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Component And Cladding Wind Design Using ASCE/SEI 7-22

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Module 1: High-Rise Building Envelope Wind Design: Understanding C&C Requirements Above 60 ft

1.1 Engineering Context

For buildings with mean roof heights greater than 18.3 m (60 ft), the design of the building envelope becomes a distinct wind-engineering task that should not be treated as a simple extension of low-rise component and cladding calculations. ASCE/SEI 7-22 addresses this condition through the provisions of Chapter 30, Part 2, which provides the framework for determining component and cladding wind pressures on buildings above the 18.3 m (60 ft) mean-roof-height threshold. The procedure applies to enclosed, partially enclosed, and partially open buildings and accommodates common roof configurations including flat, gable, multi-span gable, hip, monoslope, stepped, and sawtooth roofs.

The distinction is important in practice because the wind environment acting on a taller building envelope changes significantly with elevation. Velocity pressure increases with height, façade components are subjected to localized positive and negative pressures, and exterior wall systems may be governed by demands that differ substantially from the forces used to design the building's primary lateral-force-resisting system.

The 18.3 m (60 ft) threshold should therefore be understood as a procedural boundary within ASCE 7 rather than as a general architectural definition of a "high-rise" building. A building may not be considered high-rise under another code provision and may still fall within the Chapter 30 Part 2 procedure because its mean roof height exceeds 60 ft. For wind-envelope design, the controlling issue is the applicability of the ASCE 7 procedure, not the informal classification of the building as low-rise, mid-rise, or high-rise.

This distinction is particularly relevant during design review. A calculation package may correctly establish the global wind loads on the main wind-force-resisting system and still be incomplete if the façade, glazing, roof components, or parapets have not been evaluated using the appropriate component and cladding procedure.

1.2 MWFRS and Component & Cladding Wind Effects

The Main Wind Force Resisting System, or MWFRS, and the Component and Cladding system serve different structural functions and therefore require different wind-load treatment.

The MWFRS consists of the structural system responsible for maintaining the overall stability of the building under wind. Depending on the structural configuration, this may include shear walls, braced frames, moment frames, diaphragms, collectors, and the associated load-transfer system extending to the foundation.

Component and cladding elements perform a more localized function. They receive wind pressure directly from the building surface and transfer that pressure through their immediate supports and connections into the primary structure. Curtain-wall mullions, glazing panels, exterior wall panels, roof coverings, roof attachment systems, and parapets are typical examples.

This distinction is not merely terminology. It affects the pressure coefficients used in design, the effective wind area assigned to a component, the applicable pressure zones, and the magnitude of the resulting local demand.

A common error in design practice is to assume that a façade element can be designed using the same wind pressure applied to the overall structural frame. That approach can be unconservative because localized external pressures acting on relatively small areas of the building envelope can exceed the averaged pressures associated with global structural response.

The building envelope must therefore be considered as a load-transfer system in its own right. The design sequence is conceptually represented as:

***Wind Pressure → Envelope Component → Attachment or Connection →
Supporting Structural Element***

Failure at any point in this sequence can interrupt the intended load path even when the primary building frame remains structurally adequate.



C&C load path: the design pressure must remain traceable through the complete envelope support system.

Figure 1. C&C load path through the building envelope.

For this reason, C&C design should not be treated as a secondary documentation exercise performed after the main structural analysis is complete. It is an integral part of the wind-resistant design of the building.

1.3 Practical Implications of C&C Design in Building Envelope Performance

The practical significance of Component and Cladding design becomes most apparent when the engineer evaluates how localized wind demands affect individual envelope systems. Unlike the primary structural frame, which is typically designed to resist a distributed wind demand transferred through the overall building geometry, envelope components are exposed to concentrated pressures acting over limited tributary areas. These localized demands frequently govern the design of connections, attachments, and component capacities.

In professional design review, envelope-related deficiencies are often associated with an incomplete understanding of the relationship between pressure magnitude, effective wind area, component stiffness, and attachment capacity. A curtain-wall mullion, for example, may satisfy strength requirements under one effective wind area while requiring a different pressure coefficient when evaluated as a supporting element

for smaller glazed panels. Similarly, roof edge components may experience demands significantly different from those calculated for interior roof regions because of localized flow separation and increased external pressure effects.

The engineer responsible for wind design must therefore evaluate not only the calculated pressure value but also the manner in which that pressure is transferred through the envelope system. A technically correct pressure calculation can still result in an inadequate design if the selected pressure is assigned to the wrong component, applied over an incorrect effective wind area, or transferred through an attachment system that was not designed for the resulting demand.

This consideration is particularly important for high-rise buildings where multiple envelope systems, specialty consultants, and delegated design responsibilities must be coordinated. The structural engineer of record should ensure that the design criteria issued to project participants remain traceable to the governing ASCE/SEI 7-22 provisions and that each component receives the appropriate wind demand corresponding to its location, geometry, and support condition.

For complementary coverage of MWFRS wind design for low-rise buildings, see the author's course **Calculating Wind Loads on Buildings Using the Envelope Procedure of ASCE 7-22 Code**.

1.4 Application of ASCE 7-22 Chapter 30 Part 2

The procedure addressed in this course is specifically concerned with buildings having mean roof heights greater than 18.3 m (60 ft). The reference example provided in the ASCE wind-load guide illustrates the procedure using a 160-ft-tall office building with a mean roof height of 47.9 m (157 ft) and a 0.91 m (3 ft) parapet. This course adapts the published reference example into an integrated engineering workflow to demonstrate the application of ASCE/SEI 7-22 C&C procedures in professional design practice. The building uses glazed exterior panels supported by mullions spanning between floor slabs, providing a representative building-envelope system for the application of Chapter 30 Part 2.

For complementary treatment of MWFRS wind design where simplified envelope procedures are no longer adequate, see the author's course, ***Mastering the ASCE 7-22 Directional Procedure for Irregular & Multi-Level Buildings: A Step-by-Step Workflow to Eliminate Torsion Errors and Reduce Wind Design Risk***.

Before pressure coefficients are selected, the engineer must first confirm that the building falls within the scope of the procedure being used. The Chapter 30 Part 2 procedure addressed here applies to enclosed, partially enclosed, and partially open buildings with roof geometries covered by the standard.

Once applicability has been established, the design process is governed by several interrelated parameters. These include the building risk category, basic wind speed, exposure category, directionality factor, topographic factor, ground-elevation factor, enclosure classification, internal pressure coefficient, and the variation of velocity pressure with height.

The influence of height becomes particularly important for wall components. In the reference example, velocity pressure is developed at multiple elevations rather than represented by a single uniform value over the full height of the building. The example evaluates the wind field at elevations extending from the lower portion of the building to the roof and parapet level.

This height-dependent treatment is one of the practical differences engineers must recognize when moving from a low-rise C&C procedure to the design of taller building envelopes.

The governing pressure relationship in Chapter 30 Part 2 is based on the algebraic interaction of external and internal pressure. In the reference example, the design pressure is evaluated in the form:

$$p = qK_d(GC_p) - q_iK_d(GC_{pi})$$

where q represents the applicable external velocity pressure, q_i represents the velocity pressure used for internal pressure, K_d is the wind directionality factor, GC_p is the external pressure coefficient, and GC_{pi} is the internal pressure coefficient.

The specific value of q depends on the building surface being considered. For windward walls, the reference procedure uses velocity pressure evaluated at the applicable height z . For leeward walls, side walls, and roofs, velocity pressure is evaluated at mean roof height.

This distinction has direct practical consequences. Two façade elements with identical dimensions but located at substantially different elevations may not experience the same positive design pressure because the external velocity pressure can vary with height.

Design Basis and Load-Level Convention

The Chapter 30 pressures developed in the reference case are strength-level design pressures. ASCE/SEI 7-22 Chapter 2 assigns a wind load factor of 1.0 for strength design and 0.6 for allowable stress design. The pressure calculations in this course are therefore carried forward at the strength-design level unless a specific ASD conversion is stated. This distinction is documented at the outset so that façade, roof, and delegated-design criteria are not inadvertently mixed between strength and allowable-stress formats.

1.5 Critical Building Envelope Components

The application of Component and Cladding wind design becomes most effective when the engineer recognizes that building-envelope systems are composed of individual elements with different structural roles, support conditions, and wind-response characteristics. Although these elements form a continuous exterior enclosure, each component must be evaluated according to its own geometry, tributary area, connection configuration, and applicable ASCE/SEI 7-22 pressure coefficients.

Curtain-wall systems provide a representative example of this component-based approach. A typical system consists of vertical mullions, horizontal framing members, glazing panels, anchors, and connections that

transfer wind forces into the supporting structure. These elements do not necessarily experience the same design pressure because their effective wind areas and structural functions are different. A mullion extending between floor slabs may resist wind over a larger tributary area than an individual glazing panel, resulting in different pressure coefficient selection even when both elements are located within the same façade region.

In the reference design example, separate evaluations are performed for mullions and glazed panels because each component represents a different load-resisting element within the envelope system. The governing pressure for each component is established based on the applicable effective wind area, wall zone, elevation, and support condition rather than by assigning a single pressure value to the entire façade.

The same engineering approach applies to roof components. Roof coverings, perimeter elements, and attachment systems are exposed to pressure distributions that vary with location and effective wind area. Edge and corner regions may experience increased suction demands because of localized flow behavior, and these effects must be considered when selecting design pressures for roof components and their connections.

Parapets represent another specialized envelope component because they are subjected to pressure effects on multiple surfaces. Their design requires consideration of wind direction, location on the building perimeter, and the applicable provisions of ASCE/SEI 7-22 Chapter 30. The resulting design forces may differ significantly from pressures used for adjacent wall or roof components.

For professional design practice, the critical requirement is maintaining a clear relationship between the envelope component being evaluated and the wind demand assigned to it. Curtain walls, glazing systems, roof assemblies, and parapets should therefore be treated as distinct structural components with individual design criteria, connection requirements, and verification procedures.

Component Review Note:

During design review, the most reliable pressure schedules are those that clearly identify the component type, effective wind area, pressure zone, elevation, and governing load condition. This level of traceability reduces the possibility of applying a correct pressure value to an incorrect building-envelope element.

1.6 Building Envelope Design as a Coordination Problem

In professional practice, many building-envelope wind problems occur at interfaces between disciplines rather than in the calculation of wind pressure itself.

