

Aluminum Screen Enclosures

Screen enclosures are complex structures and have gained popularity in many parts of the country and coastal areas, such as the Texas Gulf Coast. Several years ago, a wind tunnel investigation was performed on aluminum screen enclosures. The result of this investigation was published in a study titled: “Wind Loads on Screen Enclosures”¹. The investigation also resulted in the inclusion of Table AH107.4(1) into Appendix H of the International Residential Code (IRC). Items addressed in the study include: the screen mesh and the associated drag coefficients, free standing enclosures, and enclosures that are located next to and attached to an enclosed building. The test configurations included monoslope, gable, and hip roofs and structures with solid and screen roofs.

We generally see two types of screen enclosures:

- (1) A screen enclosure that is commonly referred to as a “pool enclosure”. This enclosure is normally used in conjunction with “swimming pools”. It has screen roof and walls and is generally attached to an existing or host structure.
- (2) The other type of screen enclosure that is commonly constructed is one that has a solid monoslope roof (most commonly sandwich panels) and full or partial screen walls and is also attached to an existing or host structure. This type of enclosure is referred to as “patio screen enclosure”. The roof in this type of screen enclosures could also be gable or hip configuration.

The study pointed out that the wind loading on screen enclosures is generated in a somewhat different manner from wind loading developed on buildings with solid surfaces. Wind loads on buildings with solid surfaces are developed by pressures that result from the flow around the structure. For very porous screens, the loads are largely related to the action of wind as it flows through the screen. Therefore, the screen mesh density is very important when determining the design wind loads of these structures.

Table AH107.4(1)

In Appendix H of the 2006 (IRC), Table AH107.4(1) provides load cases, wall and roof requirements, and design pressures based on basic wind speeds and exposure category. The design pressures shown in the table are low in comparison to structures with solid surfaces. The footnotes associated with the table are important and must be applied when using the values provided in the table. Footnotes a, b, and c are more of the informational nature. However, footnotes d, e, and f must be applied to the screen enclosure whether the screen enclosure is a “pool enclosure” or “patio screen enclosure”.

Application of L/W Ratio: L is defined as the dimension parallel to the wind and W is defined as the dimension perpendicular to the wind. It is permissible to interpolate the values in the table for

1. Reinhold, Timothy; Belcher, Joseph; Miller, David; Everley, Charlie, “Wind Loads on Screen Enclosures.”

L/W between 1 and 2 but you should use the values for $L/W = 2$ for any value of L/W greater than 2.

Load Case “A” shall be used for the design of the wall members directly supporting the screen surface perpendicular to the wind. Load Case A is to check the bending and connections of the members in the walls (columns and wall members in the middle of the walls). Purlins and girts may have to be checked for axial buckling depending on the wind direction that is being considered. That is, they would have to be designed for the pressure applied by the wind action on the screen as given in Load Case A. Load Case “A” pressures are applied to the effective area of the member.

Load Case “B” shall be used for the design of the overall structural system to ensure that it has sufficient lateral bracing and that the members can handle the combined load effects from the wind acting on various surfaces. Load Case “B” pressures are applied to the projected frontal area of the enclosure.

Application of Wind Loads

Following is the application of footnotes d, e, and f. The Load Case, Wall, and Design Pressures are taken from Table AH107.4(1) of Appendix H. The Basic Wind Speed is 120 mph, 3-sec gust, with an Exposure Category of C. Please note that “L” shown in Table AH107.4(1) is the dimension parallel to the wind and “W” is the dimension perpendicular to the wind.

Footnote “d” – footnote “d” states: For Load Case “A” *flow thru* condition, the pressure given shall be applied simultaneously to both the upwind (windward) and downwind (leeward) screen walls acting in the same direction as the wind. The structure shall also be analyzed for wind coming from the opposite direction. For *non-flow thru* condition, the screen enclosure wall shall be analyzed for the load applied acting toward the interior of the enclosure. The application of Load Case A is as follows: Three (3) checks must be made:

- 1) The *flow thru* condition wind blowing from North to South; see Figure 1. The table pressure is applied to the North (left side) of the structure. It is also applied to the South (right side) of the structure. The table pressure is determined as follows: from the table, the windward (North) and leeward (South) walls are flow thru and the dimension parallel to the wind is 24 feet and the dimension perpendicular to the wind is 10 feet; thus, the L/W ratio is 2.4 (24/10) and the applicable pressure is 19 psf. As previously indicated, the table pressure is applied to the effective area of the member.
- 2) The *flow thru* condition with the wind blowing from South to North. The table pressure is applied to the South (right side) of the structure. It is also applied to the North (left side) of the structure. The L/W ratio and the applied pressure will be the same as in check 1 above. The table pressure is applied to both walls. As previously indicated, the table pressure is applied to the effective area of the member.
- 3) The *non-flow thru* condition (windward wall non-flow) and the wind blowing from the West, Figure 1. The table pressure is applied to the West (front side) of the structure. The back (rear wall) is *non-flow thru*. In this case, the dimension parallel to the wind is 10 feet and the dimension perpendicular to the wind is 24 feet; thus the L/W ratio is .42 (10/24).

The applicable table pressure in this case is 17 psf. The load is applied acting toward the interior of the enclosure and is applied to the effective area of the members.

Footnote ‘e’– footnote “e” states: For Load Case “B,” the table pressure multiplied by the projected frontal area of the screen enclosure is the total drag force, including drag on screen surfaces parallel to the wind, which must be transmitted to the ground. Use Load Case “A” for members directly supporting the screen surface perpendicular to the wind. Load Case “B” loads shall be applied only to structural members which carry loads from more than one surface.

Three (3) checks must also be made for Load Case “B”. Essentially, the same procedure is followed as with Load Case “A” with the exception that the table pressure and the area used will be different. Referring to Table AH107.4(1), since the example structure does not have a gable roof under the column headed Wall, Windward: Non Gable is chosen and since the Basic Wind Speed is 120 mph and the Exposure Category is “C”, the table pressure is 24 psf. Also, footnote “e” specifies that the frontal projected area of the enclosure is be used.

- 1) The *flow thru* condition and wind blowing from North to South, see Figure 3. The table pressure is applied to the North (left side) of the structure and it is also applied to the South (side) of the structure. The table pressure, 24 psf, is applied to the projected area of 90 square feet and this load transmitted to the foundation and ground. Please note that all members are not subject to carrying this load to the foundation.
- 2) The *flow thru* condition and wind blowing from South to North, see Figure 4. The table pressure is applied to the South (right side) of the structure and it is also applied to the North (side) of the structure. The table pressure, 24 psf, is applied to the projected area of 90 square feet (9’ x 10’). Please note that all members are not subject to carrying this load to the foundation.
- 3) The *non-flow thru* condition and the wind blowing from the West, see Figure 2. The table pressure remains the same but the projected area is calculated to be 216 square feet (24’ x 9’). The table pressure is applied to the projected area (216 sq. ft. x 24 psf). This load must be transmitted to the foundation and the ground.

Footnote ‘f’ – footnote f states: The roof structure shall be analyzed for the pressure given occurring both upward and downward.

Again, referring to Table AH107.4(1), since there is a solid roof and the Basic Wind Speed is 120 mph, Exposure Category “C”, the applicable table pressure is 18 psf. This pressure is to be applied both upward and downward to the roof structure.

Upward Pressure - The upward or uplift pressure on the roof structure will be a factor when determining load imposed on the host structure, the connection of the roof structure to beams and columns, and columns to foundation.

Downward Pressure – The downward pressure is a factor when considering axial bending on columns.



