifications & Existing Standards

Expanded Metal

- EMMA 557-18
- ASTM F 1267-18

Cold-Rolled

- ASTM A 366 / A 366M, A 611

Hot-Rolled and Hot-Rolled Pickled and Oiled

- ASTM A 1008 / A 1008M, A 1011 / A 1011M

Galvanized Before Expanding or Electro-galvanize

- ASTM A 653 / A 653M, A 879

Hot Dip Galvanized (Post Galvanize Coating)

- ASTM A 123 / A 123M

Specifications & Existing Standards

- Aluminum - Most Common

  ASTM B 209

  Alloys 3003 H14, 5005 H34 and 5052 H32

- Stainless Steels

  ASTM A 666

  Types 304, 304L, 316, 316L

  ASTM A 176

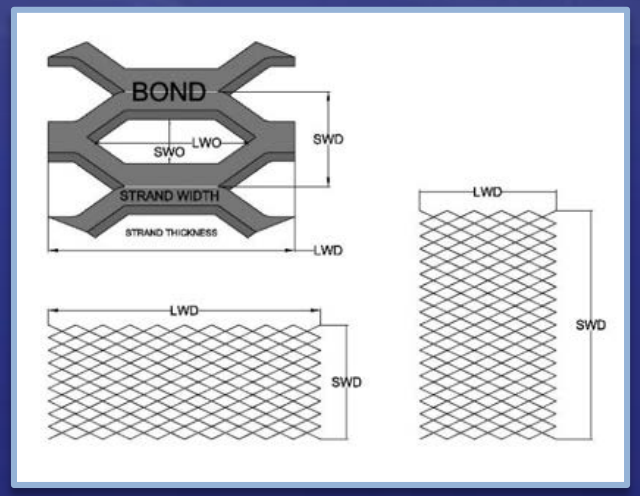
  Most 400 types

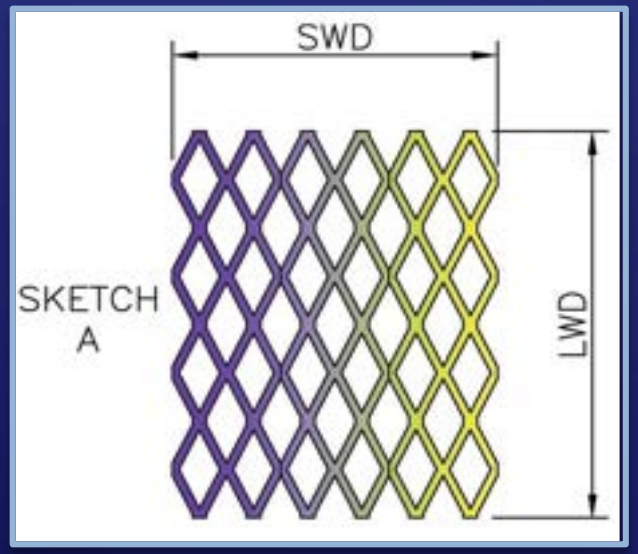
  ASTM A 167

  Type 309 and 310

Manufacturing Tolerance

Expanded Metal Stock Size Sheets





Raised Expanded Metal

SWD (Short Way of Diamond) tolerance is -0”, +1/4” per foot of SWD width (48” could be 49”).
STAINLESS STEEL – SWD tolerance is -0”, +1/2” per foot of SWD (48” could be 50”).
LWD (Long Way of Diamond) tolerance is -0”, +1/4.”
STAINLESS STEEL – LWD tolerance is -0”, +1/2.”

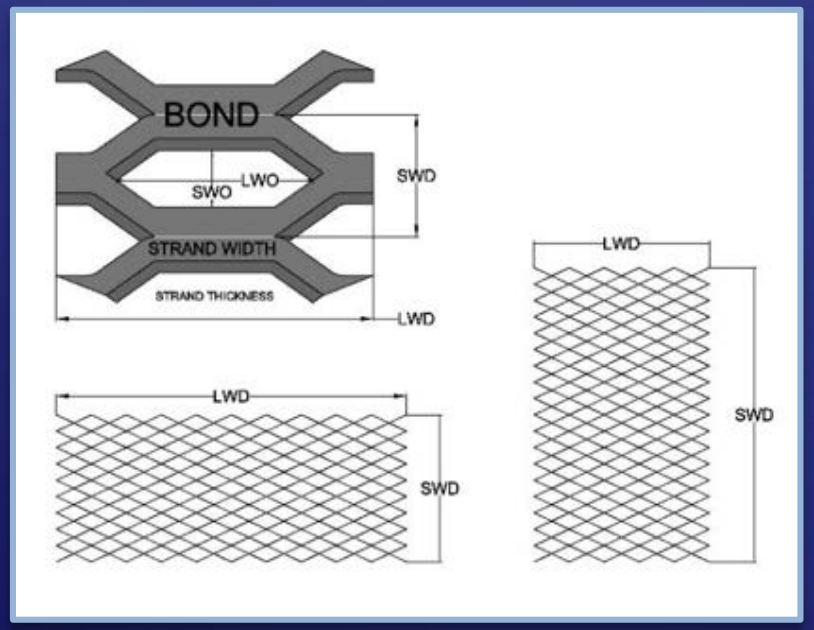
Flattened Expanded Metal

SWD (Short Way of Diamond) tolerance is
-0, +1/4” per foot of SWD width (48” could be 49”).
STAINLESS STEEL – SWD tolerance is -0”, +1/2” per foot of SWD (48” could be 50”).
LWD (Long Way of Diamond – All Alloys) tolerance is -0”, +1/4” per foot of length .
(Example: 96” could be 98”).

