All About

FABRIC AWNINGS

A guide for architects, design professionals, and city officials.

PROFESSIONAL AWNING MANUFACTURERS ASSOCIATION

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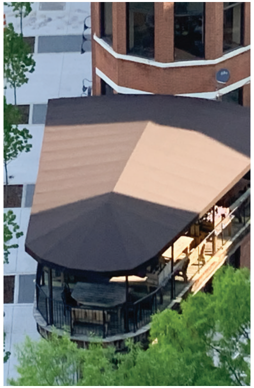


Brief Summary of Building Codes as They Relate to Awnings and Canopies

International Code Council (ICC) is a non-profit organization dedicated to developing a single set of comprehensive and coordinated model construction codes. ICC publications relating to the awning industry are the International Building Code (IBC), International Residential Code for one-and-two-family Dwellings (IRC), and International Fire Code (IFC). These codes address the allowable construction materials, structural system, location and fire resistance of awnings. Each city, county and state adopt and enforce these codes to regulate the built environment.

Awning

An architectural fabric projection that provides weather protection, identity or decoration and is wholly supported by the building to which it is attached. An awning is comprised of a lightweight, frame structure over which a cover is attached.

Canopy

An architectural projection that provides weather protection, identity or decoration and is supported by the building to which it is attached and at the outer end by not less than one stanchion. A canopy is comprised of a lightweight frame structure over which a cover is attached.

Retractable Awning

A moveable awning that rolls or folds against a building or other structure by which it is entirely supported.

Shade Sail

A tension structure design with large spans and double curvature and no center support. A shade sail is often utilized in dynamic designs or to provide a cool, comfortable environment.

General Design Considerations

Major Elements of Awning-system Design

- Purpose
- Style, Configuration, Color
- Size and Fit
- Economy
- Safety: Egress and Fire
- Stability
- Strength
- Anchorage
- Drainage
- Graphics
- Fixed vs. Moveable

Purpose

An awning and canopy purpose would satisfy any one or all the following functional objectives: energy savings; weather protection (sun, rain, snow, sleet, hail, wind), identification, or aesthetics (architecture).

Standard Awning Designs

Style, Configuration, Color

Most awnings and canopies consist of fabric stretched over and secured to a fixed metal frame by laces or screws.. These frames may be welded, bolted or otherwise connected. Other awnings and canopies that consist of individual fabric panels can be attached using the staple-in method. Still other awnings and canopies consist of rollers and lateral arms that can be retracted manually or automatically. It should be noted, however, that the possible combinations of styles, configurations and colors are limitless.

PAMA has adopted standard names for awning and canopy styles, which are shown below with the representative designs.

Size and Fit

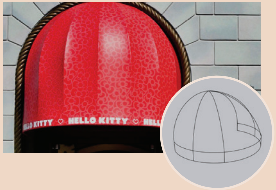
The size of an awning is determined by its length, width and projection from the building to which it is attached. Other aspects of size include clear height (underneath), rise (pitch) of roof and post or rafter spacing. These features are usually important to those involved in the planning and review process.

The fit of an awning is determined by the interfacing of its frame with other connecting structures (most often a building, but frequently the ground or a concrete slab on the ground). In the case of a building, it is important to coordinate the appropriate parts of the awning frame with structural members in the building so that loads are transmitted properly.

Standard Awnings Shapes

Concave

Dome



Elongated Dome

Lateral/Arm Retractable

Quarter Round/Convex

Rounded Entrance Canopy

Traditional

Economy

The economy most directly affects customers and awning contractors. It is clear that an awning system should not have to meet the same code requirements as a high-rise building. However, in most cases, a code does strictly apply. In rare cases when it is not expressly required, there is still a moral and legal obligation to install an awning that can withstand any foreseeable loads.

To develop an economical awning system, the designer must understand how to arrange, size and connect structural members so that the foreseeable loads will be transmitted to its supports while incorporating safety factors, without over- engineering the system.

