ATSM-1250: ARCHITECTURAL SHEET METAL ASM

Cuyahoga Community College

Viewing: ATSM-1250 : Architectural Sheet Metal ASM

Board of Trustees:
March 2020

Academic Term:
Spring 2020

Subject Code
ATSM - Applied Ind Tech- Sheetmetal

Course Number:
1250

Title:
Architectural Sheet Metal ASM

Catalog Description:
Covers the function and forms of architectural sheet metal including consequences resulting from expansion and contraction on various metals, methods of maintaining moisture control and procedures employed to counter environmental effects on structures. Also includes fabrication and application techniques used to install architectural sheet metal using flashings, laps, seams and different sealants.

Credit Hour(s):
6

Lecture Hour(s):
6

Requisites

Prerequisite and Corequisite
Departmental approval: admission to Sheet Metal Worker's apprenticeship program.

Outcomes

Course Outcome(s):
Discuss the primary function and forms Architectural Sheet Metal (ASM) and identify the metals used and respective properties and characteristic of sheet metal

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):
1. List and define the terms related to ASM.
2. Discuss the history of ASM from past to present.
3. Identify the metals used for architectural form
4. List and explain the properties and characteristics of the metals.
5. Discuss the various metal gauges and describe the uses for each.
6. Discuss the safety concerns for working with ASM including electrical, Personal protective equipment (PPE), fall protection, and the use of hand and power tools.

Course Outcome(s):
Discuss the importance of moisture control and expansion and contraction properties including absorption and ice dams and thermal expansion with respective to resulting damage.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Explain how gravity through proper sloping and channeling expels water and maintains the life and beauty of the structure.
2. Explain how water adhesion of various ASM metals affects water shedding.
3. Explain the function of capillary action and describe the relationship to wind, absorption, and seam/laps.
4. Describe the creation of ice damming on a roof and explain the methods used to counter its effects.
5. Discuss the principles of differential pressure and explain the respective effects including climate, relative humidity, water vapor, and moisture flow.
6. Discuss the properties of expansion and contraction including the coefficients of thermal expansion of various metals.
7. Explain the causes and effects of thermal movement.

Course Outcome(s):

Discuss the various sealants including soldering used in the architectural sheet metal industry, identify respective types and function and demonstrate application ability.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. List and describe the different sealants used in architectural sheet metal.
2. Discuss the characteristics of sealants and explain the function and application of each.
3. Prepare the base material with proper cleaning procedures with respect to manufactures recommendation.
4. Explain the importance of solder applications to seal joints and fabrications
5. Differentiate between sealant and fastening.
6. List and explain the various types of solder with respective to base material
7. Explain the importance of proper flux/acid and solder selection with respect to different base metal types.
8. Demonstrate the ability to safely apply sealants and solder, including tool selection and technique, to architectural sheet metal.

Course Outcome(s):

Discuss the importance of proper flashing installed on roofing and wall panels used to address the vulnerabilities of slopes, corners, and penetration and describe the control of moisture and movement of materials.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Describe the importance of flashing with respect to a building's waterproofing system.
2. List and define the terms related to sheet metal flashing.
3. List the different types of flashing used in the sheet metal industry.
4. Discuss the effects of the environment on structures with respect to roofs, curbs, coping, and penetrations.
5. Explain how the movement of installed flashing and moisture is accommodated.
6. List criteria use for selecting flashing.

Course Outcome(s):

Demonstrate the ability to properly select and install flashings on different structures.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Recognize the structural architectural design and select the flashing type needed for expansion and moisture control.
2. List the tools and equipment required for proper flashing installation.

3. Calculate the material requirements including flashings, hardware, and fasteners.
4. Fabricate the selected flashings to accommodate the design to include angles, stiffeners, and radius,
5. Identify and apply OSHA standards for installation in high work areas.
6. Install flashings using compatible materials and proper lapping and seaming techniques.
7. Apply proper sealants to maintain moisture control and material and structural movement.