The structural engineer may determine design pressures, while a façade consultant designs the curtain-wall system. A glazing manufacturer may provide product capacities. A specialty engineer may design attachment brackets. The architect may define panel dimensions and joint locations. The structural engineer of record must still ensure that the design criteria transmitted to these parties are consistent with the governing ASCE 7 requirements.

For a curtain-wall system, a useful design pressure schedule must identify more than a single pressure value. It should allow the recipient to determine which pressure applies to which component, at what elevation, over what effective wind area, and within which wall zone.

The same principle applies to roof systems. A roof component may be adequate in an interior zone but inadequate near a perimeter or corner. Similarly, a glazing system selected for one elevation or zone may not necessarily be adequate elsewhere on the same building.

This coordination issue becomes more significant as building height increases because the envelope is often divided into multiple design regions, elevations, façade systems, and delegated-design packages.

A calculation that is technically correct but poorly translated into design criteria can therefore produce the same practical result as an incorrect calculation: the wrong pressure may be used for the component being designed.

1.7 Why the 48.8 m Office Building Is a Useful Design Case

The 48.8 m (160 ft) office building used throughout this course provides a useful reference because it brings several common building-envelope conditions into a single design problem.

The building has a mean roof height of 47.9 m (157 ft), a flat roof, a 0.91 m (3 ft) parapet, and a glazed exterior wall system supported by mullions spanning between floor slabs. The case study represents an office building located in La Porte, Texas. The wind parameters used in this training example are adopted from the referenced ASCE wind-load example and are maintained consistently throughout the course for instructional purposes. Actual project design shall obtain wind parameters based on the exact project location, applicable ASCE Hazard Tool data, adopted building code requirements, and jurisdictional criteria. Subsequent course calculations will be presented exclusively in SI units in accordance with the course format.

The example allows the design procedure to be followed through the principal C&C components encountered on a taller commercial building: mullions, glazing, roof components, and parapets.

More importantly, the example demonstrates that C&C design is not a collection of unrelated pressure calculations. The same wind-design inputs are carried through several different envelope components, while the effective wind area, pressure zone, elevation, and coefficient selection change according to the component being evaluated.

That continuity is central to the engineering approach used throughout this course.

The following modules therefore develop the design in the same sequence used in professional practice. Wind parameters and velocity pressures are established first. Wall components are then evaluated, followed by roof components and parapets. The complete case study ultimately consolidates the results into a coordinated set of design pressures suitable for engineering review and building-envelope design.

Professional Verification Approach

Before releasing C&C design criteria for project use, the engineer should verify that the calculated pressures remain consistent with the intended component application. This verification process begins with confirming the building classification, enclosure condition, and applicable ASCE/SEI 7-22 procedure. The engineer then confirms that the selected effective wind area, pressure zone, and coefficient values correspond to the specific component under consideration.

This verification approach is especially important when design responsibilities are divided among multiple parties. The final pressure schedule should provide sufficient information for downstream designers to understand the basis of the assigned loads and avoid unintended substitution of values between different envelope components.

Maintaining this traceability from code provisions to final design criteria represents an essential aspect of professional engineering judgment in building-envelope wind design.

Design Office Note

For buildings above 60 ft, the most common conceptual error is not a failure to calculate wind pressure; it is the assumption that one pressure can represent the entire building envelope. Reliable C&C design requires the engineer to preserve the relationship between **height, effective wind area, pressure zone, component type, and load path** from the initial ASCE 7 calculation through the final design criteria issued to the project team.

Module 2: Wind Parameters and Design Inputs for Buildings Above 60 ft

Practical Wind Design Workflow Using a Real Project — 48.8 m Tall Office Building Case Study

The accuracy of Component and Cladding (C&C) wind design depends primarily on the correct definition of the wind environment surrounding the building. For buildings with mean roof heights greater than 18.3 m (60 ft), the engineer must carefully establish the governing wind parameters before calculating any component pressures. A small error in the initial selection of exposure, enclosure classification, or velocity pressure can propagate through the entire design process and result in incorrect demands on curtain walls, glazing systems, roof components, and parapets.

Unlike the design of the Main Wind Force Resisting System (MWFRS), where the primary objective is to determine global forces and structural stability effects, C&C design requires a more localized evaluation. The engineer must determine the wind pressure acting on specific portions of the building envelope, considering elevation, surface location, effective wind area, and applicable external and internal pressure coefficients.

This module establishes the complete wind-design input workflow using a representative high-rise office building case study. The same project will be carried through subsequent modules to evaluate wall components, glazing systems, roof components, and parapets.

2.1 Project Definition and Design Scenario

The design example considered in this course represents a commercial office building with a mean roof height greater than 60 ft. The reference example from the ASCE wind-load guide considers a building with a top-of-parapet elevation of approximately 48.8 m (160 ft) and a mean roof height of approximately 47.9 m (157 ft), a flat roof configuration, and a 3-ft parapet. The exterior wall system consists of glazed panels supported by vertical mullions spanning between floor slabs.

The building configuration represents a common condition encountered in U.S. commercial construction, where the structural engineer is responsible for establishing the wind design criteria used by façade engineers, specialty contractors, and delegated designers.

Before calculating component pressures, the engineer must establish the governing wind parameters required by ASCE/SEI 7-22. These parameters define the intensity of the wind event, the characteristics of the surrounding terrain, the aerodynamic response of the building, and the internal pressure condition.

The case-study geometry and site conditions are retained consistently throughout the course. The plan dimensions are 30.5 m by 61.0 m, the mean roof height is 47.9 m, and the parapet extends to approximately 48.8 m above grade. Curtain-wall mullions span 3.35 m between floor slabs at 1.52 m spacing, while typical glazed panels are 1.52 m wide by 1.68 m high. The project is located in La Porte, Texas, on flat terrain in a suburban exposure.

Table 1. Case-study project criteria

Project criterion	Case-study value
Building use	Office building, Risk Category II
Plan dimensions	30.5 m × 61.0 m
Mean roof height	47.9 m
Parapet height	0.91 m
Top of parapet	48.8 m above grade
Basic wind speed	62.6 m/s
Exposure Category	B
Directionality factor, K_d	0.85
Topographic factor, K_{zt}	1.0
Ground elevation factor, K_e	1.0
Enclosure classification	Enclosed
Internal pressure coefficient, GC_{pi}	±0.18
Mullion span / spacing	3.35 m / 1.52 m
Typical glazed panel	1.52 m × 1.68 m

The enclosure classification follows ASCE/SEI 7-22 Section 26.12.3 and Table 26.13-1. In the reference project, impact-resistant glazing is provided over the lower 18.3 m of the building in accordance with ASTM E1886 and ASTM E1996, and the debris-source condition described in the source example does not require extending that protection higher. Windborne debris protection requirements are determined by the adopted building code and project location requirements. ASTM E1886 and ASTM E1996 define the testing procedures and performance criteria for impact-resistant glazing and protective systems.

2.2 Engineering Judgment in Defining Wind Design Inputs

The selection of wind-design inputs represents one of the most important engineering judgment steps in a Component and Cladding analysis. Although the calculation procedures provided by ASCE/SEI 7-22 are well defined, the reliability of the final design pressures depends on the accuracy of the assumptions established before the calculations begin.

In professional practice, errors in wind design are frequently associated with incorrect interpretation of project conditions rather than incorrect application of equations. The selected exposure category must represent the actual upwind terrain affecting the building, the enclosure classification must reflect the performance of the completed building envelope, and the selected velocity pressure elevation must correspond to the component being evaluated.

For high-rise buildings, these decisions become increasingly significant because the envelope extends through multiple wind environments along the building height. A pressure value developed using an incorrect exposure category or an inappropriate elevation may appear mathematically correct while still producing an unsuitable design demand for the component under consideration.

A complete wind-design input review should therefore establish a clear connection between the project characteristics, the applicable ASCE/SEI 7-22 provisions, and the resulting design parameters used in subsequent C&C calculations.

2.3 Establishing Wind Design Parameters

The first stage of the workflow is the determination of the basic wind speed and associated environmental factors.

The basic wind speed represents the reference wind velocity used to establish the design wind pressures for the building. It is selected based on the project location, risk category, and applicable provisions of ASCE/SEI 7-22.

The velocity pressure used in C&C design is not based only on wind speed. Under ASCE/SEI 7-22 Equation 26.10-1, it reflects the exposure coefficient, topographic effects, and ground-elevation effects through K_z , K_{zt} , and K_e . Wind directionality is introduced separately through K_d in the Chapter 30 component-and-cladding design-pressure equation. Keeping these operations separate prevents the directionality factor from being applied twice.

The general velocity pressure relationship used in ASCE 7 wind design is:

$$q_z = 0.613 K_z K_{zt} K_e V^2 \quad \text{N/m}^2$$

When velocity pressure is reported directly in kilopascals, the equivalent form is:

$$q_z = 0.000613 K_z K_{zt} K_e V^2 \quad \text{kPa}$$

where:

q_z = velocity pressure at height z , in kPa

K_z = velocity pressure exposure coefficient

K_{zt} = topographic factor

K_e = ground elevation factor

V = basic wind speed, in m/s

For C&C design of taller buildings, the selection of the appropriate velocity pressure elevation is particularly important because wind pressure varies with height.

The engineer should therefore avoid assigning a single uniform velocity pressure to the entire façade unless specifically permitted by the applicable provisions.

2.4 Risk Category and Basic Wind Speed Selection

The determination of Risk Category is the first classification step because it influences the applicable design wind speed and associated reliability level.

The engineer must identify the building occupancy and importance classification before selecting the wind speed used in design. This classification should be coordinated with the project structural criteria and the requirements of ASCE/SEI 7-22.

For the office building case study, Risk Category II applies under ASCE/SEI 7-22 Table 1.5-1. The basic wind speed is 62.6 m/s, obtained for La Porte, Texas, using the ASCE 7 Hazard Tool and Section 26.5.1. The suburban terrain is treated as Exposure B under Section 26.7.3, provided the required upwind extent of that terrain is satisfied. These are project-specific inputs, not illustrative assumptions, and they are used consistently through the worked examples.

A properly documented wind design input table should clearly identify the selected parameters and their sources so that subsequent reviewers can verify the assumptions.

2.5 Exposure Category Evaluation

Exposure category represents the effect of terrain roughness on the development of wind pressures with height.