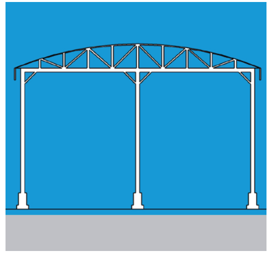
The awning industry and building and code officials should develop a working relationship to better understand each other's needs. In addition, the industry members' active involvement in implementing code changes is very important. The objectives should be to ensure public safety and to avoid needless, expensive over-design. Sound economical design does not necessarily result in the lowest first cost.

Safety: Egress and Fire

Except in rare cases, this is not a significant issue with modern awning and canopy systems. In most cases, frame materials are non-combustible, and fabrics are flame-retardant. However, this point should be ascertained whenever appropriate, such as for enclosed walkway canopies and enclosed patio canopies.

The answer is not necessarily to require fire doors and sprinklers for these systems. But the building official does have the right (indeed the obligation) to design systems that provide an open, safe and quick exit to the outside.

Stability

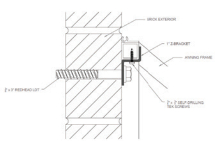


The average designer may have a concept of how beams and posts work structurally. But to design a safe structure, one must fully understand stability issues. A structure comprised of simple beams mounted on the top of simple posts is inherently unstable. This means that the structure is susceptible to falling down because of the number, arrangement and method of connection of the members.

Common post and beam structures, such as pole barns, are rendered stable by the addition of siding, roofing, "X"-bracing and fixed cantilevered footings.

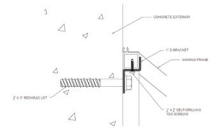
Fabric has no in-plane stiffness; therefore, it does not replace, in an awning or canopy, the function that siding or roofing performs as in a pole barn. This in-plane stiffness, which is instrumental to the development of stability, can usually be supplied by triangulation of structural members.

Examples of triangulation are demonstrated as follows: The important lesson to learn here is that substituting larger beams or posts for smaller ones doesn't solve the problem of instability.



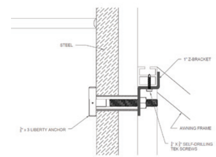
Attachments

This involves the location, style and strength of connections from the awning or canopy to the building or to its foundations. Proper design of this element assumes a recognition of the amount of force occurring, and the direction in which this force acts, at the connection at the time that the maximum design load occurs on the frame. Most common types of attachments involve bolt-through, expansion anchors, wood lag screws and adhesive anchors.



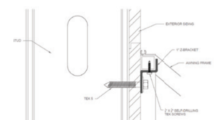
Bolt-through

Bolt-through connections are preferable, when they are feasible, because the bolt and the nut are manufactured to controlled specifications, and there is a wealth of data on the strength provided by such a connection. Such connections are not generally subject to site questions that are often associated with other types.



Expansion Anchors

Expansion anchors are used to fasten awnings to concrete surfaces. They develop their essential strength by pressing hard against the side of the drilled hole in which they are set. This pressure results in high frictional resistance to pull-out. While these kinds of anchors have been in successful use for a long time and may be well-manufactured, their use requires more good judgment than the use of a simple bolt-through solution. Obviously, when fastening surfaces, expansion anchors may be the only practical choice.



Wood Lag Screws

Wood lag screws are tapered to a point and do not utilize nuts. These are not as sound as bolt-through connections because they are subject to pulling out as the wood surrounding their threads crumbles or chips. Their strength, then, is proportional to the hardness of the wood in which they are embedded. In many awning applications that require fastening to wood framing, bolt-through connections are not possible and wood lag screws may be the best available option.

Adhesive Anchors

Adhesive anchors have been made available in recent years to provide the awning installer a way to address field situations in which the preceding anchor types are not suitable. Examples of such conditions are veneer brick surfaces and fasteners located close to comers, where the high pressures associated with expansion anchors will raise the risk of being pulled out. Adhesive anchors are bonded directly to the substrate by filling an oversized drilled hole, which contains the threaded fastener, with an epoxy adhesive. This system does not rely on pressure. A certain amount of cure time may be required before the anchor can be loaded.

When anchoring awnings and canopies, the awning contractor is often attaching to existing structures (building's wall, roof, foundations, slab, etc.). Responsibilities for assuring that these structures are safe for the additional loads imposed on them must be properly coordinated. Proper anchorage is the single most important structural quality of an awning design.

