



Research Report

Impact of CC loads due to ASCE/SEI 7-16

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Structural Building Components Association (SBCA)

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This research report is based on practical scientific research (literature review, testing, analysis, etc.). This research report complies with the following sections of the building code:

- [IBC Section 104.11.1](#) and [Section 1703.4.2](#) – "**Research reports.** Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from *approved sources*."
- [IBC Section 202](#) – "**APPROVED SOURCE.** An independent person, firm or corporation, *approved by the building official*, who is competent and experienced in the application of engineering principles to materials, methods or systems analyses."

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Introduction:

ASCE/SEI 7-16 Minimum Design Loads for Buildings and Other Structures has revised Chapter 30 regarding Components & Cladding (C&C) wind loads on roofs. The changes are dramatic and will have an impact on a wide range of roof products/applications (rake connections, roof sheathing suction loads/connections, rafter spans, roof framing capacity, solar panel attachments, etc.).

Unless revised during the code development hearings, the impact on prescriptive code requirements will be felt in the 2018 editions of the International Residential Code (*IRC*) and International Building Code (*IBC*), as well as in product specific referenced documents like American Wood Council's Wood Frame Construction Manual (*WFCM*) and Special Design Provisions for Wind (*SDPWS*). If the building codes are not updated to match ASCE/SEI 7-16, pre-engineered roof truss designs will be at a great disadvantage.

Scope of changes:

- Impacts ASCE 7, Chapter 30 Parts 1 & 2 (low rise, enclosed/partially enclosed, $h \leq 60$ ft)
- Impacts roof design (not wall)
- Separates gable and hip roofs (different figures for each)
- Increases number of zones and modification of zone locations
- Only changes one of 3 values (GC_p) used to calculate C&C pressure: $p = q_h[(GC_p) - (GC_{pi})]$. q_h & GC_{pi} do not change.
- Because both the zones and slope ranges for gable roofs changed in ASCE/SEI 7-16 (4 instead of 3), the net difference is difficult to compare.

Key Definitions:

AUTHORITY HAVING JURISDICTION (AHJ): ([IBC Section 104.1](#))

The building code official authorized and directed to enforce the provisions of a building code who also has the authority to render interpretations of this code and to adopt policies and procedures in order to clarify the application of its provisions.

BUILDING DESIGNER: (*ANSI/TPI 1* Section 2.2)

The owner of the building or the person that contracts with the owner for the design of the framing structural system and/or who is responsible for the preparation of the construction documents. When mandated by the legal requirements, the Building Designer shall be a registered design professional.

BUILDING, ENCLOSED: (ASCE/SEI 7-10, revised in 7-16)

A building that does not comply with the requirements for open or partially enclosed buildings.

BUILDING, LOW-RISE: (ASCE/SEI 7-10, same at 7-16)

Enclosed or partially enclosed buildings that comply with the following conditions:

1. Mean roof height h less than or equal to 60 ft (18 m) and
2. Mean roof height h does not exceed least horizontal dimension.

BUILDING, PARTIALLY ENCLOSED: (ASCE/SEI 7-10, same at 7-16)

A building that complies with both of the following conditions:

1. The total area of openings in a wall that receives positive external pressure exceeds the sum of the areas of openings in the balance of the building envelope (walls and roof) by more than 10% and
2. The total area of openings in a wall that receives positive external pressure exceeds 4 ft² (0.37 m²) or 1% of the area of that wall, whichever is smaller, and the percentage of openings in the balance of the building envelope does not exceed 20%.

COMPONENT AND CLADDING WIND LOADS (C&C): (ASCE/SEI 7-10, similar at 7-16)

26.1.2.2 Components and Cladding. Wind loads on components and cladding on all buildings and other structures shall be designed using one of the following procedures:

1. Analytical procedures provided in Parts 1 through 6, as appropriate, of Chapter 30; and
2. Wind tunnel procedure as specified in Chapter 31.

DESIGN PRESSURE, P: (ASCE/SEI 7-10, same at 7-16)

Equivalent static pressure to be used in the determination of wind loads for buildings.