For taller buildings, exposure selection becomes particularly important because the building envelope extends through a significant vertical range where the wind profile changes.

The surrounding terrain is classified using the exposure definitions and upwind-fetch requirements of ASCE/SEI 7-22.

Exposure B generally represents urban and suburban terrain, Exposure C represents open terrain, and Exposure D applies to unobstructed areas adjacent to large bodies of water, subject to the detailed exposure definitions and upwind fetch requirements of ASCE/SEI 7-22.

Exposure Selection in Design Review Practice

Exposure classification should be based on the terrain influencing the approaching wind flow rather than the immediate appearance of the project site alone. A building located within a developing area may experience

a transition between terrain conditions, requiring the engineer to evaluate the surrounding area over the applicable upwind distance.

During design review, exposure selection should be supported by documented site observations, mapping information, or project records that demonstrate the basis for the selected category. This documentation becomes particularly important when the difference between Exposure B and Exposure C produces a significant change in velocity pressure and final component demands.

The selected exposure category directly affects the velocity pressure coefficient K_z , and therefore influences all subsequent C&C pressure calculations.

A common design-review issue is the use of an exposure category based only on the immediate project site rather than the larger surrounding terrain. The wind environment should represent the actual approach flow affecting the building.

2.6 Directionality, Topography, and Ground Elevation Effects

After establishing wind speed and exposure, the engineer applies the additional modification factors required by ASCE/SEI 7-22.

The wind directionality factor K_d accounts for the reduced probability of maximum directional wind effects occurring simultaneously with the critical structural orientation.

The topographic factor K_{zt} accounts for acceleration of wind flow over hills, ridges, and escarpments where applicable.

The ground elevation factor K_e accounts for changes in atmospheric density associated with significant elevation above sea level.

For most conventional building sites, K_{zt} may equal unity when no qualifying topographic features exist. However, this determination should be documented rather than assumed.

In professional design practice, these factors are often small individually, but their combined influence affects the final pressure values used for façade and attachment design.

2.7 Enclosure Classification and Internal Pressure

The enclosure classification of the building is one of the most influential decisions in C&C design because internal pressure can significantly modify the final design pressure acting on envelope components.

ASCE/SEI 7-22 categorizes buildings based on the characteristics of openings and the ability of the building envelope to resist wind-driven internal pressure changes.

The applicable internal pressure coefficient GC_{pi} is selected based on the enclosure classification.

The design pressure relationship is expressed as:

$$p = qK_d(GC_p) - q_iK_d(GC_{pi})$$

where:

p= design wind pressure, in kPa

q = external velocity pressure, in kPa

q_i = internal velocity pressure, in kPa

GC_p = external pressure coefficient

GC_{pi} = internal pressure coefficient

The sign convention and pressure combination must be carefully evaluated because both positive and negative pressure cases may govern different components.

For example, glazing panels, curtain-wall mullions, and roof components may not be controlled by the same pressure case.

2.8 Velocity Pressure Variation with Building Height

One of the most important differences between taller buildings and low-rise buildings is the variation of velocity pressure along the building height.

For the 48.8 m (160 ft) office building case study, velocity pressures are evaluated at multiple elevations rather than using a single pressure value for all components. The reference example develops pressures at different heights extending from lower building elevations to the roof level.

This approach reflects actual wind behavior. The upper portions of the building experience a different wind environment compared with lower elevations because the atmospheric boundary layer develops with increasing height.

The selected velocity pressure must correspond to the location of the component being designed. A curtain-wall mullion, roof component, or parapet may therefore require different pressure inputs even within the same building.

2.9 Worked Example — Velocity Pressure Profile for the 48.8 m Office Building

The velocity-pressure profile is developed using ASCE/SEI 7-22 Equation 26.10-1 with Exposure B coefficients from Table 26.10-1. Because K_d is applied later in the Chapter 30 C&C pressure equation, it is

not included in the velocity-pressure calculation. This separation prevents the directionality factor from being applied twice.

At the mean roof height, $K_z = 1.07$, $K_{zt} = 1.0$, $K_e = 1.0$, and $V = 62.6$ m/s. Therefore,

$$q_h = 0.000613(1.07)(1.0)(1.0)(62.6)^2 = 2.57 \text{ kPa}$$

At the top of the parapet, $K_z = 1.08$ and the corresponding pressure is

$$q_p = 0.000613(1.08)(1.0)(1.0)(62.6)^2 = 2.59 \text{ kPa}$$

The same calculation is repeated at intermediate elevations. The resulting profile is summarized below.

Table 2. Velocity-pressure profile for the case-study building

Elevation above grade, z (m)	K_z	q_z (kPa)
0–4.57	0.57	1.37
9.14	0.70	1.68
15.24	0.79	1.90
24.38	0.90	2.16
36.58	1.00	2.40
Roof = 47.85	1.07	2.57
Parapet = 48.77	1.08	2.59

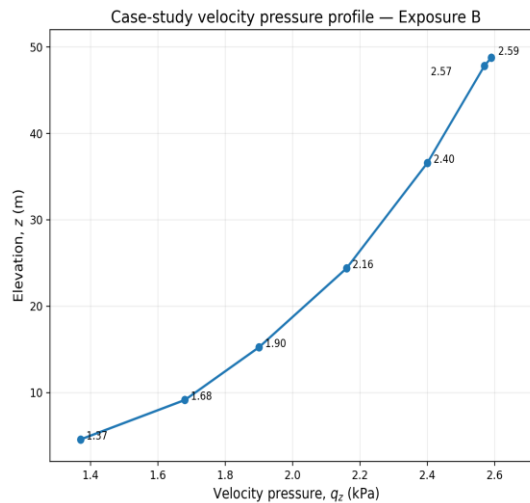


Figure 2. Velocity pressure increases with elevation for the Exposure B case study

This profile is used directly in the wall-pressure calculations that follow. Windward-wall positive pressures vary with q_z at the component elevation, while leeward-wall, side-wall, roof, and internal-pressure terms use the velocity pressure prescribed by Chapter 30 for the applicable surface.

Design Review Considerations for Velocity Pressure Application

The velocity-pressure profile developed in this module illustrates an important aspect of taller building envelope design: the pressure assigned to a component must represent its actual location and exposure condition. Applying a single velocity pressure value to all elevations may simplify calculations but can misrepresent the demand on components located at significantly different heights.

In practice, the engineer should verify that each pressure schedule identifies the elevation basis used for the calculation. This verification is particularly important for façade systems extending over multiple stories, where lower and upper portions of the same system may experience different velocity pressures.

2.10 Engineering Workflow Summary

The wind-design workflow established in this module follows the sequence used in professional practice:

The building characteristics are first defined, followed by selection of the applicable ASCE 7 procedure. Wind speed, exposure, and environmental modification factors are then established. The enclosure classification determines the internal pressure condition, after which velocity pressures are developed at the appropriate elevations.

These inputs provide the foundation for the component-specific evaluations performed in the following modules. The next step is to apply these parameters to wall components, curtain-wall mullions, and glazing systems where effective wind area and pressure zones become the controlling factors.

Professional Consideration

A reliable C&C wind design begins before any pressure coefficient is selected. The most significant engineering judgments often occur during the definition of the project inputs: exposure classification, enclosure condition, and the selection of the appropriate velocity pressure elevation. Errors introduced at this stage are rarely corrected later in the calculation process because every subsequent design pressure depends on these initial assumptions.

Module 3: Wall Component & Cladding Design: Curtain Walls and Glazing Systems

Designing Critical Building Envelope Components

The exterior wall system of a tall building represents one of the most critical applications of Component and Cladding (C&C) wind design. Unlike the primary structural system, which is designed to resist the overall wind forces acting on the building, wall envelope components are subjected to localized pressures that vary significantly depending on their location, size, and supporting configuration.

For buildings with mean roof heights greater than 18.3 m (60 ft), ASCE/SEI 7-22 Chapter 30 Part 2 provides the procedure for determining the wind pressures used for the design of exterior wall components. The engineer must evaluate each component according to its effective wind area, applicable pressure zone, and the corresponding external and internal pressure effects.

In modern commercial construction, curtain-wall systems are commonly used as the exterior enclosure. These systems typically consist of vertical mullions, horizontal framing members, glazing panels, anchors, and connections transferring wind forces into the supporting structure. Although these components occupy the same façade surface, they do not necessarily experience the same design pressure because their structural role and tributary areas are different.

The design process therefore begins with understanding how wind pressure is transferred from the exterior surface of the building into each individual component.

Wind Pressure → Glazing or Mullion → Connection System → Supporting Structure

The reliability of the building envelope depends on maintaining this complete load path.

3.1 Curtain Wall Mullion Design

Curtain-wall mullions are primary vertical load-carrying elements within many façade systems. Their function is to collect wind pressure from the glazing panels and transfer the resulting forces through anchors and connections into the building structure.

The wind demand on a mullion depends on its geometry, support condition, tributary load path, and local pressure environment.

For a curtain-wall mullion, the governing variables are its tributary width, vertical span between structural supports, effective wind area, wall pressure zone, external pressure coefficient, and internal pressure condition.

A common design mistake is to apply glazing panel pressure directly to mullions without evaluating whether the effective wind area of the mullion is different from the glass panel it supports. Because pressure

coefficients in ASCE 7 are dependent on effective wind area, different components within the same façade system may be governed by different pressure values.

The ASCE 7-22 Chapter 30 Part 2 procedure requires the engineer to determine the effective wind area associated with the component being designed. For a mullion spanning between floors, the effective wind area is generally related to the tributary area supported by that mullion segment rather than the area of an individual glazing panel.

The reference example used in this course evaluates curtain-wall mullions spanning approximately one story between floor slabs. The mullions are analyzed separately from the glazed panels because their effective wind areas and design pressures are different.

Mullion Structural Behavior and Connection Responsibility

A curtain-wall mullion should be evaluated not only as a pressure-resisting element but also as a component within a complete structural load-transfer system. The wind pressure collected by the mullion is transferred through anchors, fasteners, and supporting attachments into the primary building structure. Therefore, the adequacy of the mullion design depends on both the component strength and the ability of the connection system to transfer the developed forces.

In professional design review, a common concern is the separation between the calculated component pressure and the actual connection design responsibility. A properly selected C&C pressure does not ensure an adequate envelope system unless the associated reactions, attachment forces, and supporting details are evaluated consistently.