Strength

After a stable configuration has been established for an awning design frame, members should be chosen for a strength consistent with the amount and type of stress imposed on them. The most common types of stress are tension, compression, bending and shear.

A common misconception about awnings is that they are safe as long as they don't fall down. All code and engineering standards have long required that a safe design use members that are 1 .67 to 2 times stronger than the yield strength required to satisfy the actual design stress. The yield strength is the strength at which the material no longer fully recovers to its original shape when the load is removed; the yield strength is usually significantly lower than the ultimate strength. Thus, it can be immediately recognized that a "safe" structure is stressed well below its breaking strength when it is exposed to its maximum design load.

Drainage and Ponding

Provisions must be made to drain water off an awning or canopy. Fundamentally, this involves establishing a steep enough pitch, properly spaced bows or rafters, as well as maintaining a taut fabric, so that draining water or melting snow cannot cause the fabric to sag and collect water on the surface. Lack of proper attention to this detail can result in potentially large gravity forces on the frame and anchors.

Graphics

The overall success of a commercial awning may hinge on the design of its graphics.

A variety of methods are used to apply graphics to awnings, painting, cut out lettering, appliqué, heat color transfer, pressure sensitive graphics and eradicating. Local codes and ordinances may dictate the size and other characteristics of this feature.

Frames: Fixed vs. Moveable

Frame systems are recommended by the manufacturer, according to personal preference and regional "norms." Frames are joined by special fittings or welding, according to manufacturer recommendations and regional variations.

A fixed awning's frame cannot be deployed from a stowed position and vice versa. A moveable awning can be stowed against the building to which it is attached. The standard lateral arm and drop arm awnings are examples of moveable awnings.

Benefits of Awnings

Fabric awnings can meet various design needs. Many modern fabrics are long-lasting, bright, easily cleaned, strong and flame-retardant. Modern frame materials offer high strength-to-weight ratios and corrosion resistance. The proper combination of these properties can result in safe, strong, economical and attractive products.

Energy

The Department of Energy findings indicate that exterior awning shade provide up to 90% reduction in solar heat. Awnings provide an effective solution for reducing energy costs. By utilizing PAMA's Energy Savings Calculator users can determine cost savings when applying awnings to residential and commercial buildings.

Visit Textiles.org/Awning to learn more.

Weather Protection

These systems afford protection from the sun, rain, snow, sleet and hail. In certain configurations, they can also protect from wind.

Brand and Advertising

Applying graphics directly to awning fabrics provides identification and/or advertisement without the need for "add-on" sign structures.

Architecture

Creative designers and architects can develop useful and intriguing designs for modern awning and canopy systems that incorporate shape, light, color, texture, graphics and structure, at modest cost. Most awning frames are custom made by cutting, bending and welding metal tubing, and fitting the fabric to the frame. With these custom methods, almost any shape and size can be attained and covered with awning fabric. Hence, the same surface can serve at least three necessary functions: weather protection, identification and architecture.

When looking at fabric versus metal awnings, the benefits of fabric include aesthetics (look/feel, appearance, textures and colors) and sustainability (LEED, green and environmentally friendly). While metal awnings can offer added durability, fabric provides design options and helps to reduce the carbon footprint. For the full fabric vs. metal report visit Textiles.org/Awning.

Design Loads

Loads for which fixed awnings may need to be designed can be categorized as follows:

Dead Load

This is the self-weight of the fixed awning or canopy frame, fabric and hardware. This load must always be included with other design loads since it is always acting on the structure. For instance, if one were designing an awning for 20 psf snow load, and the structure itself weighed 2 psf, then the design for snow should actually account for 22 psf total load.

Wind Load

This load, as well as snow load, are usually the most critical loads on fixed awnings.

- Speed or Velocity

  Basic wind pressure is a function of its speed. Basic wind pressure (psf) can be computed as the product of 0 .00256 times the square of the wind speed (mph). It can be readily observed then, for example, that the wind forces on an awning are four times greater if the wind speed is doubled, and the forces are nine times greater if the wind speed is tripled. Design wind speeds are generally shown on maps published in the building code. Local codes may require higher design wind speeds.