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EAVE HEIGHT, h_e : (ASCE/SEI 7-10, same at 7-16)

The distance from the ground surface adjacent to the building to the roof eave line at a particular wall. If the height of the eave varies along the wall, the average height shall be used.

EFFECTIVE WIND AREA, A : (ASCE/SEI 7-10, similar at 7-16)

The area used to determine (GC_p). For component and cladding elements, the effective wind area (in Figs. 30.4-1 through 30.4-7, 30.5-1, 30.6-1, and 30.8-1 through 30.8-3) is the span length multiplied by an effective width that need not be less than one-third the span length. For cladding fasteners, the effective wind area shall not be greater than the area that is tributary to an individual fastener.

MEAN ROOF HEIGHT, h :

The average of the roof eave height and the height to the highest point on the roof surface, except that, for roof angles of less than or equal to 10° , the mean roof height is permitted to be taken as the roof eave height.

Background:

The Wind Committee of ASCE 7 has made significant changes to the wind section in each of the editions, especially since 2005. Many of the changes have been more or less editorial, like moving the wind provisions from Chapter 6 into Chapters 26-31 in the 2010 edition for clarity of presentation. The 2010 edition also changed the wind speed maps to include strength-level basis of design, Exposure D in hurricane prone regions, windborne debris regions recalibrated, minimum pressure reduce, gust factor and natural frequency, the simplified method for enclosed simple diaphragm buildings ≤ 160 ft, exceptions to wind torsion cases and wind tunnel procedure limitations.

Continuing with the trend of changes in the wind section of ASCE 7, based on research done by Kopp and Morrison (*Component and Cladding Pressures and Zones for the Roofs of Low-Rise Buildings*, 2014), the low-rise roof provisions included in the draft of ASCE/SEI 7-16 have been significantly revised.

Application:

C&C wind loads impact a wide range of applications: fasteners, structural members that are not part of the MWFRS, etc.

[Tables 1-4](#) illustrate the percentage of difference in the minimum net pressure (minimum of 16 psf) at the stated slope conditions. Note that the zone designation is not the same for each slope group. Since the zone designations are not the same between the two editions of ASCE/SEI 7, where possible, values for ASCE/SEI 7-10 have been determined as best as possible to reflect the zones used in ASCE/SEI 7-16. When values are missing in the ASCE/SEI 7-16 figures, appropriate values have been entered in the calculations used to produce the tables below.

The following parameters are used in all cases:

Mean roof Height (h)	25 ft
Wind speed (V_{ult})	170 mph
Directionality Factor (K_d)	0.85
Exposure Category	B
Topographic Factor (K_{zt})	1.00
Velocity pressure exposure coefficient (K_z)	0.70
Building Category	Enclosed
Velocity pressure at MRH (q_h)	44.02
Internal Pressure coefficient ($GC_{pi} \pm$)	0.18
$p = q_h[(GC_p) - (GC_{pi})]$	

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	Zone	7-16 Min. Net Pressure	7-10 Min. Net Pressure	Difference	% Difference
ROOF	1	-47.54	-51.94	4.40	-8%
	1	-82.76	-51.94	-30.81	59%
	2	-109.17	-87.16	-22.01	25%
	3	-148.79	-131.18	-17.61	13%
	All	16.00	16.00	0	0%
OVERHANG	1	-82.76	-82.76	n/a	n/a
	1	-82.76	-82.76	0	0%
	2	-109.17	-148.79	-26.41	32%
	3	-148.79	-82.76	0	0%

Table 1: Slope 4.76 degrees (1:12 pitch)

	Zone	7-16 Min. Net Pressure	7-10 Min. Net Pressure	Difference	% Difference
ROOF	1	-95.96	-47.54	-48.42	102%
	2e	-95.96	-82.76	-13.21	16%
	2n	-139.99	-82.76	-57.23	69%
	2r	-139.99	-82.76	-57.23	69%
	3e	-139.99	-122.38	-17.61	14%
	3r	-166.40	-122.38	-44.02	36%
	All	22.89	16.00	6.89	43%
OVERHANG	1	-117.97	-	-	-
	2e	-117.97	-104.77	-13.21	13%
	2n	-162.00	-104.77	-57.23	55%
	2r	-162.00	-104.77	-57.23	55%
	3e	-188.41	-170.80	-17.61	10%
	3r	-214.82	-170.80	-44.02	26%