Course Outcome(s):

Discuss the different types of laps and seams, fasteners and joinery, tools—hand and power and layout techniques including independent measurement, distances and curves used in the architectural sheet metal fabrication industry.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. **Identify the common lap and butt seams used and describe the purpose and strength of each.**
2. **Explain how properly fabricated laps and seams weatherproof and accommodate thermal movement.**
3. **Describe the basic form of fasteners and joinery commonly used and identify appropriate application and accepted techniques of each.**
4. **Demonstrate ability to safely use and operate hand and power tools including proper use of aviation snips for circle cutting and notching.**
5. **Determine and calculate independent measurements required for field and shop installations including distance, areas, triangles, and curves.**

Methods of Evaluation:

1. Test
2. Quizzes
3. Class participation
4. Shop projects

Course Content Outline:

1. Functions, Forms, and Metals
    a. Terminology
        i. Coefficient
        ii. Flashing
        iii. Expansion
        iv. Solder
        v. Cupola
        vi. Finial
        vii. Galvanized
        viii. Electrolysis
        ix. Coatings
        x. Alloy
        xi. Sealant
        xii. Dome
        xiii. Adhesion
        xiv. Water shed
        xv. Oil canning
        xvi. Expansion joint
        xvii. Fasteners
    b. History
        i. Past
            1. Stonehenge
            2. Egyptian
            3. Babylon
            4. Roman
        ii. Present

1. 18th century
2. Industrial revolution
3. Modern
    a. Skyscraper
    b. Museums
    c. Universities

c. Metals
    i. Copper
    ii. Galvanized
    iii. Lead
    iv. Nickle
    v. Stainless
    vi. Cadmium
    vii. Zinc
    viii. Gold
    ix. Silver
    x. Mild steel

d. Properties and characteristics
    i. Property
        1. Hardness
        2. Density
        3. Coatings
        4. Heat treatment
        5. Alloy
    ii. Characteristics
        1. Strength
        2. Corrosion resistance
        3. Expansion
        4. Property of variables
        5. Polymers
        6. Anneal

e. Metal gauges
    i. Weight
    ii. Thickness
    iii. Formability

f. Safety
    i. Electrical
        1. Hazards
        2. Conductivity
        3. Grounding
        4. Lock-out/tag-out
    ii. P.P.E
        1. Gloves
        2. Lanyard
        3. Eye protection
        4. Hearing protection
        5. Knee
    iii. Fall protection
        1. Guard rail
        2. Nets
        3. Hole covers
        4. Personal fall arrest system
        5. Controlled access
        6. Warning line
    iv. Hand and power tools

2. Moisture control, expansion and contraction

a. Gravity
    i. Sloping
        1. Low
        2. Medium
        3. Steep
    ii. Water shed
    iii. Channeling
        1. Direct water flow
        2. Metal shape
b. Adhesion
    i. Surface metal
    ii. Attraction
    iii. Movement
c. Capillary action
    i. Wicking
    ii. Environmental
    iii. Metals
    iv. Effects
        1. Leaks
        2. Material deterioration
    v. Prevention
        1. Sealants
        2. laps
        3. Joint design
d. Ice dam
    i. Creation
        1. Climate
        2. Wind
        3. Rain
        4. Ice
        5. Temperature
    ii. Control
        1. Temperature equalization
        2. Membranes
e. Differential pressure
    i. Properties
        1. Relative humidity
        2. Condensation
    ii. Vapor
        1. Pressure
        2. Moisture flow
f. Expansion and contraction
    i. Thermal movement
    ii. Coefficients
        1. Thermal expansion
        2. Metals
    iii. Specific materials
        1. Non metals
        2. Flashing
    iv. Solar factor
        1. Building direction (lay out)
        2. Color
        3. Coating
g. Thermal movement
    i. Causes
        1. Seismic activity
        2. Imposed load
        3. Settlement
        4. Gauge
    ii. Effects