- Exposure

  This is a general category for the amount of protection from the wind that is afforded by the surrounding environment. Consult your local building codes for requirements.

- Gusts

  These are short-term excursions of velocity above the steady design velocity, which must be accounted for in the design.

- Drag, Lift

  Drag is the wind-induced pressure toward the fabric surface, and lift is the pressure away from the fabric surface. Wind forces on an awning system act in different directions (toward or away from the fabric surface depending on a variety of factors). When designing an awning frame, all these factors must be taken into account.

- Return Period

  This term is used to describe the time interval which is the basis for establishing the required design wind speed. For most applications the return period is 50 years. This simply means that the required design wind speed is that which has a 0 .02 statistical prob- ability of occurring once in 50 years. Loss and safety experts have determined that it is an acceptable level of risk and have based code design requirements on it.

Snow Load

Required design snow loads are established by maps published in the building code. As in the case for wind, sometimes local requirements are more stringent. On the other hand, in many localities there is no requirement for snow load design. Check with the local department of building and safety.

- Ground Snow

  The beginning point for snow design, this is the pressure of the designed snow load occur- ring at ground level.

- Exposure

  This is a general category for the amount of protection from the wind that is afforded by the surrounding environment. Consult with your local building codes for requirements.

- Flat Roof Snow Load

  This is the design load occurring at the actual roof level, and results from factoring the ground snow load by a coefficient accounting for exposure and height. Many times, the flat roof snow load can be as little as 0 .6 or 0 .7 times the ground snow load. For example, the snow map or the code may indicate a 20 psf ground snow load; the actual design pressure required for an awning may be as little as 12 psf.

- Drifting

  Building codes require that the phenomenon of drifting snow be accounted for in the design of roofs; this includes awnings and canopies. While it is beyond the scope of this publication to discuss this in detail, the effects of drifting snow can be significant. The codes describe the procedure for designing with snow drifting in mind.

- Return Period

  See discussion under Wind Load.

Live Load

These are loads that are associated with the forces related to human occupants, furniture, equipment, etc. Since these loads are movable, the live load stipulation is an allowance for the most severe anticipated condition or case. Common code requirements for roof live loads are from 12 to 20 psf. Provided that the case of ponding water is properly addressed, live loading is not a practical requirement in the design of awnings. Some codes do not require a live load design, and others greatly reduce the requirement.

Seismic Load

These are loads due to earthquakes or earth tremors. The design process for earthquake loads is also too elaborate to be included in this publication. However, awnings and canopies tend to fare well in earthquakes for the following reasons:

- They are lightweight; lightweight structures do not have a lot of mass; therefore, relatively small seismic forces are likely to be developed. F=ma.

- They are generally small, secondary structures. Compared to the structures to which they are attached, which are subject to significant destructive forces due to their larger mass, these structures are relatively unaffected. F= ma. Although seismic design requirements are not rigorously pressed in geographical areas not significantly affected by earthquakes, most model codes contain the provision in current editions.

Ponding

Addressed elsewhere in this publication, this is a potential load on an awning or canopy and must be addressed in one of several ways:

- Design for ponding must be taken structurally.
- Keeping the fabric properly supported and taut will avoid the problem.
- Remove snow before it melts and ponds water.

Choices Of Materials

The range of modern materials available for awning designers is impressive. The following is a brief overview of the more popular choices for fabric and framing in the industry.

Fabrics

Popular awning fabrics include:

- Acrylic (solution-dyed)
- Polyester (solution-dyed)
- PVC laminated or coated polyester
- PVC coated mesh
- Acrylic coated polyester
- Expanded PTFE
- HDPE

Some of these fabrics are heat-sealable, which results in a water-tight joint (assuming that the fabric itself is water-tight). Other properties of interest to the designer are:

- Colors
- Light transmittance
- Warranty
- Water repellency
- UV resistance
- Graphics acceptance

Framing

- Steel Pipe

  In most cases, primarily designed as a conduit for liquids or gases, pipe is sized by its inside diameter. The size designation is referred to as nominal size. Pipe is characterized as having a relatively thick wall section of mild steel and is available black or hot dip galvanized. It is easily welded, bolted or threaded and is adaptable to many shop environments. It is functional but heavy and not necessarily highly aesthetic. It is easily bent to designer shapes. Most hardware and fittings for use in frame construction are designed to work with Schedule 40 pipe.