All stock or machine run to size sheets shall have closed diamonds all sides.

Manufacturing Tolerance

Expanded Metal Walkway Grating Stock Size Sheets



Raised Expanded Metal Walkway Grating

SWD (Short Way of Diamond) tolerance is -0”, +1/4” per foot of SWD width (48” could be 49”).

STAINLESS STEEL – SWD tolerance is -0”, +1/2” per foot of SWD width (48” could be 50”).

LWD (Long Way of Diamond) tolerance is -0”, +1/2.”

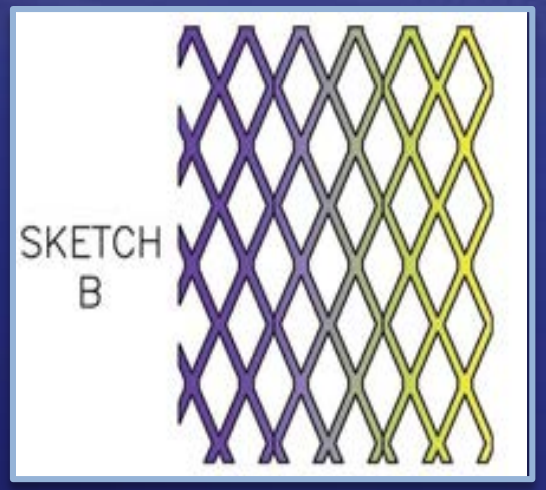
Flattened Expanded Metal Walkway Grating

Consult with the Manufacturer as this is generally not available from producers due to manufacturing limitations.

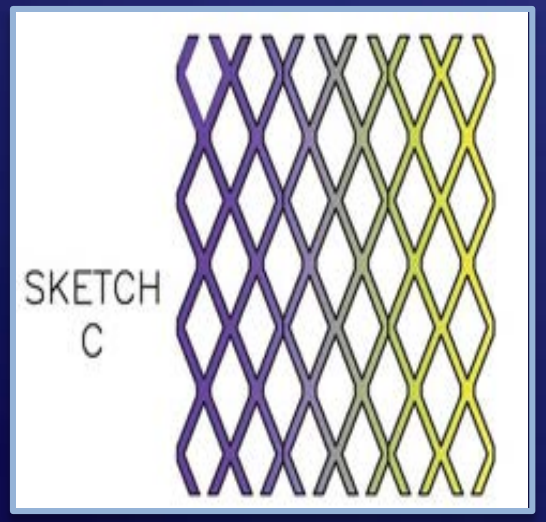
All stock or machine run to size sheets shall have closed diamonds all sides.

Manufacturing Tolerance

Shearing Options and Tolerances for Expanded Metal Sheets - Raised, Flattened, and Grating



Sheared One Side & One End:
Expanded Metal – Tolerance ± 1/4”.
Expanded Metal Walkway Grating – Tolerance ± 1/2”.
Open diamonds will occur on the random sheared sides.



Sheared Both LWD Ends:
Expanded Metal – Tolerance ± 1/8”.
Expanded Metal Walkway Grating – Tolerance ± 1/4”.
Open diamonds will occur on the random sheared ends.

Manufacturing Tolerance

Shearing Options and Tolerances for Expanded Metal Sheets - Raised, Flattened, and Grating

Random Sheared All 4 Sides:
Expanded Metal – Tolerance ± 1/8”.
Expanded Metal Walkway Grating – Tolerance ± 1/4”.
Open diamonds will occur on all random sheared sides.

Random Shear Both SWD Sides:
Expanded Metal – SWD sheared Tolerance ± 1/8”.
LWD end tolerances ± 1/2 diamond size.
Expanded Metal Walkway Grating – Tolerance ± 1/4”.
Open diamonds will occur on the random sheared sides.

Manufacturing Tolerance

Camber, Squareness & Flatness Tolerances for Expanded Metal Raised & Flattened Sheets & Walkway Grating

- **Camber** – Is measured by placing a straight edge parallel to the LWD touching both ends of the sheet. The maximum distance from the straight line shall not exceed 3/32” per foot of dimension.
- **Taper (Raised Sheets) –** Edges shall not deviate from parallel by more than 1/16” per foot of dimension, or 1/4” maximum overall.
- **Taper (flattened Sheets) –** Edges shall not deviate from parallel by more that 1/8” per foot of dimension, or 3/8” maximum overall.
- **Squareness (Expanded Metal) –** Ends shall not be more than 1/8” per foot or 1/2” maximum out of square.
- **Squareness (Walkway Grating) –** Ends shall not be more than 1/8” per foot or 1” maximum out of square.
- **Flatness** (Levelness) – Sheets shall be free from waves or buckles that are in excess of 1-1/2” from a plane surface.