For this reason, the engineer should maintain traceability between the selected wind pressure, the tributary area assigned to the mullion, the resulting component forces, and the connection requirements provided to the façade designer.

3.2 Effective Wind Area Selection for Wall Components

Effective wind area is one of the most important design parameters in C&C calculations because it directly influences the selection of external pressure coefficients.

The engineer should determine the actual surface area over which wind pressure is transferred to the component under consideration. This area depends on the structural behavior of the component, its support conditions, and the manner in which wind forces are distributed.

For a curtain-wall mullion, the effective wind area may include the full tributary area between adjacent supports. For an individual glazing panel, the effective wind area may be limited to the area of the panel itself.

Using an incorrect effective wind area can lead to an incorrect pressure coefficient and therefore an incorrect design demand.

The design process should therefore follow the sequence:

Component Identification → Effective Wind Area → Pressure Coefficient → Design Pressure

This sequence should be maintained throughout the calculation process.

Effective Wind Area Selection in Design Review Practice

The selection of effective wind area requires engineering judgment because the area used for coefficient selection must represent the structural behavior of the component being evaluated. It is not necessarily equal to the visible surface area of the building element.

For example, a glazing panel may be evaluated based on its individual dimensions, while a mullion may resist wind forces collected from a larger tributary region between structural supports. Applying the glazing effective wind area to the mullion, or applying the mullion area to the glazing panel, can result in an incorrect pressure coefficient selection.

During design review, the engineer should verify that each component pressure is supported by a clearly defined effective wind area and that the selected area corresponds to the actual load-transfer mechanism.

3.3 Wall Pressure Zones and Localized Wind Effects

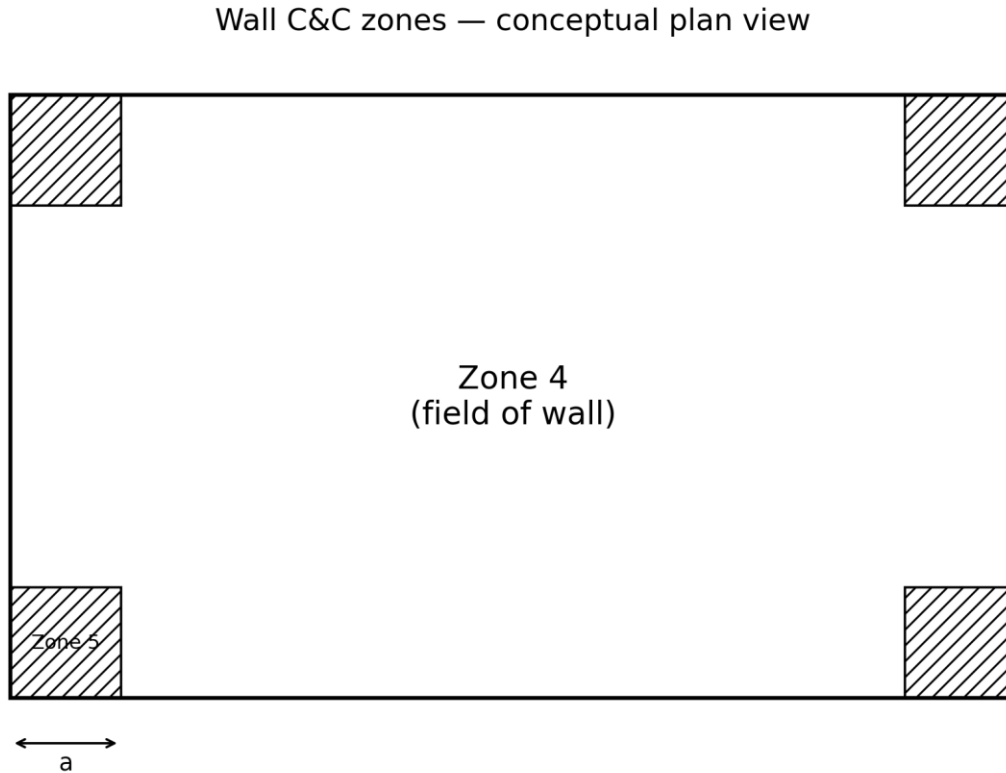
Wind pressure on exterior walls is not uniform across the building surface. ASCE 7 recognizes that corner regions experience different aerodynamic behavior compared with the central portions of walls.

For wall components above 60 ft, the design procedure distinguishes the general wall region from localized corner regions where suction effects are typically more severe.

The reference example evaluates wall pressures using Zones 4 and 5, where Zone 5 represents the more critical corner region with increased localized suction effects. The wall coefficients used in the worked example follow the published erratum to Figure 30.4-1 identified in the reference guide; the calculation record should note this explicitly so that coefficient selection remains reproducible.

This distinction is particularly important for curtain-wall systems because a façade element located near a building corner may experience significantly higher negative pressure than an identical component located away from the corner.

During design review, one of the common issues encountered is the use of a single wall pressure value for an entire elevation. Such an approach may overlook the increased demand at corners and result in inadequate component or connection design.



Case study: $a = \max(0.10 \times 30.5 \text{ m}, 0.91 \text{ m}) = 3.05 \text{ m}$

Figure 3. Conceptual schematic of wall Zones 4 and 5 used for C&C design.

3.4 Positive and Negative Design Pressures

C&C wall components must be evaluated for both positive and negative wind pressures.

Positive pressure generally represents wind acting toward the building surface, while negative pressure represents suction pulling the component away from the building.

For curtain walls and glazing systems, negative pressure often controls because exterior components must resist the tendency to separate from their supporting structure.

The design pressure is determined by combining external and internal pressure effects:

$$p = qK_d(GC_p) - q_iK_d(GC_{pi})$$

where the sign and magnitude of each term depend on the pressure case being evaluated.

The engineer must consider the pressure combinations that produce the most critical demand for each component. The controlling case for a glazing panel may not be identical to the controlling case for a mullion or attachment connection.

This is why C&C design requires evaluation of multiple pressure cases rather than selecting a single maximum pressure value.

3.5 Glazed Panel Wind Design

Glazed panels represent a different design condition from curtain-wall mullions because the glass system responds as an individual envelope component.

Glazed-panel design therefore requires a component-specific evaluation rather than reuse of the mullion pressure by default.

For each glazed panel, the engineer evaluates the panel dimensions, effective wind area, applicable pressure coefficient, positive and negative design pressures, and the framing and connection conditions that complete the load path.

The reference office building example evaluates glazed panels separately from mullions and develops design pressures based on the applicable effective wind area and wall pressure zones.

Although glazing panels and mullions occupy the same façade, they should not automatically be assigned identical wind pressures. The difference in component size and load-transfer mechanism can result in different governing pressures.

3.6 Worked Example — Curtain-Wall Mullion and Glazed-Panel Pressures

The reference façade geometry permits the effective wind areas to be determined from actual support dimensions rather than assumed values. For a mullion spanning 3.35 m between floors at a tributary width of 1.52 m, the directly tributary area is

$$A_e = (3.35)(1.52) = 5.11 \text{ m}^2$$

ASCE/SEI 7-22 Section 26.2 also requires the effective width used with the span not to be less than one-third of the span. The alternative area is therefore

$$A_e = (3.35)(3.35/3) = 3.74 \text{ m}^2$$

and the controlling mullion effective wind area is 5.11 m^2 . For the typical 1.52 m by 1.68 m glazed panel,

$$A_e = (1.52)(1.68) = 2.55 \text{ m}^2$$

which exceeds the corresponding one-third-span alternative. The wall-corner width is

$$a = \max[0.10(30.5), 0.91] = 3.05 \text{ m}$$

Using Figure 30.4-1 together with the published erratum identified in the reference guide, the applicable coefficients are summarized below.

Table 3. Mullion and glazed-panel effective wind areas and pressure coefficients

Component	A_e (m ²)	Positive $G C_p$	Zone 4 negative $G C_p$	Zone 5 negative $G C_p$
Curtain-wall mullion	5.11	+0.77	−0.81	−1.45
Glazed panel	2.55	+0.82	−0.85	−1.59

For a mullion in Zone 4 at roof height, the controlling negative case combines external suction with positive internal pressure:

$$p = (2.57)(0.85)(-0.81) - (2.57)(0.85)(+0.18) = -2.17 \text{ kPa}$$

The same mullion in Zone 5 develops

$$p = (2.57)(0.85)(-1.45) - (2.57)(0.85)(+0.18) = -3.56 \text{ kPa}$$

The roof-level positive pressure for the mullion is controlled by negative internal pressure:

$$p = (2.57)(0.85)(0.77) - (2.57)(0.85)(-0.18) = +2.08 \text{ kPa}$$

For the glazed panel, the corresponding roof-level values are +2.18 kPa in positive pressure, −2.25 kPa in Zone 4 suction, and −3.87 kPa in Zone 5 suction. The complete height-dependent pressure schedule is shown below.

Table 4. Curtain-wall mullion pressure schedule

Elevation range (m)	Zone 4 + (kPa)	Zone 4 − (kPa)	Zone 5 + (kPa)	Zone 5 − (kPa)
0–4.57	1.29	−2.17	1.29	−3.56
4.57–9.14	1.49	−2.17	1.49	−3.56
9.14–15.24	1.63	−2.17	1.63	−3.56
15.24–24.38	1.81	−2.17	1.81	−3.56
24.38–36.58	1.96	−2.17	1.96	−3.56
36.58–47.85	2.08	−2.17	2.08	−3.56

Table 5. Glazed-panel pressure schedule

Elevation range (m)	Zone 4 + (kPa)	Zone 4 – (kPa)	Zone 5 + (kPa)	Zone 5 – (kPa)
0–4.57	1.35	–2.25	1.35	–3.87
4.57–9.14	1.57	–2.25	1.57	–3.87
9.14–15.24	1.72	–2.25	1.72	–3.87
15.24–24.38	1.91	–2.25	1.91	–3.87
24.38–36.58	2.07	–2.25	2.07	–3.87
36.58–47.85	2.19	–2.25	2.19	–3.87

The schedule demonstrates why façade criteria should identify both elevation and wall zone. A single pressure value would conceal the height dependence of positive pressure and the stronger localized suction in Zone 5.