Table 2: Slope 9.46 degrees (2:12 pitch)

	Zone	7-16 Min. Net Pressure	7-10 Min. Net Pressure	Difference	% Difference
ROOF	1	-73.95	-47.54	-26.41	56%
	2e	-73.95	-82.76	8.80	-11%
	2n	-117.97	-82.76	-35.22	43%
	2r	-117.97	-82.76	-35.22	43%
	3e	-117.97	-122.38	4.40	-4%
	3r	-166.40	-122.38	-44.02	36%
	All	22.89	22.89	0.00	0%
OVERHANG	1	-95.96	-	-	-
	2e	-95.96	-104.77	8.80	-8%
	2n	-139.99	-104.77	-35.22	34%
	2r	-139.99	-104.77	-35.22	34%
	3e	-166.40	-170.80	4.40	-3%
	3r	-214.82	-170.80	-44.02	26%

Table 3: Slope 22.62 degrees (5:12 pitch)

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	Zone	7-16 Min. Net Pressure	7-10 Min. Net Pressure	Difference	% Difference
ROOF	1	-87.16	-51.94	-35.22	68%
	2e	-87.16	-60.75	-26.41	44%
	2n	-95.96	-60.75	-35.22	58%
	2r	-87.16	-60.75	-26.41	44%
	3e	-148.79	-60.75	-88.04	145%
	3r	-95.96	-60.75	-35.22	58%
	All	31.69	31.69	0.00	0%
OVERHANG	1	-104.77	-	-	-
	2e	-104.77	-95.96	-8.80	9%
	2n	-131.18	-95.96	-35.22	37%
	2r	-104.77	-95.96	-8.80	9%
	3e	-184.01	-95.96	-88.04	92%
	3r	-131.18	-95.96	-35.22	37%

Table 4: Slope 33.69 degrees (8:12 pitch)

Conditions of Use:

Since this SBCA Research Report is based on a draft version of ASCE/SEI 7-16, none of the results should be used for any design purposes. It is intended to be illustrative of the proposed changes to ASCE/SEI-7.

Building Designer Responsibility:

Unless the AHJ allows otherwise, the Construction Documents shall be prepared by a Building Designer (e.g., Owner, Registered Design Professional, etc.) for the Building and shall be in accordance with [/IRC Section R106](#) and [/IBC Section 107](#). The Construction Documents shall be accurate and reliable and shall provide the location, direction and magnitude of all applied loads and shall be in accordance with [/IRC Section 301](#) and [/IBC Section 1603](#). Construction Documents shall be submitted to the Building Official for approval and shall contain the plans, specifications and details needed for the Building Official to approve such documents.

Responsibilities:

- The information contained herein is a product, engineering or building code compliance research report prepared in accordance with the referenced building codes, testing and/or analysis using accepted engineering procedures, experience, and good technical judgment.
- Product design and code compliance quality control are the responsibility of the referenced company. Consult the referenced company for the proper detailing and application for the intended purpose. Consult your local jurisdiction or design professional to assure compliance with the local building code.
- SBCA Research Reports provide an assessment of only those attributes specifically addressed within a given report.
- The engineering evaluation was performed on the dates provided in this report, within SBCA's scope of work.

This research report is subject to periodic review and revision. For the most recent version of this report, visit sbcindustry.com. For information on the current status of this report, contact SBCA.

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References:

ANSI/AWC National Design Specification (NDS) for Wood Construction; American Wood Council; 2015.

ANSI/TPI 1 – National Design Standard for Metal Plate Connected Wood Truss Construction; Truss Plate Institute; 2007.

ASCE/SEI 7 – Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers and the Structural Engineering Institute; 2010 3rd printing & 2016 (draft).

International Building Code; International Code Council; 2015.

International Residential Code; International Code Council; 2015.