Note - Custom tolerances are available; consult with manufacturer.

Sustainability

Expanded Metal Sustainable Features

Production and Life Cycle

- Product can be specified for both pre and post consumer content in a variety of metal types.
- Little scrap created in production compared to other meshes.
- EMMA traceability standards make third party material ingredients and sourcing possible when required.
- Product is easily recyclable after use.
- Regional producers.

Design and Function

- Metal finished with powered-coated, plated, or anodized processes is an inherently non-emitting source.
- Reduced cooling costs when expanded metal used as sun shade.
- Allows natural light in (depending upon orientation of sheets).

Material Tracking and Reporting

Certificate of Compliance

- This certificate can be requested on material that is on order or material that has shipped. Purchase order or invoice number must be given when you request this certificate.
- Certificate will include:
  1. Quantity and type of material purchased.
  2. EMMA material standard met.

Material Testing Report

- This report must be requested on the purchase order.
- Report will include the heat number showing the chemistry of the raw material used to manufacture the product.

LEED Credit Contributions

- Products can contribute to LEED V4.
  - **Material and Resources Credits**
    - Building Product Disclosure and Optimization- Sourcing Raw Materials.
  - **Indoor Environmental Quality Credits**
    - Low-Emitting Materials – Ceilings, Wall Panels, Floors, and Furniture.
    - Daylight.
    - Acoustic Performance.

Applications & Case Studies

Applications

Sun Shades

Applications

Ceilings and Roofs

Interior and Exterior

Applications

Railing Infill Panels

Applications

Gates and Barriers

Fences and Guards

Applications

Walkways

Gabion Walls

Other Applications

- Decorative panels
- Room portions
- Air and fluid filters
- EMI/RFI shielding
- Battery cells
- Ventilation systems
- Strainers
- Satellite and radar antennas
- Partitions
- Outdoor furniture
- Speaker grills
- Machine and window guard
- Security walls, ceilings and floors
- Fencing
- Shelving and racks
- Concrete reinforcement
- Containers
- Greenhouse benches

Case Study: BBVA STADIUM Monterrey, Mexico

- Designed by multinational architecture firm Populous with the Mexican firm VFO.
- The football stadium to received LEED Silver certification.
- Expanded metal mesh in 75 feet tall sheets was selected as a crowd control barrier around the entire perimeter of the stadium. The designers needed a rigid mesh with a high open area (70%) that could be supplied as one continuous sheet.

Case Study: BBVA STADIUM Monterrey, Mexico

- Expanded metal was also chosen for the mesh ceiling panels above the walkways throughout the interior of the stadium.

- Expanded metal provided the desired aesthetic while concealing electrical conduit, air conditioning ducts, etc., without restricting airflow.

Case Study: BBVA STADIUM Monterrey, Mexico

- Expanded metal was again utilized throughout the stadium for a variety of additional functional, visual and decorative purposes.

Case Study: St. Barnabas Medical

- A parking structure with an expanded metal panel facade creates a functional, modern solution that fit with the rest of a hospital campus.

- For a more dramatic visual effect than narrow strands, the expanded metal panels have a custom wide strand 5-inch pattern.

Case Study: St. Barnabas Medical

- The wavy appearance was created using expanded metal panels, custom sub-framing, brackets, and frames.
- The 1/8-inch expanded aluminum panels are 60 inches wide by 64 inches high. At eaves, panel widths were fixed, but lengths varied.
- The project was completed in 2017.

Case Study: New Musem

- The New Museum opened in 2007.
- An aluminum mesh skin was required to clad the seven-story building with aesthetic and structural considerations.
- Architects had design for strong winds and ice loading.
- To meet warranty, the aluminum mesh was anodized. Prior to anodizing, the mesh was polished to minimize dulling.
- The specialized material was traced throughout the manufacturing process.

Case Study: Bert Ogden Arena. Edinburg, Texas

- The Bert Ogden Arena is a 9,000-seat multievent venue located in the Rio Grande Valley of Texas.
- Expanded metal with a 3” x 8” diamond was selected for the façade above the main entrance to the facility for both esthetics and functionality.
- The expanded metal panels created an angular profile to the project and allowed for visual screening

Course Summary

Now the designer will be able to:

- **Explain** what expanded metal is and how it is manufactured, including various materials, designs, and applications
- **Recall** standards put forth by the Expanded Metal Manufacturers Association regarding specifications and manufacturing tolerances so that expanded metal is installed properly and safely
- **Illustrate** how expanded metal is a sustainable material that can be used to apply for LEED credits for recyclable material and local resources
- **Apply** new knowledge to specify and install expanded metal according to EMMA standards so that new expanded metal applications are safe and accessible for future occupants

Standards for Expanded Metal

Selection, Manufacture & Application

Course Sponsor

Expanded Metal Manufacturers Association, a division of NAAMM (National Association of Architectural Metal Manufacturers)

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An AIA Continuing Education Program

Credit for this course is 1 AIA HSW CE Hour

COURSE NUMBER

EMM05B