Engineering Application Example — Converting Wind Pressure into Component Demand

After determining the design pressure, the engineer must convert the pressure into component demand based on the tributary width and support condition. For a uniformly loaded curtain-wall mullion, the applied line load may be estimated as:

$$w = p \times b_t$$

where:

w = applied line load on the component

p = design wind pressure

b_t = tributary width

Field Verification and Construction Coordination Considerations

The final reliability of a curtain-wall wind design depends on maintaining consistency between design assumptions and constructed conditions. Changes in mullion spacing, glazing dimensions, attachment details, or support conditions during construction may affect the effective wind area and load-transfer behavior assumed during design.

For this reason, field coordination and submittal review should confirm that the installed façade system remains consistent with the design criteria developed from ASCE/SEI 7-22 wind provisions.

Construction coordination is particularly important for delegated façade systems because the final performance depends on the interaction between the engineered components, connection details, and supporting structure.

3.7 Integrated Curtain Wall Design Considerations

A complete curtain-wall wind evaluation requires coordination between structural design requirements and façade system behavior.

The structural engineer should communicate the governing façade design criteria in a form that can be applied directly by the façade designer.

Those criteria should identify the applicable design pressures, pressure zones, elevation ranges, positive and negative pressure cases, and required load combinations.

The façade designer then applies these criteria to the detailed curtain-wall system, including mullions, glass panels, anchors, and connections.

The final design objective is not simply obtaining a pressure value; it is ensuring that the entire envelope system can safely transfer wind forces into the supporting structure.

Reviewer's Comment

In high-rise building envelope design, the most frequent C&C-related review issue is not the absence of a calculation. It is the incorrect assignment of a pressure to the wrong component. A technically correct pressure coefficient applied to an incorrect effective wind area, façade zone, or component type can produce an unreliable design. The engineer should always verify the complete relationship between **component geometry, tributary area, pressure zone, and load path** before accepting C&C design results.

Module 4: Roof Component & Cladding Wind Pressures

Designing Roof Envelope Components Against Wind Actions

The roof system of a building above 60 ft represents one of the most critical regions for Component and Cladding (C&C) wind design because wind flow behavior near roof edges and corners can generate significant localized uplift pressures. Unlike the overall structural design of the building, where roof loads are considered as part of the global wind-force-resisting system, roof component design focuses on the localized pressures transferred to individual roof elements, attachments, and cladding systems.

For taller buildings, the engineer must evaluate roof components using the procedures of ASCE/SEI 7-22 Chapter 30 Part 2, where the magnitude of wind pressure depends on several interacting factors, including roof location, effective wind area, external pressure coefficients, and internal pressure effects.

A roof component that performs adequately in the central roof region may not have the same capacity requirement near the perimeter or corner regions. This variation is a direct result of localized aerodynamic effects and is one of the primary reasons that roof C&C design requires careful evaluation of pressure zones and component tributary areas.

The objective of roof C&C design is therefore not to determine a single roof wind pressure, but to establish the governing pressures that each roof component must resist while maintaining a complete and reliable load path from the roof surface to the supporting structure.

4.1 Roof Components and Their Wind-Resisting Function

Roof systems are composed of multiple layers and components that participate in transferring wind forces. Depending on the building configuration, these components may include roof membranes, metal roof panels, insulation systems, attachment systems, clips, fasteners, secondary framing members, and supporting structural elements.

The wind pressure acting on the roof surface is transferred through these components until it reaches the structural support system. Therefore, the design of roof components cannot be separated from their attachment details and supporting elements.

The basic load-transfer mechanism can be represented as:

Wind Uplift Pressure → Roof Component → Attachment System → Supporting Structure

An adequate roof C&C evaluation must consider not only the pressure applied to the roof surface but also the capacity of the connections responsible for transferring that pressure.

Roof System Failure Mechanisms and Design Implications

Roof component failures observed after severe wind events are frequently associated with localized uplift demands and deficiencies in the attachment system rather than failure of the primary structural frame. Because roof assemblies consist of multiple interconnected layers, the performance of the complete system depends on the capacity and continuity of each component within the load path.

Wind uplift acting on the roof surface must be transferred through membranes, panels, insulation systems, fasteners, clips, secondary framing elements, and finally into the supporting structure. A weakness at any stage of this transfer mechanism can interrupt the load path and result in localized damage or progressive failure.

For this reason, roof C&C design requires evaluation beyond the calculated pressure value. The engineer must verify that the selected pressure corresponds to the actual roof component, that the effective wind area represents the structural behavior of that component, and that the attachment system is capable of resisting the resulting forces.

In professional design review, roof-related deficiencies are often associated with applying a correct pressure value to an incorrectly defined component or connection condition. Maintaining traceability between ASCE/SEI 7-22 pressure criteria and the final roof attachment design is therefore an essential part of reliable wind-resisting design.

In design practice, roof failures during severe wind events are frequently associated with attachment deficiencies rather than inadequate capacity of the primary structural frame. This observation highlights the importance of evaluating roof components using the appropriate C&C procedures.

4.2 Roof Pressure Zones and Localized Wind Effects

Wind pressure distribution over a roof surface is not uniform. ASCE 7 recognizes that different regions of the roof experience different aerodynamic effects, particularly near edges and corners where flow separation can generate increased suction.

For C&C design, roof surfaces are divided into pressure zones based on their location and aerodynamic behavior. These zones represent areas where different external pressure coefficients apply.

The engineer must identify the applicable roof zones before selecting design pressure coefficients. Applying an interior roof pressure coefficient to a perimeter component can significantly underestimate the design demand.

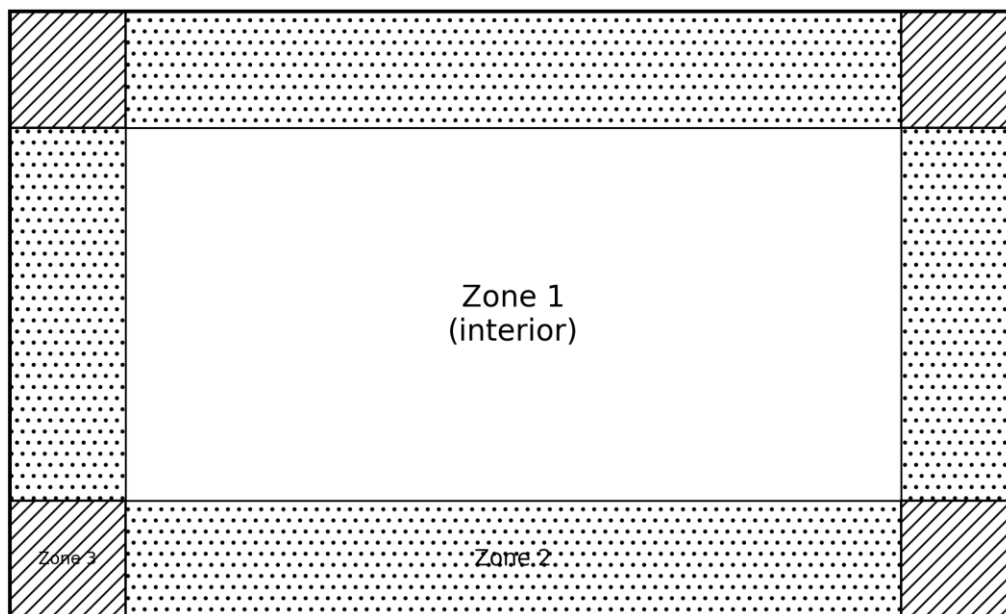
For the flat roof building considered in the case study, roof pressures are evaluated using the applicable roof zones and effective wind areas required by ASCE 7-22 Chapter 30 Part 2. The example demonstrates that the controlling roof pressure depends on both the location of the component and the effective wind area being evaluated.

Code Application Note

For roofs with slopes greater than or equal to 7 degrees, Figure 30.4-1 Note 6 directs the designer to the applicable C&C pressure coefficients for sloped roofs. **The case study developed in this course is limited to a flat-roof building.**

The practical implication is that roof design criteria should clearly identify the applicable zone and pressure case rather than providing one generalized uplift value for the entire roof.

Flat-roof C&C pressure zones — conceptual plan view



For the 0.91 m parapet in this case study, Figure 30.4-1 Note 7 permits Zone 3 to be treated as Zone 2.

Figure 4. Conceptual schematic of roof pressure regions used in the case study.

4.3 Effective Wind Area Effects on Roof Components

Effective wind area is a critical parameter in roof C&C design because the external pressure coefficient is influenced by the size of the component being evaluated.

A small roof component, such as an attachment element or localized cladding component, may experience a different pressure coefficient than a larger roof panel or system.

The design sequence remains consistent:

***Identify Roof Component → Determine Effective Wind Area → Select Pressure Coefficient →
Calculate Design Pressure***

The engineer should define the effective wind area based on the actual structural behavior of the component rather than simply using the geometric area visible on the roof plan.

For example, a roof panel supported continuously by multiple attachments may have a different effective area than an individual attachment point transferring load to the supporting structure.

Incorrect effective wind area selection is one of the most common sources of error in C&C roof calculations because it directly affects the coefficient used to determine the final pressure.

Effective Wind Area Selection for Roof Attachments

Roof components require careful evaluation of effective wind area because different elements within the same roof assembly may resist wind forces over different tributary regions. A roof panel, attachment clip, fastener group, or supporting member may each represent a different structural component with a different effective area.

For example, a continuous roof panel may distribute wind forces through multiple attachment points, while an individual clip or fastener may resist load from a smaller tributary area. Applying the panel effective wind area directly to the attachment component may result in an inappropriate pressure coefficient selection.

The engineer should therefore define the effective wind area based on the actual force-transfer mechanism of the component being evaluated and confirm that the selected coefficient represents the intended design condition.

4.4 External and Internal Pressure Effects

The design pressure acting on roof components results from the combined effect of external wind pressure and internal building pressure.

The general relationship used in C&C design is:

$$p = qK_d(GC_p) - q_iK_d(GC_{pi})$$

where:

p = design wind pressure

q = external velocity pressure

q_i = internal velocity pressure

K_d = wind directionality factor

GC_p = external pressure coefficient

GC_{pi} = internal pressure coefficient

For roof components, the internal pressure contribution can significantly influence the final uplift demand depending on the enclosure classification of the building.

The engineer must evaluate the appropriate pressure combinations because the governing uplift condition may not always correspond to the maximum external suction alone. The interaction between external roof suction and internal pressure can produce the critical design case for certain roof components and attachments.

4.5 Flat Roof High-Rise Building Application

The roof design application in this module uses the same 48.8 m (160 ft) office building case study introduced in the previous modules.