1. Oil canning
2. Cracking
3. Joint failure
4. Buckling
5. Structural damage
6. Structural integrity

3. Sealants and Soldering
   a. Types
      i. Silicone
      ii. Liquid polymer
      iii. Polyisobutylene—Butyl rubber
      iv. Non- drying butyl
      v. Synthetic resin
   b. Characteristics
      i. Advantages
         1. Silicone and liquid polymer
            a. Application ease
            b. Temperature range
            c. Flexibility
         2. Polyisobutylene—Butyl rubber
            a. Synthetic
            b. Flexible
            c. Climate tolerant
            d. Pliability
         3. Non-drying butyl
            a. Synthetic
            b. Highly elastic
            c. Water proof
            d. Adhesive
         4. Synthetic resin
            a. Water tight
            b. Elastic
            c. Ultra violet exposure tolerant
      ii. Disadvantages
         1. Non-paintable silicone and liquid polymer factor
         2. Polyisobutylene—Butyl rubber melting factor
         3. Cost
         4. Application difficulty
   c. Material preparation
      i. Cleaning procedures
         1. Chemical
         2. Moisture free
         3. Rust removal
         4. Prime
      ii. Storage
      iii. Manufacturer specification
   d. Solder applications
      i. Joint sealing
      ii. Fabrications
      iii. Importance
         1. Sealer vs. fastener
         2. Solder ability /primary metals
      iv. Selection
      v. Material selection
      vi. Tools
         1. Iron
         2. Hot box
   e. Sealant vs. fasteners

i. Sealant
    1. Water proofing
    2. Air seal
    3. Constant state
    4. Non-load bearing
ii. Fasteners
    1. Material joining
    2. Weld
    3. Nuts, bolts, screws
    4. Load bearing

f. Solder types
i. 50/50
    1. Tin and lead
    2. Flow-ability
    3. Melting point: 420 degrees F
    4. User friendly
ii. 60/40
    1. 60% tin/stronger
    2. Lower melting point
    3. Application
        a. Low slope
        b. Flow-ability
iii. 40/60
    1. Strength
    2. High melting point
iv. 95/5
    1. 95% tin/high melting point
    2. Antimony
    3. Application
        a. Tanks
        b. Vessels

g. Flux/acid
i. Types
    1. Corrosive—copper, stainless
    2. Non-corrosive—copper, stainless
    3. Muriatic acid—galvanized, copper, stainless
    4. Zinc chloride—brass, copper, lead, stainless, tin plate, galvanized, turn plate
    5. Ammonium chloride—brass, copper, lead, stainless, tin plate, galvanized, turn plate

h. Application
i. Tool selection
    1. Portable
    2. Electrical
    3. Site location
    4. Iron
ii. Technique
    1. Material selection
    2. High slope
    3. Solder matrix
    4. Vertical
    5. Horizontal
    6. Sweat
    7. Cap soldering
    8. Heat application
    9. Joint cleaning
        a. Before
        b. After
    10. Joint cooling
    11. Travel speed

4. Flashing

a. Waterproofing systems
    i. Roof
        1. Ridge
        2. Valley
        3. Hip
    ii. Penetration
        1. Vents
        2. Heat, ventilation, and air conditioning (HVAC) system
        3. Chimney, saddle, and cricket
        4. Skylights
        5. Plumbing
        6. Electrical
b. Terminology
    i. Flashing
    ii. Curb
    iii. Seams
    iv. Gravity
    v. Moisture control
    vi. Capillary action
    vii. Penetration
    viii. Ridge, hip, and valley
    ix. Thermal movement
    x. Counter flashing
    xi. Saddle
    xii. Cricket
c. Types
    i. Valley
    ii. Ridge
    iii. Exposed
    iv. Concealed
    v. Roof to wall
    vi. Counter
    vii. Base
    viii. Chimney
    ix. Saddle
    x. Roof penetration
    xi. Curb
    xii. Through wall
    xiii. Dormer
    xiv. Shingle
d. Environmental effects
    i. Wind
    ii. Rain
    iii. Snow
    iv. Ice
    v. Heat
e. Structural movement/expansion
    i. Flashing hardware
    ii. Sealants
    iii. Flashing
    iv. Expansion joints
    v. Counter flashing
f. Flashing selection
    i. Structural materials
    ii. Environmental
    iii. Geographic
    iv. Architectural
5. Flashing installation

