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Garage Door Design Wind Pressure Determination: Effective Wind Area

Introduction

This Technical Data Sheet provides guidance on how to determine effective wind area for garage doors based on ASCE 7-16 and subsequent editions. It is intended for architects, structural engineers, and others responsible for determining design wind pressure requirements.

Determination of the required design wind pressure on a garage door involves a number of factors, one of which is effective wind area. In general, smaller effective wind areas result in higher design wind pressures, because small, localized wind gusts can be significantly faster than average wind speed.

ASCE 7-16 Definition

The definition of effective wind area is "the area used to determine the external pressure coefficient", which is used in the calculation of design pressure.

Effective Wind Area for Components and Cladding in General

Chapter C26 of ASCE 7-16, the commentary on wind load requirements, describes two cases for effective wind area:

> "In the usual case, the effective wind area does correspond to the area tributary to the force component being considered. For example, for a cladding panel, the effective wind area may be equal to the total area of the panel." *(Note: ASCE 7 considers doors to be a type of cladding.)*

The commentary goes on to explain that the second type of case "arises where components such as roofing panels, wall studs, or roof trusses are spaced closely together". In that type of case:

> "The area served by the component may become long and narrow. To better approximate the actual load distribution in such cases, the width of the effective wind area . . . need not be taken as less than one-third the length of the area. This increase in effective wind area has the effect of reducing the average wind pressure acting on the component."

For an example of this type of case, consider roof trusses 24 ft long and spaced at 2 ft. The total tributary area (the area transferring load to the truss) is 24 x 2 = 48 ft^2. Since a wind gust is unlikely to be shaped so long and narrow, the commentary suggests a more realistic estimate of 24 x (24/3) = 192 ft^2. As noted above, increasing the effective wind area decreases the wind design pressure. Note that the adjustment was accomplished by using a width (24/3) larger than the actual width tributary to the individual roof truss. Note also that this L/3 method is an *optional allowance*, resulting in a lower design pressure, and not a penalty that increases the design pressure. Lastly, note that the allowance is available for components; no cladding application is mentioned.

How to Determine Effective Wind Area for Garage Doors

Prior to 2016, ASCE 7 regarded the effective wind area of garage doors as equal to the area of "each structural component composing the door or window system," in other words, the area of an individual section. Based on evidence presented by DASMA and others, ASCE's Wind Load Subcommittee concluded that this language was not correct, that it penalized garage doors and other products with inflated design pressures. Consequently, this language was revised in the 2016 cycle.

Chapter C26 of ASCE 7-16 omits any specific reference to sectional doors, and addresses windows and doors in general as follows. The same section of ASCE 7-22 is identical:

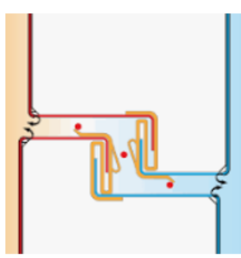
> "For windows, doors, and other fenestration assemblies, the effective wind area for typical single-unit assemblies can be taken as the overall area of the assembly. For assemblies comprised of more than one unit mulled together or for more complex fenestration systems, it is recommended that the fenestration product manufacturer be consulted for guidance on the appropriate effective wind area . . ."

In line with this ASCE 7 commentary, garage door manufacturers agree that the effective wind area of a garage door is ordinarily the overall area of the door.

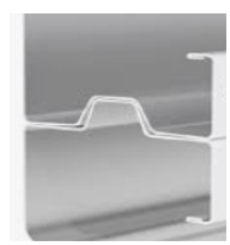
Summary of Reasoning

The reasoning and evidence considered by DASMA and the ASCE Wind Load Subcommittee was based on design knowledge and experience with testing.

1. **Garage Door Design:** Sections reinforce adjacent sections through their interlocking joints, which are shiplap or tongue-in-groove, and through hinges between sections. For sectional garage doors, wind loads are distributed both horizontally and vertically such that the door acts like a one-piece door. Testing confirms that irregular reinforcement (See Photo #1) provides a unified performance under wind load. Sections are differently reinforced but fail together.



Shiplap

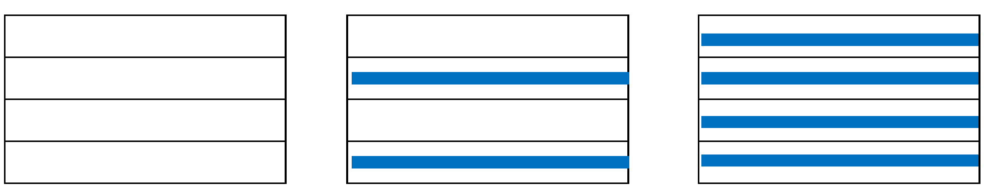


Tongue-in-Groove

Photo #1

2. **Decades of Test Experience**: Over many years of lab testing, DASMA members have consistently witnessed load sharing causing door assemblies to act as a unit. For example, manufacturers have tested:
   a. A door with no struts (Door 1)
   b. An identical door with some of the sections having one strut, the others having no struts (Door 2)
   c. An identical door where every section had a single strut (Door 3)

   Door 2 failed at a pressure in between Doors 1 and 3. If effective wind area were the area of one section, Doors 1 and 2 would have failed at the same pressure.



Door 1 Door 2 Door 3

<u>Extra Large or Specialty Doors</u>

Doors too large to be tested by approved labs according to recognized procedures present a special case. Contact the door manufacturer for effective wind area guidance.