The example considers a flat roof configuration and evaluates roof component pressures using the applicable Chapter 30 Part 2 procedure. The calculation process demonstrates how the engineer moves from project wind parameters to final roof design pressures.

The workflow includes:

Establishing the roof geometry and design conditions, identifying the applicable roof pressure zones, selecting effective wind areas for the components under consideration, determining the corresponding external pressure coefficients, and combining external and internal pressure effects to obtain the final design pressures.

The resulting pressures are then used as design criteria for roof components and attachment systems.

The importance of this approach is that the final pressure values are not isolated numbers; they represent the result of a complete engineering process connecting building geometry, wind environment, aerodynamic response, and component behavior.

4.6 Worked Example — Flat-Roof C&C Uplift Pressures

The case study uses the mean-roof velocity pressure $q_h = 2.57$ kPa. For an enclosed building, positive internal pressure produces the controlling negative roof pressure. The internal-pressure contribution is

$$p_i = (2.57)(0.85)(0.18) = 0.39 \text{ kPa}$$

For a representative effective wind area of 9.29 m^2 , the Figure 30.4-1 coefficients are $GC_p = -1.11$ in Zone 1 and $GC_p = -1.89$ in Zones 2 and 3. The corresponding design pressures are

$$p_{Z1} = (2.57)(0.85)(-1.11) - 0.39 = -2.81 \text{ kPa}$$

and

$$p_{Z2/Z3} = (2.57)(0.85)(-1.89) - 0.39 = -4.52 \text{ kPa}$$

The full range of effective areas evaluated in the reference example is summarized below. For the 0.91 m parapet used in this project, Figure 30.4-1 Note 7 permits Zone 3 to be treated as Zone 2.

Table 6. Flat-roof C&C coefficients and design pressures by effective wind area

Effective wind area, A_e (m^2)	Zone 1 GC_p	Zones 2/3 GC_p	Zone 1 pressure (kPa)	Zones 2/3 pressure (kPa)
<0.93	-1.40	-2.30	-3.45	-5.42
1.86	-1.31	-2.18	-3.26	-5.15
9.29	-1.11	-1.89	-2.81	-4.52
23.23	-0.99	-1.72	-2.55	-4.16
37.16	-0.93	-1.64	-2.42	-3.98
≥ 46.45	-0.90	-1.60	-2.36	-3.89

The governing pressure for a particular roof component must be taken from the row corresponding to that component's effective wind area and the zone in which it is located. The table is therefore a design schedule, not a single roof-wide uplift value.

4.7 Coordination Between Structural and Roof Design Teams

Roof C&C design often involves coordination between the structural engineer, architect, roofing consultant, and specialty contractors.

The structural engineer should issue roof-design criteria in a form that can be applied directly by the roof-system or delegated designer.

The issued roof-design criteria should identify the applicable pressure zones, positive and negative pressure cases, design elevations, effective wind areas used in the calculations, and the load-transfer assumptions that the roof designer is expected to follow.

The roof designer or delegated engineer must then ensure that the selected roof system, attachments, and connections are capable of resisting the specified demands.

A technically correct pressure calculation can still result in an inadequate roof system if the design criteria are not properly communicated or if attachment details do not provide a continuous load path.

Roof Design Review and Submittal Verification

During project review, roof design submittals should be evaluated against the wind criteria established during the structural design process. The reviewer should confirm that the proposed roof system, attachment layout, and connection details correspond to the pressure zones, effective wind areas, and design cases identified in the C&C calculations.

Changes in roofing materials, attachment spacing, support conditions, or installation procedures may alter the assumed load-transfer behavior. Such changes should be reviewed to verify that the final constructed system remains consistent with the original wind design assumptions.

This verification process is particularly important for delegated roof-system designs where the final component capacity is developed by specialty designers based on criteria issued by the engineer of record.

4.8 Engineering Judgment in Roof C&C Design

Roof component design above 60 ft requires careful interpretation of the interaction between aerodynamic effects and component behavior. The governing roof pressure is not necessarily the largest value shown in a table; it is the pressure associated with the specific component, location, and effective wind area being evaluated.

The engineer's responsibility is to ensure that the selected pressure represents the actual behavior of the roof component and that the resulting force can be transferred safely through the attachment system into the supporting structure.

Engineering Judgment

A reliable roof C&C design is achieved by connecting the code procedure to the physical behavior of the roof system. The most important verification step is not only confirming the calculated pressure, but confirming that the pressure corresponds to the correct roof zone, effective wind area, and component load path. Misidentifying any one of these factors can produce an incorrect design criterion even when the calculation itself appears complete.

Module 5: Parapet Wind Design for Tall Buildings

A Frequently Overlooked Envelope Component

Parapets are among the most frequently overlooked components in building envelope wind design. Although they are often considered architectural features, parapets represent exposed structural elements located at the roof edge and are subjected to localized wind effects that differ from those acting on the adjacent roof surface.

For buildings whose wall and roof C&C pressures are determined using ASCE/SEI 7-22 Chapter 30 Part 2, parapet C&C pressures are evaluated separately in accordance with Chapter 30 Part 4. Their design requires consideration of geometry, location, effective wind area, the applicable parapet load case, and connection behavior.

A parapet does not simply experience the same pressure acting on the roof below it. Because it projects above the roof surface, it interacts directly with the wind flow and can develop significant inward and outward pressure demands. These forces must be transferred safely through the parapet framing and attachment system into the supporting roof structure.

The complete load path can be represented as:

Wind Pressure → Parapet Component → Attachment System → Supporting Structure

A reliable parapet design therefore requires evaluation of both the wind pressure and the structural ability of the parapet system to transfer these forces.

5.1 Role of Parapets in Building Envelope Wind Design

The primary purpose of evaluating parapets separately is that their aerodynamic behavior differs from conventional roof components.

A roof surface primarily experiences upward or downward pressures distributed over a horizontal plane, while a parapet introduces a vertical exposed surface at the roof perimeter. These pressure effects influence the design of parapet panels, supporting framing members, attachment systems, and the roof-edge structural elements receiving the transferred forces. In design practice, parapet failures frequently occur because the element is treated as a minor architectural feature rather than as a wind-loaded structural component.

The engineer must therefore evaluate the parapet using the same disciplined approach applied to other C&C components by identifying the component behavior, defining the effective wind area, selecting the appropriate pressure condition, and verifying the complete load transfer mechanism.

5.2 Parapet Pressure Zones and Governing Wind Cases

Parapet wind pressures are influenced by their location around the building perimeter. Similar to other envelope components, corner regions may experience more severe aerodynamic effects than straight wall regions.

The engineer must evaluate the applicable parapet location and identify the governing wind cases.

Two primary pressure conditions require consideration:

Outward pressure condition

This condition produces suction that tends to pull the parapet away from the building interior and places demand on the exterior face and attachment system.

Inward pressure condition

This condition produces pressure acting toward the roof side of the parapet and may govern certain framing or connection configurations.

The controlling case depends on the parapet geometry, supporting system, and connection behavior. The largest numerical pressure value is not necessarily the governing design case unless it produces the critical structural demand for the component being evaluated.

Parapet net pressure directions — conceptual schematic

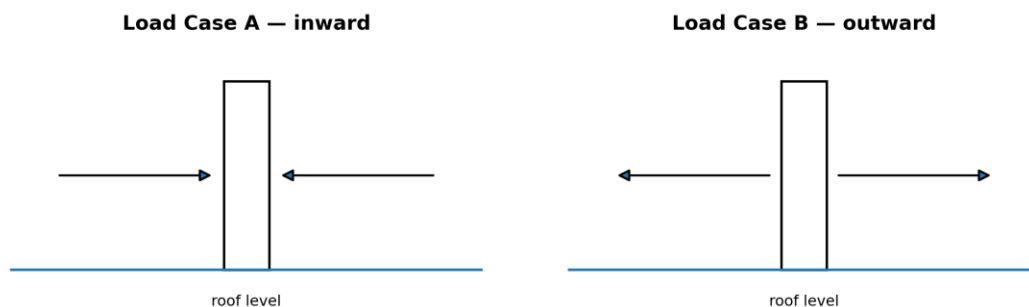


Figure 5. Conceptual inward and outward parapet pressure cases.

5.3 Effective Wind Area and Pressure Coefficient Selection

Effective wind area is a critical parameter in parapet design because it influences the selection of the applicable external pressure coefficient.

The effective wind area should represent the actual area over which wind forces are transferred to the component being designed.

The effective wind area depends on which part of the parapet system is being evaluated.

For a parapet system, the engineer should distinguish the exposed parapet surface area from the tributary area carried by supporting framing members and from the more localized area that may govern individual attachment components.

The design workflow follows the same engineering sequence used throughout C&C design:

Identify Parapet Component → Determine Effective Wind Area → Select Applicable Pressure

Coefficient → Calculate Design Pressure

Incorrect selection of effective wind area can result in selecting an inappropriate pressure coefficient and developing an inaccurate design criterion. This consideration is particularly important for parapet systems where the exposed surface area of the parapet element may differ from the tributary area resisted by the supporting framing and connection components.

This issue is particularly important when parapet design is delegated to specialty contractors because the structural engineer's design pressure must correctly represent the intended load path.

5.4 Numerical Example — 0.91 m Parapet Design

High-Rise Office Building Case Study

The parapet is evaluated under ASCE/SEI 7-22 Chapter 30, Part 4 rather than by applying the ordinary roof pressure directly to the vertical parapet surface. The reference parapet is 0.91 m high and is treated as nonporous. Its effective wind area is taken as approximately 0.84 m^2 , corresponding to the 0.91 m by 0.91 m area used in the source example. The velocity pressure is evaluated at the top of the parapet, where $q_p = 2.59 \text{ kPa}$ and $K_d = 0.85$.

Because the parapet is nonporous, the reference example does not include building internal pressure in the parapet calculation. Instead, the net demand is obtained from the opposing surface pressure coefficients prescribed for the applicable parapet load case. For Load Case A,

$$p_A = (2.59)(0.85)[0.90 - (-2.30)] = 7.06 \text{ kPa}$$

and the pressure acts inward. The -2.30 coefficient corresponds to the roof-edge condition used by the reference example. Because the parapet is 0.91 m high, Figure 30.4-1 Note 7 permits the Zone 3 condition to be treated as Zone 2 for this case.