- Steel Tubing

  Available in a range of wall thicknesses and shapes including round, square and rectangular as well as various yield strengths. It is easily welded or bolted. The thinner wall section makes threading difficult. It is easily bent to designer shapes. Steel tubing is normally sized in outside measurements.

- Aluminum Pipe

  Manufactured with the same dimensions as steel pipe, it weighs only one-third as much.

- Aluminum Tubing

  This is available in a wide variety of shapes, sizes and tempers, with an array of advantages and disadvantages in comparison to steel. Tubing measurements are described with outside dimensions.

- Staple-on Extrusions

  Aluminum tubing is extruded into cross-sections that are used to connect fabric panels to the face of the tubing. Connections are made stapling the fabric inside a groove that is filled with a pressure-installed weather strip/trim piece.

- Metal Finishing

  All framing can be mill-finish, painted, or powder coated. Finishing improves aesthetics and protects the substrate against corrosion.

Historical Awnings

According to the U.S. Department of the Interior, National Park Service, Heritage Preservation Service, historic photographs from the nineteenth and early twentieth centuries offer ample precedent for the use of awnings on windows, above storefronts and at entrances. Decisions on particular projects must be based on the circumstances of each building, but as a general rule, in restoration projects, awnings are acceptable when the physical evidence or documented research clearly shows they were once on the building and the historic appearance is being accurately restored. In rehabilitation projects, awnings may be acceptable when they do not negatively affect the historic character of the building.

As "Interpreting the Standards Bulletin" No. 86-79 makes clear, awnings can in some cases so impair the historic character of a structure that denial of certification may result. However, historic photographs of streetscapes document a great profusion of awnings. Awnings of many sizes, shapes, patterns and colors ranged from one building to the next. Sometimes more than one appeared on the same building. While careful scrutiny of awnings is justifiably part of the National Park Service review of tax act projects, care must be exercised in this area not to substitute strictly personal preferences for professional evaluations of historic character.

Partnerships

When an awning is needed on a commercial building, it's important to form a partnership with all or some of the following community partners: awning company, city engineer, city officials, architect and others. Awning companies can be seen as the first source of information. They often have information about anchoring guidelines and the cost-efficiency of awnings. It is clear that an awning system should not have to meet the same code requirements as a high-rise building. However, a code does apply. There is a moral and legal obligation to install an awning that can withstand any foreseeable loads.

The architect, engineer and/or city official must understand how to arrange, size and connect structural members so that the foreseeable loads will be transmitted to its supports while incorporating safety factors without over-engineering the system.

The above partners should develop a working relationship to better understand each other's needs. Most awning companies are the experts in fabricating awnings, engineers and code officials are experts in permits, and architects' experts in design. All parties are needed and can assist each other.

ATA | ADVANCED TEXTILES ASSOCIATION

Advanced Textile Association (ATA) is a not-for-profit trade association comprised of member companies representing the international specialty fabrics marketplace. Member companies range in size from one-person shops to multinational corporations. Members' products cover the broad spectrum of specialty fabrics and include fibers, fabrics, end products, equipment and hardware.

ATA | PROFESSIONAL AWNING MANUFACTURERS ASSOCIATION

Professional Awning Manufacturers Association (PAMA) represents companies providing awning and awning-related products and services to end users. It raises awareness of awnings as an image enhancing, energy saving and attractive addition to residential and commercial structures to architects and engineers. PAMA provides a forum to exchange information, solve common problems and develop mutually beneficial relationships.

ATA | ADVANCED TEXTILES ASSOCIATION

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Notice and Disclaimer: The information contained in the All About Fabric Awnings brochure was developed by awning industry professionals. We recommend consulting with all local code officials for any relevant codes and standards that may apply to your local awning design, construction and installation.