a. Selection
    i. Architectural design
    ii. Engineering
    iii. Penetration
        1. Roof to wall
        2. Wall
        3. Mechanical
b. Tools and equipment
    i. Tools
        1. Hand
            a. Snips
            b. Hammer
            c. Measuring
            d. Plier
            e. Clamp
            f. Tong
            g. Level
            h. Pop rivet gun
        2. Power
            a. Nailer
            b. Drill motor
            c. Seamer
            d. Grinder
            e. Double cut
            f. Saw
            g. Impact wrench
            h. Uni shear
            i. Nibbler
    ii. Equipment
        1. Crane
        2. Man life
        3. Fall protection
        4. Spot welder
        5. Compressor
        6. Shear
        7. Brake
        8. Drill press
c. Material calculation
    i. Material type
    ii. Gage
    iii. Line length
    iv. Perimeter
    v. Yield
    vi. Angle
d. Flashing fabrication
    i. Handling
    ii. Bend allowance
    iii. Lengths
    iv. Hole punch
    v. Layout
    vi. Order of operation
    vii. Procedures
        1. Layout
        2. Handling
        3. Notching
        4. Forming
        5. Assembly
e. OSHA standards

i. Fall protection
ii. Tool handling
iii. P.P.E.
iv. Crane signaling
v. Hoisting and rigging
vi. Aerial lift

f. Material compatibility
i. Corrosion
ii. Electrolysis
iii. Galvanic reaction

g. Sealant
i. Selection
ii. Compatibility
iii. Function
iv. Technique
1. Bead width
2. Material preparation
3. Manufacturer specification
4. Environmental conditions
5. Angle of application
6. Application speed
7. Coving

6. Seams, fasteners, tools and layout
a. Laps and butt seams
i. Types
1. Laps
a. Typical
b. Joggle
c. Soldered
d. Riveted
2. Butt seams
a. Back up plate
b. Fasten/loose
c. Cover plate
d. Cover plate with back up plate

ii. Purpose
1. Moisture control
2. Air infiltration
3. Expansion and contraction
4. Aesthetics

iii. Strength
1. Wind control
2. Expansion and contraction
3. Weather proofing

b. Laps and seams: weatherproofing and thermal movement
i. Weatherproof
1. Lap design
2. Sealant

c. Thermal movement
i. Seam design
ii. Clips
iii. Expansion/contraction allowance

d. Fasteners and Joinery
i. Types
1. Screws
2. Rivets
3. Power activated
4. Expansion anchors
5. Adhesives

- ii. Joinery
  1. Laps
  2. Locks
  3. Seams
- iii. Application
  1. Time allowance
  2. Appearance
  3. Accessibility
  4. Load factors

e. Hand and Power tools
- i. Safety
  1. Personal protective equipment (PPE)
  2. Electrical concerns
  3. Training
- ii. Hand tools
  1. Selection
     a. Layout and measurement
     b. Fabrication
     c. Cutting
  2. Aviation snips
     a. Cut direction
     b. Material thickness
     c. Curve or straight line
     d. Double cut
     e. Type
- iii. Power tools
  1. Drill motor
  2. Unishear
  3. Double cut
  4. Seamer
  5. Spot welder
  6. Reciprocating saw
  7. Band saw
- iv. Application
  1. Circle cutting
     a. Direction
     b. Tool selection
  2. Notching
     a. Size
     b. Pattern forming
  3. Cornice work

f. Independent measurement
- i. Installations
  1. Component size
  2. Fit
  3. Appearance
  4. Material estimating
  5. Alignment
- ii. Distances
  1. Lengths and runs
  2. Offset measurement
  3. Centerlines
- iii. Area
  1. Square footage
  2. Stretch out measurement
  3. Pattern
- iv. Curves

1. Diameter
2. Radii
3. Arcs

v. Triangles
1. Patterns
2. Flashings
3. Pythagorean theorem
4. Triangulation
5. Parallel line development

Resources

SMACNA. *Architectural Sheet Metal*. 6th. SMACNA, Chantilly, Va., 2003. 2004.

ASM. *International Training Institute for Sheet Metal and A/C Industry*. First. SMACNA, Alexandria, Va., 2006. 2006.

Grand Valley State University,. *Pioneer Construction*. current. Progressive AE, Grand Rapids, Mi., 2006.

Resources Other

www.sheetmetal-iti.org (http://www.sheetmetal-iti.org)
www.smacna.org (http://www.smacna.org)

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