Load Case B is checked separately for wall-corner and mid-wall conditions. In a Zone 5 corner region,

$$p_{B,5} = (2.59)(0.85)[0.90 - (-1.80)] = 5.96 \text{ kPa}$$

acting outward. In a Zone 4 mid-wall region,

$$p_{B,4} = (2.59)(0.85)[0.90 - (-0.90)] = 3.97 \text{ kPa}$$

also acting outward. The governing magnitude for the parapet framing in this example is therefore 7.06 kPa inward, while the attachment design must still be checked for the outward cases because force direction can change the controlling connection response.

This corrected calculation is important because the parapet procedure is not obtained by simply reusing the building internal pressure coefficient $G C_{pi} = \pm 0.18$ from the enclosed-building wall and roof calculations. The parapet is evaluated under the specific Chapter 30 Part 4 provisions applicable to the element and its porosity.

5.5 Connection and Load Path Considerations

The parapet design is incomplete unless the calculated pressure can be transferred through the entire structural system.

The expected load path is:

Parapet Surface → Framing Member → Anchorage → Roof Structure

The connection review should confirm the complete load path from the parapet surface into the supporting roof structure.

Verification should confirm that the attachment detail represents the assumed analytical model, that fasteners and anchors resist the governing pressure direction, that corner parapet conditions are evaluated separately where required, and that the supporting roof structure can receive the transferred forces.

A parapet calculation that does not address the connection system provides only a partial design evaluation.

5.6 Design Review Observations

Several recurring issues appear during professional review of parapet wind design:

Using roof uplift pressure instead of parapet-specific pressure can underestimate demand.

Ignoring outward pressure cases may overlook the condition that governs attachment design.

Applying one pressure value around the entire roof perimeter may fail to capture increased corner effects.

Providing connection details without verifying the calculated wind forces can interrupt the intended load path.

These issues demonstrate that parapet design is not only a pressure calculation; it is a complete component-level structural evaluation.

5.7 Engineering Judgment in Parapet Design

Although parapets represent a relatively small portion of the building envelope, they frequently control local connection design because they are directly exposed to wind flow at the roof edge.

The engineer should evaluate parapets with the same level of attention applied to larger envelope components. The critical design factor is not the physical size of the element but the relationship between aerodynamic loading, component capacity, and connection reliability.

Construction Insight

Parapets illustrate an important principle in building-envelope wind design: small components can generate significant structural demands when their location exposes them to localized wind effects. A successful design requires maintaining the complete connection between the calculated C&C pressure, the physical parapet system, and the supporting structure receiving the transferred load.

Module 6: Complete High-Rise C&C Design Case Study: From Building Data to Final Design Pressures

Integrated Application of ASCE 7-22 Chapter 30 Part 2 Procedures

The previous modules established the individual components of high-rise Component and Cladding (C&C) wind design, including curtain walls, glazing systems, roof components, and parapets. This module integrates these concepts into a complete engineering workflow representative of the process followed in professional structural design practice.

The objective of this case study is to demonstrate how project information is transformed into final design pressures that can be issued as design criteria for building-envelope components.

The process begins with the definition of the building geometry and site conditions, followed by the determination of governing wind parameters. These parameters are then applied to individual envelope components to develop the final positive and negative design pressures.

The case study represents a typical commercial office building where the structural engineer provides wind-pressure criteria for façade and roof-envelope systems.

6.1 Project Definition and Building Geometry

The integrated case study uses the same project data established in Module 2. The structure is a rectangular commercial office building in La Porte, Texas, with plan dimensions of 30.5 m by 61.0 m. The mean roof height is 47.9 m and a 0.91 m parapet extends the building envelope to approximately 48.8 m above grade. The roof is flat. The façade consists of glazed panels supported by vertical curtain-wall mullions spanning 3.35 m between floor slabs at 1.52 m spacing.

The governing wind-design basis is Risk Category II, a basic wind speed of 62.6 m/s, Exposure B, $K_d = 0.85$, $K_{zt} = 1.0$, $K_e = 1.0$, and an enclosed-building internal pressure coefficient of $GC_{pi} = \pm 0.18$. These values remain unchanged throughout the module; no new assumed wind environment is introduced.

6.2 Velocity Pressure Basis

The velocity pressure is determined using ASCE/SEI 7-22 Equation 26.10-1 without K_d :

$$q_z = 0.000613 K_z K_{zt} K_e V^2 \quad \text{kPa}$$

At the mean roof height, $K_z = 1.07$, giving

$$q_h = 0.000613 (1.07) (1.0) (1.0) (62.6)^2 = 2.57 \text{ kPa}$$

At the top of the parapet, $K_z = 1.08$, giving $q_p = 2.59 \text{ kPa}$. The intermediate values developed in Module 2 are retained for the positive windward-wall pressure calculations.

6.3 Curtain-Wall Mullion Design Pressure

The mullion effective wind area is based on the actual 3.35 m span and 1.52 m tributary width:

$$A_e = (3.35)(1.52) = 5.11 \text{ m}^2$$

The alternate one-third-span area is 3.74 m^2 , so 5.11 m^2 governs. Using the Figure 30.4-1 coefficients applicable to this effective area, $GC_p = +0.77$ for positive pressure, $GC_p = -0.81$ for Zone 4 suction, and $GC_p = -1.45$ for Zone 5 suction.

At roof height, the positive design pressure is

$$p = (2.57)(0.85)(0.77) - (2.57)(0.85)(-0.18) = +2.08 \text{ kPa}$$

The Zone 4 negative pressure is

$$p = (2.57)(0.85)(-0.81) - (2.57)(0.85)(+0.18) = -2.17 \text{ kPa}$$

and the Zone 5 corner pressure is

$$p = (2.57)(0.85)(-1.45) - (2.57)(0.85)(+0.18) = -3.56 \text{ kPa}$$

For positive pressure below roof level, q_z varies with elevation as shown in Module 2. The suction pressures remain governed by the mean-roof velocity pressure for the surfaces represented in the reference pressure schedule.

6.4 Glazed-Panel Design Pressure

The typical glazed panel measures 1.52 m by 1.68 m, giving

$$A_e = (1.52)(1.68) = 2.55 \text{ m}^2$$

The corresponding coefficients are $GC_p = +0.82$, -0.85 in Zone 4, and -1.59 in Zone 5. At roof height, the positive pressure is $+2.18 \text{ kPa}$, the Zone 4 suction is -2.25 kPa , and the Zone 5 suction is -3.87 kPa . The larger Zone 5 suction demonstrates the combined effect of smaller effective wind area and corner-zone aerodynamics.

6.5 Roof Component Design Pressure

Roof C&C pressure is developed from $q_h = 2.57 \text{ kPa}$. Positive internal pressure controls the negative roof pressure. For a representative effective wind area of 9.29 m^2 , the coefficients are $GC_p = -1.11$ in Zone 1 and $GC_p = -1.89$ in Zones 2 and 3. The resulting design pressures are -2.81 kPa and -4.52 kPa , respectively.

For smaller components with $A_e < 0.93 \text{ m}^2$, the corresponding pressures increase to -3.45 kPa in Zone 1 and -5.42 kPa in Zones 2 and 3. The roof design criterion must therefore be issued as a pressure schedule keyed to effective wind area and roof location rather than as a single uplift value.

6.6 Parapet Design Pressure

The nonporous 0.91 m parapet is evaluated under Chapter 30 Part 4 using the velocity pressure at the top of the parapet, $q_p = 2.59 \text{ kPa}$. The three governing checks from Module 5 are retained without modification: 7.06 kPa inward for Load Case A, 5.96 kPa outward in Zone 5 corner regions, and 3.97 kPa outward in Zone 4 mid-wall regions. The inward case governs by magnitude for the parapet framing, while the outward cases remain mandatory for attachment verification.

6.7 Final C&C Design Pressure Schedule

The final output should be issued in a form that a façade engineer, roof-system designer, or delegated specialty engineer can use without reconstructing the calculation. The table below consolidates the controlling case-study criteria.

Unless explicitly noted otherwise, the pressures in the following schedules are strength-level wind pressures consistent with the ASCE/SEI 7-22 basis used for the case study. When the criteria are issued for allowable stress design, the engineer should apply the applicable 0.6 wind load factor from Chapter 2 and clearly identify the pressure level on drawings, specifications, and delegated-design criteria so that strength-level and ASD values are not mixed.

Table 7. Wall and roof C&C pressure schedule.

Envelope component	Location / condition	Effective wind area	Positive pressure (kPa)	Negative pressure (kPa)	Governing criterion
Curtain-wall mullion	Zone 4 at roof	5.11 m ²	+2.08	−2.17	Check both directions
Curtain-wall mullion	Zone 5 corner	5.11 m ²	+2.08	−3.56	−3.56 kPa suction
Glazed panel	Zone 4 at roof	2.55 m ²	+2.19	−2.25	Check both directions
Glazed panel	Zone 5 corner	2.55 m ²	+2.19	−3.87	−3.87 kPa suction
Roof component	Zone 1	9.29 m ²	—	−2.81	−2.81 kPa uplift
Roof component	Zones 2/3	9.29 m ²	—	−4.52	−4.52 kPa uplift
Small roof component	Zones 2/3	<0.93 m ²	—	−5.42	−5.42 kPa uplift

Table 8. Parapet pressure schedule.

Parapet condition	Effective wind area	Pressure (kPa)	Direction	Design use
Load Case A	0.84 m ²	7.06	Inward	Governs parapet framing by magnitude
Load Case B, Zone 5	0.84 m ²	5.96	Outward	Check outward attachment resistance
Load Case B, Zone 4	0.84 m ²	3.97	Outward	Check outward attachment resistance

Design Criteria Communication and Coordination

The final pressure schedule represents the transition between structural wind analysis and project implementation. In professional practice, the value of a C&C analysis depends not only on the accuracy of the calculated pressures but also on the clarity with which the design criteria are communicated to the engineers responsible for the building-envelope systems.

Each issued pressure should identify the applicable component, effective wind area, pressure zone, elevation basis, and governing load condition. This information allows façade engineers, roof-system designers, and delegated specialty contractors to apply the criteria without reconstructing the original wind calculations.

A coordinated pressure schedule reduces the possibility of misinterpretation during design development and construction because each envelope component can be directly related to the governing ASCE/SEI 7-22 provisions and the assumptions established during the structural analysis.

6.8 Traceability of the Final Pressures

Each pressure in the schedule can be traced to a specific building elevation, effective wind area, pressure zone, and coefficient selection. This traceability is the principal quality-control feature of the case study. The final deliverable is not merely a list of numbers; it is a coordinated pressure schedule that preserves the link between the governing ASCE 7 provision and the physical envelope component to which that provision is applied.

Quality Control Review of C&C Pressure Schedules

Before finalizing a C&C pressure schedule, the reviewing engineer should verify that each pressure value remains consistent with the component for which it was developed. The review should confirm that the selected effective wind area, pressure zone, coefficient selection, and load direction correspond to the actual envelope condition represented in the project documents.

This quality-control process is particularly important when multiple design disciplines are involved because envelope components may be designed by different parties using criteria issued by the structural engineer. Maintaining consistency between the calculated wind demand and the final delegated-design requirements is essential for preserving the intended load path.

6.9 Engineering Application and Review Considerations

In a professional project environment, the final output of a C&C analysis is not only a calculation package. It is a coordinated set of design pressures that must be clearly communicated to façade engineers, roof designers, and specialty contractors.

A complete review should confirm that the component being designed corresponds to the assumed effective wind area, that the selected pressure zone represents the actual building location, that the connection design reflects the governing force direction, and that the final design pressure is compatible with the delegated design responsibility.

Verification Tip

A high-quality C&C design package should allow another engineer to trace every final pressure value back to the original building geometry, wind parameters, effective wind area, and pressure coefficient selection. The most reliable calculations are not necessarily the longest ones; they are the ones where every assumption can be independently verified.

Module 7: Practical Design Insights and Common Mistakes

Engineering Review Considerations for High-Rise C&C Wind Design

A technically correct Component and Cladding (C&C) wind calculation depends not only on the mathematical procedure used to determine pressures, but also on the engineering decisions made before and after the calculation process. In professional practice, many C&C design deficiencies are not caused by incorrect equations or arithmetic errors; they result from incorrect interpretation of the building configuration, improper selection of design parameters, or insufficient coordination between the structural engineer and other members of the project team.

For buildings evaluated using ASCE/SEI 7-22 Chapter 30 Part 2, the reliability of the final design pressures depends on maintaining a clear relationship between the building geometry, wind environment, component behavior, effective wind area, pressure zone, and structural load path.

This module summarizes common design and review issues encountered in high-rise building envelope wind design and provides practical guidance for improving the quality and reliability of C&C design documentation.

7.1 Incorrect Effective Wind Area Selection

Effective wind area is one of the most influential parameters in Component and Cladding design because it directly affects the selection of external pressure coefficients.

A common design issue occurs when the effective wind area is selected based only on the visible size of an element rather than its actual structural behavior.

For example, a glazing panel and its supporting curtain-wall mullion may occupy the same façade location but may not have the same effective wind area. The glazing panel transfers pressure over its individual panel area, while the mullion may collect load from a larger tributary region between supports.

Using the glazing panel area to select the mullion pressure coefficient, or using the mullion tributary area for the glass panel, can result in an incorrect design pressure.

The engineer should always verify that the selected effective wind area represents the actual load-transfer behavior of the component being evaluated.

In delegated-design applications, this verification becomes especially important because specialty designers may develop component capacities based on the issued wind criteria. The structural engineer should therefore ensure that the effective wind area stated in the design criteria corresponds to the component behavior intended by the original C&C analysis.

A reliable review question is:

“What physical area is actually contributing load to this component?”

If the answer does not correspond to the effective wind area used in the calculation, the design assumption should be reconsidered.

7.2 Confusing MWFRS and C&C Design Pressures

One of the most common conceptual errors in wind design is treating MWFRS pressures and Component and Cladding pressures as interchangeable.

The MWFRS procedure evaluates the overall wind response of the building and establishes forces used for the design of the primary structural system. C&C design evaluates localized pressures acting on individual building-envelope components.

Although both procedures originate from the same wind environment, they address different structural behaviors.

A curtain-wall anchor, glazing panel, roof attachment, or parapet connection should not automatically be designed using the pressure obtained for the main structural frame.

During design review, the engineer should verify the origin, procedure, and intended use of each pressure before accepting it.

The review should confirm that the calculated pressure corresponds to the intended component, that the applicable ASCE 7 procedure has been used, and that the pressure has not been carried over from an unrelated MWFRS calculation.

The distinction is especially important for taller buildings where localized envelope pressures can govern component design.

7.3 Incorrect Pressure Zone Selection

Pressure zones represent the variation of wind effects across different portions of the building envelope.

A frequent error is applying one pressure coefficient to an entire wall or roof surface without considering whether the component is located in a more critical region.

Building corners, roof edges, and other discontinuities can experience increased localized suction due to wind-flow separation.

For example, a curtain-wall component located near a building corner may require a different pressure coefficient than an identical component located in the center of the wall elevation.

Similarly, roof components near perimeter or corner regions may experience greater uplift demands than components located in interior roof zones.

The engineer should confirm that the selected pressure zone corresponds to the actual physical location of the component being designed.

A pressure coefficient is meaningful only when it is associated with the correct location and component condition.

7.4 Common Building Envelope Wind Design Review Comments

During professional design reviews, several recurring comments appear in C&C wind calculations.

One common issue is incomplete documentation of design assumptions. A reviewer should be able to identify the building geometry, wind parameters, exposure category, enclosure classification, effective wind area, pressure zone, and final design pressure without reconstructing the entire calculation independently.

Another frequent issue is insufficient explanation of load transfer. A pressure value alone does not demonstrate that the component can safely resist wind forces. The calculation should establish how the load moves from the exterior surface through the component and connection system into the supporting structure.

Additional review concerns commonly involve the use of outdated ASCE 7 editions, failure to distinguish positive and negative pressure cases, inconsistencies between effective wind areas shown in calculations and project drawings, and insufficient coordination between structural design criteria and delegated façade design responsibilities.

A strong calculation package is not necessarily the longest document; it is the one where each engineering assumption can be clearly verified.

For a broader discussion of recurring wind-design errors, regional practice issues, load-path concerns, and professional review considerations, see the author's course, ***Wind Load Design in the U.S.: Best Practices and Common Pitfalls***.

7.5 Coordination Between Structural Engineers and Façade Designers

High-rise building envelope design requires continuous coordination between the structural engineer, architect, façade consultant, and specialty contractors.

The structural engineer typically establishes the governing wind design criteria, while the façade designer develops the detailed system capable of resisting those demands.

Successful coordination depends on a clear and complete transfer of the governing design criteria.

The project documents should communicate the design pressures together with the applicable pressure zones, elevation ranges, component locations, load directions, and connection-design requirements.

A common coordination problem occurs when the pressure criteria issued by the structural engineer do not clearly define the intended application. For example, providing a single pressure value without identifying the associated component, zone, or effective wind area may lead to incorrect application by the façade designer.

The design team should therefore treat C&C pressures as engineering criteria that require interpretation, not simply numerical values transferred between documents.

7.6 Developing Better C&C Design Documentation

A professional C&C calculation package should allow an independent reviewer to follow the complete design logic.

The reviewer should be able to trace the process:

***Building Geometry → Wind Parameters → Component Classification → Effective Wind Area →
Pressure Zone → Final Design Pressure***

Maintaining this sequence improves both design reliability and project communication.

For delegated-design components, this approach also provides a clear boundary between the engineer's responsibility and the specialty designer's responsibility.

7.7 Verification Items That Should Appear in a Professional Review

A reviewer should also confirm that the final C&C pressure magnitude satisfies the minimum pressure requirement of ASCE/SEI 7-22 Section 30.1.4. Where a calculated net pressure is less than 0.77 kPa in either direction, the prescribed minimum governs. The case-study pressures developed in this course exceed that threshold, but documenting the check is part of a complete professional calculation package.

This verification should be documented within the calculation package rather than assumed from the final pressure values alone. Explicitly recording the minimum pressure check demonstrates that all applicable ASCE/SEI 7-22 requirements have been considered before the criteria are issued.

A concise review comment can often expose a missing design assumption more effectively than another page of arithmetic. For example: **“The submitted façade calculation does not identify the effective wind area used to select the mullion pressure coefficient. Revise the calculation to document component span, effective width, wall zone, applicable Figure 30.4-1 coefficient, and the resulting positive and negative design pressures.”** This type of comment is specific, verifiable, and directly tied to the design decision that must be corrected.

The final design review should also confirm the governing ASCE 7 edition, the pressure level (strength design or ASD), enclosure classification, pressure-zone boundaries on drawings, and the consistency of the final pressure schedule with delegated-design notes and specifications.

7.8 Final Engineering Perspective

Component and Cladding wind design is often viewed as a calculation procedure, but in practice it is an exercise in engineering judgment. The accuracy of the final design depends on how well the engineer understands the relationship between wind behavior, component response, and structural load transfer.

The most reliable designs are those where every pressure value has a clear physical meaning and every component has a verified path for transferring wind forces into the supporting structure.

Professional Consideration

The most valuable skill in C&C wind design is not memorizing pressure coefficients; it is recognizing when the selected pressure represents the actual behavior of the component being designed. A careful engineer continuously verifies the connection between the code procedure, the physical building envelope, and the final construction details.

Calculation Basis, Verification, and Design Application

Numerical examples in this course are presented in SI units. Intermediate values shown in the calculations are rounded for presentation purposes; however, final design pressures are calculated using unrounded intermediate values.

Values adapted from the ASCE wind-load reference example have been independently recalculated using the reported design parameters and pressure coefficients and are not obtained solely by converting rounded imperial results.

In accordance with ASCE/SEI 7-22, the wind directionality factor K_d is applied within the Chapter 30 Component and Cladding (C&C) pressure equations and is not included in the velocity pressure calculation q_z .

Unless specifically noted otherwise, the pressure schedules presented in this course represent strength-level wind pressures. Application of wind pressures for allowable stress design shall follow the applicable ASCE/SEI 7 load combinations and adjustment factors.

Parapet pressures are evaluated separately in accordance with ASCE/SEI 7-22 Chapter 30 Part 4 provisions.

Project-specific design applications shall be verified against the adopted building code, applicable local amendments, current errata, and the governing project design criteria established by the responsible engineer.

References

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3. ASTM E1886. *Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials*.
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5. ASTM E330/E330M-14(2021). *Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference*.